UNIVERSITY OF BIRMINGHAM

School of Biosciences

Guide to Module Choices for Incoming Exchange Students

2017/2018

Version date: July 2017

Introduction

This booklet sets out the modules offered to exchange students visiting the School of Biosciences in University of Birmingham in 2016-17. We make a wide range of modules available to incoming exchange students.

Please complete the College of Life and Environmental Sciences - Preferred College Exchange Student Module Application Form and return it to bio-yr1-ugadmin@contacts.bham.ac.uk by **25th August 2017**.

Credits

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

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 year students. Each module has a school code. The first number in the code indicates the year. So BIO325 is a Year 3 module, BIO268 is a Year 2 module, etc.

Please note: *Year 1 = Level C Year 2 = Level I Year 3 = Level H*

Students must check that their sending university is happy with their module selections. The responsibility is with the student.

All modules are worth 20 credits, except for BIO152L, BIO172, BIO173, BIO174 and BIO230 which are 10 credit modules (BIO152L is a shortened version of BIO152).

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.

[1] Exceptions to this need to be agreed with the student's sending university. Previously some students have exceptionally taken 50 credits in one semester and 70 credits in the other. Students may not have an 80:40 split.

[2] 20 Birmingham Credits = 10 ECTS Credits.

Taught Modules:

The university timetable is divided into blocks, as shown in the tables below. If a student picks one module from each block their timetables should be compatible and if two modules are in the same block they cannot be taken together (exceptions to these are marked with an asterisk and listed below).

Semester 1

Block 1	BIO145	BIO230*	BIO262*	BIO277*	BIO348*	BIO379*
Block 2	BIO152*	BIO152L*	BIO173*	BIO213	BIO397	BIO325
Block 3	BIO237*	BIO258*	BIO325*	BIO335*	BIO387*	

Semester 2

Block 4	BIO154	BIO261*	BIO265*					
Block 5	BIO172	BIO174*	BIO273		BIO317*	BIO336*	BIO380*	BIO398*
Block 6	BIO175*	BIO143	BIO171	BIO268*	BIO278*	BIO273	BIO389	
	BIO270							

***The following exceptions apply:**

BIO139: Cannot be taken with BIO174
BIO152: May be taken with BIO173
BIO152L: May be taken with BIO173
BIO173: May be taken with BIO152 or BIO152L
BIO174: Cannot be taken with BIO139
BIO230: May be taken with BIO262 or BIO277
BIO237: May be taken with BIO258. Cannot be taken with BIO348 or BIO379
BIO258: May be taken with BIO237. Cannot be taken with BIO348 or BIO379
BIO261: May be taken with BIO265
BIO262: May be taken with BIO230
BIO265: May be taken with BIO261
BIO268: May be taken with BIO278
BIO270: Cannot be taken with BIO154, BIO139, BIO143, BIO171, BIO261, BIO319, BIO384, BIO388
BIO277: May be taken with BIO230
BIO278: May be taken with BIO268. Cannot be taken with BIO319 or BIO384
BIO279: Cannot be taken with BIO273
BIO317: May be taken with BIO311 or BIO380 or BIO398
BIO325: May be taken with BIO335 or BIO387
BIO335: May be taken with BIO325
BIO336: May be taken with BIO311 or BIO380 or BIO398
BIO348: Cannot be taken with BIO237 or BIO258
BIO379: Cannot be taken with BIO237 or BIO258
BIO380: May be taken with BIO317 or BIO336
BIO387: May be taken with BIO325
BIO398: May be taken with BIO317 or BIO336

Module Availability 2017-18

Code	Banner	Module	Semester	Credits
Year 1 Modules				
BIO143	22652	Physical Biochemistry	2	20
BIO145	22924	Introduction to Evolution & Animal Biology	1	20
BIO152	23318	Cell Biology & Physiology	1	20
BIO152L	23319	Essentials of Cell Biology & Physiology	1	10
BIO154	23320	Genetics I	2	20
BIO171	27806	Ecological Concepts and Plant Sciences	2	20
BIO172	28777	Introduction to Microbiology	2	10
BIO173	28776	Fundamentals of Biochemistry	1	10
BIO174	28778	Metabolism	2	10
BIO175	30143	Human Nutrition & Metabolism	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
BIO265	13160	Genetics II	2	20
BIO268	24985	Cell and Developmental Biology	2	20
BIO270	24986	Field course: Adaptations to Aquatic Environments	EASTER	20
BIO273	26999	Human Structure and Function	2	20
BIO277	28780	Evolution of Humans and Other Animals	1	20
BIO278	28822	Animal Biology: Principles & Mechanisms	2	20
BIO279	30145	Critical Issues for 21st Century Ecosystems	2	20
Final Year Modules				
BIO317	25343	Bacterial Gene Regulation	2	20
BIO325	11221	Eukaryotic Gene Expression	1	20
BIO335	28011	Human Health & Disease	1	20
BIO336	27876	Conservation Practice: Genes to Ecosystems	2	20
BIO348	21783	Genetics III: Genetic Variation in Humans and other Eukaryotes	1	20
BIO379	14675	Cellular Neurobiology	1	20
BIO380	25349	Human Evolution	2	20
BIO387	21893	Cancer Biology	1	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 40	23993	Lab Project	1+2	40
Lit Rev	23991 23392	Evidence-based Literature Review Critical Analysis: Developing a Research Project	1 2	40

03 22652	BIO143	Physical Biochemistry	Credits: 20
Level: C	Semester: 2	Staff responsible: Dr K Fütterer	
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
Pathways:	This Module sits squarely alongside BIO171, Ecological Concepts and Plant Sciences and Environmental Biology in that it covers many aspects of 'whole animal biology'. You will find that the module prepares you for some of the second year modules such as the field courses as part of BIO259, Glacial Ecology in Norway, and BIO237, Plant Sciences: from cells to the environment. In addition to up to date knowledge the module provides a range of applied skills from practical sessions where you are encouraged to translate theory into practice. The skills you develop in generating data during practical sessions prepare you well for modules in the second year and are early preparation for the scientific writing you will undertake in projects and dissertations in the third year.
Delivery:	Lectures, Practicals
Assessment:	In-course Assessment (30%) comprising: Evolution workbook and MCQ Test (15%) Two animal biology practical write-ups, each worth 7.5% 2 hour written examination in May/June (70%) made up of multiple choice and short answer questions**.**

Banner: 03 22924 BIO145		**Introduction to Evolution and Animal Biology** **Credits: 20**
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
Pathways:	This Module sits squarely alongside BIO171, Ecological Concepts and Plant Sciences and Environmental Biology in that it covers many aspects of 'whole animal biology'. You will find that the module prepares you for some of the second year modules such as the field courses as part of BIO259, Glacial Ecology in Norway, and BIO237, Plant Sciences: from cells to the environment. In addition to up to date knowledge the module provides a range of applied skills from practical sessions where you are encouraged to translate theory into practice. The skills you develop in generating data during practical sessions prepare you well for modules in the second year and are early preparation for the scientific writing you will undertake in projects and dissertations in the third year.
Delivery:	Lectures, Practicals
Assessment:	In-course Assessment (30%) comprising: Evolution workbook and MCQ Test (15%) Two animal biology practical write-ups, each worth 7.5% 2 hour written examination in May/June (70%) made up of multiple choice and short answer questions**.**

03 23318	BIO152	Cell Biology and Physiology	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.

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

Pathways: This is a foundation module for a number of others in year two, three and four. These particularly include BIO262 (Membrane, Energy and Metabolism), BIO268 (Cell and Developmental Biology). The module is also propaedeutic to final year modules such as BIO379 (Cellular Neurobiology), BIO387 (Cancer Biology) and BIO384 (Human Reproductive Biology and Development). The module includes three laboratory practicals which along other lab tasks aim to prepare you for working in a laboratory when doing final year projects. The module is also beneficial to any animal and human biology modules or projects.

Delivery: Lectures, Practicals

Assessment: Continuous Assessment (30%) comprising:
MCQ class test (15%)
Practical Write-up (15%)

2 hour written examination comprising multiple-choice and short-answer questions (70%)

03 23319	**BIO152L**	**Essentials of Cell Biology and Physiology**	**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

Pathways: This is a foundation module for a number of others in year two, three and four. These particularly include BIO262 (Membrane, Energy and Metabolism), BIO268 (Cell and Developmental Biology). The module is also propaedeutic to final year modules such as BIO379 (Cellular Neurobiology, BIO387 (Cancer Biology) and BIO384 (Human Reproductive Biology and Development). The module is also beneficial to any animal and human biology modules or projects.

Delivery: Lectures

Assessment: Continuous Assessment (30%) comprising:
MCQ class test (30%)
90 minute written examination (70%) comprising multiple-choice and short-answer questions

03 23320	**BIO154**	**Genetics I**	**Credits: 20**
Level: C	**Semester: 2**	**Staff responsible: Prof Thomas**	
Description:	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.		
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.
Pathways:	Understanding 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. Understanding the mechanisms of inheritance and evolution is an essential part of understanding microbes, plants and animals, as well as health, disease, ecology and behaviour. You will use bacteria and plants to investigate genetic phenomena and knowing something about the biology of these organisms is important to properly use them as model organisms which allow us to explore general issues in biology. You will also be expected to understand the molecules involved in genetic processes and the basic biochemistry of DNA replication, mutation, gene expression, recombination and DNA repair. Finally the module involves important experimental design and data processing and thus the general skills you learn from this will be applicable to other courses. This module therefore provides you with a key foundation stone for your degree and will link with not just second year genetics, but with basically any other Biosciences course that you do. Understanding the language of genetics should be part of your skills as a Bioscientist.
Delivery:	Lectures, Practicals, Workshops
Assessment:	In-course assessment (30%) comprising: Practical Reports 10% Workshop Problems 10% MCQ Class Test 10% 2 hour written examination in May/June (70%) comprising multiple-choice and short-answer questions

03 27806	BIO171	Ecological Concepts and Plant Biology	Credits: 20
Level: C	Semester: 2	Staff responsible: Dr Pritchard	

Description:

This module provides a broad overview of the biology of our environment. As plants are key to shaping our environment, course fosters an understanding of the biology of plants with emphasis on plant physiology structure/function relationships, developmental processes and the exploitation of plants by humans. A set of basic plant physiological processes are considered, with special reference to physiological modifications that have ecological, agricultural and economic consequences. The course also covers plant hormones, life cycles, reproduction and evolution, all of which are key to environmental stability and feeding the planet. There is focus on *Arabidopsis,* which has become the model species for plant molecular genetic research. However, the course also considers crop plants, including crop domestication and methods for crop improvement including crop genetic modification.

You will consider definitions and methods to quantify animal and plant biodiversity in its many forms and some of the key concepts in animal ecology. You will study the relationship between animals and their environment, some of their behavioural and physical adaptations and the methods used to study them. You will then look at the use of modern DNA-based techniques that have defined the field of molecular ecology. Interesting and perplexing biological problems relating to population structures, speciation, biodiversity and conservation can only have been addressed by the use of genetic markers. These genetic markers of the past two decades are now giving way to whole genome-based studies of natural populations, which are opening new doors for fundamentally understanding the origin and maintenance of ecologically important attributes of animal and plant species. You will consider the diversity of the planet's biome in light of how environments vary across the globe. The various anthropogenic pressures on these environments will also be examined including habitat fragmentation, invasive species and pollution, in particular, emphasizing the effects of increased temperatures and levels of greenhouse gases that are driving climate change. A range of strategies will be considered to facilitate conservation for the natural world and sustainable solutions in 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 plants, particularly flowering plants.
- Introduce key concepts of ecology and environmental biology.
- Place ecology and environmental biology in a modern context.
- Provide a greater appreciation of biodiversity and the implications associated with ecological challenges.

Pathways: 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
- Understand how plants were domesticated and how the continual improvement of crop plants will meet the demands of an expanding global population
- Describe the different types of natural environments and outline the major threats to this biodiversity
- Understand key principles and methods in animal ecology.
- 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
- Develop skills in scientific writing

Delivery: Lectures, Practicals

Assessment: Continuous Assessment (30%) comprising:

- Satisfactory engagement with Peerwise MCQ web site (5%)
- Practical write-up (25%)
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2 hour written examination in May/June comprising multiple-choice and short-answer questions (70%)

Banner: 03 28777 BIO172		**Introduction to Microbiology**	**Credits: 10**
Level: C	**Semester: 2**	**Staff responsible: Dr Julia Lodge**	

Description: This module will provide students with broad introduction to microbiology. You will learn about the major microbial groups: bacteria, fungi, protists, archaea and viruses. Common themes will be explored including how microorganisms are studied, microbial lifestyles, their key structural components, and the key features of the different types of microbial cell.

Lab practical classes will provide opportunities to develop important competencies in handling, isolating and growing different types of microorganisms as well as introducing methods for analysing the effect of different growth conditions.

Learning outcomes:

- describe the key features of the major microbial groups and understand key similarities and differences between them
- explain how their key structural components allow these small organisms to exist in diverse environments
- Demonstrate an understand the evolutionary relationships between and within prokaryotic and eukaryotic microorganisms
- apply an understanding of the principles underlying isolation and growth of different types of microorganisms and methods for analysing the effect of different growth conditions;
- demonstrate an understanding of aseptic technique and develop competencies in safe handling of microorganisms
- work as a group to resolve a real life infectious disease control problem

Delivery: Lectures, practical classes, on-lines quizzes, workshops

Assessment: **Continuous Assessment (30%) comprising**:
Pre lab assessment 10%
Peer marked practical manual 10%
Video test on understanding of aseptic technique and safe handling of microorganisms

Sessional examination in May/June (70%) consisting of a 1.5 hour paper in two parts: MCQs and compulsory SAQs

Banner: 03 28776 BIO173		**Fundamentals of Biochemistry** **Credits: 10**
Level: C	**Semester: 1**	**Staff responsible: Dr Roisin Madigan**

Description: This module will provide students with a broad introduction to biochemistry: the chemistry underlying the processes that take place in cells
You'll study:

- how the structure of molecules explains their function, focusing on proteins such as enzymes;
- how cellular processes are determined by energy relationships;
- the sources of biological energy, and how energy present in food is captured and used by cells

In parallel, students will use independent learning texts to learn or revise fundamental topics: chemical bonds; concentrations and amounts; reaction kinetics; pH and pKa; and energetics and redox reactions. Core quantitative skills will be explored through workshops on concentrations, plotting graphs and Logs and Algebra.

Lab practical classes will provide opportunities to experience core techniques in biochemistry: the application of spectrophotometry to the quantitative analysis of proteins using and the kinetics of enzyme activity.

Learning outcomes:

- demonstrate knowledge of the structures and interactive properties of amino acids, and be able to discuss the structure-function relationships of proteins
- describe the key features of metabolism with reference to central sugar metabolism, the tricarboxylic acid cycle, redox reactions, and the integration and regulation of metabolism
- demonstrate an understanding of enzymes and introductory enzyme kinetics
- carry out practical exercises to illustrate methods of quantitative analysis including studies of enzyme activity
- understand fundamental chemical concepts of bonds, concentrations, reaction kinetics, pH and buffers and redox potentials
- demonstrate manipulative skills and problem solving in the workshops
- use and learn from a specific independent learning component of the course

Delivery: Lectures, practical classes, workshops, independent learning manual

Assessment: **Continuous Assessment (30%) comprising**:
MCQ test (15%)
Practical write-up (15%)

1.5 hour written examination in January (70%)

Banner: 03 28778 BIO174	**Metabolism**	**Credits: 10**
Level: C	**Semester: 2**	**Staff responsible: Dr Roisin Madigan**

Description: This module will provide students with in-depth study of metabolism as a progression from the semester 1 module Fundamentals of Biochemistry (10 credits).
We will discuss the metabolism of carbohydrates and pyruvate, and of fatty acids in detail. We will emphasise the experimental techniques, evidence and unifying concepts behind our current understanding of metabolic processes.
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Learning outcomes:

- demonstrate understanding of the features of metabolism exemplified by the major pathways of carbohydrate and fat metabolism
- interpret some disorders of metabolism by analysis of clinical data in case studies
- demonstrate observational, manipulative, numerical and deductive skills, and write reports (through experience gained in the practical and data-handling classes)
- develop improved skills of independent learning and verbal reporting in the clinical case studies
- develop knowledge of core microbiology including the gut microbiome and knowledge of how to culture microorganisms

Delivery: Lectures, laboratory practical, workshop, two case studies

Assessment: **Continuous Assessment (30%) comprising**:
Laboratory practical report (15%)
Case study (15%)

1.5 hour written examination in May/June (70%)

03 30143	BIO175	Human Nutrition and Metabolism	Credits: 20
Level: C	Semester: 2	Staff responsible: Dr Eleanor Cull	

Description: Upon completion of this module, students will be aware of, and be able to demonstrate understanding of the basic biochemistry that underpins the functioning of the human body. Four broad themes will be explored here:

- Nutrition- including recall of nutrient groups and basic processing within the body , exploring deficiencies and overdose problems
- Energy metabolism – Pathways involved in release of ATP from biomolecules including both anabolic and catabolic reactions
- Practical biochemistry techniques- Research led practical aspects to introduce students to common biochemical techniques used in research studies
- Regulation and Deregulation of metabolic pathways- The control of metabolic pathways including the effect of enzyme/ protein denaturisation, redox, key enzymes and starvation

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

1. Demonstrate a detailed understanding of important aspects of human nutrition.
2. Describe some of the techniques used to isolate cellular components and to purify and characterise proteins
3. Demonstrate understanding of the features of metabolism exemplified by the major pathways of carbohydrate, protein and fat metabolism
4. Interpret disorders of metabolism by analysis of clinical data in case studies
5. Demonstrate observational, manipulative, numerical and deductive skills, and write reports (through experience gained in the practicals and in the clinical case studies)

Delivery: Work based learning activities, laboratory practical classes, lectures

Assessment: In Course Assessments to comprise 40%:
25% Practical write ups
5% case study
10% workshop

1.5 hour end of year exam to comprise 60%

Reassessment: Supplementary Examination to include aspects of the case study and workshops as well as lecture material

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 in controlled conditions, demonstrate, an understanding of the blood system, its cellular and protein components and their roles.
- Independently and in controlled conditions demonstrate an understanding of molecular neurobiology with particular reference to the action of neurotransmitters.
- Independently and in controlled conditions 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.

Pathways:

This module applies and builds upon some of the knowledge gained in the 1st year modules in Biochemistry (BIO151), Enzymes & metabolism (BIO107), Human Biochemistry (BIO139) and Cell biology and Physiology (BIO152). The knowledge gained from this module provides a basis of understanding for the more molecular-medical related modules in the 3rd year, such as Cellular signalling (Bio319), Molecular and cellular mechanisms of toxicity and cancer (BIO304), Cancer biology (BIO387) and Cellular neurobiology (BIO379).

Delivery:	28 hrs lectures; 9 hrs practicals; 2 hrs case studies; 1 hrs videos
Assessment	**Continuous assessment (40%)** One 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, 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

Pathways: This module builds on what you learned in the first year genetics. It is core to all aspects of the Biosciences and you will find that the technologies that are introduced in this module have been exploited to further our understanding in areas as diverse as ecology, medicine and biochemistry. Second and third year modules will follow on themes which have been introduced in BIO230. If your interests are in molecular aspects of biology these links will be obvious to you. Even if you are more interested in whole organisms and ecology you will find that molecular approaches are widely used in these fields. Did you know that High Throughput sequencing has been used to identify organisms sampled by collecting windscreen splatter? This gives us a more accurate picture of the diversity of organisms present.

Delivery: Lectures, practicals and workshops.

Assessment	**Continuous assessmen**t: 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 Dr George Bassel Dr Dan Gibbs	

Description:

The aim of this course is to develop an understanding of how plants function, via their development and physiology, in relation to key influences in their natural environment. This includes both a consideration of physical factors, and the influences of other interacting organisms, some of which have positive consequences for plant performance, others of which are very detrimental. The module takes an integrated view of plant function at both the single-cell and the whole-plant level. The module will reflect the growing emphasis on integrating physiological, molecular and more recent computational approaches to (i) understand how plants develop and function and (ii) engineer plants for non-ideal environments. The module exploits developing research strengths within the School.

Learning outcomes:

KNOWLEDGE BASED

Show an understanding of how plants perceive and respond to a range of physical stimuli and signals in order to better adapt themselves to their environment

- Appreciate the role of model plants including *Arabidopsis* in understanding plant function and how knowledge from these plants can be transferred to crop plants.
- Understand the fundamentals of plant development and patterning.
- Understand the key ways in which plants perceive, transduce and respond to various signals from their environment.
- Understand the key attributes of both biotrophic and necrotrophic modes of parasitic nutrition and how these relate to the spectrum of symbiotic interactions.
- Understand the different strategies used by specific plant pathogens and herbivores to infect their hosts and plant responses to infection.

SKILLS BASED

Be able to design and execute scientific experiments

- Work in groups to design hypotheses and test them by carrying out specific experiments
- Apply your knowledge to problem solving and data handling, including reading the scientific literature.
- Present experimental data in written form
- Use computer based resources and simulations to support learning.

Pathways:

This module sits between your first year studies in BIO171, Ecological Concepts and Plant Sciences and the more research-focussed modules in the final year (BIO389, Adaptations to changing Environments, BIO398 Plant Science in the 21st Century) as well as a wider range of final year projects. You will find that the module complements some of the second year field courses such as BIO259, Glacial Ecology in Norway. In addition to up to date knowledge the module provides a range of modern techniques increasingly used in plant science research. The skills you develop in collecting and analysing and writing up experimental data build on the *Arabidopsis* exercise you undertook in BIO171 and provide an excellent preparation for the scientific writing you will undertake in projects and dissertations in the final year.

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, Hotchin & 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.

The lectures on diseases caused by fungal pathogens will mainly be delivered using a 'flipped teaching' approach. You will be asked to use material on Canvas or read an article to prepare for each teaching session. The lectures will be interactive sessions addressing areas of difficulty and incorporating a range of formative exercises.

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).

Pathways:

In the Fungal growth and virulence" workshop you will work through data on fungal growth in liquid and solid culture and on different methods for the assessment of fungal virulence.

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.
- Work as a group to produce a microbiology resource

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:	Formative Data handling questions based on the practical and workshop elements Summative Two pieces of continuous assessment: A group assignment to produce a microbiology resource (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	On line feedback on your microbiology resource. There will be a feedback and revision session based on the formative assessment 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

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.

Pathways: The course continues from the descriptions of proteins, enzymes and biophysical techniques in first year modules. It complements BIO262 in the first semester and aspects of CHM252, in particular spectroscopy. Students are expected to know the relevant material from these modules. Natural Sciences students who have not taken these modules should inform the course organiser, in case they need additional background reading or support. Information from this module will form part of the basis of BIO340 in the third year. It is also relevant to many of the third year modules, in particular BIO311- 'Structures of Destruction'.

In addition to the academic content, this course develops data handling skills and begins to discuss experimental design and interpretation, both in the workshops and in the practical classes.

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

Assessment: **Continuous assessment**

- Practical write up - 15%
- Data-handling test - 20%

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 Alderwick, Dr Kreft, Dr Knowles, Dr Dunn	

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

Pathways:	The module builds on concepts taught in Year 1, the essential roles of lipids and membranes, how energy is generated and stored and how metabolism is regulated. The module links well with other Year 2 modules, eg *Microbes and Man*, *Cell Physiology* and *Proteins and Enzymes*, especially when analysing individual protein and enzyme components of biological membranes. Whether studying lipid components, analysing transport through membranes or calculating bioenergetic paramaters, data handling is an essential skill that we will develop in the practicals and data-handling workshops. The module is an invaluable foundation for several Year 3 modules, including *Cell Signalling*, *Microbiology*, and *Biochemical Data Handling and Interpretation*.
Delivery:	Lectures, practicals (summatively assessed), data-handling classes and directed independent reading
Assessment:	**In-course Assessment – 30%** Practical 1 Snake Venom – 15% Practical 2 Redox consisting of pre-practical test and Lab write-up 15% **Examination May/June – 70%** 2 hour written examination in May/June consisting of essay and short answer questions. **Reassessment:** Supplementary examination Resit mark for the module is based solely on exam performance. Continuous assessment marks are not counted. Resit examinations will assess all Learning Outcomes

03 13160	BIO265	Genetics II	Credits: 20
Level: I	Semester 2	Module Organiser: Dr Luo Teaching Staff: Drs, Armstrong, Leach, Lee, Lund, Minchin	

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 show 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

Pathways: The second year genetics module follows on from the knowledge and skills acquired from the first year genetics module (BIO154). It is essential for those students who wish to have a genetics label attached to their final degree. It is also a requirement for students who wish to take modules BIO348 (Genetics III) and BIO387 (Cancer Biology).

Delivery: Lectures, experimental practical classes), problem solving classes

Assessment **Continuous assessment** throughout the course. This will be derived from 2 tests based on practicals and problem solving classes. It will comprise 30% (15% 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 70% of the mark of the course.

03 24985	BIO268	Cell and Developmental Biology	Credits: 20
Level: I	Semester 2	**Module Organiser: Dr Tomlinson** **Teaching Staff:** Dr Yun Fan, Dr Neil Hotchin, Dr Natalie Poulter (Medical School), Prof Alice Roberts, Dr Mike Tomlinson	

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:

- describe relevant model systems for use in Cellular and Developmental Biology
- evaluate relevant methods in Cellular and Developmental Biology
- Recognize, recall and define terms and processes relevant to the study of the cytoskeleton, cell adhesion, the extracellular matrix, cell migration and epithelial differentiation
- 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

Pathways: This module builds on information regarding Molecular Cell Biology and Cellular Physiology obtained in the first year (e.g. BIO152: Cell Biology and Physiology), as well as methodological approaches linking to information previously gained in first year modules (e.g. BIO139: Human Biochemistry). Aspects of this module will be important in third year modules (e.g. BIO387: Cancer Biology, as well as BIO384: Human Reproductive Biology and Development, and BIO398: Plant Sciences in the 21st Century). The practical component of this module will teach students methods for the analyses of cultured cells.

Delivery: Lectures, interactive session, feedback session, data handling/analysis workshop and practical.

Assessment

In-course assessment (30%)

- 1 practical involving cell counting and viability assays (10%).
- 1 test paper (20%). This will involve multiple choice questions in 60 minutes. It will be based upon data handling, data analysis and other skills developed during the practical, workshop and interactive sessions.

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

Examination in May (70%)

2 hour written examination in May/June consisting of essay and short answer questions
Overall the examination will comprise 70% of the total mark for the module.

Banner: 03 24986 BIO270		Field course: Adaptations to Aquatic Environments	Credits: 20
Level: I	**Semester:** Easter vacation	**Module Organiser: Dr Julia Lodge** **Teaching staff: Dr Julia Lodge, Dr Steve Publicover, Dr Julia Myatt, Dr Neil Hotchin**	

Description:

STUDENTS MUST BE AVAILABLE FOR FIELD WEEK ON THE 3RD APRIL – 10TH APRIL 2018 INCLUSIVE

The module is a field course based in Orielton Pembrokeshire.

You will be able to spend 2 days on the sea shore at Orielton examining the conditions on the sea shore that make it a unique life support system, and how representatives of different animal and plant phyla have adapted their behaviour and physiology to meet the variable conditions prevailing in their natural environment.

A major feature of the course is the opportunity to spend a further 4 days as part of a small group on a project designed to examine physiological or behavioural adaptations to aquatic environments. This work will then be written up independently. Students will be expected to present their findings orally. The module will allow students to develop planning and organisational skills as well as skills of experimental design, data analysis, communication and teamwork.

The lecture component of the module will introduce you to the biotic and abiotic characteristics of the marine environment with particular reference to the littoral (shore) zone. You will learn about the abundance and diversity of animals and plants that inhabit the marine littoral and their specific adaptations to life in this challenging and highly unpredictable environment.

Note that this course will only run if sufficient numbers of students are recruited. If the ceiling is not reached students may be offered another related field module or asked to take an additional conventional module.

Learning Outcomes:

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

1. Identify key species found on the seashore environment at Orielton.
2. Explain, using specific examples, how environmental conditions change in different zones of the seashore environment, and how these changes influence the distribution, abundance and diversity of the resident fauna and flora.
3. Describe the range of physiological and behavioural adaptations that allow organisms to survive and reproduce in this environment
4. Show competence in some basic field, lab and analytical techniques for studying animal and plant diversity and distribution
5. Keep a formal record of data collected in the field using a field journal
6. Work in small teams and individually to solve the practical and theoretical problems encountered during field or laboratory projects
7. Write up an independent research project to provide an evidence base supporting the achievement of learning outcomes 1-6

Present the results of research/practical work and communicate these findings orally.

Pathways:	This Field Course module is part of a suite of field based opportunities offered to second and third year Biological Sciences and Natural Sciences students. It is ideal for students who want to develop field study skills or to study animals and plants in the field. It builds on the environmental biology part of First Year *Ecological Concepts and Plant Sciences* and on *Introduction to Evolution and Animal Biology*. It works well with second year modules: *Animal Biology.* In the final year students who wish to do further field work can choose to take the field project module and there are also opportunities to do a field based project.
Delivery:	The core of this module is a one week field course. The module will also involve 4-6h of lectures taught during term time at the University of Birmingham or during the field course at the field centre.
Assessment:	Essay on the sea shore environment (20%) Species identification test (20%) Written report on field course project (35%) Field course performance: including individual species description and field note book (15%) Oral presentation (10%)
Feedback:	Feedback is provided on the essay before the field work component of the module. Opportunities for formative feedback on your project report are provided during the field course.
Additional Information	The field course will run during the Easter vacation, you should be aware that this will impinge on revision time for your summer examination; students often bring revision with them. You will be required to be available for 8 days, during the Easter Vacation; this includes travel to and from the field studies centre. Students are required to make a contribution towards the cost of the field course (£200).

03 26999	BIO273	Human Structure and Function	Credits: 20
Level: I	**Semester: 2**	**Module Organiser: Dr Eleanor Cull** **Teaching staff: To be announced**	

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. The module employs a diverse range of teaching methods including interactive lectures and the discussion of real-life clinical cases. Students should be aware that some lectures contain graphic images and videos of surgical operations and diseases.

Learning Outcomes:

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

- 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 evolution of some of the major anatomical adaptations 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
- Communicate in a variety of ways including posters

Pathways:

BIO273 builds on topics initially established in the following 1st year modules:
BIO139, BIO145, BIO152 and BIO152L
BIO273 also complements the content of other second year modules, notably:
BIO213, BIO268, BIO277 and BIO278

Delivery:	Lectures, practicals, workshops
Assessment:	**In course assessment** – 40% comprising: Practical write-up (20%) MCQ Test (20%) **Examination** – 60% 2 hour written examination in May/June consisting of essay and short answer questions

03 28780 BIO277	Evolution of Humans and Other Animals	Credits: 20
Level: I Semester: 1	**Module Organiser: Dr Anja Deppe** **Teaching Staff: Dr Chappell, Dr Brandstaetter, Dr Myatt**	

Description:

The primary aim of this module is to provide students with a comprehensive understanding of comparative animal biology in an evolutionary context. Humans are part of the animal kingdom, and our own evolution is also best understood from this perspective. We will develop student understanding of evolution in the four dimensions in which it occurs: genetic, epigeneic, behavioural and symbolic, and how these dimensions interact in different ways in different species during the process of evolutionary change. We will explore numerous examples that point to the fact that evolution shapes biodiversity, not merely by the rise and fall of species over millions of years, but also by the often rapid transition of species traits from one form to another at pace with rapid environmental changes, some caused by humans. Having obtained this broad overview, we will focus on the processes by which evolution operates in the four dimensions, resulting in adaptation and/or speciation, by studying key themes in animal biology, such as the evolution of the circadian system, sociality, locomotion and tool use. Insodoing, the course will expand student understanding of core evolutionary concepts such as convergent evolution and units of selection, and will broaden their knowledge of the origins and maintenance of biodiversity.

The module will include a number of practicals to give students experience of handling and interpreting fossil material, particularly Mesozoic reptiles and great apes, including early hominins. These practicals will help students understand the extent to which it is possible to infer behaviour, social organisation, culture, ecological context etc. of extinct animals from the fossil record. We will also have workshops to facilitate thought experiments on the evolutionary consequences of future events (e.g. major climate change or key species being wiped out) and to debate, within the group, pressing questions surrounding evolution.

Learning outcomes:

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

- Understand that in addition to genetic inheritance, epigenetic, behavioural and cultural inheritance provides variation on which natural selection can act
- Critically compare and synthesize information from molecular biology and behavioural ecology to develop an integrated underestanding of the four dimensions through which evolution occurs
- Describe major events in animal evolution and their impact on biodiversity
- Explain how human adaptations show that modern humans and our ancestors have been subject to the same evolutionary processes as the rest of the animal kingdom
- Understand the origins of different forms of similarity between different species, and be able to differentiate between them, using examples
- Understand and discuss evolutionary principles sufficiently well to be able to 1) conduct thought experiments on the evolutionary consequences of future events and 2) convey evolutionary principles and events in an appropriate way for school children to understand
- Work as a team to examine fossil remains to establish genus/species, morphological

	similarities and key life history traits • Formulate and express own ideas concisely through independent learning and writing • Construct a logically sound well structured argument when writing and be able to recognise and critically analyse weak arguments when reading them • Use the skills gained in the peer marking sessions to reflect on ways to improve their own academic writing
Pathways:	BIO277 links to the evolutionary principles and introduction to human evolution covered in BIO145, and provides a firm basis for the final year module in Human Evolution (BIO380). Since the course seeks to understand the forces that have driven human evolution, it also links to all courses that address the way in which animals, particularly mammals, interact with their physical and social habitats, and thus their ecology.
Delivery:	Lectures, practicals, workshops and small discussion groups
Assessment:	**In-course Assessment – 50%** In-course assessment (50%) is split into two parts, a group-produced poster to present evolutionary principles to school children (25%) and an assessed SAQ (25%). The practicals, lecture material, workshops and the student's independent reading will provide relevant information for the SAQs. The word limit for the SAQs will be one-page, 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. Students will be provided with a choice of essay titles (including citations for 3 key references) 14 days in advance of the exam so that they can pre-select the questions they will answer and revise specific topics in detail. They will answer 2 essays questions 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.

03 28222	BIO278	Animal Biology: Principles and Mechanisms	Credits: 20
Level: I	Semester 2	Module Organiser: Dr Brandstaetter Teaching Staff: Dr Publicover, Dr Chappell, Dr Myatt	

Description: The central theme of this module is to cover aspects of comparative Zoology including different life history stages and different levels of organisation – from cellular to organismal. Animals display specific adaptations in their morphology, physiology, and behaviour to the environments they live in. These adaptations reflect the ecological diversity and adaptive radiation of animals. During this module we will explore common and distinct elements of early development in animals and how environmental adaptation has shaped early life history stages. We will also focus on understanding how animals perceive their environment by utilising a variety of species- and environment-specific sensory system and how this information is processed and integrated by the brain to regulate physiology and behaviour in order to maintain homeostasis. We will examine how development, sensory systems, neurobiology and behaviour influence the ways animals manage adaptation to their environments and cope with the challenges that these pose, which also reflects the ecological diversity and adaptive radiation of animal species. It will also consider animals' responses to dynamic changes in environments, such as those caused by extreme environments, climate change, environmental problems and urbanisation. The module consists of lectures, practicals and interactive tutorials, i.e. workshops that will build the foundation for the practical work and encourage independent active learning.

Learning outcomes:

- Demonstrate an understanding of different animal systems and how they are morphologically, physiologically, and behaviourally adapted to the environments they live in, ranging from invertebrates to humans.
- Explain the principles and mechanisms of the generation of behaviour by the nervous system and sensory coding by the sense organs and the brain, i.e. the difference between sensation and perception and the processing and integration of neural information, and use this knowledge to
- model the integration of environmental information and its translation into complex behaviour
- Answer specific questions on how animals form during their development to cope with changing environments and extreme environmental challenges.
- Collect, record, handle and interpret scientific data and apply practical and manipulative laboratory skills.

Pathways: This module sits between your first year studies in BIO145 and BIO152 and the more research focussed modules in the final year, such as BIO392, BIO397, and a wider range of final year projects. The knowledge you will acquire in this module will provide an excellent preparation for the scientific writing you will undertake in final year projects in the fields of Neuroscience, Circadian Biology, and Animal Behaviour.

Delivery: Lectures, practicals and tutorials.

Assessment ***Continuous assessment*****:** 40% comprising:
Practical skills – Data handling and interpretation - Test 40%

Examination: 2 hour written examination in May comprising essay and short-answer questions. Overall the paper will comprise 60% of the marks of the course.

03 30145	BIO279	Critical Issues for 21st Century Ecosystems	Credits: 20
Level: I	Semester: 2	**Module Organiser:** Dr Nigel Maxted	

Description:

Module Aim: To provide core skills in ecosystem knowledge and lead into for third year research led-modules.

Module background: This module will provide a second-year module that bridges the generalised first year and research-focussed third year modules in ecology/conservation. It will provide you with an ecosystem approach which is truly dynamic in its content and delivery, reacting to issues of the 'moment'. It is an opportunity for you to experience research-led teaching as the themes taught in the module are directly related to core College research themes.

Module structure: The module would be structured around four semi-independent topics related to critical issues in biosystems/ecosystems that map onto expertise within both BIOS and GEES. The topics covered each year may include for example: Climate change, Food security, Pollution, Over-harvesting, Threatened ecosystems, Anthropomorphic ecosystems, Ecosystem valuation & conservation.

- **Lectures** will be based around case studies that promote skills training but not exam assessment.
- **Practical/skills session:** These will include off site visits and will allow you the opportunity to collect and analyse ecological data

Mini-projects: Students will select one of the four topics and undertake the mini-project. Students will work in groups containing a deliberate mix of Bio and GEES students to get diversity of skills and perspectives.

Learning outcomes:

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

- Explain key scientific, political and ethical issues associated with global and local ecosystem valuation, threats and maintenance.
- Design and organise experiments, collect, record, analyse and interpret data.
- Discuss strategies and techniques to sustain ecosystem services for humankind in the future.
- Present results orally and in written format suitable for a scientific paper or conference presentation, individually or as a group, so as to contribute to the existing scientific knowledge base.

Delivery:

Large-group lectures, small group problem solving, tutorials, seminars.

Assessment:

Assessments associated with four topics and mini-project:

- Topics assessment (40% of module mark):
  - Class test to include data interpretation and analysis and SAQs (25%).
  - Ministerial briefing (15%).
- Mini-project assessment (60% of module mark): (a) 1 page Project plan (group 15%), (b) a 15 min group research report presentation (group 25%), and (c) a 2,000-word project report (individual 60%).

Reassessment: Repeating failed components, module mark capped at the pass mark.

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

Pathways:	The module builds on concepts taught in earlier years, how protein function and structure are interdependent, and using structure to gain insight, concepts that are strengthened through two molecular graphics classes. Students that have little prior experience benefit from a dedicated introductory/refresher course on molecular graphics. Whether studying individual proteins, or large macromolecular complexes such as viruses, conveying data in a clear and simplified manner to a lay audience is an essential skill that we develop in the group poster preparation. The module links well with other Level 3 courses such as BIO303: Applied and Environmental Microbiology, BIO305: Molecular Basis of Bacterial Infection, and BIO340: Experimental Design, Analysis and Interpretation of Biochemical Data
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 - 15% (10% staff mark; 5% peer mark) Molecular Graphics 1 - 0% (formative) Molecular Graphics 2 - 15% **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: Lectures, 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, Murphy, 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.

Pathways: This module develops the basic concepts of cell signalling taught within the Second Year modules BIO262 (Membranes,energy and metabolism) and BIO213 (Topics in Medical Biosciences) to bring the students to the 'cutting edge' of current knowledge.

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%

03 11221	BIO325	Eukaryotic Gene Expression	Credits: 20
Level: H	Semester: 1	Module Organiser: Dr Minchin Teaching Staff: Dr Brogna, Dr Soller	

Description:

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.

The module 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.

It 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. Students 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, communication skills will be developed in a series of “News & Views” workshops in which students will develop the 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 students the opportunity to practice examination skills, particularly how to structure an essay to answer an examination question and how to use additional material in their answer. The feedback on this assessment will help you to develop these skills further.

Aims:

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.

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

Pathways: This module leads on from the BIO154 Genetics I and BIO265 Genetics II modules in additional it will also provide functional insights into some of the topics covered in Cell and Developmental Biology modules in years 1, 2 and 3. It complements several final year modules including Bacterial Gene Regulation, Genetics III, Cancer Biology and Human Reproductive Biology and Development.

Delivery: Lectures and Workshops

Assessment: **In-course Assessment - 40%**
Summarising a research paper assessment (20%)
Mock" Examination (20%)

3 hour written Examination in May - 60%

03 28011	BIO335	Human Health and Disease	Credits: 20
Level: H	Semester: 1	Module Organiser: Dr Eleanor Cull	

Description:

At some point in our lives we all sufferer from disease. Arguably it is only really when something goes wrong that we realise how vital each component in our bodies really is. The aim of this module not to describe all types of disease, but to give you an insight into how disease occurs (pathogenesis), how it can be diagnosed and treated/managed and how disease impacts on society (and society impacts on disease).

During the module we will explore a selection of disease states and consider advanced aspects of anatomy and physiology relevant to their diagnosis and treatment. Additionally, we will explore some of the major ethical issues that need to be considered in real-life clinical practice and research.

Pathways: This module builds on the material covered in BIO273 (Human Structure and Function). BIO335 complements content delivered in a number of other third year modules including BIO384 and BIO387.

Delivery: Lectures, seminars, laboratory practicals, clinical skills practicals

Assessment: In-course assessment – 35%
3 hour written examination in May – 65%

03 27876 BIO336		Conservation Practice: Genes to Ecosystems	Credits: 20
Level: H	Semester: 2	Staff responsible: Nigel Maxted	

Description:

This is a stand-alone module but complements GGM317 Biodiversity and Conservation Management which runs in Semester 1

The course examines the scientific basis for conservation, its genetic foundation, why population size is critical and how biodiversity is maintained either in nature or at a backup location. The relevance of key areas of biology, such as genetics and ecology, to conservation practice are emphasised using case study examples for primate, bird, carnivore and plant genetic resource, as well as freshwater and upland peat habitat, conservation. A practical approach to conservation is further illustrated by a review of environmental ethics, ecosystem services, ecological restoration and how conservation action can be enhanced by working with local communities.

Learning outcomes:

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

- Have gained an understanding of key scientific, political, economic and ethical issues associated with conservation biology, both globally and locally.
- Be able to discuss the strategies and practical techniques used to conserve biodiversity at the genetic, species and habitat levels, and set practical conservation in the local community development context.
- Have an understanding of how the basic principles of conservation biology are applied to major groups of taxa and specific habitats, which provides the ability and confidence to formulate effective management policies and conservation strategies.
- Have acquired general skills in acquisition of knowledge, problem solving and the presentation of ideas.

Delivery:

Lectures, seminars, tutorials

Assessment:

In-course assessment - 50%

- Mock grant application (40%)
- Presentation of a seminar (10%)

3 hr written Examination in May/June - 50%

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

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. Students 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

Pathways: This Module follows your first and second year studies in Genetics (BIO154 & BIO265). You will find that the module concentrates in Eukaryotic genetics specially in human genetics. You will use the knowledge that you developed in Genetics I (BIO154) in the especially about how is stored the genetic information, and how it is transmitted: mitosis and meiosis; how DNA damage produces mutations. Furthermore, you also will use the accumulated knowledge in Genetics II (BIO265) especially about the organisation and structure of genes and genomes in higher eukaryotes; the basis by which genetic variation arises and is transmitted from generation to generation; the phenomenon of epigenetic inheritance; the molecular basis of gene regulation and the methods used to analyse gene expression. Students will familiarise with a range of genetical techniques applicable to humans and other higher eukaryotes that could be useful for a wider range of final year projects. You will find that the module complements the third year modules BIO325 "Eukaryotic Gene Expression", BIO384 "Human Reproductive Biology and Development", BIO387 "Cancer Biology" and BIO398 "Plant Science in the 21st Century". The skills you will develop in analysing data and researching bibliography during your in-course assignments will provide you with an excellent preparation for your exams and project dissertations in the final year.

Delivery: Lectures; workshops where you will get formative feedback to do the different in-course assignments; 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.

- **News & Views Article (15%)**
- **Quantitative analysis (mini-project) (20%)**

3 hour written examination in May - (65%)

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, cellular and genetic 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 look into the molecular and cellular mechanisms underlying the most common brain diseases, such as Alzheimer's and Parkinson's diseases, Multiple Sclerosis, Schizophrenia, Anxiety and depression, as well as spinal cord injury.

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 genetic, molecular and cellular mechanisms of neural development
- 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 the different concepts that explain developmental events and diseases in the brain, and how to approach them to improve therapeutic solutions
- Handle and interpret quantitative data
- Assess primary information from the scientific literature

Pathways:

This module follows from BIO274, which dealt with nervous system function and behaviour. You would also benefit from background on cell biology and developmental biology, e.g. BIO268.

Delivery:

Lectures: tutorials, student seminars/discussions.

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 Deppe Teaching Staff: Dr Chappell, Dr Deppe, 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. Understand key limitations in our ability to interpret the fossil record due to muscle plasticity and explore the functional implications of muscle plasticity through the drawing workshop
8. Formulate and express their own ideas through independent learning and writing skills.

Pathways: BIO380 follows on directly from the broad introduction to human evolution, adaptation and behaviour provided in BIO263. It also relates to coverage of evolutionary principles introduced in BIO145. Since the course seeks to understand the forces that have driven human evolution, it links to all courses that address the way in which animals, particularly mammals, interact with their physical and social habitats, and thus their ecology.

Delivery: Lectures, Research topics (2 hours drop in and 2x2 hours presentations), Practical, Workshop, 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. Two weeks before the exam 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 21893	BIO387	Cancer Biology	Credits: 20
Level: H	Semester: 1	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.

In parallel 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 show understanding of the following topics:

- the biology of cell multiplication in vitro and in vivo, including phases of the cell cycle, and how the cell cycle progression is regulated by cyclin/cyclin dependent kinases
- growth factors and how they signal via cell surface receptors to effect gene transciption and progress through the cell cycle
- the role of oncogenes and tumour suppressor genes in normal cell cycle control and in cancer
- DNA damage and repair mechanisms
- the biological features of naturally occurring tumours
- the mechanisms involved in malignant tumour formation, including angiogenesis and metastasis
- the biochemical mechanisms involved in programmed cell death (apoptosis) and its relevance to development of cancer
- epidemiology, cancer risk and prevalence
- genetic predisposition to tumour formation
- recent developments in cancer diagnosis, therapy and prevention

Pathways:

This module builds on the genetics, molecular and cellular biology knowledge you have gained in years 1 and 2 and applies this to our current understanding of cancer biology. This mode will be particularly relevant of those of you undertaking literature reviews or research projects where knowledge of cell signalling is required. The continual assessment part of the module is specifically designed to complement the lecture material and develop the reading and writing skills required to achieve high marks in your final examination.

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:

In-course 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: Dr Klaus Futterer Teaching Staff: Prof Jon Green	

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) innate immunity and the role of phagocytes, inflammatory responses and intracellular killing mechanisms, (ii) adaptive immunity and the role of B cells, T cell subsets, antigen presenting cells, interleukins and cell surface receptors, (iii) 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

Pathways: This module builds on aspects of cell biology in BIO268 and microbiology in BIO258 and links in well with a range of other modules in the final year. As well as giving you up to date information on how the immune system works to combat various types of infection, the module also covers unwanted effects of the immune system such as autoimmune disease and transplant rejection. There is emphasis on the experimental methods used to establish the role of cells and molecules in the immune system and you will develop skills in data interpretation. The in-course assessment on 'controversies in immunology' builds on your essay writing and critical thinking skills that you began to develop in the second year and will help you to think about how evidence can support different ideas. This will help in your approach to writing essays in the final year exams.

Delivery: Lectures, practical session and 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	Module Organiser: Dr Hayward Teaching Staff: Dr Pritchard, Prof. Colbourne, Dr Orsini, 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.
  - Daphnia 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

Pathways:

BIO389 builds on topics initially established in the following 1st and 2nd year modules: **BIO145** Introduction to Evolution and Animal Biology; **BIO171** "Ecological Concepts and Plant Sciences", and some content from **BIO152** "Cell Biology and Physiology"; **BIO259** "Alpine Ecology Field Trip"; and **BIO237** "Plant Sciences: from Cells to Environment".
BIO389 also complements aspects of other 3rd year modules, including **BIO398** "Plant Science in the 21st Century" and **BIO336** "Conservation Practice: Genes to Ecosystems".
While there are no pre-requisites for this module, additional background reading will be required if these earlier modules have not been taken. This is especially relevant to any GEES students selecting this module, that may have taken a different range of modules en-route to their final year.

Delivery:

The module is primarily based upon lectures.

Assessment:

In-course Assessment – 30%

- 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 Blanchard Teaching Staff: Drs Brandstaetter, Chappell, Deppe & 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.

Pathways:

This module builds directly on knowledge gained in the first year module **BIO145 Introduction to Evolution and Animal Biology** and the second year module **BIO274 Animal Biology.** As a **behavioural ecology** module it also links in with and follows on from other modules such as **BIO171 Ecological Concepts and Plant Sciences**, **BIO263 Human Evolution, Adaptation and Behaviour** and the second year **field courses**.

In the final year it complements a number of the other modules available including: **BIO336 Conservation Practice: Genes to Ecosystems; BIO380 Human Evolution** and **BIO389 Adaptation to Changing Environments**.

Delivery:

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

Assessment:	**In-course Assessment - 50%** Summative Assessment: 600 word public science written article (25%) A4 poster (20%) 2-minute individual 'flash' presentation (5%) Formative Assessment: Small-group discussion sessions 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 written Examination in May - 50%**

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.

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 drought.
(iii) Regulation of developmental processes; for example how plants regulate their root system architecture.
(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.

Pathways:	This module follows on from BIO171 Ecological Concepts and Plant Sciences and BIO237 Plant Sciences: from Cells to the Environment. It also integrates information learnt in previous molecular biology modules including BIO230, Molecular Biology and its Applications. Importantly, it develops skills required broadly in your final year for projects and dissertations and interfaces with a number of literature and laboratory projects on offer.
Delivery:	Interactive lectures; 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%**