

LEVEL 2 BIOL UNITS

The Faculty of Life Sciences has conducted a review of its undergraduate curriculum which has resulted in significant changes to the level 2 course units on offer in 2011-12. Below you will find a list of the new curriculum together with an outline for each course unit.

Please note: due to increased student numbers and limited class sizes for RSM (Research Skills Module) units, the Faculty is unable to offer any places on RSM units to Study Abroad or Erasmus students for 2011/12. We will review the situation on an annual basis.

Code	Title	Sem.	Coordinator
BIOL21101	Genome Maintenance & Regulation	1	Dr David Boam
BIOL21111	Proteins	1	Dr Stephen Prince
BIOL21121	The Dynamic Cell	1	Dr Martin Pool
BIOL21132	Cell Metabolism & Metabolic Control	2	Dr Lisa Swanton
BIOL21141	Cell Membrane Structure & Function	1	Dr Martin Lowe
BIOL21152	'Omic Technologies & Resources	2	Prof. Richard Reece
BIOL21162	Chemistry of Biomolecules	2	Dr David Leys
BIOL21172	Principles of Developmental Biology	2	Dr Keith Brennan
BIOL21181	Prokaryotic Microbiology	1	Dr Dennis Linton
BIOL21192	Principles of Infectious Disease	2	Dr Jen Cavet
BIOL21202	Plants for the Future	2	Dr Patrick Gallois
BIOL21212	Ecology & Ecosystems	2	Dr Keith White
BIOL21221	Animal Diversity	1	Dr Jonathan Codd
BIOL21232	Fundamentals of Evolutionary Biology	2	Dr Casey Bergman
BIOL21242	Immunology	2	Dr Peter Wood
BIOL21252	Parasitology	2	Dr Richard Grecnis
BIOL21261	Endocrinology	1	Dr Steve Bidey
BIOL21272	Human Physiology	2	Dr Peter Brown
BIOL21281	Animal Physiology	1	Dr Holly Shiels
BIOL21291	Human Anatomy & Histology	1	Dr Bip Choudhury
BIOL21302	Clinical Drug Development	2	Dr Tracey Speake
BIOL21312	Drugs & the Brain	2	Dr Mike Dascombe
BIOL21321	Membrane Excitability: Ion Channels & Transporters in Action	1	Dr Jon Turner
BIOL21332	Motor Systems	2	Dr Enrico Bracci
BIOL21341	Sensory Systems	1	Dr Ken Grieve

Code	Title	Sem.	Coordinator
BIOL21351	Cells & Tissues in Human Disease	1	Dr Mauro Esposti
BIOL21361	Haematology	1	Dr Michelle Keown
BIOL21371	Organismal Genetics	1	Dr Kathy Hentges
BIOL21381	Introduction to Virology	1	Dr Nicky High

GENOME MAINTENANCE & REGULATION

BIOL21101

Unit Coordinator(s): Dr David Boam
(dave.boam@manchester.ac.uk)

Semester 1
Credits 10

Aims

To provide a general overview of how a genome is maintained and regulated in both prokaryotes and eukaryotes. This will be achieved using an example and paradigm-orientated approach, emphasising common themes related to mechanism.

Intended Learning Outcomes

Students will be expected to have basic knowledge and understanding of:

- The mechanisms by which prokaryotes and eukaryotes detect and repair DNA damage
- Recombination and mobile gene elements, and their roles in genome function and evolution
- Regulation of DNA replication during cell growth and interaction with transcription and DNA repair processes
- Genome structure including nuclear and organelle genomes and implications for regulation
- Genome regulation at the transcriptional, post-transcriptional and translational levels

Lecture Content

- Gene regulation in prokaryotes
 - Promoter architecture, regulatory networks, gene regulation and signalling by nutrients and stress in prokaryotes; roles of RNA in prokaryotic gene regulation
- Gene regulation in eukaryotes
 - Sequence-specific transcription factors families; mechanisms of transcriptional stimulation – coactivators, repressors and chromatin remodelling; signalling to the nucleus; tissue-specific and developmental gene regulation
 - The co-transcriptional regulation of mRNA processing; generating the transcriptome - alternative splicing, mRNA turnover, RNA interference; RNA nucleocytoplasmic export and the control of mRNA localization
 - The mechanism and control of eukaryotic protein synthesis
- DNA replication - basic models of regulation during cell growth in yeast and higher eukaryotes, bacterial and viral DNA replication
- Mechanisms of DNA repair – error-prone, recombination, transcription-coupled excision repair; detection of DNA damage in eukaryotes and prokaryotes
- Horizontal gene transfer - transduction, transformation, conjugation; DNA segregation.
- Transposons and retroviruses; their effect on genome evolution, organisation and function
- Organelle genomes, evolution, composition, regulation and maintenance

eLearning Activity

elearning modules with both formative and summative online assessment; group based Wiki and ePoster activities

Assessment

1hour 45 minute written examination (85%), problem-based eLearning exercises (5%), Wiki (5%) and a group-based ePoster presentation (5%).

Feedback

Online MCQs based on lectures will allow students to practice MCQs and obtain continuous formative feedback on their own progress and understanding. Electronically marked components of the unit assessment allow students to monitor their own progress. An online discussion forum is available for communication between students and staff.

Prerequisites

BIOL10212 (Recommended); **BIOL10221 (Compulsory)**

Recommended Reading

- Watson et al., *Molecular Biology of the Gene (6th edition)* 2008. Pearson
- Lewin B, *Genes X (10th edition)* 2011. Jones and Bartlett

Teaching Staff

Dr Mark Ashe, Dr David Boam, Dr Anil Day, Dr Finbarr Hayes, Dr Dean Jackson

PROTEINS

BIOL21111

Unit Coordinator(s): Dr Steve Prince
(steve.prince@manchester.ac.uk)

Semester 1
Credits 10

Aims

To provide core knowledge of the form, function and role of protein molecules in biological processes and further enable an understanding of biological phenomena at the molecular level.

Intended Learning Outcomes

Students will be able to

- Describe the main stages of ribosomal protein synthesis and the features of proteins which lead to organelle targeting and subsequent post-translational modification.
- Describe protein folds in terms of secondary structural elements and the restrictions on peptide structure imposed by the planarity of the peptide bond.
- Select appropriate experimental techniques for protein isolation/characterization, and describe the relative precision of various approaches and the assumptions implied by each.
- Outline methods for 3D structure determination by X-ray crystallography, NMR and electron microscopy
- Analyze and manipulate structural data (including the use of the Protein Data Bank in Europe)
- Analyze data relating to protein function and demonstrate an understanding of associated variables (resolution, K_d , K_m & V_{max}).
- Distinguish between various modes of protein-protein interaction and catalysis.

Lecture Content

Course material can be divided into three broad themes and will comprise lectures on (1) Peptide synthesis, protein folding and modification, protein isolation, identification and characterization; (2) Methods for protein structure determination and rational modelling (including an interactive computer workshop); (3) Protein interactions and enzyme characterization.

e-Learning Activity

Each of the themes outlined above will be supported by 2 Blackboard e-learning modules each including an online quiz and discussion board. One of the e-learning modules associated with theme (2) will involve an interactive computer workshop.

Assessment

2 hour written examination – consisting of essay and/or data interpretation-based questions (75%). Each of the 6 e-learning modules outlined above will contribute to the remaining portion of the assessment (25%).

Feedback

Feedback will be provided directly via online discussion boards and through comments on a directed self-assessment carried out by each student as part of e-learning modules 2,4 & 6.

Prerequisites

BIOL10212 (Compulsory); BIOL10111 (Recommended) **or** CHEM10021/CHEM10022 (Recommended)

Recommended Reading

- Price & Nairn, *Exploring Proteins*, 2009, Oxford University Press
- Whitford, *Proteins, Structure & Function*, 2005, Wiley

Teaching Staff

Professor Jeremy Derrick, Professor Andrew Doig, Dr Hui Lu, Dr Steve Prince, Dr Jim Warwicker

THE DYNAMIC CELL

BIOL21121

Unit Coordinator(s): Dr Martin Pool
(martin.r.pool@manchester.ac.uk)

Semester 1
Credits 10

Aims

To provide an integrated approach to the understanding of the biology of the cell, from understanding the molecular mechanisms that underpin cellular processes through to how such processes allow cells to function in their physiological context (ie. in tissues and during development). To introduce both 'classical' and leading edge experimental approaches to cell biology research. To provide a good grasp of cell biology to those Biological Scientists who will not continue in this area.

Intended Learning Outcomes

Students will be able to:

- Understand how cells are able to move
- Understand how cell motility can be directed and organized to allow single cells, small groups and whole fields of cells to migrate
- Appreciate how cells interact with other cells and the extracellular matrix allowing formation and maintenance of tissues
- Understand the spatial organization within the cell and how cellular asymmetry and polarity can be established and maintained and why this can be important for cell function
- Understand homeostatic mechanisms that allow cells to adapt to changes in development and cellular physiology

Lecture Content

- **Cell movement:** Mechanisms and regulation of cell migration: the importance of actin polymerisation. Co-ordination of actin and microtubule dynamics, and membrane traffic. Role of the small GTPases Rho, Rac and Cdc42. Importance of assembly and disassembly of focal adhesions.
- **Directing cell motility:** Sensing of a chemical gradient by single cells, signalling cascades regulating asymmetric membrane and cytoskeletal organisation. Group migration: effects of scale (distance, cell number & dimension) on cell movement, signal relays & interplay between adhesion & movement. Sheet migration: movement of whole tissues during embryogenesis and wound healing.
- **Cell adhesion:** Tight junctions, desmosomes, adherens junctions, gap junctions, hemidesmosomes. Roles and composition.
- **Cell polarity:** Establishment and function of apical-basolateral and planar polarity in epithelia, role in formation of neural tube. Spindle positioning in symmetric and asymmetric division. Role of cytoskeletal elements, motors and Par proteins.
- **Tissue homeostasis:** Turnover and maintenance of cells within tissues: adhesion, cell polarity stem cells and apoptosis.
- **Cellular asymmetry and homeostasis:** *Spatial organization and movement within cells: mRNA localisation, nuclear-cytoplasmic transport, GTPases as spatial regulators. Regulation of organelles: unfolded protein response and plasma cell development.*

e-Learning Activity

Five scenario-based learning modules introducing students in a guided manner to primary literature associated with the lecture material. Developing skills in interpreting different types of data, importance of controls etc. using examples from classic papers.

Assessment

1.5 hour written examination composed of short answers and 1 essay question (95%);

e-Learning activity (5%).

Feedback

Mid-semester formative mini-exam, online discussion forum, post-exam clinic.

Prerequisites

BIOL10232 (Compulsory)

Recommended Reading

- Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P, *Molecular Biology of the Cell (5th edition)*, 2008, Garland Science
- Lodish H, Berk A, Kaiser C, Krieger M, Scott M, Bretscher A, Ploegh H & Matsudaira P, *Molecular Cell Biology (6th edition)*, 2008, W. H. Freeman

Teaching Staff

Prof Viki Allan, Dr Keith Brennan, Dr Tom Millard, Dr Martin Pool and Dr Chris Thompson.

Unit Coordinator(s): Dr Lisa Swanton
(lisa.swanton@manchester.ac.uk)

Semester 2
Credits 10

Aims

To provide knowledge of the essential features of cellular metabolism, and an understanding of the mechanisms through which metabolism is controlled. This will be achieved using specific examples and model situations to illustrate principal control mechanisms. Diseases caused by defects in metabolism will be studied to emphasise the importance of metabolic control. The course will focus on mammalian systems, with some reference to plants and microbes.

Intended Learning Outcomes

Students will:

- Have knowledge of cellular metabolism, including central catabolic and anabolic pathways.
- Understand the principals and importance of metabolic control.
- Be able to describe the main mechanisms through which metabolic processes are controlled, and appreciate that control occurs at multiple levels.
- Understand how different control mechanisms may be integrated to coordinate cell metabolism and function.
- Understand how metabolism is coordinated in mammals, and have knowledge of how disturbances in metabolism contribute to disease.

Lecture Content

1. Principles of metabolic control and control mechanisms:

Overview of metabolism - functions and end-products, anabolism and catabolism, energy metabolism; concepts of metabolic control
Control mechanisms – levels of control, isoenzymes, branched and linear pathways, allostery, control by covalent modification, control of enzyme level.

2. Regulation of core metabolism:

Carbohydrate metabolism - long-term regulation of glucose utilisation, enzyme-level control of glycolysis and gluconeogenesis, links to fatty acid metabolism, glycogen turnover, sugar interconversions and the citric acid cycle.

Lipid metabolism – regulation of fat mobilisation, lipoprotein metabolism, fatty acid oxidation, lipid synthesis, links to glucose metabolism, ketones.

Amino acid metabolism – control of protein turnover, nitrogen handling, links to nucleic acid metabolism, amino acid oxidation, integration with citric acid cycle.

Metabolism in plants - starch/sugar metabolism and fermentation for biofuels, storage lipid biosynthesis: regulation and applications.

3. Integration and adaptation of metabolism:

Metabolic states and signals, tissue cooperation, adaptation of metabolism to physiological/pathological situations (feeding-starvation, diabetes, obesity).

e-Learning Activity

An e-learning quiz (in the form of online short-answer questions) will supplement lecture material.

Assessment

1.5 hour written examination, composed of short-answer questions (50%) and choice of essay (50%).

Feedback

Feedback will be provided via return of model answers to the e-learning exercise and

through the use of discussion boards.

Prerequisites

BIOL21111 (Recommended)

Recommended Reading

- Nelson & Cox, *Lehninger, Principles of Biochemistry 5th edition*, 2008, W. H. Freeman or other good biochemistry reference book
- Frayn, K.F., *Metabolic Regulation: A Human Perspective 3rd edition*, 2010, Portland Press

Review articles and commentaries as recommended by the lecturers.

Teaching Staff

Professor Alan Dickson, Professor Chris Grant, Dr Jon Pittman, Dr Lisa Swanton,

CELL MEMBRANE STRUCTURE & FUNCTION

BIOL21141

Unit Coordinator(s): Dr Martin Lowe
(martin.lowe@manchester.ac.uk)

Semester 1
Credits 10

Aims

To provide an understanding of the structure, organisation and function of cellular membranes. Particular emphasis will be placed on membrane composition and organisation, and involvement of membranes and membrane proteins in ion and solute transport, signal transduction and vesicular transport. Diseases that arise from defects in these processes will be used to exemplify the importance of this topic to life science.

Intended Learning Outcomes

Students will have an understanding of:

- How the biochemical and biophysical properties of membranes constituents contribute to the structure and organisation of membranes
- Cell compartmentalisation and how proteins are transported between organelles.
- The principles and organisation of signal transduction pathways
- How ions and solutes are transported across membranes

Lecture Content

- **Membrane Structure and Function**
These lectures will describe the composition of biological membranes, and how the constituent lipids and proteins determine membrane identity and physical properties. How membrane domains are formed and the dynamic properties of membranes will also be covered.
- **Membrane Trafficking**
There will be an overview of the endomembrane system and membrane trafficking pathways. The lectures will describe the molecular machinery that is required for formation of membrane carriers, their movement within the cell, and how they fuse with target compartments to deliver their contents. Emphasis will be given to the mechanisms underlying these processes. The secretory and endocytic pathways and their role in health and disease will be covered.
- **Signalling From Membranes**
The general principles of signalling will be introduced. The lectures will describe enzyme-linked receptors and G-protein-coupled receptors, and how membrane lipids act as signalling mediators. The mechanisms by which signalling is terminated and how membranes participate in organisation of signalling pathways will also be covered.
- **Membrane Transporters and Ion Channels**
Membrane transport and transport proteins will be introduced. Active and passive transport, facilitated transport, and secondary active transport will be described. Appropriate examples will be used to illustrate the key points. Ion channel gating and channel permeability and selectivity will be covered, with examples of how defects in these processes leads to disease.

e-Learning Activity

- Discussion forum
- Mid-semester mini-exam with answers provided
- Problem questions with worked answers

Assessment

1.5 hour written examination with both short answer and essay questions (100%)

Feedback

- Mid-semester mini-exam with answers provided
- Post-exam clinic

Prerequisites

BIOL10212 (Recommended); BIOL10232 (Recommended)

Recommended Reading

- Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P *Molecular Biology of the Cell (5th edition)* 2008 Garland Science (Recommended)
or
- Lodish H, Berk A, Kaiser C, Krieger M, Scott M, Bretscher A, Ploegh H & Matsudaira P *Molecular Cell Biology (6th edition)* 2008 W. H. Freeman (Recommended)

Teaching Staff

Dr Katherine Hinchliffe, Dr Martin Lowe, Dr Craig P Smith, Dr Paolo Tammaro, Professor Philip Woodman

Unit Coordinator: Professor Richard Reece
(richard.reece@manchester.ac.uk)

Semester 2
Credits 10

Aims

This unit will introduce a range of molecular biology, genetic engineering and bioinformatic techniques and illustrate how these can be, and have been, applied and adapted to answer major questions in the biological sciences and medical genetics. Using a topical example-driven approach – including human, animal, plant and micro-organismal – students will be exposed to a number of the important techniques that underpin many of the recent advances in understanding biological systems at the molecular level. They will be exposed to the step change that occurs between the analysis of single genes, proteins etc. and the analysis of most, or all, of the genes and proteins within an organism. In addition, they will gain an understanding of the cross-talk and interactions that occur between different genes and gene products.

Intended Learning Outcomes

Upon completion of this unit, students will gain an understanding of:

- Gene cloning, engineering alterations in a gene, screening for genes, genome mapping and sequencing projects
- How proteins can be made and manipulated
- Using single-celled organisms, plants and animals as tractable experimental models
- Dealing with large-scale datasets generated from 'omic scale experiments.

Lecture Content

- Analysis of individual genes
- Analysis of genomes (*transcriptomics*)
- Understanding gene function (*proteomics*)
- Analysis of small molecules (*metabolomics*)

e-Learning Activity

A Blackboard module in which students will be able to explore many of the topics that are discussed in a hands-on setting.

Assessment

1.5 hour examination (95%) consisting of two parts (A and B). Part A will consist of 8 short-answer questions, all of which should be attempted. In part B, students will be required to answer 1 essay question from a choice of 3. Continual assessment - ePBL (5%).

Feedback

Students will receive feedback via the Blackboard module for this unit, which forms part of the continuous assessment of the unit. Students will also be afforded the opportunity to receive written feedback on an examination-style essay.

Prerequisites

BIOL10221 (compulsory); BIOL21101 (recommended)

Recommended Reading

- Reece, RJ, *Analysis of Genes and Genomes*, 2003, John Wiley and Sons Ltd
- Brown, TA, *Genomes. 3rd Edition*, 2006, Garland Science

Teaching Staff

Dr Sam Griffiths-Jones, Dr Graham Pavitt, Professor Richard Reece, Dr. Joy Wang

CHEMISTRY OF BIOMOLECULES

BIOL21162

Unit Coordinator(s): Professor David Leys
(david.leys@manchester.ac.uk)

Semester 2
Credits 10

Aims

To provide information about biochemically important aspects of the chemistry of proteins, carbohydrates, nucleic acids and lipids, using appropriate examples. This includes organic, inorganic and physical chemistry aspects of biomolecules. Key emphasis is placed on understanding the structural principles that govern reactivity/physical properties of molecules as opposed to learning structural detail. The emphasis is on knowledge at the atomic level.

Intended Learning Outcomes

Students should:

- Have knowledge of the structure/conformational freedom of biomolecules, e.g. proteins, DNA/RNA, carbohydrates and key metabolites/co-factors, e.g., be able to draw and recognize key structures such as the 20 amino acids, 5 nucleotides and major metabolites
- Understand and demonstrate how the structure of biomolecules determines their chemical properties and reactivity
- Draw molecules and reaction mechanisms, derive simple rate equations from first principles, understand and propose site-directed mutagenesis experiments aimed at elucidating mechanism
- Be able to understand how various structures/cofactors come together and form a biological process such as respiration/photosynthesis/cell signalling and clarify the role of these components in these processes
- Understand biochemistry at the atomic level.

Lecture Content:

- 3 lectures on **basic chemistry**, required to appreciate and understand biochemistry, focussed entirely on biologically relevant atom species (C, N, H, O, S, P, various metals) and their properties. Bonding, reaction mechanism and structure/function relationships are discussed.
- 8 lectures on **organic chemistry** of biomolecules: ranging from amino acids, enzyme cofactors, oligonucleotides to oligosaccharides. Each are introduced in detail from a structure/function perspective with appropriate examples presented to illustrate their role in biochemistry
- 5 lectures on **inorganic chemistry**: i.e. metals in biology, focussing on both redox and not-redox roles of metals in biochemistry, as well as on metal specific experimental techniques relevant to biochemistry
- 2 lectures on **kinetic theory**, aimed at underpinning reaction mechanism studies.
- 3 overview lectures, each studying a key chemical process relevant to life: **respiration, photosynthesis** and **signalling**. These lectures will aim to bring together material seen in previous lectures and explore the chemical basis underpinning these processes.
- An exam workshop(s) will be organised at the end of the lectures series.

e-Learning Activity

A marked assessment (15%) will be conducted on material presented in the first 3 lectures. This will be held early on in the lecture series, to make sure students revise their basic chemical knowledge, so they can follow to more advanced concepts introduced in the remaining lectures.

Assessment

2 hour written examination (85%) and one online module (15%).

Feedback

Students will be invited to test their knowledge via blackboard multiple choice tests. These will span the various main topics: basic chemistry; organic chemistry; metals in biology; physical chemistry; overview lectures. In each case, the test assessment will be available immediately after the last lecture of that topic. Immediate feedback is given when answers are incorrect. Assessments remain open during the lecture course and students can retake them as many times as they want.

Prerequisites - a first year level chemistry course, such as BIOL10111, CHEM10021 or CHEM10022 (Strongly recommended)

Recommended Reading

- Voet & Voet, *Biochemistry*, 4th edition, 2011, Wiley (or earlier editions)

Teaching Staff

Dr Andrew Almond, Professor David Leys, Professor Andrew Munro, Professor Nigel Scrutton

PRINCIPLES OF DEVELOPMENTAL BIOLOGY

BIOL21172

Unit Coordinator(s): Dr Keith Brennan
(keith.brennan@manchester.ac.uk)

Semester 2
Credits 10

Aims

To provide a general introduction to the mechanisms used in both plants and animals to produce and position, during embryonic development, the many different cell types required to create a functional adult organism.

Intended Learning Outcomes

To understand the basic mechanisms used to produce different cell types and to arrange cells in three dimensions during development. To understand how these basic mechanisms are linked to establish the axes and segments of the embryo. To appreciate that very similar mechanisms are used in very diverse organisms. To understand the role developmental biology plays in medicine.

Lecture Content

- ***A conceptual tool kit for development.*** These lectures will introduce the basic concepts and terms of developmental biology. In addition the general mechanisms by which cells adopt different fates will be described.
- ***Maternal control of development and establishment of the major embryonic axes.*** In most organisms maternal information is deposited in the egg which is essential for the establishment of anterior-posterior (head-tail), dorsal-ventral (front-back) and left-right axes of the embryo during the very earliest stages of development. These lectures will cover the different strategies used in plants and animals during this process.
- ***Segmentation, pattern formation and tissue identity.*** These lectures will cover the mechanisms by which different regions of the organism become specified. Examples include how segmentation occurs along the anterior-posterior axis in flies and vertebrates, and how organ identity is controlled in plants.
- ***Conservation of developmental mechanisms.*** Rather surprisingly, the development of many organs is highly conserved between very diverse species. For example, specification of the eye is very similar in flies and humans. These lectures will provide specific examples of these conserved mechanisms.
- ***Application of developmental biology to modern medicine.*** Finally the importance of developmental biology in novel therapies in medicine will be discussed, covering stem cell therapy, tissue engineering and regenerative medicine.

e-Learning Activity

The unit will have a series of five scenario-based PBL exercises that simulate developmental biology experiments and cover important concepts from the course.

Assessment

1.5 hour written examination containing both short-answer and essay questions (85%), completion of eLearning modules (5%) and online examination (10%).

Feedback

Feedback is given throughout the semester by the completion of 5 ePBL exercises that simulate developmental biology experiments, and a discussion board. Within the ePBL exercises, there are quiz questions with feedback for incorrect answers. There is also a data analysis exercise set during the semester to provide formative feedback. This exercise will be marked, but the mark will not contribute to the unit mark.

Prerequisites

BIOL10521 (Compulsory)

Recommended Reading

- Gilbert, SF (2010) *Developmental Biology (9th edition)*. Sinauer
- Wolpert, L (2007) *Principles of Developmental Biology (3rd edition)*. Oxford University Press

Teaching Staff

Dr Keith Brennan, Dr Kathy Hentges, Dr Matthew Ronshaugen, Prof Simon Turner

PROKARYOTIC MICROBIOLOGY

BIOL21181

Unit Coordinator(s): Dr Dennis Linton
(james.d.linton@manchester.ac.uk)

Semester 1
Credits 10

Aims

This unit will provide students with a comprehensive overview of bacterial cell structure/function, metabolism and regulatory mechanisms. It will also outline the evolutionary history of prokaryotes and the rich diversity of bacterial species. Finally, students will be introduced to the key emerging technological developments that are shaping the future of bacteriology.

Intended Learning Outcomes

Students will appreciate and be able to describe:

- The detailed molecular structure and functioning of the key components of the bacterial cell
- The principal sensing and regulatory mechanisms employed by bacteria
- Bacterial metabolism and metabolic diversity
- Prokaryotic phylogeny, including the Bacterial and Archaeal Domains and their major subdivisions
- The diverse habitats that bacteria occupy and their adaptations to these environments
- Recent technological developments, including the rise of bacterial genomics and metagenomics.

Lecture Content

- **Cell envelopes:** Cell envelope structure of Gram positive and Gram negative bacteria, peptidoglycan, LPS, S-layers,
- **Cell division & cell shape:** processes involved in cell division & variety of cell shapes
- **Microbial growth:** fundamentals of bacterial growth including exponential nature, batch and continuous cultures, biofilms
- **Motility:** Structure and function of flagella, interaction with chemotaxis systems.
- **Bacterial signalling and sensing:** Sporulation in Gram positive bacteria, quorum sensing and two component regulatory systems
- **Structures associated with bacterial outer membrane:** OMPs and porins, pili/fimbriae
- **Protein secretion systems:** diversity of pathways for protein secretion in Gram-negative and Gram-positive bacteria
- **Bacterial metabolic processes:** energy sources and storage in bacterial cells, variety of bacterial metabolic pathways.
- **Bacterial phylogeny:** sequence based phylogenies, fundamental division of prokaryotes into Bacteria and Archaea, principal subdivisions of Bacterial and Archaeal domains
- **Bacterial genomics and metagenomics:** genome sequencing, methodologies and resultant insights into bacterial evolution, transcriptomics, RNAseq technologies, metagenomics, bacterial communities, human microbiome

e-Learning Activity

An e-learning based coursework exercise to write a short scientific “news and views” style article based upon a topical subject related to course content. This will be set following lecture 10 and completed during reading week and the following week, when there will be no lectures for this course. It will be set and marked via Blackboard and will contribute 15% to the overall unit assessment.

Assessment

1.5 hour written examination comprising two essay questions (85%). An e-learning based coursework exercise to write a short scientific “news and views” style article based on topical subject related to course content (15%).

Feedback

Feedback will be given on completion of the e-learning module, by a mid semester mini-exam and by end of semester exam marks. This will include: (i) detailed written formative individual feedback to all students regarding the e-learning activity (within 15 days of submission), and (ii) feedback on individual exam performance will be made available through a drop-in session run by the unit coordinator . Informal feedback throughout the course will also be provided during lectures and via discussions on Blackboard.

Prerequisites

BIOL10532 (Recommended)

Recommended Reading

- Madigan, Martinko, Dunlap & Clare, *Biology of Microorganisms (12th Edition)*, 2008, Pearson (Strongly Recommended)

Up-to-date review articles recommended in lectures (Optional).

Teaching Staff

Dr Dennis Linton, Professor Jeremy Derrick, Professor Ian Roberts

Unit Coordinator(s): Dr Jen Cavet
(jennifer.s.cavet@manchester.ac.uk)

Semester 2
Credits 10

Aims

To explore the fundamentals of how microorganisms cause disease and the interactions that occur between a pathogen and host during infection. To study the mechanisms of microbial pathogenicity, starting with pathogen transmission and entry into the host, progressing through adhesion, invasion and pathogen survival strategies within a host, to cell and tissue damage and host responses to infection.

Intended Learning Outcomes

To provide students with a broad understanding of the biology of microbial infections, with an emphasis on bacterial infections of man. Students will gain knowledge of:

- The role of host defences in preventing infection
- The various strategies used by microorganisms to penetrate host defences and colonise the host to cause disease
- The role of microbial products in the pathology of infectious disease (such as endotoxins, exotoxins, teichoic acid, peptidoglycan, pili, polysaccharide capsules, haemagglutinins and neuraminidases)
- The physiological adaptations that allow microorganisms to survive in a host
- Examples of selected human infectious diseases in detail, as paradigms of pathogen-host interactions.

Lecture Content

Basic concepts of microbial pathogenicity and virulence

- Colonisation and invasion of the host: Routes of entry and exit. Host surface defences. Microbial mechanisms of colonisation and invasion.
- The normal flora & opportunist infections
- Encounter with innate immunity: Phagocytic effector cells and complement, mechanisms of microbial killing. Microbial survival strategies
- Encounter with adaptive immunity: Pathogen adaptation to growth in the host and antibody avoidance

Mechanisms of cell and tissue damage

- Introduction to toxin types and septic shock
- Toxins in specific diseases (eg diphtheria, botulism, tetanus, cholera & whooping cough)

Selected human infectious diseases in detail

- Survival in macrophages: *Mycobacterium tuberculosis* and the disease TB
- Gastro-intestinal diseases: Examples to include diarrheagenic *Escherichia coli*, *Shigella sp.* and *Campylobacter sp.*
- Colonisation of the stomach mucosa by *Helicobacter pylori*

Emerging diseases

- Examples to include *Legionella pneumophila* and Legionnaires' disease. *Clostridium difficile* and pseudomembranous colitis. The spirochetal diseases, Lyme disease and Syphilis. Fungal infections of the immuno-compromised. The emergence of endemic and pandemic influenza viruses

e-Learning Activity

An e-learning based coursework exercise to write a short scientific "news and views" style article will be set using Blackboard and will be based upon a topical subject related to course content. This will be undertaken during the week involving lecture slots 12 and 13 when there will be no lectures for this course. This e-learning exercise will form part (10%) of the overall assessment of the unit. In addition, lecture slides, details of up to date

relevant review articles and materials that support the lecture material will also be will be posted on Blackboard.

Assessment

1.5 hour written examination comprising 2 essay questions (90%) and one e-learning module to complete (10%).

Feedback

Feedback will be given on completion of the e-learning module and by end of semester exam marks. This will include: (i) written formative individual feedback to all students regarding the e-learning activity (within 15 days of submission), and (ii) general feedback on exam performance by releasing a document addressing general strengths and weaknesses of answers and how questions were answered. Additional individual guidance (written or verbal) on exam and e-learning performance will also be provided upon request. Informal feedback throughout the course will also be provided by verbal comments during lecture sessions and by Bulletin Board comments on Blackboard.

Prerequisites

BIOL21181 (Recommended); BIOL21242 (Recommended)

Recommended Reading

- Wilson, B.A., Salyers, A.A., Whitt, D.D. & Winkler, M.E., *Bacterial Pathogenesis : A Molecular approach (3rd Edition)*, 2010, ASM Press

Details of up to date relevant reviews will be provided during the course (available on Blackboard)

Teaching Staff

Dr Jen Cavet, Dr Dennis Linton

PLANTS FOR THE FUTURE

BIOL21202

Unit Coordinator(s): Dr Patrick Gallois
(patrick.gallois@manchester.ac.uk)

Semester 2
Credits 10

Aims

To provide a knowledge and understanding of:

- The key concepts in plant physiological response to environmental stress
- How this knowledge is utilised to address the future issues of food security
- The contribution of plant sciences to solving major societal and environmental challenges.

Intended Learning Outcomes

Upon completion of this unit, students will have knowledge and understanding of:

- The contribution of plant sciences to solving major societal and environmental challenges: examples of links between basic plant sciences and sustaining our food supply, providing renewable energy, and improving the environment
- A selection of key concepts in plant physiology
- Issues linked to food security
- The physiology behind the predicted impact of climate change on crop production
- An understanding of how plants continuously monitor and respond to environmental stimuli such as light, temperature and the availability of nutrients.

Lecture Content

Each lecture addresses an aspect of plant biology and how this is related to a future challenge faced by humanity. The course will give an overview of the regulation of plant growth by hormones, the biology of root, leaf and seeds and plant nutrition. Lectures will illustrate how understanding these principles will allow to meet some of the challenges caused by climate change and increased population. These challenges include flood tolerance in rice; better climate change models; reducing yield losses in crops from competition with weeds; optimizing the control of flowering time by temperature and seasons; tailoring plant architecture to increased yield; enhancing wood formation in trees, improving drought, cold and salt tolerance of crops; controlling plant senescence, allowing bioremediation of contaminated soils using plants.

e-Learning Activity

e-Learning knowledge assessment on lectures 1-10 to ensure that students understand the lecturers' expectations in knowing and using the appropriate level of detail in exam conditions.

Assessment

2 hour written examination - two short essays out of four (80%), assessed abstract on one example of the contribution of Plant Sciences (15%), e-learning assessment (5%)

Feedback

Performance in e-learning knowledge assessment, written feedback on one abstract (online), Exam clinic.

Prerequisites - BIOL10511 (Recommended)

Recommended Reading

- Taiz, L. & Zeiger E., *Plant Physiology (5th edition)*, 2010, Sinauer Associates, Inc
- *Plant Physiology* 5th edition companion website: <http://5e.plantphys.net/>
- Alison Smith et al., *Plant Biology*, 2009, Garland science.
- Slater, A, Scott, N, Fowler, M *Plant Biotechnology: The Genetic manipulation of plants (2nd Ed.)*, 2008, Oxford University Press

Teaching Staff - Dr Patrick Gallois, Dr. Thomas Nuhse, Dr. Jon Pittman, Prof. Simon R. Turner, Prof. Terry Brown

ECOLOGY & ECOSYSTEMS

BIOL21212

Unit Coordinator: Dr Keith White
(keith.white@manchester.ac.uk)

Semester 2
Credits 10

Aims

To provide a knowledge and understanding of: (i) the interactions that determine the distribution and abundance of organisms in the natural environment through the study of key ecosystems and biomes; (ii) methods and approaches used in the assessment and prediction of population and community interactions and ecosystem change.

Intended Learning Outcomes

Students will gain an understanding of:

- The interactions at the population and community level that determine distribution and abundance of organisms through the study of key ecosystems and biomes;
- Methods and approaches used in the assessment and prediction (modelling) of population and community interactions and ecosystem change.

And will be able to:

- Appreciate the importance of descriptive, functional and evolutionary approaches in understanding how organisms interact with the biotic and abiotic environment;
- Appreciate the importance of field and laboratory studies in testing ecological ideas;

Lecture Content

- **Introduction to ecology.** Definition; importance to biology and humans; levels of organization and hierarchy; energy and nutrient cycling; ecosystem modelling.
- **The freshwater ecosystem** (theme: *ecosystem structure and nutrient cycling*) The hydrosphere; freshwaters as continua; producers, consumers and decomposers; the abiotic world; diversity; human impacts and water security.
- **The soil ecosystem** (theme: *evolutionary ecology*) Community structure and soil ecosystems; foodwebs; competition; definitions of niche; competitive exclusion; mutualism: microbe/plant interactions in the rhizosphere; parasitism and virulence.
- **Temperate forests** (theme: *community ecology and ecosystem development*) The deciduous forest biome; factors determining distribution; ecosystem dynamics; ecophysiology of forests; forest management; climate change.
- **Tropical grasslands and savannas** (theme: *population ecology*) Grasses and the C4 pathway; maximising fitness; life history strategies; advantages and disadvantages of group living; modelling - foraging, predator-prey and individuals.

e-Learning Activity

1. Introduction complemented by self directed e-learning module to ensure all students have a basic knowledge and understanding of key concepts.
2. Self directed e-learning modules will accompany each component of the unit.

Assessment

Two hour written examination (75%), assessed poster (20%), e-learning assessment (5%).

Feedback

Performance in e-learning revision assessment; written comments on poster; overview of student posters; question/answer session in final session

Prerequisites - None

Recommended Reading

- Odum, E, Brewer, R & Barrett, G. *Fundamentals of Ecology* (5th edition), 2005. Thompson Brooks/Cole, London.

- Begon M, Townsend, C & Harper, J. *Ecology: from Individuals to Ecosystems* (5th edition), 2005, Wiley-Blackwell, San Francisco.

Teaching Staff

Dr Giles Johnson, Dr Daniel Rozen, Dr Bill Sellers, Dr Keith White

ANIMAL DIVERSITY

BIOL21221

Unit Coordinator(s): Dr Jonathan Codd
(jonathan.codd@manchester.ac.uk)

Semester 1
Credits 10

Aims

To provide students with a general overview of the major animal groups. A brief introduction will be given to evolution before the major groups will be described in terms of their structure, phylogeny, adaptations and characteristics. This unit is ideal for Biology, Zoology, Biochemistry, Genetics and Molecular Biology students as well as those taking more organismal focussed degrees and options (e.g., Plant Sciences, Microbiology, Developmental Biology).

Intended Learning Outcomes

Students will be able to:

- Appreciate how evolutionary forces act to create complex biological systems
- Gain knowledge of the similarities and differences between vertebrate & invertebrate groups: anatomy, functional morphology, behaviour & diversity
- Appreciate the nature of classification and the various schemes that can be used to identify and classify organisms
- Gain an understanding of the nature of adaptation and the importance of morphological and/or functional constraints on evolution
- Develop independent and critical thought, with the ability to look for principles
- Apply evolutionary concepts to understand the evolution of major animal groups.

Lecture Content

Lecture	Title	Synopsis
1	Introduction	Course intro, what evolution is, why evolution is true
2	Classification & phylogeny	Understanding why animals are grouped how they – techniques and methods
3	Molluscs I	Structure, phylogeny, adaptations and characteristics
4	Molluscs II	Snails, scallops, squid ammonites
5	Segmented Worms & Arthropods	Platyhelminthes, annelida, onychophora
6	Crustaceans I	Myriapods & crustacea
7	Crustaceans II	Structure, phylogeny, adaptations and characteristics
8	Insects I	Hexapods, classification, metamorphosis
9	Insects II	Coleoptera, hymenoptera
10	Insects III	Ants
11	Chordates	Structure, phylogeny, adaptations and characteristics
12	Fishes I	Hemichordates, jawless vertebrates, acanthodians, placoderms
13	Fishes II	Sharks, bony fishes
14	Modern Amphibians	Frogs, salamanders
15	Reptiles I	Amniote origins
16	Reptiles II	Modern reptiles, lizards, snakes turtles
17	Mammals I	Mammal-like reptiles
18	Mammals II	Modern mammals
19	Support & Movement I	Skeletons & Tissues
20	Support & Movement II	Movement on land, water, air
21	E-learning Quiz	MCQ & SAQ on animal diversity
22	Museum Session	Animal form & function

Assessment

1.5 hour written examination (80%), e-learning exam (10%) e-learning museum coursework (10%)

Feedback

Feedback will be given throughout the course following completion of the online e-learning exam and group feedback will be given following the museum session. Written or oral one-one feedback is available on request.

Prerequisites - None.

Recommended Reading

- Hickman, Roberts, Larson, L'Anson, Eisenhour *Integrated Principles of Zoology* (13th Ed.), 2006, McGraw-Hill
- Kardong, *Vertebrates: comparative anatomy, function, evolution* (4th Ed.), 2006, McGraw-Hill
- Hildebrand, Goslow *Analysis of Vertebrate Structure* (5th Ed.), 2001, Wiley Publishing
- Barnes, Calow, Olive, Golding Spicer *The Invertebrates: a synthesis*, 2002, Blackwell Publishing

Additional References will be given in lectures

Teaching Staff

Professor Matthew Cobb, Dr Jonathan Codd, Dr Bill Sellers

Unit Coordinator(s): Dr Casey Bergman
(casey.bergman@manchester.ac.uk)

Semester 2
Credits 10

Aims

This unit aims to provide a deep understanding of the mechanisms that underlie the evolution of biological systems. By blending classical theory with cutting-edge examples, this unit will demonstrate how microevolutionary processes lead to the macroevolutionary patterns of life on earth. Fundamental evolutionary concepts and techniques will be used to explain some of the greatest mysteries of life on earth, such as the evolution of sexual reproduction and the origin of modern humans.

Intended Learning Outcomes

Upon completion of the unit, students will be able to:

- Understand the theoretical basis behind how the forces governing evolution (e.g. mutation, natural selection) work to cause heritable change in natural populations
- Understand the principles and techniques needed to infer phylogenetic relationships among populations and species
- Understand how the processes of speciation and extinction work to create patterns of biodiversity over space and time
- Appreciate how evolutionary forces act to create complex biological systems
- Apply evolutionary concepts to understand the evolution of modern humans

Lecture Content

- Evolutionary Forces (mutation, natural selection, genetic drift, migration and non-random mating)
- Phylogenetics and Phyllogeography (concepts and methods to build phylogenetic trees, using phylogenies to study relationships among taxa, geographic patterns of biodiversity)
- Speciation and Macroevolution (mechanisms of speciation, rates of speciation and extinction over time, adaptive radiations)
- Co-evolution and the Evolution of Sex (host-parasite evolution, evolution of virulence, the cost of sexual reproduction, hypotheses for the advantages of sex, why is there a 1:1 sex ratio?)
- Human Evolution (origin of modern humans, relationships with Neanderthals, global migration patterns)

e-Learning Activity

Exercises on population genetics and phylogenetics in week 6.

Assessment - 1.5 hour written examination (95%), assessed exercises (5%).

Feedback

Provided via (i) assessed mid-unit online assessed exercises, (ii) an online discussion forum for students and lecturers, and (iii) an end-of-unit review session with students and lecturers.

Prerequisites - BIOL10521 (Compulsory)**Recommended Reading**

- Futuyma, D. *Evolution*. (2005) Sinauer Press.
- Barton, N.H., Briggs, D.E.G, Eisen, J.A., Goldstein, D.B., Patel, N.H. *Evolution* (2007) Cold Spring Harbor Press

Teaching Staff - Dr Casey Bergman, Dr Terry Brown, Dr Daniela Delneri, Dr David Robertson, Dr Cathy Walton

IMMUNOLOGY

BIOL21242

Unit Coordinator(s): Dr Peter Wood
(peter.j.wood@manchester.ac.uk)

Semester 2
Credits 10

Aims

- To understand the components and functioning of the immune system

Intended Learning Outcomes

Students should understand:

- The role of the immune system, innate immunity and the specific immune system, recognition of microbes by the specific immune system and how the immune system protects against different pathogens. They should also have an appreciation of some aspects of immunopathology: allergy, autoimmunity, transplantation and AIDS.
- The concepts that enable the immune system to function properly and the consequences of it going wrong.

Lecture Content

Lectures will cover the main role of the immune system in providing defense against infection caused by bacteria, viruses, yeasts and parasites. They will describe the two main arms of the immune system, the innate immune system and the specific immune system. The different anatomical, cellular and molecular components of the two systems will be covered and how these systems detect the presence of infectious pathogens will be an important part of the unit. How the immune system actually deals with infectious organisms will also be described as well as some of the challenges to the immune system such as in HIV/AIDS. Finally the unit will cover some of the problems that arise when the immune system 'gets it wrong'; this will include allergy and autoimmune diseases such as type 1 diabetes, multiple sclerosis and rheumatoid arthritis.

e-Learning Activity

Mini-exam

Assessment

1.5 hour examination (100%) consisting of short note answers including drawing diagrams.

Feedback

Feedback on mini-exam

Prerequisites

None

Recommended Reading

- Wood, P, *Understanding Immunology (3rd Ed.)*, 2010 Pearson Press

Teaching Staff

Dr Douglas Millar, Dr Mark Travis, Dr Peter Wood

PARASITOLOGY

BIOL21252

Unit Coordinator(s): Professor Richard Grencis
(richard.grencis@manchester.ac.uk)

Semester 2
Credits 10

Aims

The aim of the unit is to provide an understanding of the molecular and cellular interactions underpinning the functional interactions between animal parasites (protozoa and helminths) and their hosts, and to provide an appreciation of the scope and relevance of parasitism in terms of parasite biology and human and animal disease.

Intended Learning Outcomes

On successful completion of this unit, students should:

- Gain an appreciation the diversity of parasitic infection and the importance of parasitism as a life strategy
- Know the major groups of parasites and their influence upon animal and human biology and health
- Have an understanding of the different mechanisms used by different parasites to gain entry to their hosts and survive within them, at the genetic, molecular, cellular, whole organism and population levels
- Identify key features of the major human parasites, the diseases they cause and understand their life cycles
- Be able to integrate knowledge about different parasitic organisms and infections; cross reference information from gene to population level, compare and contrast different strategies used within and across different parasitic groups
- To begin to understand how a parasite interacts with its host at the level of the immune system.

Lecture Content

Lectures will cover the major groups of parasites and each lecture will illustrate a particular feature such as host invasion or the strategies used by parasites to avoid being destroyed by the host immune system. The lectures will also describe how this information can be utilised alongside that emerging from parasite genomes studies to develop new methods of control including vaccines.

e-Learning Activity

This will comprise an online spotter test plus interactive websites specifically related to the course. One compulsory e-learning component will be for students to watch a short video entitled "Survival: *Intestinal dwelling nematodes III* Immunoregulation. The good the bad and the wormy - the science" between lectures 15 and 16. This component will be facilitated by key questions for students to answer and concepts will be extended in Lecture 16.

Assessment

1.5 hour examination (90%) and spotter test (10%). The spotter test will be taken in one of the multi-user labs within FLS.

Feedback

Feedback on progress in the course will be given via two "How well am I doing?" sessions spaced towards the middle and end of the course. These will be given in lecture theatres in the form of spotter tests (similar to the end of course test). After each question the students will be given instant feedback on whether they have given the correct answer; the correct answer will be given and the students will also be able to see the class score for the individual answers as well as the overall class score for the test. There is also an additional online practice spotter test associated with the course that students can work through in their own time.

Prerequisites - None

Recommended Reading

There is no set course text book. Students will be directed to relevant reading during the lectures. For those students who are not taking the 'Immunology' (BIOL21242) unit in the second year, the following text may be helpful:

- Wood, P *Understanding Immunology (3rd edition)* Pearson Press, 2006

Teaching Staff

Professor Kathryn Else, Professor Richard Grencis

Unit Coordinator(s): Dr Steve Bidey
(steve.bidey@manchester.ac.uk)

Semester 1
Credits 10

Aims

To explore the biochemistry, physiology, and pharmacology of endocrine control systems, and to describe their individual and interactive roles in humans and other mammalian species.

Intended Learning Outcomes

To have gained an understanding of (i) the structure and function of mammalian endocrine tissues, and (ii) the manner in which the regulatory control and actions of individual endocrine tissues are integrated to maintain appropriate physiological and metabolic responses to changes in the internal and external environment.

Lecture Content

As a highly-specialised tissue-to-tissue signalling network, the endocrine system plays a fundamental role in maintaining metabolic homeostasis within the human body. Initial lectures will consider how endocrine control mechanisms are fundamentally dependent on interaction between a structurally-diverse family of chemical signalling molecules (hormones) and specific receptors for such molecules on or within target cells. The clear mechanistic links between endocrine and neurological signalling mechanisms will then be examined, and the manner in which they serve to enable the endocrine system to respond to environmental changes will be discussed. Key illustrative examples will include the endocrine responses to day length, temperature, water and food availability, as well as to internal events such as physical and emotional stress. Fundamental to our understanding of endocrine physiology has been the development of diagnostic procedures to detect and quantify vanishingly small levels of individual hormones within biological fluids. The theory and application of such techniques will be considered, and their key roles in elucidating the mechanistic links between the hypothalamo-pituitary axis and distal endocrine tissues will be discussed. As a key interface between the neural and endocrine systems, the hypothalamic-pituitary axis regulates and responds to the diverse activities of other endocrine tissues, e.g. the thyroid, adrenal, ovaries and testes, each of which will be the topic of individual lectures. Further endocrine mechanisms that function independently of the hypothalamo-pituitary axis, as exemplified by the endocrine pancreas and parathyroid glands, will also be considered. As an interactive network of chemical signalling mechanisms, capable of integrating the responses to both internal and external stimuli, the endocrine system plays a vital role in such diverse events as appetite regulation, water conservation, temperature regulation, puberty, and pregnancy. The endocrine involvement in each of these will be described, before considering the more common abnormalities in such processes that can be attributed to defects in the underlying endocrine control mechanisms.

e-Learning Activity

Directed reading assignments with self-assessment provided on Blackboard.

Assessment

1.5 hour written examination comprising 15 short answer questions & 1 essay out of a choice of 3 (90%) and electronically marked Blackboard exercises (10%).

Feedback

1. By publication of a general feedback document addressing general strengths and weaknesses of students' examination essays, and giving an indication of how questions were answered

2. By attending a post-examination 'drop-in' clinic session, where students are able to see examiners' comments on their answers.

Prerequisites - None

Recommended Reading

- Porterfield S & White B *Endocrine Physiology (3rd edition)*, 2007, Elsevier London: Mosby Physiology Monograph series. Recommended
- Hadley M *Endocrinology (5th edition)*, 2000, Prentice Hall. Optional

Teaching Staff

Dr Steve Bidey, Professor Mark Dunne, Dr Donald Ward, Dr Melissa Westwood

HUMAN PHYSIOLOGY

BIOL21272

Unit Coordinator(s): Dr Peter Brown
(peter.d.brown@manchester.ac.uk)

Semester 2
Credits 10

Aims

- To study the principal functions of the mammalian (human) gastro-intestinal (GI) tract and the renal system
- To learn how these systems are affected by diseases and about the available treatments.

Intended Learning Outcomes

Students will gain an understanding of:

- The mechanism and regulation of nutrient absorption by the GI tract
- The importance of the kidneys in maintaining body electrolyte and water balance
- Examples of diseases of the GI tract and kidney, which are targets for important therapeutic drugs
- How molecular genetics has enhanced our understanding of transport processes in the intestines and kidneys

Lecture Content

Part 1:

- **Introduction:** Principals of epithelial transport & chemistry of dietary components.
- **The physiology of the G.I. tract:** Digestion and absorption; Control of G.I function; The mechanism and regulation of salivary, gastric and pancreatic secretion; G.I. motility. Management of peptic ulcers and diarrhoea.
- **Renal physiology:** Glomerular filtration; Reabsorption of nutrients and ions; Production of a concentrated urine; Control of extracellular fluid volume & electrolyte balance; Acid-base balance. Mechanisms of action of diuretic drugs. Renal failure.

Part 2:

- **The molecular physiology of iron transport proteins:** Ferric reductase, DMT-1, ferroportin, transferrin, the transferrin receptor and hepcidin.
- **Genetic diseases of epithelial transport.** *Cystic Fibrosis:* The molecular genetics of C.F.; Determining ion channel function; CFTR an anion channel and channel regulator. *Bartter Syndrome:* Impaired Na⁺ absorption in the kidney tubule (TAL) caused by mutations to five different proteins.
- **Hunger, thirst and satiety:** How the brain senses hunger, thirst and satiety. The changes made in physiology in response to these conditions.

e-Learning Activities

CAL on: 1) The pharmacokinetics of diuretic drugs and 2) The molecular physiology of Bartters Syndrome.

Assessment

1.5 hour summative examination (95%) comprising one essay question plus short-note and multiple-choice questions. eLearning modules (5%)

Feedback

- Feedback will be provided as part of two online multiple-choice assessments on lecture content and of the two assessments associated with the e-learning activities
- A "Question and Answer session" will be held to discuss any student-raised concerns and/or past examination questions

- A formal feedback session will be held in the subsequent semester in which students will have access to their marked examination scripts and to generic comments from the essay markers.

Prerequisites

BIOL21141 (Recommended); BIOL21321 (Recommended)

Recommended Reading

For Part 1 of the unit, useful background information will be found in the texts below. For Part 2 of the unit, essential information will be found in lecture specific references, which will be listed in the unit handbook.

- Boron W & Boulpaep EL *Medical Physiology (2nd edition)* 2009 Saunders
- Rang HP, Dale MM, Ritter JM & Flower R *Rang & Dale's Pharmacology (6th edition)* 2007 Churchill Livingstone

Teaching Staff

Dr Peter Brown, Professor Simon Luckman, Dr Liz Sheader, Dr Craig Smith

**Unit Coordinator(s): Dr Holly Shiels
(Holly.Shiels@manchester.ac.uk)**

**Semester 1
Credits 10**

Aims

To study phenotypic plasticity across levels of biological organisation and to understand how this allows animals to adapt to their environment. To study mechanisms of physiological adaptation in response to environmental challenges including: thermoregulation, osmoregulation and gas convection in vertebrate and invertebrate animals.

Intended Learning Outcomes

An understanding of invertebrate and vertebrate animal physiology, emphasising control mechanisms and response strategies used to cope with different external environments. Students will appreciate how physiological plasticity is key to maintaining and adjusting physiological processes in terrestrial and aquatic animals.

Lecture Content

The nature and fundamental mechanisms of environmental adaptation will be discussed under the broad lecture themes of:

- Water and Ion Balance.
- Respiratory and Cardiovascular Systems
- Muscle Systems
- Thermoregulation

Assessment

1.5 hour written examination (90%), e-learning assessment (10%)

Feedback

Students will receive feedback on the e-learning assessments that will occur at 3 points during the semester. Drop-in clinics after the exam will allow feedback on exam performance.

e-learning activity

All lectures slides will be posted on Blackboard. Journal articles that support the lecture material, and websites specifically created to enhance learning (i.e. osmoregulation) will be made available. Interactive learning tools that provide more details on the basics (for example animations explaining the Donnan-equilibrium and the Nernst potential) are also provided.

Prerequisites

None

Recommended Reading

- Hill, Wyse & Anderson (2008) *Animal Physiology* (2nd edition) Sinauer Associates.
- Willmer, Stone & Johnston (2004) *Environmental Physiology of Animals* (2nd edition). Blackwell Science
- Schmidt-Nielsen (1997) *Animal Physiology: Adaptation and Environment* (5th edition) Cambridge University Press.

Teaching Staff

Dr Holly Shiels, Dr Jonathan Codd, Dr Martin Steward, Prof Andrew Loudon

HUMAN ANATOMY & HISTOLOGY

BIOL21291

Unit Coordinator(s): Dr Bip Choudhury
(bipasha.choudhury@manchester.ac.uk)

Semester 1
Credits 10

Aims

This unit focuses on the human alimentary, urinary and reproductive systems and aims to integrate anatomy, histology and embryology with clinical and pathological topics. In addition to lectures, students will gain practical experience of the overall structure of these organ systems and of their components by working with prosections, models and histological specimens in the dissecting room. The dissecting room sessions are designed to complement the lecture course.

Intended Learning Outcomes

- Understand the anatomy of the alimentary, urinary and reproductive systems
- Understand the structural arrangement of the abdomen and its contents
- Understand the structural arrangement of the pelvis and its contents
- Understand the histological arrangement of all of the above structures
- Relate the structural anatomy to pathological processes that may occur

Lecture Content

Anatomy and histology of the gastrointestinal tract will be covered in detail. The musculature of the anterior and posterior abdominal walls, as well as composition of the pelvis are covered. Anatomy and histology of the genitourinary tracts are also covered in detail. The pathology lectures link together important anatomical concepts and describe basic pathological problems.

e-Learning Activity

Task 1: critically analysing a paper from a well-known anatomical journal. Students are put into groups of 5-6 from differing degree programmes. They utilise group-specific discussion boards and chat rooms to complete the task. Peer assessment makes up 40% of the total mark available for this e-learning node.

Task 2: solve a clinical case using their anatomical knowledge. Students are put into groups of 5-6 from differing degree programmes. They utilise group-specific discussion boards and chat rooms to solve the case. Peer assessment makes up 40% of the total mark available for this e-learning node.

Assessment

1.5 hour written examination (92%) comprising of a choice of 5 essay questions from which students have to answer two. Two e-learning modules to complete (8%).

Feedback

Feedback given via blackboard on completion of the 2 e-learning nodes. Informal verbal feedback as required.

Prerequisites

BIOL10811 (Recommended)

Recommended Reading

- Snell RS *Clinical Anatomy by Regions (8th edition)* 2008 Lippincott Williams & Wilkins
- Moore & Dalley *Clinically Orientated Anatomy (5th edition)* 2007 Lippincott Williams & Wilkins
- Stevens A & Lowe JS *Human Histology (3rd Edition)* 2005 Elsevier

- Kumar V, Fausto N, Abbas A, Robbins & Cotran *Pathologic Basis of Disease (7th Edition)* 2004 Saunders
- Cui D *Atlas of Histology with functional and clinical correlations* (1st edition) 2011 Lippincott Williams & Wilkins
- Ross MH, Pawlina W *Histology a text and atlas* (6th edition) 2011 Lippincott Williams & Wilkins
- Gosling J A *Human Anatomy (4th Edition)* 2002 Mosby

Teaching Staff

Dr Bip Choudhury, Professor Anthony Freemont, Dr Stefan Gabriel, Dr Niggy Gouldsborough, Dr Tokiharu Takahashi

CLINICAL DRUG DEVELOPMENT

BIOL21302

Unit Coordinator(s): Dr Tracey Speake
(tracey.speake@manchester.ac.uk)

Semester 2
Credits 10

Aims

- To explain the appliance of science whereby new drugs are discovered and developed from initial ideas through to full clinical use in man
- To explain how consideration of how an individual's handling of drugs, i.e. pharmacokinetics, is important in the development of new drugs
- Illustrate the interplay between business aspects and the biosciences

Intended Learning Outcomes

Students will gain an understanding of:

- The major approaches to drug discovery
- Application of molecular biology techniques to identifying lead compounds
- Methods for determining the pharmacological and toxicological properties of compounds
- The role of pharmacokinetic principles in the drug discovery process
- Regulatory requirements for drugs
- Clinical evaluation of drugs

Lecture Content

- **Overview:** Medicines: the discovery processes. The pharmaceutical industry.
- **Initial stages:** Target discovery. Applications of molecular biology. Lead discovery. Lead optimisation. *In silico* methods.
- **Measurement of drug properties:** Assay techniques. Agonists (full, partial and inverse). Competitive antagonists. *In vivo* models. Pharmacokinetic profiles of compounds. Pharmacogenetics. Formulations. Pre-clinical safety assessment.
- **Later stages:** Pharmaceutical development. Clinical evaluation: Phase I and II. Concepts in clinical trial design. Regulatory affairs.

e-Learning Activity

- Discussion board will be open to encourage dialogue between students.
- Additional resources to support the lecture content will be provided
- eLearning self-assessment modules: four question sets based on the course content and additional reading will be presented for summative assessment.

Assessment

Coursework components include a drug discovery game (15%) and eLearning modules (5%). Summative 1.5 hour examination (80%) comprising MCQs (40%) and short-note questions (60%).

Feedback

- Students will be encouraged to ask questions during lectures and receive immediate feedback from staff and also via the Blackboard Discussion Board, which will be the main vehicle for providing feedback. Staff will also give individual feedback to questions raised by email.
- Students will receive feedback throughout the drug discovery game.

Prerequisites

BIOL10822 (Strongly Recommended)

Recommended Reading

- Griffin JP & O'Grady J, *The Textbook of Pharmaceutical Medicine (5th edition)*, 2005, London BMJ
- Rang HP, *Drug Discovery and Development: Technology in Transition*, 2005, Churchill Livingstone
- Rang HP, Dale MM, Ritter JM & Flower, R, *Rang & Dale's Pharmacology (6th edition)*, 2007, Churchill Livingstone

Teaching Staff

Caroline Booth (AstraZeneca), Dr Cyril Clarke (ICON), Dr Natalie Gardiner, Professor Alison Gurney, Dr Chris Pollard (Astrazeneca), Dr Richard Prince, Dr Tracey Speake, Dr Sian Taylor, Professor Richard Walmsley

DRUGS & THE BRAIN

BIOL21312

Unit Coordinator(s): Dr Mike Dascombe
(mike.dascombe@manchester.ac.uk)

Semester 2
Credits 10

Aims

To describe

- the range of mechanisms by which drugs can interfere with neurotransmission in the central nervous system (CNS)
- how neurotransmitter activities can be modified by drugs leading to the rational treatment of CNS disorders
- how an understanding of neurotransmitters and mechanisms of drug action can lead to more selective treatment of CNS disorders.

Intended Learning Outcomes

To:

- detail important classes of drugs used in medicine and/or biological research to influence central neuronal activity, particularly in humans
- describe the mechanisms of action of these drugs in terms of their effects on major neurotransmitters
- describe mechanism-related drug side-effects

Lecture Content

- Introduction to neuropharmacology
- The central synapse: neurotransmitter systems as targets for drug therapy
- Accessing the central synapse: the blood-brain barrier to drugs
- Pharmacology of movement disorders such as Parkinson's disease
- Pharmacology of general anaesthetics
- Pharmacology of antipyretic-analgesic drugs
- Pharmacology of opioid analgesic drugs
- Pharmacology of antiepileptic drugs
- Pharmacology of anxiolytic drugs
- Pharmacology of CNS stimulants and psychotomimetics
- Pharmacology of antipsychotic drugs
- Pharmacology of antidepressant drugs

e-Learning Activity

All lecture slides available for e-learning including self-completion exercises. Online assessment for formative feedback. Links to available CAL programmes.

Assessment

1.5 hour written examination comprising 40 compulsory multiple choice questions (50%) and one essay question from a choice of three (50%).

Feedback - Mid-session formative assessment and feedback. Post-exam guidance.

Prerequisites - BIOL10822 (Compulsory); BIOL21302 (Compulsory)

Recommended Reading

- Rang HP, Dale MM, Ritter JM & Flower, R *Rang & Dale's Pharmacology (6th Edition)* 2007 Churchill Livingstone (Compulsory)
- Waller DG, Renwick AG & Hillier K *Medical Pharmacology and Therapeutics (2nd Edition)* 2005 WD Saunders (Optional)

Teaching Staff - Professor Richard Baines, Dr Mike Dascombe, Dr Ken Grieve, Dr Richard Prince

MEMBRANE EXCITABILITY: ION CHANNELS & TRANSPORTERS IN ACTION

BIOL21321

Unit Coordinator(s): Dr Jon Turner
(j.turner-2@manchester.ac.uk)

Semester 1
Credits 10

Aims

The aim of this module is to give students the strongest grounding in our current understanding of excitable cell pharmacology and physiology through study of the key elements of membrane excitability. It will also provide a solid theoretical framework in membrane excitability irrespective of which degree programme the students are pursuing. It will treat each area in a logical, fresh and exciting manner highlighting relevance to function and disease. In addition, students will be encouraged to think critically and to appreciate the special challenges intrinsic to studying excitable membrane function.

Intended Learning Outcomes

In relation to membrane excitability, students should be able to describe in detail: (i) the key governing principles, (ii) the role of ion channels and ion transporter proteins, (iii) the relationship between cellular structure and the function of excitable cells, (iv) the features of the synapse that underpin fast chemical neurotransmission and its modification, and (v) the methods used to analyse or predict cell excitability.

Lecture Content

- Lipid components, their organization, and types of membrane protein
- Regulation of cell volume and contents including pH_i and [Ca²⁺]_i
- Selective ion permeability and membrane potential generation
- The action potential, its propagation and the impact of myelination and disease
- Functional diversity of voltage-gated ion channels and their pharmacology
- Cell polarization in epithelia and neurones, and the role of compartmentalization
- Cytoskeleton and the differential trafficking of membrane-targeted proteins
- Electrical and chemical neurotransmission and transmitter-gated ion channels
- Transmitter synthesis, vesicle exocytosis and recycling
- Synaptic integration and plasticity

e-Learning Activity

Blackboard discussion board topics as suggested by contributors. Mid-semester exam marked in manner of mini-exams short questions. Further application of the Nernst and the Goldman Hodgkin Katz equations. Exam format questions with model answers

Assessment

1.5 hour examination (90%): 18 short questions (9 min each), E-learning modules (10%)

Feedback

Mid-semester exam seminar to provide answers and Q & A session on work so far. Calculations seminar/tutorials. Exam clinic to follow in semester 4

Prerequisites

BIOL10832 (Compulsory)

Recommended Reading

- Boron, WF & Boulpaep, EL *Medical Physiology*, 2008, Saunders Elsevier
- Aidley, DJ *The Physiology of Excitable Cells*, 1998, Cambridge University Press

Teaching Staff

Dr Peter Brown, Dr Liz Fitzgerald, Dr Owen Jones, Dr Richard Prince, Dr Jon Turner

MOTOR SYSTEMS

BIOL21332

Unit Coordinator(s): Dr Enrico Bracci
(e.bracci@manchester.ac.uk)

Semester 2
Credits 10

Aims

This course aims to explain our current understanding of how the mammalian nervous system plans and executes movements, with particular reference to the human case. Topics will include the anatomy and physiology of the motor systems, spanning from muscles contraction to spinal reflexes, cortical and sub-cortical control of movement and how certain neurological diseases affect movement. In this way, the students will be exposed to the many levels of motor control, and will acquire a critical knowledge of what we know (or don't yet know) about the structure and function of human motor control systems.

Intended Learning Outcomes

- By the end of this course students should be able to critically assess the current knowledge of motor control and to communicate these topics in a concise manner that recognises the limitations of current hypotheses.
- Students should also have acquired the following skills:
- an understanding of the motor systems at a variety of levels (from cellular to systems neuroscience).
- an accurate understanding of the different strategies used by the nervous system to control movement.
- an understanding of the different roles played by muscles, the spinal cord, midbrain, cortex, cerebellum and basal ganglia in the organisation of movement.
- A critical knowledge of the different experimental methods used to investigate motor control.

Lecture Content

1. Muscular contractile mechanisms
2. The motor unit and muscle action
3. Motoneurone pools and their functional organization
4. Diseases of the motor unit
5. Proprioceptors and muscle sense
6. Spinal interneurons and Spinal reflexes
7. Proprioceptive guidance of movement
8. Descending motor pathways: brainstem and spinal cord
9. Anatomy of the motor cortex
10. The role of the primary motor cortex in voluntary movements
11. The role of premotor cortical areas in voluntary movement
12. How the cortices organise movement: population coding
13. The control of gaze: Eye movements
14. Vestibular reflexes
15. Cerebellum 1: Anatomy and circuitry
16. Cerebellum 2: Role in motor control
17. Cerebellum 3. Involvement in movement disorders
18. Basal Ganglia: Anatomy and circuitry
19. Basal Ganglia: Role in motor control
20. Basal Ganglia: Involvement in movement disorders
21. Locomotor pattern generation in invertebrates
22. Locomotor pattern generation in vertebrates

e-Learning Activity

Moderated discussion board on Blackboard.

Assessment

1.5 hour written examination (100%) composed of 21 compulsory short answer questions.

Feedback

Students will have the opportunity to take part in mid semester mini-exams

Prerequisites

BIOL10832 (Recommended); BIOL21341 (Recommended)

Recommended Reading

- Kandel ER, Schwartz JH & Jessel TM *Principles of Neural Science (4th ed.)* 2000 McGraw-Hill

Teaching Staff

Dr Enrico Bracci, Dr Fred Cody, Professor Cathy McCrohan

SENSORY SYSTEMS

BIOL21341

Unit Coordinator(s): Dr Ken Grieve
(ken.grieve@manchester.ac.uk)

Semester 1
Credits 10

Aims

This course aims to explain:

- how external stimuli impact upon central neural pathways to give rise to perception
- the nature and extent of sensory systems from periphery to CNS, with emphasis on the higher mammalian systems, but including appropriate comparative comparisons.
- basic elements of the cognitive processes involved in sensory interpretation and reaction.

Intended Learning Outcomes

Upon completion of this unit, students will be able to:

- comprehend the ability of nervous systems to access, integrate and interpret sensory information
- understand the common plan of sensory systems across species, as models for neuroscience research
- look beyond 'sense' to cognition.

Lecture Content

Lecture	Title	Synopsis
1	Introduction to comparative sensory physiology	What is a sense? How do we, and other creatures, interact with a physical reality?
2	The Eye - window on the soul?	Capturing light - in mammals and others.
3	Retina	"First Contact" with the central nervous system - how to convert light to brain messages.
4	The vision we don't "see"	Projection of information through secondary visual pathways; circadian rhythms
5	Comparative Colour Vision	"The peacock's tail and other colourful facts"
6	Thalamus - gateway to cortex?	Passive gateway or active amplifier? To sleep, perchance... to "attend".
7	The Primary Visual Cortex	The "beginning" of cortical processing - the human "condition".
8	Higher Visual Cortices	"To V2 and Beyond!" - how does cortex communicate information - hierarchy or "cloud"?
9	Higher Visual Cortices	...when things go wrong - amblyopia, blindsight, neglect and other short stories...
10	From ear to hear..	What is sound? Sound in the air; "sound" for other animals
11	Cochlea - transduction, amplification and more	Hair cells, fluid mechanics and the "I-pod" generation!
12	From hearing to speaking	Central "interpretation" of sounds - and language, from bats to whales, and us.
13	Chemo-reception	A "taste" of science.
14	Chemo-reception	Olfaction, the "world" of scent
15	Mechanoreceptors	The basic unit of the somatic sense
16	Mechanoreceptors	Understanding mechanotransduction - "feeling" your way....
17	Somatosensory Pathways and the Somatosensory Cortex	From skin to the spinal cord and higher - through thalamus to cortex.
18	Whiskers and Barrels	Specialisation in somatosensation - the rodent whisker system
19	Pain	The "sense" of nociception and "feeling of pain".... sense to perception.
20	Somatosensation: Cognition and decision	Plasticity, Phantom Limbs and other "higher" aspects of somatosensation
21	Cognition & Sense(s)	Integration of cortical sense pathways -
22	Top Down?	Decisions, decisions.. and gambling - the betting game of neuroeconomics.

e-Learning Activity

All lecture material will be offered in advance on Blackboard. An appropriate mini-exam will

be provided for ~week 7 and a forum for discussion. "Interesting examples" of non-lecture materials, designed to highlight aspects of the lecture-based material, will be provided.

Assessment

1.5 hour written examination (100%) in short answer format, covering all aspects of the course, lecture-based or Blackboard.

Feedback

All students are given the Unit Coordinator's email address for questions or comment, as well as being encouraged to contact lecturing staff immediately following the lecture, or later by email or in the Blackboard discussion forum.

Prerequisites

BIOL10832 (Compulsory)

Recommended Reading

- Kandel E.R., Schwartz J.H. & Jessel T.M. *Principles of Neural Science (4th edition)* 2000, McGraw-Hill Medical
- Bear, M.F., Connors B.W. & Paradiso M.A. *Neuroscience: exploring the brain (3rd edition)* 2006, Lippincott, Williams and Wilkins

Teaching Staff

Dr Ken Grieve, Professor Rob Lucas, Dr Rasmus Petersen

CELLS & TISSUES IN HUMAN DISEASE

BIOL21351

Unit Coordinator(s): Dr Mauro Degli Esposti
(mauro.esposti@manchester.ac.uk)

Semester 1
Credits 10

Aims

To introduce cellular mechanisms of human diseases and the drugs to treat them.

Intended Learning Outcomes

Students will acquire knowledge of the basic cellular mechanisms underlying common human diseases and will understand how drugs act on cellular and tissue dysfunctions to ameliorate these diseases.

Lecture Content

In sum, the course presents the cellular and molecular causes of common diseases such as diabetes and cancer, with their pharmacological strategies and the following themes.

- Cell death and disease
- Cell adhesion and its pathological defects
- Cellular base of autoimmunity
- Autoimmune and other forms of diabetes
- Inflammation and anti-inflammatory drugs
- Anti-migraine drugs
- Molecular pathology of cancer
- Cancer chemotherapy

e-Learning Activity

A new graphical MCQ exercise (contributing 10% of the final mark) and an optional test exam essay on the subject of diabetes and its pharmacology.

Assessment

A graphical MCQ e-learning exercise on diabetes (10%) plus written Exam with MCQs (40%, 1 hour) and 1 essay (50%, 1 hour).

Feedback

One dedicated lecture, one e-learning activity (test exam essay) and post-exam guidance.

Prerequisites

BIOL10822 (Strongly Recommended)

Recommended Reading

- Rang HP, Dale MM, Ritter JM & Flower, R *Rang & Dale's Pharmacology (6th Edition)* 2007 Churchill Livingstone
- Kumar V, Abbas A, Fausto N, Aster J Robbins and Cotran *Pathological Basis of Disease (8th Edition)* 2009 Saunders.

Teaching Staff

Dr Mike Dascombe, Dr Mauro Degli Esposti, Dr Andrew Gilmore, Dr Douglas Millar

CELLS & TISSUES IN HUMAN DISEASE

BIOL21351

Unit Coordinator(s): Dr Mauro Degli Esposti
(mauro.esposti@manchester.ac.uk)

Semester 1
Credits 10

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Feedback

One dedicated lecture, one e-learning activity (test exam essay) and post-exam guidance.

Prerequisites

BIOL10822 (Strongly Recommended)

Recommended Reading

- Rang HP, Dale MM, Ritter JM & Flower, R *Rang & Dale's Pharmacology (6th Edition)* 2007 Churchill Livingstone
- Kumar V, Abbas A, Fausto N, Aster J Robbins and Cotran *Pathological Basis of Disease (8th Edition)* 2009 Saunders.

Teaching Staff

Dr Mike Dascombe, Dr Mauro Degli Esposti, Dr Andrew Gilmore, Dr Douglas Millar

HAEMATOLOGY

BIOL21361

Unit Coordinator(s): Dr Michelle Keown
(michelle.e.keown@manchester.ac.uk)

Semester 1
Credits 10

Aims

This unit is aimed at providing an extensive knowledge of the main areas of haematology including understanding, diagnosis and treatment of haematological disorders and to introduce the main areas of interest in blood transfusion.

Intended Learning Outcomes

Students will be able to:

- demonstrate an understanding of the underlying processes in blood cell formation
- describe, discuss & diagnose diseases of blood including anaemia, leukaemia and disorders of haemostasis & thrombosis
- describe the role of haematology in the investigation of disease in general
- bring together, evaluate and apply knowledge from biochemistry and cell biology in interpretation of the functions of blood & related diseases
- interpret biochemical & morphological data in the diagnosis of certain blood disorders/diseases
- reflect critically & analytically on their study learning styles so as to be able to identify and review additional literature to enhance learning

Lecture Content

- 1 Introduction to module
- 2 Blood cell formation: haemopoiesis
- 3-6 Red blood cell and haemoglobin, red blood cell membrane and enzyme disorders
Iron metabolism, Vitamin B12 and Folate, Anaemias
- 7-8 Haemoglobinopathies-thalassaemia and sickle cells
- 9-12 Haemostasis-platelets and coagulation cascade, Coagulation cascade: lab tests/anticoagulant therapy
Disorders of haemostasis
- 13 White blood cells (WBC): structure, function and differentiation
- 14 WBC:reactive proliferation, benign and infection
- 15-20 Basis and classification of haematological malignancies
Neoplastic lymphoproliferative disorders
Neoplastic myeloproliferative disorders
- 21 Blood transfusion:introduction
- 22 Exam practice

Assessment

1.5 hour examination (90%) - short answer questions and 1 essay question from a choice of 3. Five online group based learning (GBL) activities each worth 2% (Total: 10%).

Feedback

Online GBL:feedback on Blackboard within 2 weeks (10 working days) of submission deadline. Individual feedback on request or if appropriate. Generic feedback and discussion in lecture: 6 working days post submission deadline.

Prerequisites

BIOL10212 (Optional); BIOL10401 (Optional); BIOL10811 (Optional)

Recommended Reading

- Hoffbrand AV, Moss PAH & Petit JE *Essential Haematology (5th edition)* 2007 Blackwell Publishing

- Hughes-Jones NC, Wickramasinghe SN & Hatton CSR *Lecture notes on Haematology (8th edition)* 2009 Wiley-Blackwell
- Moore G, Knight G, Blann A. *Fundamentals of Biomedical Science: Haematology (1st Edition)* 2010. Oxford University Press

Teaching Staff

Dr Shazia Chaudhry, Dr Michelle Keown

ORGANISMAL GENETICS

BIOL21371

Unit Coordinator(s): Dr Kathy Hentges
(kathryn.hentges@manchester.ac.uk)

Semester 1
Credits 10

Aims

The aim of this unit is to provide students with a deeper understanding of fundamental genetic concepts. Specifically, emphasis will be placed on understanding the analysis of mutant phenotypes generated through various genetic manipulations in a wide range of organisms to determine gene function, providing a foundation for further study in any discipline.

Intended Learning Outcomes

After completion of this unit, students will be able to describe model systems used in the study of genetics, understand different types of mutant alleles, be able to link genotype and phenotype variations and understand how genetic manipulations aid in dissecting gene function. They will also gain an understanding of approaches used to investigate human genetic disease. Furthermore, they will understand how genetic approaches are integrated with other biochemical, physiological and developmental analyses to facilitate the uncovering of biological mechanism and its relevance to the whole organism.

Lecture Content

- **Genomic Alterations:** Introduction to large-scale chromosomal rearrangements, the concepts of ploidy, dosage balance, duplication events and hybrid organisms. These lectures will feature examples from species such as yeast, plants, and worms to compare methodologies for dissecting gene function and genome conservation.
- **Genetic Analysis:** These lectures will examine the ways in which gene function can be determined through genetic experimentation. Both loss of function and gain of function approaches will be explored. Examples from a variety of organisms will be covered.
- **Complex Traits:** Examples of non-Mendelian phenotypes and effects of multiple genes on phenotypes will be presented, with an example of mouse models of human diseases.
- **Alleles and Genetic Interactions:** These lectures will examine how varied mutations affect gene function and discuss specific genetic reagents for the study of allele series and somatic mutations. Specific examples of using genetic approaches to identify signalling pathways and understand brain function will be discussed.
- **Fitness, Epistasis, and Plasticity:** The concepts of genetic interactions, copy number variations, and genotype-environment interactions will be presented.
- **Human Genetics:** Specific genetic approaches used in the study of human disease and human genetic variation will be discussed. Future challenges to identify genetic contributions to human disease will be explored.

e-Learning Activity

There are 5 ePBL scenarios in which the student assumes the role of a genetics researcher to perform virtual genetics experiments and interpret data. Each scenario has quiz questions with feedback provided for incorrect answers. Completion of each scenario within the specified time period achieves 1% of unit marks.

Assessment

1.5 hour written examination (85%), in-class poster session (10%) and completion of online ePBL exercises (5%).

Feedback

Feedback will be provided to students on their group work by written comments on marking sheets and direct dialogue with instructors at the in-class poster session. Group feedback

will also be given by peer assessment of posters at the in-class poster session. Individual feedback is provided by completion of the ePBL scenarios, which have quiz questions embedded within the ePBL with feedback for incorrect answers.

Prerequisites

BIOL10221 (Strongly Recommended), BIOL10521 (Strongly Recommended)

Recommended Reading

- Griffiths, Wessler, Carroll, Doebley, *Introduction to Genetic Analysis*, 2011, Freeman, Recommended
- Watson, Myers, Caudy, and Witkowski, *Recombinant DNA*, 2007, CSHL Press, Further Reading
- Meneely, *Advanced Genetic Analysis*, 2009, Oxford University Press, Further Reading

Teaching Staff

Dr Martin Baron, Dr Mike Briggs, Dr Daniela Delneri, Dr Kathy Hentges

INTRODUCTION TO VIROLOGY

BIOL21381

Unit Coordinator(s): Dr Nicky High
(nicky.high@manchester.ac.uk)

Semester 1
Credits 10

Aims

The aim of this unit is to provide an understanding of viruses and viral disease. It will provide an introduction to viral structure and function and explain how viruses subvert host cell function to generate viral factories. Details of the pathogenic mechanisms used by viruses to cause disease will be explained using examples such as the influenza virus and HIV. The design of viral vaccines will also be covered and their use in eradicating viral infections such as polio discussed.

Intended Learning Outcomes

At the end of the course students will have an appreciation of:

- viral structure
- the interaction of virus and host
- the mechanisms of viral replication in host cells
- viral pathogenesis
- immune response to viral infections
- acute, chronic and latent viral infections
- viral vaccines and anti-viral drugs
- viral epidemiology

Lecture Content

- What is a virus?
- Viral structure
- Viral genomes and replication
- Viral interactions with the host
- Acute viral infections
- Latent and persistent viral infections
- Viruses and immunodeficiency
- Viruses and Cancer
- Viral vaccines
- Anti-viral therapy
- Viral evolution
- Emerging viral infections
- Zoonotic viral diseases

e-Learning Activity

HIV doesn't cause AIDS – The Duesberg phenomenon. Students will be asked to address the nine points made by Duesberg and produce a rebuttal of his contention, made in his original *Science* article, that “HIV is not the cause of AIDS because it fails to meet the postulates of Koch and Henle, as well as six cardinal rules of virology.”

Assessment

1.5 hour written examination at the end of the unit (80%); E-learning project (10%); MCQs (10%).

Feedback

Feedback will be provided on the e-learning projects. Knowledge will also be assessed by 4 MCQ exams set at intervals throughout the course.

Prerequisites

None

Recommended Reading

- Dimmock, Easton and Leppard, *Introduction to Modern Virology*, 6th edition, Blackwell Publishing.
- Cann, *Principles of Molecular Virology*, 4th edition, Elsevier Flint, Enquist, Racaniello and Skala *Principles of Virology*, 3rd edition. ASM press.

Teaching Staff

Dr. Nicky High, Professor Ian Roberts, Dr. David Robertson