School Of Medicine, Medical Sciences & Nutrition

BM4010

Advanced Molecules, Membranes & Cells (Stem Cells & Regeneration)

Course Handbook
2019-20

UNIVERSITY OF ABERDEEN

Contents

Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology

Course Summary

This course provides core material for students to gain an understanding of professional biomedical research at the molecular, cellular and systems levels. It contains a series of lectures on Stem Cells and Regeneration that are an essential component of the Degree Programme for students undertaking degrees in Human Embryology and Developmental Biology, BMS (Developmental Biology) and BMS (Anatomy). The course provides a much more detailed insight into research methods and recent findings with detailed presentations of current research topics from individual academic staff of Medical Sciences. The course consists of 3-4 lectures per week. Additionally, 1 intensive full day practical session will be given where small groups will gain experience of biomedical research techniques and data analysis. The course will be examined in a 3 hour written examination and by continuous assessment, which will comprise of one essay, one oral examination and a report.

Course Aims & Learning Outcomes

1. To provide detailed core knowledge of techniques used in the study of aspects of molecular and cellular bioscience, stem cells and developmental biology.

2. To relate recent research findings and discuss current trends and controversies in key research areas.

3. To provide a description of research work and bring the students close to the borders of our current understanding of several fields of biomedical science, including stem cell technology, tissue regeneration, and neuronal growth and development.

Course Teaching Staff

Course Co-ordinator(s):

Professor Colin McCaig (c.mccaig@ abdn.ac.uk); Prof Martin Collinson (m.collinson@abdn.ac.uk)

Other Lecturing Staff:

Dr J Barrow (JB), Medical Sciences

Dr M Baldassarre (MB), Medical Sciences

Ms S Thomson (STh), Careers Service

Professor P Fowler (PFow), Obstetrics & Gynaecology

Professor P McCaffery (PMc), Medical Sciences

Professor B Platt (BP), Medical Sciences

Dr D Scott (DSc), Medical Sciences

Dr D Shewan (DS), Medical Sciences

Prof Iain Gibson (IG) Medical Sciences

Professor Cosimo De Bari (CdB), Medical Sciences (CDB)

Dr Ann Rajnicek (AMR), Medical Sciences

Dr Annesha Sil (AS), Medical Sciences

Assessments & Examinations

a) Continuous assessment - 30% of the total assessment will be based on the essay prepared in October-December, the oral examination in November and the practical report September-October. Essay topics will be distributed in early October.

b) Examination - This will take place in the summer diet, April/May. It will take the form of an essay based examination, which will comprise 70% of the assessment for BM4010. The format will be a three hour paper with a choice of 3 questions from a total of 8. The examination paper will be divided into two sections; A consisting of 3 and B consisting of 5 questions. Only one question from section A and two questions from section B are to be attempted. All assessments (continuous and examined) will be made using the Medical Sciences Common Grade Scheme (copy attached).

c) Satisfactory performance - Students are expected to attend all elements of the course and to complete all class exercises.
The minimum performance acceptable is attendance at 80% of the course.
The completion of all course work, written and oral, is an absolute requirement for your degree.

Class Representatives

We value students' opinions in regard to enhancing the quality of teaching and its delivery; therefore, in conjunction with the Students' Association we support the Class Representative system.

In the School of Medical Sciences, we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.
What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit **www.ausa.org.uk** or email the VP Education & Employability **vped@abdn.ac.uk**. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: **www.abdn.ac.uk/careers**.

Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with alone they should notify the course coordinator immediately. If the problem relates to the subject matter general advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (**medsci@abdn.ac.uk**) in the Medical Sciences Office (based in the Polwarth Building, Foresterhill), or Mrs Sheila Jones (**s.jones@abdn.ac.uk**) in the Old Aberdeen office associated with the teaching laboratories, to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e work from second semester during the summer vacation), coursework will be kept until the end of Freshers' Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

The lecturer responsible for each section of the course will provide a detailed reference list which will enable students to follow up topics of particular interest. The core text for Human Embryology and Developmental Biology Honours year courses is Gilbert SF, 2010. Developmental Biology (9th edition) (Sinauer: Sunderland. Mass. USA).

Lecture Synopsis

Lecture 1: **Introduction to Course and discussion of honours projects - Dr D Shewan/Professor M Collinson**

Lecture 2: **Careers Lecture - Ms Sandra Thomson**

We will discuss careers for biomedical science graduates and job seeking skills

Lectures 3-8 **Genetic manipulation technology - Professor M Collinson**

Techniques for production of transgenic mice and other animals, applied to biomedical research. Origins of embryonic stem cells and ES cell technology. Use of transgenes as cell markers and for the analysis of gene regulation. Enhancer traps. Production of mouse mosaics and their uses. Classical mutagenesis techniques and Cre-lox targeted mutagenesis of mice. Gene traps. Knock-ins. Uses of these technologies. Detailed examples of transgenic techniques, targeted mutagenesis and chimeras used to elucidate control and function of a single gene. Developing technologies that may become routine in future. Genetic analysis of transcriptional regulation and protein function. Genome editing including CRISPR/Cas9 technology, Zinc finger nucleases and TALENs. iPS cells.

Lecture 9: **Citing referencing and plagiarism - Dr D Scott**

Lectures 10-11: **New Imaging Techniques - Professor Colin McCaig**

There has been a technological revolution in the development of new imaging techniques in the last decade. Four new techniques will be introduced. We shall discuss what they are, how they work, what they allow us to visualise and how they are used both to challenge old concepts and to introduce new clinical therapies. **Lecture 1** will concentrate on Optogenetics, the use of light to control the behaviour of specific cells. Fluorescent transgenes targeting cell

receptors, intracellular signalling molecules, or even individual gene expression can be activated with light probes. The first clinical trials are underway to treat human blindness using optogenetics.

Within the last decade the NIH has funded the Human Connectome project. Similar to the Genome project, this is an ambitious drive to map the entirety of the connections within the human brain. Many psychiatric diseases may arise from misconnected neuronal networks, but without understanding the details of how the brain is connected up correctly, unravelling where mapping goes wrong in order to correct it is almost impossible. We shall discuss the Brainbow technique which allows each individual neurone to be colour coded and so its multiple projections and connections are visualised. **Lecture 2** will discuss a technique called Clarity which makes tissues completely transparent and allows fly-through visualization in 3 dimensions. Together with the Brainbow method of barcoding each individual cell with a different colour, these are the major tools used in mapping the Connectome. Finally, we shall dip our toes into Algebraic Topology a branch of Mathematics that is being used to explore and model the brain in up to 11 dimensions(!). By studying the algebraic patterns of brain coding it claims to be able to visualise the moment the brain makes a decision.

Lectures 12-14 Genomic and Proteomic technologies - Dr John Barrow

Genomics and proteomics are relatively new fields that are largely only possible with the advent of high powered computer technology. They are shaping the way we can test and measure global changes in cells, tissues and whole organisms. These lectures will focus on recent research in both of these fields, highlighting key advances and changes to our understanding that have been brought about. Key examples and reading material will also be highlighted as the lectures progress.

Lectures 15-17 Axon Guidance - Dr Derryck Shewan

The growth cone: the motile tip of an axon that senses its environment and responds to it. How detection of extracellular signals leads to re-organisation of the axonal cytoskeleton. The physical, chemical and electrical characteristics of guidance signals underlying developmental axon growth to target tissues.

Attractive and repulsive axon guidance cues combine to ensure accurate pathfinding. Axons and their molecular environments change during development: consequences for nerve regeneration after injury. Examples of recent research will illustrate the rapid progress being made in understanding the molecular nature of nerve growth and repair.

The retinotectal projection. The accurate transmission of information from the eye to the brain is achieved because axons from neighbouring neurons in the retina map to neighbouring positions in the optic tectum. The molecular mechanisms underlying this amazing precision are discussed.

Lecture 18: **Statistics - Dr D Scott**

Lectures 19-23: **Endocrine Signalling and Reproductive Biology**

Profs Peter McCaffery and Paul Fowler

Endocrine signalling through nuclear receptors. Background to endocrinology, definitions, hormone production, methods of hormone transport in the body. Types and mechanisms of action of hormone receptors. Outline of male and female reproductive organs, with special emphasis on reproductive endocrine glands. Hormones with reproductive roles and functions. Contrast between male and female endocrine cycles. The hypothalamo-pituitary-gonad axis. The principles of endocrine feedback, as illustrated by the control of the female ovarian cycle. The role of signal transduction and endogenous timekeepers in regulating reproductive endocrine cycles. The course will end with a brief overview of comparative reproductive endocrinology, focusing on specialised reproductive adaptations of various mammalian species.

Lectures 24-27: **Cell/substrate interactions**

Dr M Baldassarre and Prof Iain Gibson

First two lectures (MB): Introduction to extracellular matrix (ECM). Interactions between cells and ECM, physiological and pathological implications. Overview of the molecules and the molecular mechanisms involved in the process with a focus on the integrins receptors, their structure and functions. ECM remodelling in tumour invasion. Matrix metalloproteases structure and activation cascade.

The final two lectures two lectures (IG) will describe the role of biomaterials in regeneration or repair. This will include naturally occurring extracellular matrix (ECM) and synthetic ECM or scaffolds. These scaffolds can have a number of functions: (1) for cell delivery to a specific site for regeneration or repair; (2) to guide the differentiation of multipotent stem cells down a specific lineage; (3) to provide structure for guiding the shape of the regenerating tissue. Examples will include biomaterial scaffolds used in the regeneration/repair of nerve, bone, liver, bladder and cartilage. Additionally, the role of state-of-the-art culture conditions in controlling tissue regeneration will be discussed, including in vitro bioreactors and ‘in vivo bioreactors.

Lecture 28-29 & 31: Tissue Stem Cells and Regeneration – Professor M Collinson

The concept of stem cell is rooted in classic developmental biology experiments, which have shown that the cell nucleus contains the instructions for creating form and shape of the embryo. How do we know that stem cell exist? We will define what a stem cell is and what the hallmarks of stem cells are. We will introduce concepts of totipotency, pluripotency, self-renewal and differentiation, which are associated with stem cells. But we will also discuss the idea that cancer is closely associated with embryonic and adult stem cells. The lectures will address current and future challenges for stem cell technology. Human regenerative therapy requires human stem cells, but the ethical consideration preclude many of the experimental options that are available in model animal systems. These lectures looks at other sources of human stem cells, in particular those that can be isolated from the umbilicus, which is a source of haematopoietic and mesenchymal stem cells. We will use the eye as an example of the role of adult stem cells in maintaining tissues.

Lecture 30: Models of Alzheimer's disease – Prof Bettina Platt

Examples of transgenic methods used to create murine models of Alzheimer's Disease and other dementias will be presented. General over-expression lines will be compared with regional- and cell-type specific knock-in models, and viral gene delivery in cell culture systems. Translational approaches such as PET imaging and EEG will be discussed, and the use of models for drug discovery will be briefly explored.

Lectures 32-34: Neural stem cells and neurogenesis - Profs M Collinson & P McCaffery

The normal developmental biology of the CNS will be discussed, whereby neural progenitor cells become neurogenic stem cells (radial glia), and subsequently either differentiate, die, or become adult stem cells. Stem cells in the retina will be described. Until the early 1990s, dogma held that new neurons could not be generated in the adult brain – you were born with a fixed number at birth and it was only downhill from then on. It is now understood that certain regions of the brain have a slow turnover of neurons – in those regions new neurons are born, while others die, throughout your life. These regions of the brain are the hippocampus, hypothalamus and a region close to the lateral ventricles known as the subventricular zone. Much research has been devoted to the understanding of why neurogenesis occurs, and this process is believed to be involved in regulation of learning and memory in the hippocampus and control of energy balance in the hypothalamus. The possibility exists as well that the slow rate of neurogenesis could be artificially accelerated after brain injury to repair damage. This lecture will discuss these functions together with the signalling systems controlling neurogenesis.

Lecture 35: Planaria and Stem Cells - Dr A Rajnicek

Flatworms, Planaria, have astounded biologists for over a hundred years for their ability to regenerate after being cut into fragments or after prolonged periods of starvation. In large part this is because of retention, in the adult, of a population of stem cells, neoblasts. This lecture will review the roles and activities of neoblasts in Planarian regeneration, as we try to understand principles and molecular pathways that could inform strategies for human stem cell-based therapies.

Lectures 36-37: Stem Cells in Skeletal Regenerative Medicine - Professor C De Bari

These lectures describe the molecular basis of skeletal regeneration and repair and discuss roles and strategies for stem cells in these processes.

Lectures 38-40: Human Embryo Manipulation, Gene and Stem Cell Therapy - Professor M Collinson

The one cell embryo is the supreme stem cell. This lecture describes techniques for the manipulation in vitro of early human embryos, IVF, the technical issues and potential for early embryo screening in human clinical science. Examples of cutting edge strategies for effecting human gene therapy and the use of stem cells for curing disease will be described.

Practical/Lab/Tutorial Work

Each student will carry out three tasks as part of their coursework. You will be assessed on all of these tasks and the marks will be combined to form 30% of your final mark for this course. The examination paper in the summer will carry the other 70% of the total.

Work handed in after the deadlines without good cause **will** be penalised, i.e. up to 10% = 3 CGS marks will be deducted. If you have problems with this work please contact Professor Martin Collinson (**m.collinson@abdn.ac.uk**) (for practicals) or Colin McCaig (**c.mccaig@abdn.ac.uk**) (essays) before the submission deadline.

Tasks:

1. ***Essay (for 15% of the final mark)***: Each student will be provided with a compulsory essay title, there will be no choice of topic. The essay topics will be provided and the essay written during the first semester. The essay should be no more than 2500 words in length excluding references and figure legends. A detailed discussion in a logical sequence should be presented, and credit will be given for original ideas and criticism that can be supported by argument and citations. The text should contain references to papers, which have been used and a complete reference list of cited papers and books must be provided. The reference list should give the authors, year of publication, title of the paper, journal, volume and page numbers of each paper referenced. Deadline will be Monday 16th December 2019.

   Prof Colin McCaig **c.mccaig@abdn.ac.uk** coordinates the essays, which are assigned and submitted via MyAberdeen (announcements will be sent out about this).

2. ***Practical Report (for 7.5% of the final mark):*** You will be assigned a small group practical class on either 24th September 1st or 8th October. Attendance is compulsory and there will be no opportunity to swap groups. Some groups will operate over two half-days on these dates.

   The Practical Report should be typed (Font 11 pt), using the third person (e.g. "Patch pipettes were used...") and outline the laboratory session with an abstract, introduction, methods, results and discussion sections.

- Title Page: Give student's name and student no., practical title and the supervisor's name (your report will be anonymised before marking).

- Abstract: Max 200 words. Remember this is an executive summary describing the purpose of the study, what you did, what happened and what you concluded. In theory, someone should be able to read this and get the important information without having to read the rest of the report.

- Introduction: Outline the background to the work and briefly describe the objectives.

- Methods: Give basic details of what you have measured and how this was done. Also state what data analysis was carried out, if any.

- Results: Present your data in a logical order and include images, graphs and/or original traces of your data, with appropriate legends. Remember the results section is more than just figures or tables. It tells the story of what experiments you did and why, and what happened, so should contain a significant amount of text.

- Discussion: Give a brief interpretation of your results and describe what would be interesting to investigate next in the context of this laboratory session.

- Include a list of references used (usually 3-10 references).

- **THE WORD LIMIT is 1800 (not including references, images, figures and figure legends).**

- Deadline: Three weeks after the practical class that was assigned to you (5pm Tuesday).

  Email Practical Report to Prof Martin Collinson **m.collinson@abdn.ac.uk** with the following file name:

  SURNAME Firstname BM4004 Essay/Practical SURNAMEOFSTAFF.doc

  e.g., if you are Anthony McPartlin doing Prof Gibson's practical for BM4004

  MCPARTLIN Anthony BM4004 Practical GIBSON.doc (pdf is fine too).

3. ***Oral examination (for 7.5% of the final mark):*** The oral examination will last 10-15 minutes and will take place on Tuesday 26th November 2018 (9.00-15.00). The object of this exercise is to give you experience in oral presentation. This will help you prepare for the oral examinations, which you may have at interview, and in the summer as part of your final degree assessment. You will be given a specific published research paper to study for the viva. The questions in the oral examination will relate to the paper. The assessor at the oral exam will be asked to give some constructive comments on your performance at the end of your discussion.

University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (**https://abdn.blackboard.com/bbcswebdav/institution/Policies**). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the **University[1]s Infohub webpage** or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum

Medical Sciences Common Grading Scale

Grade	Grade Point	Category	Honours Class	Description
A1	22	Excellent	First	• Outstanding ability and critical thought • Evidence of extensive reading • Superior understanding • The best performance that can be expected from a student at this level
A2	21			
A3	20			
A4	19			
A5	18			
B1	17	Very Good	Upper Second	• Able to argue logically and organise answers well • Shows a thorough grasp of concepts • Good use of examples to illustrate points and justify arguments • Evidence of reading and wide appreciation of subject
B2	16			
B3	15			
C1	14	Good	Lower Second	• Repetition of lecture notes without evidence of further appreciation of subject • Lacking illustrative examples and originality • Basic level of understanding
C2	13			
C3	12			
D1	11	Pass	Third	• Limited ability to argue logically and organise answers • Failure to develop or illustrate points • The minimum level of performance required for a student to be awarded a pass
D2	10			
D3	9			
E1	8	Fail	Fail	• Weak presentation • Tendency to irrelevance • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts
E2	7			
E3	6			
F1	5	Clear Fail	Not used for Honours	• Contains major errors or misconceptions • Poor presentation
F2	4			
F3	3			
G1	2	Clear Fail/ Abysmal	-	• Token or no submission
G2	1			
G3	0			

Course Timetable BM4010: 2019-2020

Date	Time	Place	Subject	Session	Staff
Week 7					
Mon 9 Sep	14.00-14.30	FLT	Honours Project discussion	Lecture	DS
	14.30-15.00	FLT	Course Introduction and Careers information	Lecture	MC
	15.00-16.00	FLT	Careers	Lecture	ST
Tue 10 Sep	10.00-12.00	FLT	Searching databases Ovid and internet resources	Lecture	Library
Wed 11 Sep					
Thu 12 Sep					
Fri 13 Sep	13.00-14.00	Aud	Genetic manipulation technology 1	Lecture	MC
	14.00-15.00	Aud	Genetic manipulation technology 2	Lecture	MC
Week 8					
Mon 16 Sep	14.00-15.00	FLT	Genetic manipulation technology 3	Lecture	MC
	15.00-16.00	FLT	Genetic manipulation technology 4	Lecture	MC
Tue 17 Sep	09.00-13:00	CR3	Databases & internet resources- search practical (Optional – sign up on 11 Sep)	Practical	Library
Wed 18 Sep	10:00-11:00	Aud	Genetic manipulation technology 5	Lecture	MC
Thu 19 Sep					
Fri 20 Sep	13.00-14.00	FLT	Genetic manipulation technology 6	Lecture	MC
Week 9					
Mon 23 Sep	14.00-15.00	FLT	Citing, Referencing and Plagiarism	Lecture	DSc
	15.00-16.00	FLT	Free Slot	Lecture	
Tue 24 Sep	10.00-16.00	IMS Labs	Practical (Group A)	Practical	GSB/PMcC/PMM/AMR/MC/MD/NMo/CW/WH/IG
Wed 25 Sep	10:00-11:00	Aud	New Imaging techniques 1	Lecture	CDM
Thu 26 Sep					
Fri 27 Sep	13.00-14.00	FLT	New Imaging techniques 2	Lecture	CDM
Week 10					
Mon 30 Sep	14.00-15.00	FLT	Genomic and Proteomic Analysis 1	Lecture	JB
	15.00-16.00	FLT	Genomic and Proteomic Analysis 2	Lecture	JB
Tue 1 Oct	10.00-16.00	IMS Labs	Practical (Group B)	Practical	BP/GSB/PMcC/SDA/AMR/MC/PMM/ /WH/IG/HC
Wed 2 Oct					
Thu 3 Oct					
Fri 4 Oct	13.00-14.00	FLT	Genomic and Proteomic Analysis 3	Lecture	JB
	14.00-15.00	Aud	Axonal guidance 1	Lecture	DS
Week 11					
Mon 7 Oct	14.00-15.00	FLT	Axonal guidance 2	Lecture	DS
	15.00-16.00	FLT	Axonal guidance 3	Lecture	DS

Tue 8 Oct	10:00-16:00	IMS Labs	Practical (Group C)	Practical	BP//SDA/ AMR/MC/MD/ NMo /PMM/ HC/WH/JB/IG
Wed 9 Oct					
Thu 10 Oct					
Fri 11 Oct	13.00-14.00	FLT	Statistics	Lecture	DSc
	14.00-15.00	Aud	Endocrine Signalling and Reproductive Biology 1	Lecture	PMcC
Week 12					
Mon 14 Oct	14.00-15.00	FLT	Endocrine Signalling and Reproductive Biology 2	Lecture	PMcC
	15.00-16.00	FLT	Endocrine Signalling and Reproductive Biology 3	Lecture	PF
Tue 15 Oct					
Wed 16 Oct	10:00-11:00	FLT	Endocrine Signalling and Reproductive Biology 4	Lecture	PF
Thu 17 Oct					
Fri 18 Oct	14:00-15:00	FLT	Endocrine Signalling and Reproductive Biology 5	Lecture	PF
Week 13					
Mon 21 Oct	14.00-15.00	FLT	Cell/substrate interactions 1	Lecture	MB
	16:00-17:00	FLT	Cell/substrate interactions 2	Lecture	MB
Tue 22 Oct	12:00-13:00	FLT	Cell/substrate interactions 3	Lecture	IG
	13:00-14:00	FLT	Cell/substrate interactions 4	Lecture	IG
Wed 23 Oct					
Thu 24 Oct					
Fri 25 Oct	15:00-16:00		Free Slot/Study		
Week 14					
Mon 28 Oct	14.00-15.00	FLT	Tissue Stem Cells and Regeneration 1	Lecture	MC
	15:00-16:00	FLT	Tissue Stem Cells and Regeneration 2	Lecture	MC
Tue 29 Oct					
Wed 30 Oct	10:00-11:00	FLT	Animal Models of Alzheimer's Disease	Lecture	AS
Thu 31 Oct					
Fri 1 Nov	14.00-15.00	1:143/144	Tissue Stem Cells and Regeneration 3	Lecture	MC
	15:00-16:00	1:143/144	Free slot		
Week 15					
Mon 4 Nov	14.00-15.00	FLT	Neural stem cells and neurogenesis 1	Lecture	MC
	15.00-16.00	FLT	Neural stem cells and neurogenesis 2	Lecture	PMcC
Tue 5 Nov					
Wed 6 Nov	10:00-11:00	FLT	Neural stem cells and neurogenesis 3	Lecture	PMcC
Thu 7 Nov					
Fri 8 Nov	13:00-14:00	1:147	Planaria – Stem Cells and Regeneration	Lecture	AMR
Week 16					
Mon 11 Nov					
Tue 12 Nov					
Wed 13 Nov	09:00-11:00	FLT	Free Slot	Lecture	
Thu 14 Nov					
Fri 15 Nov	14.00-15.00	1:143/144	Stem cells in skeletal regenerative medicine 1	Lecture	CDB
	15.00-16.00	1:143/144	Stem cells in skeletal regenerative medicine 2	Lecture	CDB

Week 17					
Mon 18 Nov	14.00-15.00	FLT	Human Embryo Manipulation, Gene & Stem Cell Therapy 1	Lecture	MC
	15.00-16.00	FLT	Human Embryo Manipulation, Gene & Stem Cell Therapy 2	Lecture	MC
Tue 19 Nov					
Wed 20 Nov	10:00-11:00	FLT	Human Embryo Manipulation, Gene & Stem Cell Therapy 3	Lecture	MC
Thu 21 Nov					
Fri 22 Nov	14.00-15.00	1:147	Study/Free Slot		
Week 18 - No teaching during this week REVISION WEEK					
Mon 25 Nov					
Tue 26 Nov	09.00-15.00	IMS Offices	Viva examination	Viva	GSB/MC/DS/GMcE/SND/BP/AMR/CDM/ST/LS/ SP/ FG/ SA
Wed 27 Nov					
Thu 28 Nov					
Fri 29 Nov					

Staff

Prof Colin McCaig (CDM), (Co-ordinator)
Prof M. Collinson (MC)
Prof Gordon McEwan (GMcE)
Prof Stephen Davies (SND)
Dr John Barrow (JB)
Dr G.S. Bewick (GSB)
Prof Cosimo De Bari (CdB)
Prof P. Fowler (PFow)
Prof Iain Gibson (IG)
Prof P. McCaffery (PMcC)
Dr Ann Rajnicek (AMR)
Prof. D. Scott (DSc)
Dr D. Shewan (DS)
Ms S. Thomson (STh)
Dr Nicola Mutch (NMu)
Dr Max Baldassarre (MB)
Prof Mirela Delibegovic (MD)
Dr Wenlong Huang (WH)
Prof Graeme Nixon (GN)
Prof Bettina Platt (BP)
Dr Sergio Dall'angelo (SDA)
Dr Steve Tucker (ST)
Dr Nimesh Mody (NMo)
Dr Lianne Strachan (LS)
Dr Pablo Martinez de Morentin (PMM)
Dr Flora Groening (FG)
Prof Simon Parson (SP)

Dr Claire Whyte (CW)
Dr Annesha Sil (AS)
Dr Huan Cao (HC)