PART II PHYSIOLOGY, DEVELOPMENT AND NEUROSCIENCE 2018-2019

NST Part II Physiology, Development and Neuroscience
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Development and Reproductive Biology
Theme organiser: Professor Nick Brown
Integrative Physiology
Theme Organiser: Dr Michael Mason
Neuroscience
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Department of Physiology, Development and Neuroscience website:
http://www.pdn.cam.ac.uk/

Part II Physiology, Development and Neuroscience website:
http://www.pdn.cam.ac.uk/teaching/part2/index.shtml

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INTRODUCTION

Part II in Physiology, Development and Neuroscience offers a broad range of teaching and project opportunities covering the full spectrum of interests within the Department. Our Part II teaching is organised into modules to offer the greatest possible flexibility allowing students to design a course to match thier own interests.

The Department of Physiology, Development and Neuroscience is concerned with material central to the life sciences. It addresses questions about the way that cells, tissues and organs develop and function in people and animals. Physiology, Development and Neuroscience are broad but interlinked subjects with many different areas of specialisation. A good grounding in these subjects opens the way to a wide variety of careers: these range from those where you use your knowledge directly, to those in which the understanding you will acquire of complex organisms is put to work less directly, such as in managing equally complex human organisations. The knowledge and skills gained on this Part II course will particularly provide a valuable basis for the practice of human and veterinary clinical medicine, where a critical understanding of scientific advances is essential in designing and evaluating new treatments. Many parts of the course concentrate on important research areas where recent discoveries have changed our perception of disease and have posed new questions to be answered. The sixteen modules are organised into three themes, allowing you to spend the whole of your third year studying in depth Development & Reproductive Biology, Integrative Physiology or Neuroscience. Alternatively, those of you seeking a broader overview can select to follow a more general course, combining modules across these themes.

One major benefit of studying Part II Physiology, Development and Neuroscience will be in gaining an in-depth knowledge of key core areas of the life sciences. You will also gain important knowledge and skills that graduates *in any subject* should these days have. These skills include:

- critically assessing information you read or hear
- keeping accurate records
- writing reports and reviews, and effectively presenting and communicating your ideas
- efficiently using libraries and information databases
- selecting appropriate statistical procedures to verify hypotheses
- using modern computer software

Teaching of the course involves most members of staff of the Department of Physiology, Development & Neuroscience and is supplemented by invited specialists from across the University, and from the Royal Postgraduate Medical School, Babraham Institute, Medical Research Council and Addenbrooke's and Papworth Hospitals. We also offer a growing number of modules taught in collaboration with other Departments, allowing us to call upon the broadest range of expertise within the University.

Taking Part II in Physiology, Development & Neuroscience gives you the many advantages of a *home base* on the Downing Site. You will immediately feel an important contributing part of the vibrant research community. The social cohesion with your fellow Part II students will be enjoyable and valuable throughout the year and your academic and other questions can be informally dealt with when you happen to meet members of staff about the Department. The Department has numerous resources available to you through the year, including a well-stocked library, where you will be able to find many of the books and journals you need in a *single* place. The Department also maintains computers and printers, which you will be able to access both in the library and a dedicated Part II computer room. The friendly and supportive Part II technical staff will become well known to you and our excellent tearoom, frequented by all members of the Department, further fosters cohesion.

The scope of the course

You will probably already have an overview of some or all of physiology, development and neuroscience from your Part I courses and we will therefore build upon these basics by offering an **in depth** course in which we will not attempt to cover the whole of these subjects. We offer teaching on topics of current interest that we discuss to a much higher level than in Part I. This means that you can devote your time to those areas you find particularly interesting. While we expect that the majority will have done the Part IA and IB courses in physiology, neurobiology or developmental and/or reproductive biology, we will also

welcome those who have done only one of these courses, as well as those who approach physiology, development and neuroscience from other directions, such as biochemistry, genetics or animal biology.

The organisation of the course

All students study 4 modules. The course offers a wide choice from sixteen modules that are described in the following pages. The modules are divided into three themes: **Development & Reproductive Biology**, **Integrative Physiology** and **Neuroscience**. Some students will want to study one theme; however, others enjoy the opportunity to follow a more general course, combining modules across themes. Guidance will be given by your Departmental Advisor, a member of the staff whom you may know already as a member of your College. You will be asked to concentrate on **four** modules and you are given a free choice as to how you distribute those over the two terms (for example: two in Michaelmas and two in Lent or three in Michaelmas and one in Lent etc.), but be aware that some modules have restricted numbers (see module descriptions on page 10). In your detailed reading you will want to concentrate on the topics that particularly interest you. In the examination there will be one paper per module. Much of your formal teaching will take place during the morning, with the exception of some shared modules. Many modules also offer two or three-hour workshops, journal clubs or seminars in the afternoons. These give opportunities for a more interactive style of teaching that many students enjoy and find helpful in consolidating the lecture material. Most afternoons, during Michaelmas and Lent terms, are free for project work and private study. The Easter Term is kept largely free from formal commitments to allow time for reading and for discussion.

Projects

All students do either an experimental research project or a theory-based project, under the supervision of an appropriate member of staff. The findings are written-up in the form of an 8,500-word report. You may choose the topic of your project from those provided by members of staff, and will have the opportunity to discuss the projects with the relevant staff members at the end of Easter term. You will have the opportunity to present your progress to the Department as a poster presentation. The times that you work on your project can be negotiated with your supervisor to some extent so that you will have time available for other work and outside interests, but in general students are expected to spend about 16 hours a week on their project. The titles of a number of recent research projects are listed towards the end of this booklet, as are some of the publications arising from projects.

The small print:

This booklet describing the Part II Physiology, Development and Neuroscience course has to be produced in early-March. Some small details are likely to change. Some lecturers may change because of timetabling or leave commitments.

PART II PHYSIOLOGY, DEVELOPMENT AND NEUROSCIENCE:
A STRATEGIC ANALYSIS

Our aims

- To provide a broad multidisciplinary course in Physiology, Development & Neuroscience.
- To teach you a variety of scientific skills that will equip you for future careers in a wide range of areas: health sciences (e.g. the pharmaceutical industry and environmental physiology), medicine and veterinary medicine, research in the life sciences and related disciplines, teaching, publishing and management.

How we expect to achieve them

- By offering a modular course of lectures, workshops, seminars, informal discussions and research projects, supplemented by personal contact with members of the academic staff.
- By training you in the use of practical and conceptual tools required in many sub-disciplines: from molecular biology, through membrane and cellular physiology, to the study of systems physiology and the disorders of physiology associated with disease.
- By providing constructive feedback on your progress through personal discussion and assessment of project work.

What you can expect by the end of the course

The ability to:

- Think and write critically and creatively about what you have read, learnt and discovered.
- Analyse, both qualitatively and quantitatively, data collected during research projects.
- Use available resources to conduct research into scientific problems, e.g. libraries and computer databases, together with academic and technical expertise.
- Assess and implement practical techniques necessary to solve a particular scientific problem.
- Communicate with expert and non-expert audiences through presentations, project reports and essays.

What to do if you are interested in Part II PDN:

Two application forms must be completed:

1. **The Departmental Application:** If you think you are likely to want to take the Part II Physiology, Development and Neuroscience course **it is essential** that you complete of the application form and return it in person to Vicky Johnson in room C2 of the Physiology building **by 8th May 2018.** An application form is enclosed with hard copies of this brochure and the form is also available on the PDN website. **We cannot allocate a place if this form is not completed.**
2. **The University Application:** Formal application to take the course must also be made through CamSIS. After consultation with your Director of Studies you should make your Part II application on CamSIS between **March 16th and May 7th**.

Application forms are available on the Departmental website: http://www.pdn.cam.ac.uk

SUMMARY OF PART II PDN THEMES AND MODULES

Michaelmas term

Development and Reproductive Biology	Integrative Physiology	Neuroscience[§] *(4 modules + Experimental approaches in brain research)*
N1 Developmental Neurobiology[#] P3 Fetal and Placental Physiology P4 Development: Patterning the Embryo (*shared with Part II Zoology*) P9 Cell Assembly and Interactions (*shared with Part II Zoology*)	P1 Cellular Physiology P3 Fetal and Placental Physiology	N1 Developmental Neurobiology[#] N2 Molecular and Cellular Neuroscience[#] N4 Sensory Transduction[#] N7 Neural Circuits and Behaviour[#]

Lent term

N5 Neural Degeneration and Regeneration[#] P2 Development and Stem Cells P6 Development: Cells & Organs (*shared with Part II Zoology*) P7 Pathophysiology of Cancer	N5 Neural Degeneration and Regeneration[#] P2 Development and Stem Cells P5 Bioinformatics *(shared with Part II BBS Genetics)* P7 Pathophysiology of cancer P8 Systems and Clinical Physiology	N5 Neural Degeneration and Regeneration[#] N6 Central Mechanisms of Reward, Punishment & Emotion[#] N9 Neuronal Plasticity, Modulation and Behaviour[#]

[#] Shared with the inter-departmental Part II Psychology, Neuroscience and Behaviour course

Part II PDN: The Neuroscience Theme

The PDN Neuroscience Theme organiser is Prof. Angela Roberts (acr4@cam.ac.uk).

This PDN Neuroscience option is limited to 20 students and is particularly designed for those students with a keen interest in research. It combines the study of specific topics in neuroscience with an exploration of the process of research itself. Acquaintance with the scientific method will not only be gained through hands on research experience in the form of a two-term research project but also through participation in a series of workshops on 'experimental approaches in brain research'. The aim is to introduce you to biomedical research (through the study of the brain) and to enable you to formulate and address your own questions about living systems from molecules to behaviour.

All students must choose four neuroscience modules (from N1-2, N4-7 and N9) within PDN; attend 4 out of a possible 8 workshops on experimental approaches in brain research and take a two-term lab-based project.

Neuroscience workshops: Experimental Approaches in Brain Research

These workshops have restricted numbers. All students registering for the Neuroscience theme in Part II PDN must attend four of these workshops in addition to four modules chosen from N1-2, N4-7 and N9. Any spaces left may be filled by students not registered for the Neuroscience theme.

Each workshop will be composed of a one-hour teaching session in which the advantages and limitations of different research techniques available to the neuroscientist will be discussed in the context of specific neurobiological research topics (e.g. neuronal fate, information processing in neuronal networks, how the brain makes decisions). Students will then be given the opportunity to work in groups to follow up particular questions arising from that teaching session and to present a summary and lead a discussion of the issues in student-led presentation sessions a week later. These workshops are structured in such a way as to develop not only your intellectual abilities, but also your skills in communicating ideas effectively to others, both orally and in writing, and in working with others collaboratively. Thus you will develop skills that are of value not only in biomedical research but in many other careers as well.

List of neuroscience workshops offered in 2017/18:
(Most of these will be repeated for the coming year)

Understanding neuronal networks: current progress and future promises
Dr David Parker
Neuronal networks assemble the cellular components needed to process sensory inputs, perform cognitive functions, and pattern motor outputs. However, despite their central role in the nervous system, our understanding of neuronal networks is limited at best. This workshop will examine the conceptual and experimental approaches to examining the organisation and function of local neuronal circuits, highlighting the claims of new experimental and analytical techniques and the questions that are likely to remain.

Experimental approaches to axon guidance
Dr Geoff Cook
Experimental techniques used to characterize the mechanisms of axon guidance will be discussed and examples given of their application to specific biological systems. Those taking this workshop will be encouraged to consider the advantages and limitations of each of the experimental approaches.

Shedding light on brain function: Optogenetics and beyond
Professor Ole Paulsen
This workshop will explore new optogenetic approaches to the study of neurons and their circuit functions. We will describe the basic principles of cell-type-specific expression of light-activated channels, and how they can be used to activate or silence neurons. We will discuss the opportunities offered by this new technology, and also some possible problems and caveats.

What cellular imaging can do for neuroscience

Dr Trevor Wardill

This workshop will explore the range of cellular imaging techniques currently employed to visualize neuronal responses and the impact that such techniques have on our understanding of neurobiological mechanisms. The advantages of functional imaging (i.e. reduced mechanical damage) and drawbacks (i.e. slow reporting speed) will be compared to those of classic electrophysiology. We will highlight improvements in the processing of fixed tissue and imaging technology which allow deep neural tissue imaging. We will discuss the current limits to the effective use of such data sets, the challenge of mining them for meaningful information and how they are shifting our conceptual understanding of brain function.

Studying behaviour in translational neuroscience: the do's and don'ts

Dr Andrea Santangelo & Dr Nicole Horst

This workshop will consider a range of psychological tests that are available to the Behavioural Neuroscientist for studying the brain mechanisms that underlie cognition and emotion in animals. An intrinsic problem with all psychological tests is that they never just measure the one particular psychological process that you are interested in. So, how do you gain the specificity that you are looking for? Moreover, how relevant are the results in animals to our understanding of the brain mechanisms underlying human behaviour? This workshop will consider issues of specificity, sensitivity and translatability, focussing on reward learning, cognitive flexibility and long term memory.

Discovering endophenotypes: the connection between genes and neuropsychiatric syndromes

Dr Jeff Dalley

This workshop will review the concept of endophenotypes in experimental Psychiatry. The notion that genes and environment combine to confer susceptibility to the development of complex, polygenic brain disorders such as schizophrenia, attention-deficit hyperactivity disorder (ADHD) and drug addiction was first proposed by Gottesman and Shields in 1973. We will explore the utility of measuring intermediate phenotypes (e.g., based on neurophysiological, biochemical, endocrinological, neuroanatomical and cognitive components) to the discovery of gene influences in brain syndromes and discuss how this approach can aid disease diagnosis and the development of animal models.

Designing behavioural neurophysiological studies

Professor Wolfram Schultz

This workshop will present a range of key experiments and consider the principal factors that go into a useful study. We will look at the constraints imposed by behaviour, electrophysiology and specific species and discuss example experiments in which these have been successfully taken into consideration. We will try to identify future appropriate research questions and techniques and assess how they differ from less promising ones.

Functional Magnetic Resonance Imaging (fMRI): Uses and abuses

Dr Annemieke Apergis-Schoute

This workshop will highlight fMRI experimental designs and paradigms that can be applied to a range of fields in cognitive neuroscience. The assumptions underlying different analysis methods will be discussed, as well as the limitations resulting from the nature of the response measured by fMRI.

PART II BBS: OPTIONS IN PDN

Course Organiser: Dr Stewart Sage (sos10@cam.ac.uk)

The Part II BBS course is for students who want a course based entirely on lecture and library work, with no practical component. Students take a major subject (consisting of four lecture modules) and a minor subject (one lecture module), and write a dissertation.

Major subject 415: Physiology, Development and Neuroscience [25 places]

BBS students can offer 4 of the 16 PDN modules as their major subject, under the auspices of Part II PDN.

Some modules will schedule extra seminars or workshops for PDN students. BBS students would not have to attend these, but would be informed of any papers to be discussed.

Minor subjects [15 places each]

Two of the eight Neuroscience modules are also offered as BBS minor subjects (106, 111). Major subject 415 may be taken with one of these minor subjects, provided that the student chooses 4 modules which are different to their minor subject.

106: Module N5 Neural Degeneration and Regeneration

111: Module N6 Central Mechanisms of Reward, Punishment and Emotion

Major subject 415 may also be taken with minor subject 128 (Bioinformatics), provided that the student chooses 4 modules which are different to their minor subject.

Module descriptions can be found from page 10 onwards.

Home Office Licences and Training Courses.

All laboratory experiments that involve any use of animals are strictly regulated by Act of Parliament (Animals (Scientific Procedures) Act 1986) and anyone who takes part in them must first have obtained a Personal Licence from the Home Office. Licences are issued only to applicants who have attended an accredited training course, passed a test on it and been awarded a certificate of competence. This course and test cover legal and ethical aspects of the use of animals in research, as well as the care and handling of animals in the laboratory.

Only those Part II students who will use animals in certain projects will require Personal Licences; this will only be a very small number of students. Importantly, it takes a long time for licence applications to be processed by the Home Office; therefore, student applicants have to sign the necessary form by June before going down for the Long Vacation. If you express an interest in a project that requires a Home Office Licence, the project supervisor will ask you to sign a Home Office form and to provide the personal information the Home Office requires, but licence applications will *only be processed for those who are successful in gaining a place on the course and are allocated to such a project*. Students requiring licences will be notified about this as soon as possible after places and projects are allocated.

Those who do require licences will have to attend and be tested on the obligatory Home Office Training Course (arrangements will be made in conjunction with the project supervisor). Additionally you will be required to attend University Occupational Health for an interview <u>before</u> undertaking this training course.

THE PDN COURSE MODULES

The themes to which individual modules belong are indicated as follows: (D) Development and Reproductive Biology, (P) Integrative Physiology, (N) Neuroscience.

Michaelmas Modules

Module N1: Developmental Neurobiology (D, N) *maximum of 80 students*

This module addresses how the nervous system is assembled during embryonic development. Although we now understand a considerable amount about the processes involved, many fascinating questions remain.

We begin by discussing the formation of the vertebrate neural tube (future brain and spinal cord), and how this is patterned to generate distinct neuronal and glial cell fates in different regions, including the cerebral cortex. We also consider the formation of the peripheral nervous system from the migratory neural crest and cranial neurogenic placodes.

Once neurons have formed, they extend axons to their targets to 'wire up' the nervous system: the process of axon guidance is considered in detail. We then explore how axons make and refine the synapses that will generate functional neural circuits, and discuss how circuit designs lead to function.

We end by considering nervous system evolution (‘evo-devo’).

This course is given by researchers in the Departments of PDN, Zoology and Paediatrics, the Gurdon Institute and the MRC Laboratory of Molecular Biology.

It is best suited for students who have studied some neurobiology in Part IB, either in MVST or in NST, but others will be able to take it if they are prepared to do some background reading.

Module organiser: Dr Clare Baker (cvhb1@cam.ac.uk)

Module N2: Molecular and Cellular Neuroscience (N) *maximum of 40 students*

While many approaches can be applied to analyses of nervous systems, it is obviously important for any mechanistic understanding to determine the cellular and synaptic properties underlying sensory, motor, and cognitive functions. The voltage-dependent ion channels that determine the resting and active properties of cells form a superfamily of at least 143 genes, with further diversity and functional variability resulting from alternative splicing, posttranslational modifications, and the plasticity of the varying combinations of subunits that form channels. This results in a massive range of potential cellular properties (e.g. adaptation, tonic spiking, bursting, post-inhibitory rebound, plateau potentials). At the synaptic level there is estimated to be in excess of 200 transmitter substances, each of which can differ in the mechanisms of their release and their effects. The independent or co-release of these transmitter substances can also result in interactive effects that cannot be predicted from knowledge of their individual effects in isolation.

This module provides a basis from which you can investigate various aspects of cellular and synaptic function. The lectures will cover voltage-dependent ion channels, oligodendrocytes and glial cells, ionotropic transmitter receptors including NMDA and AMPA-type glutamate receptors, Cys-loop receptors (e.g. nicotinic acetylcholine), G protein-coupled receptors, the influence of pH on neuronal function, the role of calcium in synaptic transmission and plasticity, and mechanisms of transmitter release and activity-dependent and neuromodulator-evoked plasticity. A knowledge of these effects is essential to understanding how signals are the processed by the nervous system, and will provide insight that can cross over to other neuroscience modules.

This module **cannot** be taken with Cellular Physiology (P1).

Module organiser: Dr David Parker (djp27@cam.ac.uk)

Module N4: Sensory Transduction (N)

The process of transduction within individual sensory receptors has consequences for, and imposes limits on, the perception of sensory events. Considerable advances have been made in recent years in elucidating the means by which primary sensory stimuli are transduced and processed. The module begins by examining the molecular mechanisms which enable vertebrate photoreceptors to respond with incredible sensitivity to individual photons of light, yet which also allow the cells to recover rapidly and to respond effectively at high light intensities. This will be followed by consideration of invertebrate phototransduction, which will include the ever-more-widespread roles of TRP channels which were originally discovered in this system. The modality then shifts to the chemical senses, to discuss transduction and coding in olfactory receptors, which share some fascinating features in common with phototransduction, as well as exhibiting some marked differences. The analysis of these chemosensory signals in the olfactory bulb is then explored. The focus then switches to mechanotransduction, especially the encoding of auditory information in both vertebrate and invertebrate species. These special senses will be contrasted with the molecular and cellular mechanisms responsible for the transduction of pain.

You are also likely to find the module on Central Mechanisms of Reward, Punishment and Emotion (N6) interesting and relevant.

This module **cannot** be taken with Fetal and Placental Physiology (P3)

Module organiser: Dr Hugh Matthews (hrm1@cam.ac.uk)

Module N7: Neural Circuits and Behaviour (N) *maximum of 40 students*

Connections between groups of neurons form circuits that generate specific outputs. These outputs have traditionally been related to the properties of the component cells and synapses, but there is growing awareness that other aspects could contribute, including glial cells and extracellular signals. These circuits form the middle ground in approaches to understanding the nervous system: they assemble the molecular and cellular components needed to process sensory inputs, perform cognitive functions, and pattern motor outputs. Insight into the organisation and function of these networks is essential to understanding nervous system function and behaviour. Gaining this understanding is considered to be the major problem facing neuroscience today, as evidenced by the major funding initiatives currently supporting research into this area (the EU Human Brain Project, and the BRAIN initiative in the United States).

This module will examine the principles of neural circuit function. It will use invertebrate, lower vertebrate, and mammalian model systems (cerebellum, hippocampus, and cortex) to illustrate the general principles of circuit function and our current understanding. The module will also introduce the molecular, anatomical, electrophysiological, imaging, and computational techniques used in network analyses.

The central role of neuronal networks means that this module provides general links to other modules that focus on molecular and cellular mechanisms (e.g. how do these properties influence higher functions?), or higher-level aspects of sensory, motor, or cognitive functions (e.g. what mechanisms underlie these effects?).

This module **cannot** be taken with Development: Patterning the Embryo (P4).

Module organiser: Dr David Parker (djp27@cam.ac.uk)

Module P1: Cellular Physiology (P) *maximum of 80 students*

Cells detect and respond to changes in their external environment through a cornucopia of signalling pathways. Many of the pathways involve complex biochemical reactions, but some are more amenable to study by the physiologist – in particular membrane potential, calcium and pH. Thus, in this module we look at cellular signalling from a Physiological viewpoint rather than 'stamp collecting' all of the signalling pathways. The three main signalling mechanisms we have selected here are used by both excitable and in-excitable cells to transmit information from the cell surface to effector systems. We start the module by looking at the basic ionic regulation mechanisms that allow signalling to exist. We then move to looking at the ion channels that allow calcium into cells. This is followed by a series of lectures on intracellular calcium signalling. The calcium signals also result in pH microdomains, which are also potential signals. We then focus on the membrane, and consider how ligands can result in potential changes and how these potential changes can be modified by signalling pathways. We end the series of lectures by bringing together membrane potential changes and calcium signalling with lectures on skeletal muscle and meta plasticity. The module contains a series of workshop/seminars on mathematical modelling, molecular techniques, fluorescence measurements and microelectrode techniques.

This module **cannot** be taken with Molecular and Cellular Neuroscience (N2) or Development: Patterning the Embryo (P4).

Module organiser: Dr Christof Schwiening (cjs30@cam.ac.uk)

Module P3: Fetal and Placental Physiology (D, P) *maximum of 80 students*

The study of the fetus and placenta is a unique aspect of physiology with relevance for basic and clinical sciences. This module will explore a wide range of topics, including the normal development of the fetus and placenta, adaptations to the intrauterine environment, responses to challenges *in utero*, mechanisms of parturition and the transition at birth. The scientific basis underlying the aetiology of miscarriage, preeclampsia and sudden infant death syndrome, and the consequences of prematurity, maternal diabetes and intrauterine growth retardation will be discussed. In addition, the course will give insight to current ideas on the developmental programming of health and disease.

This module **cannot** be taken with Sensory Transduction (N4).

Module organiser: Prof. Dino Giussani (dag26@cam.ac.uk)

Module P4: Development: Patterning the Embryo (D)

This course is the first of two complementary modules (with P6), which can also be taken on their own. Our aim is to explore a fundamental biological question: how does a single cell, the fertilized egg, have all the information to make an animal? Our current knowledge of the underlying molecular mechanisms that create cell diversity and pattern in the early embryo will be examined in depth. We will discuss how the experimental advantages of different model organisms have aided the discovery of the principles of development, and the insights provided by comparing the developmental strategies of vertebrates and invertebrates. In this first module we will address key aspects of early development, including how development is regulated, how the patterning of spatial information is established and how morphogenetic mechanisms shape the embryo. At each stage we will discuss the cellular mechanisms required and the molecular networks that drive them. By comparing the development of different animals we aim to come to an understanding of conserved strategies of animal development.

These themes will be covered from the establishment of polarity in the egg, and its elaboration after fertilisation, to a consideration of how these events set the body axes. We will then see how axial patterning directs the morphogenetic movements of gastrulation and the grouping of cells into segments with differing identities.

This interdepartmental course (with Zoology) will consist of three lectures per week.

This module **cannot** be taken with Neural Circuits and Behaviour (N7) or Cellular Physiology (P1).

Module organiser: Dr Richard Adams (rja46@cam.ac.uk)

Module P9: Cell Assembly and Interactions (D)

Cells are highly organised and dynamic structures. In this module we will explore how the architecture of the cell is constructed and how cells interact with each other and their environment in order to fulfil their myriad roles in animals. Our current knowledge of these vital topics will be presented in depth, with a focus on the molecular mechanisms that regulate cell behaviour. We will examine how cells use basic cell biological mechanisms in their complex activities within animals, including cellular behaviour during development and how cellular activities provide key physiological functions in the adult.

We will begin with a discussion of current ideas about of how cells were created during evolution, and how eucaryotic cells arose from procaryotes. We then address how membrane compartments are constructed, and the dynamics of transfer between them. Next we will discuss the key role of the cytoskeleton in cell shape, organization and movement. This is followed by an examination of how cells become polarized and adhere together to form higher order multicellular assemblies. We then study how cells sense and respond to the mechanical properties of their surroundings. Finally we look at long range signalling between cells by examining how cells integrate and respond to the diverse signals that arrive at their surface, exploring how the spatial organisation of intracellular signals has a profound influence on the nature of signalling.

This is an interdepartmental course (with Zoology). In addition to lectures there are several interactive sessions (such as journal clubs) in which there will be discussions of key papers, experimental techniques and major concepts in the field.

Module organisers: Dr Milka Sarris (ms543@cam.ac.uk)

Lent Modules

Module N5: Neural Degeneration and Regeneration (D, N, P)

Many diseases and injuries of the human brain and spinal cord are tragically resistant to treatment. This lecture module investigates the cellular and molecular causes of these conditions, the reasons why regeneration does not take place, and the research now under way to permit regeneration therapies in the future. We first consider how neural damage occurs due to acute ischaemic injury (stroke), a complex process that has implications for other forms of neural degeneration. We then look at chronic neurodegenerative diseases, including Alzheimer's, Huntington's and Pick's diseases, examining their origins in genetic and/or biochemical anomalies. Progress has also been made recently in revealing the molecular genetics underlying some forms of intellectual disability, including autistic spectrum diseases, and this topic is covered next. A subsequent course covers the rapidly developing field of neural stem cells, considering both the presence of stem cells able to generate new neurons in some parts of the adult brain, and the potential of stem cells from other sources. Serious lifelong disability can be caused by an injury that interrupts axon pathways, most prominently spinal cord injury. We look at the physiological and clinical aspects, why axon regeneration fails to occur, and how re-wiring can be promoted experimentally. Returning to neurodegenerative diseases, we look at the possibility of treatment by cellular grafting or other novel approaches, particularly in Parkinson's and Huntington's diseases. Glial cells are also vital, and are the focus of demyelinating diseases such as multiple sclerosis; so finally, we look at the degeneration and possible regeneration of glial cells.

The lecturers will all discuss research which could lead to new therapies, including development of molecular inhibitors, gene therapy, neural grafting, stem cells, and remyelination. This course is mostly given by researchers from the Clinical School, Vet School, Brain Repair Centre, and Stem Cell Institute.

Module organiser: Prof. Roger Keynes (rjk10@cam.ac.uk)

Module N6: Central Mechanisms of Reward, Punishment and Emotion (N)

maximum of 80 students

How does the brain process reward and punishment and how does this help us understand emotions and their dysregulation? Wolfram Schultz will discuss the varied functions of reward including learning, approach, positive emotion and economic decision making and how these functions are instantiated in neural circuits including dopamine, the striatum, amygdala, orbitofrontal and lateral prefrontal cortex. Further discussion on positive emotion by Jane Garrison will include the concept of anhedonia and the pathological mechanisms underlying a loss of pleasure. Fabian Grabenhorst will then consider whether this same reward circuitry underlies social behaviour and social cognition. Following on from this, Angela Roberts will describe the limbic and cortical mechanisms by which punishing stimuli impact on our motivations and emotions and inform our decision making. The range of strategies at our disposal for regulating our negative emotions will also be considered and how those strategies are implemented within interacting brain circuits. How, when and why these circuits become dysregulated in psychiatric disorders will be discussed by Hannah Clarke and the importance of understanding body-brain interactions in health and psychiatric disease considered by Golam Khandaker. Finally, Fionnuala Murphy will explore the interplay between cognition and emotion. By the end of the course you should have a better sense of one of the most exciting and active areas of brain research in this decade, that is at the heart of what the brain is all about.

Module organiser: Prof. Angela Roberts (acr4@cam.ac.uk)

Module N9: Neuronal Plasticity, Modulation and Behaviour (N) *maximum of 40 students*

A fascinating feature of the nervous system is neuronal plasticity: the ability for neurons and their connections to be modified in response to an ever-changing external or internal environment. Alongside neuronal plasticity, the modulatory effects of neurochemicals provide additional flexibility in the response repertoire of neurons. In the mature mammalian brain, neuronal plasticity and modulation enables complex neural networks to remain dynamic and adaptive.

Two key questions in modern neuroscience are: what are the mechanisms of neuronal plasticity, and how do neuronal plasticity and modulation contribute to behaviour? This module will focus on the second question, and will explore examples of plasticity and modulation in defined neuronal systems, ranging from endocrine modulation of hypothalamic circuits in the context of sexual maturation and behaviour, to the plasticity of neurons in brain reward pathways and how this is hijacked by drugs of abuse, and the developmental plasticity of cortical networks, with reference to developmental disorders. Contemporary as well as traditional research methods for investigating neuronal plasticity and modulation will be considered, including opto- and chemogenetic approaches, imaging and electrophysiology. As part of this module, students will work in small groups to prepare a short critical review and a powerpoint presentation of a research paper.

This module would work very well in combination with any of Modules N2, N4, N6 and N7, although none are essential. The first lecture will include an introduction to different forms of cellular and synaptic plasticity and modulation.

This module **cannot** be taken with Systems and Clinical Physiology (P8)

Module organiser: Dr Sue Jones (sj251@cam.ac.uk)

Module P2: Development and Stem Cells: Embryonic and Extra-embryonic Tissues (D, P)

maximum of 40 students

The transformation of a fertilised egg into an embryo encompasses a series of fundamental cellular events that culminate in the divergence of the embryonic and extra-embryonic cell lineages. During this process the initial totipotent egg generates cells that, progressively become restricted to different fates. The first differentiation event is a separation between extra-embryonic trophectoderm and the pluripotent embryonic inner cell mass, and the second, within the inner cell mass, between the embryonic epiblast and the extra-embryonic primitive endoderm. In this module we will explore how these cell fate decisions are taken and what transcriptional networks and epigenetic modifications reinforce them. We will also consider subsequent functions of the extra-embryonic lineages, and how interactions between the trophectoderm and the maternal tissues lead to implantation and establishment of a successful pregnancy.

The module will start by examining the development of cell polarisation and the effects of subsequent symmetrical and asymmetrical cell division and cell position in creating unique cell populations. The subsequent differentiation of the inner cell mass, the concept of embryonic stem cells and their therapeutic potential in regenerative medicine will then be explored, with comparisons being made between the mouse and human.

We will then investigate how the extra-embryonic lineages interact with the maternal tissues to establish a human pregnancy. This will include consideration of endometrial receptivity, implantation, decidualisation and the factors that regulate trophoblast invasion, including interactions with the maternal immune system, and the role of oxygen and cytokines. The role of the extravillous trophectoderm in spiral arterial remodelling, and establishing the maternal circulation to the placenta will be considered. Correlates will be drawn between normal pregnancies and the common complications, including miscarriage and preeclampsia, in which trophoblast invasion is impaired.

The module will involve a mix of lectures, journal clubs and interactive sessions.

Useful combination modules include: P3 Fetal and placental physiology (M), P4 Development: Patterning the embryo (M), P6 Development: Cell differentiation and organogenesis (L).

Module organisers: Prof. Graham Burton (gjb2@cam.ac.uk) and Prof. Magda Zernicka-Goetz (mz205@cam.ac.uk)

Module P5: Bioinformatics (P) *maximum of 25 students*

This course *(run by the Department of Genetics)* provides an introduction to the field of complex disease genetics and the recent advances made in this field since the introduction of high-throughput sequencing (HTS) technologies.

We will first introduce fundamental concepts in genomics and bioinformatics and then how HTS technologies can be applied to the study of human population genetics, genomics and its clinical applications. Fundamental statistical concepts that are crucial for designing a population study and are required to carry out statistical analysis of genomic data will be covered.

Then we will focus on functional analysis at the genomic level. Strategies for the identification of genomic variants using HTS will be explored, providing an introduction to the basic workflows for variant identification. Emphasis will be put on variants' annotation to infer a variant's biological relevance and consequently its potential diagnostic and therapeutic value. The challenges associated with the analysis and interpretation of genomic variants will be discussed. We will also introduce relevant public databases and the outcomes of large sequencing projects, which have provided new insights into the landscape of functional variation and genetic association.

Students will also learn about network analysis and how this approach is used to acquire a functional understanding of the deregulation of signalling networks in diseases. In addition, drug developments based on the knowledge acquired through genomics approaches will be discussed as well as fundamental principles of phylogenetic analysis, structural bioinformatics and deep learning.

The course consists of 14 lectures and 9 computer-based practical sessions. During the practical sessions, students will use the Unix command-line environment and the R project for statistical computing to gain practical experience of the pipelines for variant calling, RNA-seq and network analysis.

Additional information is available at: https://bioinfotraining.bio.cam.ac.uk/undergraduate

Module organiser: Dr Gabriella Rustici (gr231@cam.ac.uk)

Module P6: Development: Cell Differentiation and Organogenesis (D)

This course is the second of two complementary Developmental Biology modules (with P4) that can also be taken on their own. This module examines a second phase of embryonic development, following the initial steps of defining axes, major cell layers, and broad pattern domains (covered in P4).

A series of topics will be presented, each using particular tissues or organs to highlight individual developmental mechanisms. Thus, the generation of airways and vasculature addresses principles of tubulogenesis; vertebral column and lung illuminate mechanisms of cell allocation and morphogenesis; limb development illustrates how patterning mechanisms are coordinated with cell proliferation; the progressive determination of cell lineages and establishment of stem cells shows how organs are derived; and the development of pharyngeal arches, neural crest cells and craniofacial organizing centres demonstrates how epithelial-mesenchymal interactions instruct cell differentiation and patterning in the head.

A mixture of examples from simpler invertebrate models and vertebrates will show how developmental mechanisms have diversified with increasing cell number.

This interdepartmental course (with Zoology) will consist of three lectures per week, and seven interactive sessions (such as journal clubs) in which we will aim to discuss key references and the concepts presented in the lectures.

Module organiser: Prof. Nick Brown (nb117@cam.ac.uk)

Module P7: Pathophysiology of Cancer (D, P) *maximum of 40 students*

We will examine cancer and malignant progression of solid tumours as examples of how to integrate a physiological approach to disease; giving consideration to modern genetic tools and techniques as well as to the unique physiological challenges of malignancy. We will also discuss how this impacts therapeutic choices and drug development. Consideration will be given to how research on pathophysiology is influenced by modern understandings of systems biology and physiology. The course will include lectures and journal club discussions of selected relevant articles. The course is suited to both NST and MVST students.

Module organiser: Prof. Randall Johnson (rsj33@cam.ac.uk)

Module P8: Systems and Clinical Physiology (P) *maximum of 80 students*

Systems physiology is central to the practice of scientific medicine. The idea behind this module is to give you a more detailed view of some aspects of systems physiology and to include some clinically oriented material that is of particular importance to the practising doctor. Cardiovascular topics include cardiac arrhythmias, the genetics and energetics of heart failure and a look at the pulmonary circulation from a clinical viewpoint. Renal physiology includes autoregulation, osmoregulation and acute and chronic renal failure. Several areas of endocrine physiology are explored in the form of pancreatic islet and gut hormones, brain control of food intake, the ever increasing problem of diabetes mellitus and the physiology and pathophysiology of bone.

The lecturers giving this course are from the Department of Medicine and the Institute of Metabolic Science as well as PDN.

This module **cannot** be taken with Neuronal Plasticity, Modulation and Behaviour (N9)

Module organiser: Dr Stewart Sage (sos10@cam.ac.uk)

Common courses

There are some skills, which we think that everyone doing Part II PDN needs to acquire, regardless of their area of specialisation. For this reason, a number of teaching sessions open to all PDN students are offered.

Some of these sessions will be held during the orientation day before lectures begin and others will be held during the year.

Topics to be included:

- *Reading and evaluating a scientific paper*
- *How to write a Part II essay*
- *Reference Management*
- *Statistics and data analysis*
- *How to tackle experimental design questions*
- *Project write-up guidance/Preparing a poster presentation*
- *Preparing a BBS dissertation*
- *Information regarding the Part II PDN Examination*

Some topics of last year's research projects	Supervisor
Two-term Experimental Projects	
The role of insulin-like growth factor 2 in placental endocrine regulation of the maternal metabolic profile	Amanda Sferruzzi-Perri
Development of a mitochondrial respiration protocol for permeabilised peripheral blood mononuclear cells (PBMCs) and comparison to Soleus muscle in hypoxia	Andrew Murray
Characterising the connectivity of the subgenual cingulate Cortex (Area 25) using neuronal tracers in the common marmoset monkey	Angela Roberts/Laith Alexander
Characterisation of the transgenic zebrafish retinal model of the P301L mutation in Tau	Angie Fleming/Ana Lopez-Ramirez
The effect of Ribosomal protein S4X knockdown on axon maintenance	Bill Harris
The Spectacle of Dissection: the visuospatial features of a dissection lesson	Cecilia Brassett/Annja Neumann
A cadaveric dissection study of the soft tissues of the knee surrounding the patella in extension	Cecilia Brassett/Jai Chitnavis/Ceri Davies
Can the morphology of the duodenal papilla predict the ease and extent of endoscopic sphincterotomy	Cecilia Brassett/Jonathan Brown
What is an 'Average' Chin?	Cecilia Brassett/Vijay Santhanam
Characterizing the molecular basis of arrhythmic substrate in an ageing murine model of mitochondrial dysfunction	Chris Huang
Can central and peripheral adaptations to sweating be independently trained?	Christof Schwiening
How closely related are electroreceptors and hair cells? Investigating the expression in paddlefish electrosensory organs of genes important for hearing	Clare Baker
Side effects of antenatal glucocorticoids in the chick embryo	Dino Giussani/Kim Botting
The role of thyroid hormones in regulating changes in skeletal muscle fibre type during ovine fetal development	Emily Camm/Abby Fowden
Assessing genetic stability in a mouse model of abnormal folate metabolism	Erica Watson
Investigating the role of focal adhesion kinase in regulating intestinal stem cell proliferation in Drosophila	Golnar Kolahgar
Can placental endocrine dysregulation modulate maternal hepatic function?	Hong wa Yung/Graham Burton
Modelling Ca feedback mechanisms in light adaptation in vertebrate cone photoreceptors	Hugh Matthews
Investigating the effects of Ca^{2+} manipulation by Epac activation on Na^{+} current activation in murine skeletal muscle	Hugh Matthews/Chris Huang
Effect of cholinergic signalling on motility and aggregation of small cell lung cancer (SCLC) cells	Hugh Robinson
A novel method for detecting arrhythmia? Testing ECG signal complexity analysis on sinus rhythm ECGs	James Fraser
Analysis of microglial activation in an R6/2 mouse model of Huntington's disease	Jenny Morton/Michelle Ware
Effects of sleep restriction on cognitive function in the Hdh knock-in mouse model of Huntington's Disease	Jenny Morton/Nigel Wood
How and when does the mesendoderm segregate into separate lineages in gastruloids and how does this compare to murine development *in vivo*?	Jenny Nichols/Peter Baillie-Johnson
Which forces govern neuronal growth?	Kristian Franze
Generating an in vitro model of the post-implantation human epiblast	Magda Zernicka-Goetz/Marta Shahbazi
Clinical vestibular anatomy investigated with micro-computed tomography and 3D reconstruction	Matthew Mason/Cecilia Brassett
Mechanisms of cross-interactions between Netrin-1 and Ephrin-A1 in *Xenopus* retinal ganglion cell axons	Max Koppers/Christine Holt
Investigating the relationship between spontaneous action potential firing and calcium spiking in a model of pancreatic neuroendocrine tumours	Michael Mason/Christof Schwiening/Hugh Robinson
Spatial and temporal signal processing during leukocyte chemotaxis in vivo	Milka Sarris/Antonis Georgantzoglou
Using online databases to investigate Drosophila melanogaster ligases and their human orthologues	Nick Brown/Steven Marygold

Moving in the right direction: what parameters of visual information determine the initial flight direction of a killer fly take-off	Paloma Gonzalez-Bellido
Ca(2+)-dependence of heterologously expressed TRPL channels	Roger Hardie
Characterising axon contact repulsion at the posterior half-somite and in the mature central nervous system	Roger Keynes/Geoff Cook
Do marine mollusc nerve cells express proton channels?	Roger Thomas/Christof Schwiening
An investigation into the tumour suppressor role of Cables1/2 using a Drosophila Melanogaster model	Sara Morais da Silva/Sarah Bray
Exploring the role and localisation of PDCD4 in Drosophila	Sarah Bray/Maria Gomez-Lamarca
Exploring glycogen cell function in the mouse placenta	Simon Tunster
Conscious action as a driver of an unconscious blink response	Steve Edgley
Investigating mechanisms by which fibrinogen inhibits thrombin-evoked platelet activation	Stewart Sage
Investigating hippocampal asymmetry; a novel assessment of hippocampal volumes with Micro CT scanning	Sue Jones/Matthew Mason/Ole Paulsen
Graph theory for comparing cortical network development and dysfunction in Rett Syndrome	Susanna Mierau/Ole Paulsen
Does Cystathionine-gamma-lyase (CSE) knock-out lead to endoplasmic reticulum stress and oxidative stress in the placenta?	Tereza Cindrova-Davies
Spectral Sensitivity of Photoreceptors in Drosophila	Trevor Wardill/Paloma Gonzalez-Bellido
Not Dropping the Ball on DropSeq: Potential methods of improving mRNA capture efficiency	Wendi Bacon
Developing a first-price auction in monkeys	Wolfram Schultz
Two-term Theory Projects	
What are the evolutionary adaptations to bipedalism, and do they have clinical impacts in modern humans?	David Bainbridge
To what extent is prenatal androgen exposure a causative factor of male homosexuality in humans?	David Bainbridge
BBS Dissertations	
Is there a role for placental endocrine malfunction in pregnancy complications?	Amanda Sferruzzi-Perri
Ketone bodies and the heart: a magic bullet for cardiovascular disease?	Andrew Murray
How does leptin modulate the reproductive axis?	Bill Colledge
Metastatic dormancy in breast cancer	Cristina Branco
Should we still use electroconvulsive therapy?	David Bainbridge
Using lessons from neurobiology to design a biologically realistic model of cognition	David Parker
How sensory input causes synaptic changes in spinal and cortical circuits	David Parker
Does aberrant glycosylation play a role in the aetiology of pre-eclampsia?	Graham Burton
The invasiveness of glioblastoma	Hugh Robinson
How did the BMA's approach to ethical practice change during the 1960s with reference to its statements on homosexuality – an area of law reform at this time?	Martin Johnson
The Warburg Effect: current and future techniques to address aberrant glucose metabolism in the prevention and treatment of cancer	Randall Johnson
Can optogenetics be used in the treatment of epilepsy?	Steve Edgley
Hypovolaemic thirst	Stewart Sage
Is Deep Brain Stimulation a suitable alternative to drug therapy in Alzheimer's disease?	Sue Jones

Recent published papers resulting from or including work from Part II projects include (with student's name in bold):-

Ashmore, T., Fernandez, B.O. Evans, C.E., **Huang, Y.**, Branco-Price, C., Griffin, J.L. Johnson, R.S., Feelisch, M. & Murray, A.J. (2015). Suppression of erythropoiesis by dietary nitrate. *FASEB J.*, **29(3)**, 1102.1112.

Burford, C. (2015). Putting the handle back on the hammer: ossicle development in Professor Boyd's embryos. Presented at the Anatomical Society Winter Meeting, December 2015.

Burford, C.M. & Mason, M.J. (2016). Early development of the malleus and incus in humans. *Journal of Anatomy*, **229**, 857-870.

Chadda, K.R., Ahmad, S., Valli, H., den Uiji, I., **Al-Hadithi, A.B.**, Salvage, S.C., Grace, A.A., Huang, C.L. & Jeevaratnam, K. (2017). The effects of ageing and adrenergic challenge on electrocardiographic phenotypes in a murine model of long QT syndrome type 3. *Scientific Reports*, **7**, 11070.

Choo, A., Wong, E., Townend, R., Brown, J. & Brassett, C. (2017). Anatomical investigation of the ileocaecal junction in cadaveric speciments. *Journal of Anatomy* (in press).

Cunniffe, N., **Munby, H.**, **Chan, S.**, Saatci, D., Edison, E., Carpenter, R.H.S. & Massey, D. (2015) Using saccades to diagnose covert hepatic encephalopathy. *Metabolic Brain Disease*, **30(3)**, 821-828.

De Blasio, M.J., Boije, M., **Bernstein, B., Davies, K.L., Plein, A.**, Kempster, S.L., Smith, G.C.S., Charnock-Jones, D.S., Blance, D., Wooding, F.B.P., Giussani, D.A., Fowden, A.L. & Forhead, A.J. (2015). Developmental expression and glucocorticoid control of the leptin receptor in fetal lung. *PLoS One*, **10(8)**, e0136115.

De Blasio, M.J., Boije, M., Kempster, S.L., Smith, G.C.S., Charnock-Jones, D.S., **Denyer, A., Hughes, A.**, Wooding, F.B.P., Blance, D., Fowden, A.L. & Forhead, A.J. (2016). Leptin matures aspects of lung structure and function in the ovine fetus. *Endocrinology*, **157**, 395-404.

Horscroft, J.A., **Burgess, S.L.**, Hu, Y. & Murray, A.J. (2015). Altered oxygen utilisation in rat left ventricle and soleus after 14 days, but not 2 days, of environmental hypoxia. *PLoS One*, Sep 21, **10(9)**, e0138564.

Hughes, A.E., **Fawcett, M.** & Tolhurst, D.J. (2016). Speed judgement measurements for synamic target patterning in human observers. *Perception*, **45**, 355.

Hughes, A.E., **Jones, C., Joshi, K.** & Tolhurst, D.J. (2017). Diverted by dazzle: perceived movement direction is biased by target pattern orientation. *Proceedings of the Royal Society B*, **284(1850)**, 20170015.

Hughes, A., **Southwell, R.V.**, Gilchrist, I.D. & Tolhurst, D.J. (2016). Quantifying peripheral and foveal perceived differences in natural image patches to predict visual search performance. *Journal of Vision*, **16(10)**, 1-17.

Hughes, A., **Vaughan, S.** & Tolhurst, D.J. (2016). Visual crowding in natural images is affected by perceptual grouping of flankers. *Perception*, **45** (Suppl), 153.

Hwa-Yeo, S., Kyle, V.R., Morris, P.G., Jackman, S., **Sinnett-Smith, L.**, Schacker, M., Chen, C. & Colledge, W.H. (2016). Visualization of *Kiss1* neuron distribution using a Kiss1-CRE transgenic mouse. *Journal of Neuroendocrinology*, **28(11)**: 10.1111/jne.12435

Kapur, M., Shah, R., Ferro, A., Basyuni, S., Brassett, C. & Santhanam, V. (2017). Sexual dimorphism and ethnic variance: their impact on the reliability of the antilingula as a landmark in human mandibular surgery. *Journal of Anatomy* (in press).

Kirwan, P., Turner-Bridger, B., Peter, M., Momoh, A., **Arambepola, D.**, Robinson, H.P.C. & Livesey, F.J. (2015). Development and function of human cerebral cortex neural networks from pluripotent stem cells in vitro. *Development*, **142**, 3178-3187.

Lam, J., Wilkinson, J.T., Brassett, C & Brown, J. (2016). Analysis of looping patterns in colonoscopy using scopeguide; Their relation to completion times and configurations in cadaveric colons. *Gut*, **65 (Suppl 1)**, A230-A231.

Lam, J., Wilkinson, J.T., Brassett, C. & Brown, J. (2017). Difference in real time magnetic image analysis of colonic looping patterns between males and females undergoing diagnostic colonoscopy. *Endoscopy International Open* (in press).

Lam, J., Wilkinson, J.T., Brown, J., Spear, M. & Brassett, C. (2016). Configurations of colonic segments in undisturbed cadaveric abdomens and the implications for difficulties encountered in colonoscopy. *Journal of Anatomy*, **230(1)**, 195.

Lever, R.A., **Hussain, A.**, Sun, B.B., Sage, S.O. & Harper, A.G.S. (2015). Conventional protein kinase C isoforms differentially regulate ADP- and thrombin-evoked Ca^{2+} signalling in human platelets. *Cell Calcium*, **58**, 577-588.

Li, M., Hothi, S.S., Salvage, S.C., Jeevaratnam, K., Grace, A.A. & Huang, C.L. (2017). Arrhythmic effects of Epac-mediated ryanodine receptor activation in Langendorff-perfused murine hearts are associated with reduce conduction velocity. *Clinical and Experimental Pharmacology and Physiology*, **44**, 686-692.

Littlechild, R., **Zaidman, N.**, **Khodaverdi, D.** & Mason, M.J. (2015). Inhibition of KCa3.1 by depolarisation and 2-aminoethoxydiphenylborate (2-APB) during Ca^{2+} release activated Ca^{2+} (CRAC) entry in human erythroleukemia (HEL) cells: Implications for the interpretation of 2-APB inhibition of CRAC entry. *Cell Calcium*, **57(2)**, 76-88.

Lu, L., Kingdom, J., Burton, G.J. & Cindrova-Davies, T. (2017). Placental stem villus arterial remodelling associated with reduced hydrogen sulphide synthesis contributes to human fetal growth restriction. *American Journal of Pathology*, **187**, 908-920.

Maartens, A.P., Wellman, J., **Wictome, E.**, Klapholz, B., Green, H. & Brown, N.H. (2016). Drosophila vinculin is more harmful when hyperactive than absent, and can circumvent integrin to form adhesion complexes. *Journal of Cell Science*, **129(23)**, 4354-4365.

McClelland, T.J. & Parker, D. (2017). Inverse modulation of motor neuron cellular and synaptic properties can maintain the same motor output. *Neuroscience*, **360**, 28-38.

Matheson, H., Veerbeek, J.H.W., Charnock-Jones, D.S., Burton, G.J. & Yung, H.W. (2016). Morphological and molecular changes in the murine placenta exposed to normobaric hypoxia throughout pregnancy. *The Journal of Physiology*, **594.5**, 1371-1388.

Padmanabhan, N., Rakoczy, J., **Kondratowicz, M.**, Menelaou, K., Blake, G.E.T. & Watson, E.D. (2017). Multigenerational analysis of sex-specific phenotypic differences at midgestation caused by abnormal folate metabolism. *Environmental Epigenetics*, **3(4)**, 1-17.

Roweth, H.G., **Yan, R., Bedwani, N.H., Chauhan, A., Fowler, N., Watson, A.H.**, Malcor, J-D., Sage, S.O. & Jarvis, G.E. (2018). Citalopram inhibits platelet function independently of SERT-mediated 5-HT transport. *Scientific Reports*, **8(1)**, 3494.

Salvage, S.C., King, J.H., Chandrasekharan, K.H., **Jafferji, D.I.**, Guzadhur, L., Matthews, H.R., Huang, C.L-H. & Fraser, J.A. (2015). Flecainide exerts paradoxical effects on sodium currents and atrial arrhythmia in murine RyR2-P2328S hearts. *Acta Physiol (Oxf)*, **214(3)**, 361-375.

Salvage, S.C., **Chandrasekharan, K.H.**, Jeevaratnam, K., Dulhunty, A.F., Thompson, A.J., Jackson, A.P. & Huang, C.L. (2017). Multiple targets for flecainide action: implications for cardiac arrhythmogenesis. *British Journal of Pharmacology*, (in press).

Schofield, P.N. & **Kondratowicz, M.** (2017). Evolving paradigms for the biological response to low dose ionizing radiation; the role of epigenetics. *International Journal of Radiation Biology*, 1-13.

Scott, R., Sewart, E.R., Spear, M. & Brassett, C. (2016). Critical evaluation of the depiction of abdominopelvic viscera in the anatomical works of Leonardo da Vinci and Andreas Vesalius. *Journal of Anatomy*, **230(1)**, 170.

Sewart, E.R., Scott, R., Spear, M. & Brassett, C. (2016). Comparative analysis of methodologies employed by Leonardo da Vinci and Andreas Vesalius in their studies of craniospinal anatomy. *Journal of Anatomy*, **230(1)**, 183.

Shah, R., Kapur, M., Ferro, A., Basyuni, S., Brassett, C. & Santhanam, V. (2017). Using the antilingula to avoid inferior alveolar nerve damage during orthognathic surgery. *Clinical Anatomy* (in press).

Stewart, M., Abood, A. & Brassett, C. (2017). Investigating the 'Box Junction' – A novel assessment of neurovascular anatomy in the anterolateral thigh flap. *Clinical Anatomy* (in press).

Terry, I.L., Brassett, C. & Chitnavis, J. (2016). Clinical and magnetic resonance imaging (MRI) correlations in patients with symptomatic meniscal tears of the knee. *Clinical Anatomy*, **30(8)**, 1115.

Valli, H., Ahmad, S., **Jiang, A.Y.**, Smyth, R., Jeevaratnam, K., Matthews, H.R. & Huang, C.L. (2017). Cardiomyocyte ionic currents in intact young and aged murine Pgc-1β-/- atrial preparations. *Mechanims of Ageing and Development*, **169**, 1-9.

Valli, H., Ahmad, S., **Sriharan, S.**, **Dean, L.D.**, Grace, A.A., Jeevaratnam, K., Matthews, H.R. & Huang, C.L. (2017). Epac-induced ryanodine receptor type 2 activation inhibits sodium currents in atrial and ventricular murine cardiomyocytes. *Clinical and Experimental Pharmacology and Physiology* (in press).

Vaughan, O.R., **Fisher, H.M.**, **Dionelis, K.N.**, **Jeffreys, E.L.C.**, Higgins, J.S., Musial, B., Sferruzzi-Perri, A.N. & Fowden, A.L. (2015). Corticosterone alters materno-fetal glucose partitioning and insulin signalling in pregnant mice. *Journal of Physiology*, **593(5)**, 1307-1321.

Vaughan, O.R., **Phillips, H.M.**, **Everden, A.J.**, Sferruzzi-Perri, A.N. & Fowden, A.L. (2015). Dexamethasone treatment of pregnant F0 mice leads to parent origin-specific changes in placental function of the F2 generation. *Reproduction, Fertility and Development*, **27(4)**, 704-711.

Webb, S.A., Brassett, C. & Chitnavis, J. (2016). MRI and clinical patterns in adults with symptomatic meniscal tears necessitating knee surgery. *Journal of Anatomy*, **231**, 448.

Wild, A.R., **Bollands, M.**, Morris, P.G. & Jones, S. (2015). Mechanisms regulating spill-over of synaptic glutamate to extrasynaptic NMDA receptors in substantia nigra dopaminergic neurons. *European Journal of Neuroscience*, **42**, 2633-2643.

Wilkinson, J.T., Lam, J., Brown, J., Spear, M. & Brassett, C. (2016). Real-time analysis of the frequency distributions of looping patterns of the colon during colonoscopy. *Journal of Anatomy*, **230(1)**, 170..

Wong, E., Choo, A., Townend, R., Brown, J. & Brassett, C. (2017). Clinical significance of structural variation in the ileocaecal valve. *Clinical Anatomy* (in press).

PROVISIONAL PART II PDN TIMETABLE 2018/19

Neuro modules that are shared with Part II Psychology, Neuroscience and Behaviour are shown in bold.

MICH.	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
9.00	**N1. Dev. neuro**		**N2. Mole. cell** P1. Cell. physiol.	**N1. Dev. neuro**	**N2. Mole. cell**
10.00	**N2. Mole. cell**	P1. Cell. physiol.	**N4. Sensory transduction**	**N4. Sensory transduction** P3. Fetal and placental	**N1. Dev. neuro**
11.00	P1. Cell. physiol. P4/M8. Devel: Patterning	**N7. Neural circuits**	**N7. Neural circuits**		**N7. Neural circuits** P4/M8. Devel: Patterning
12.00	**N4. Sensory transduction** P3. Fetal and placental	P4/M8. Devel: Patterning			P3. Fetal and placental
2.00				P9 Journal Club 2 - 4	*N4. Sensory transduction*
3.00			Expt approaches to brain res 3 - 5	Expt approaches to brain res	
4.00	P9. Cell assembly & interactions Adrian Seminar in Neuroscience		P9. Cell assembly & interactions	Foster Club Talk	P9. Cell assembly & interactions

LENT	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
9.00	**N5. Neural degen & regen**		**N5. Neural degen & regen**	**N5. Neural degen & regen**	**N7. Neuronal plasticity**
10.00	P7. Pathophys of cancer		**N7. Neuronal plasticity**	**N6. Central mechanisms**	P7. Pathophys of cancer
11.00	**N7. Neuronal plasticity** P8. Systems & clinical	**N6. Central mechanisms**	P8. Systems & clinical	*P2. Devel & Stem Cells (some sessions)*	P8. Systems & clinical
12.00	**N6. Central mechanisms**	P2. Devel & Stem Cells	P2. Devel & Stem Cells	P2. Devel & Stem Cells	
2.00	P6. Devel: Cells & organs	P6. Devel: Cells & organs 2 - 4	P6. Devel: Cells & organs	P7. Pathophys of cancer	P6. Devel: Cells & organs
3.00	P5. Bioinformatics	Expt approaches to brain res 3 - 5	Expt approaches to brain res		
4.00	Adrian Seminar in Neuroscience	P5. Bioinformatics		P5. Bioinformatics Foster Club Talk	

Applicants for Part II Physiology, Development and Neuroscience MUST submit an application to the Department AND apply via CamSIS. Application forms are available on the Department web site: http://www.pdn.cam.ac.uk