

IMPERIAL

NEUROSCIENCE AND MENTAL HEALTH BSc

Course Director: Prof Magdalena Sastre
Course Administrator: Miss Olive Thomas

Learning Outcomes:

1. Demonstrate an understanding of the role of different cell types in the nervous system and potential therapeutic applications such as stem cell therapy.
2. Demonstrate an understanding of the disease mechanisms underlying neurodegenerative disorders (such as Alzheimer's disease, Parkinson's disease, Multiple Sclerosis and Motor Neuron Disease) and psychiatric conditions (such as schizophrenia, bipolar disorder and autism), based on a multidisciplinary approach (genetics, neuropathology, cell biology and imaging).
3. Appraise current therapies and novel experimental approaches for treatment of neurological and neuropsychiatric disorders.
4. Demonstrate an understanding of the basis for both Substance misuse and addiction and behavioural addictions such as problem gambling and be familiar with different therapeutic approaches used in addiction such as pharmacological interventions and cognitive behavioural therapy.
5. Demonstrate an understanding of the psychopathology of affective disorders and current models of underlying mechanisms (molecular, cognitive, psychological).
6. Demonstrate an understanding of the psychopathology of mood instability and self-harm behaviour within a lifespan perspective, and be familiar with public health implications, current challenges in detection, measurement and available interventions.

The course is made up of:

Module 1: Three taught courses/blocks (3 X 4 weeks; 3 weeks of teaching followed by a consolidation week)

Module Leads: Dr Alexi Nott (Block 1), Prof Magdalena Sastre (Block 2) & Prof Dasha Nicholls (Block 3).

Module 2: Self-directed learning (5 weeks):

Module Leads: Dr Marco Brancaccio (Group literature review) & Dr Chris Butler (Science in Context Clinical case report).

Module 3: Research Project (14 weeks) Types of projects: clinical/lab based/data analysis

Module Lead: Dr Sam Barnes.

MODULE 1, Block 1: Cellular & Developmental Neurobiology

Topics include:

Block 1: Cellular and developmental neuroscience: from molecules to circuits

Module Leader: Dr Alexi Nott

Aims

This module aims to give insight into the molecular and cellular basis of nervous system development, circuitry and functioning, with prominence given to the clinical consequences of dysfunction and potential treatment strategies. The cells of the nervous system and their complex interrelationships is a particular theme, as is the problem of central nervous system regeneration, clues to repair strategies found in development, and the neuronal circuitry controlling systems such as pain, sleep and coordination of movement. This module also includes disorders of white matter/axonal damage, such as TBI, SCI, MS and ALS and brain tumours.

Content

The module starts with the cellular organisation and development of the nervous system. Here, after looking at the molecular basis of neural tube development, the development, interrelationships and function of neurons, astrocytes, oligodendrocytes, Schwann cells and microglia in health and disease will be examined, ending with a snapshot of some key laboratory techniques in neurobiology research, such as optogenetics. There will be a section on nervous system regeneration, the reason why this is problematic in the CNS, and practical strategies for CNS repair such as cell replacement therapies, biomaterial scaffolds, and targeted antibody therapeutics. In the next sessions, students will have an overview on computational neuroscience and finally there will be several lectures on Brain tumours. This module also includes disorders of white matter/axonal damage, such as TBI, SCI, MS and ALS, investigating both the clinical characteristics and preclinical research (animal models). The block includes extensive interactive tutorials on interpretation of papers, including journal club presentations.

Assessment: ICA1: Written Task: Commentary on a research article with the format of a BRAIN commentary; 1000 words max. The students will run a formative assessment.

Block 2: Disorders of the CNS

Module Leader: Prof Magdalena Sastre

Aims

This aim of this module is to provide a comprehensive review of the aetiology and pathogenesis of cerebral disorders which present clinically with neurological disorders. The clinical features will be reviewed followed by sessions detailing our current understanding of the neural basis of these disorders, which will include findings from genetics, molecular biology, neurochemistry, neuropathology and neuroimaging. In addition, animal models used for research for the majority of these disorders will be reviewed.

The module will draw on the broad knowledge gained in the earlier block of the neuroscience pathway, instil a sound knowledge of the biological basis of CNS diseases and provide an invaluable insight into current research strategies and the rationale for future therapeutic interventions.

Content

In this module, the aim will be to take a detailed look at some of the common, and not so common, diseases that affect the central nervous system. Common neurological conditions covered will be Stroke, Epilepsy, Alzheimer's disease and other dementias, prion disease, infections of the CNS, Huntington disease and Parkinson's disease.

There will be a Brain bank practical and a lab practical, which will include the staining of brain section from neurology patients. To complement the assessment of the images, sessions on statistics and image and data analysis are part of the module.

Assessment: ICA-2: Data analysis of the results obtained in the practical/ 1500 words results compendium / Scientific abstract / Lay abstract. The students will run a formative assessment

Block 3: Psychiatry and Mental Health

Module Leader: Prof. Dasha Nicholls

Aims

This three-week module aims to provide students with a basic foundation in the current understanding of the biological underpinnings of normal mental processes, and how they go wrong – in psychosis, affective disorder, personality disorder, eating disorders and addictions. It will cover aetiology, epidemiology, and treatment – both pharmacological and psychological.

Content

This block will describe how techniques used to examine the aetiology of neurological disorders have been applied in the context of mental health.

In week one of the course there will be a general overview of the module including an introduction to how to perform systematic reviews in Mental Health, how to perform TBL and an introduction to drug addictions and self-harm behaviour.

Week two will focus on neuroimaging and psychopharmacology and how to apply them for psychiatric disorders including depression and drug addiction.

In week three we will describe eating disorders, anxiety disorder, adolescent mental health, the aetiology of addictive behaviour (drug and alcohol misuse, policies and also gambling), and find out how our understanding of the biological basis of addiction and the psychological and social factors which lead to misuse of alcohol and drugs is shaping the development of treatments for these problems. There will also be a discussion of how research into psychedelic drugs may help us to understand the nature of consciousness.

After taking the module the student will

- Have an understanding of the aetiology and epidemiology of different psychiatric disorders and substance misuse problems.
- Have developed an understanding of how biological, psychological and social factors interact to increase the likelihood of mental disorders
- Understand how neurochemical, functional and structural imaging have led to advances in understanding the aetiology of psychoses and drug addiction

- Have an understanding of the main interventions and treatment options for people with anxiety, eating disorders, personality disorder and drug addiction
- Be able to critically appraise studies which examine the effectiveness of treatments for mental disorders including clinical trials and systematic reviews

Specific skills

- Be able to critically appraise research aimed at examining the efficacy of interventions and treatments such as randomised trials and systematic reviews.
- Have the skills required to identify and synthesis findings from previously published studies examining the efficacy of pharmacological and psychological treatments.
- Be aware of ethical dilemmas associated with clinical research.
- Have a basic understanding of how to formulate psychological problems using cognitive and systems approaches.

In-course assessment: ICA3: Oral presentation. PowerPoint presentation on planning a project based on a paper. The students will run a formative assessment

MODULE 2: self-direct learning, involving a literature review and a clinical case study (Science in Context)

Module Leaders: Dr Marco Brancaccio and Dr Christopher Butler

The literature review will consist of 3500 words (abstract 350 words) on a neurological or psychiatric disease and will be done in groups. Then, the students will review another group's review and provide a peer review referees report.

The clinical case study will consist of a virtual clinical or psychiatric case and the students need to provide answer for some of the questions raised in the case. The students will present a poster on this clinical case.

MODULE 3: research project

Module Leaders: Dr Samuel Barnes and Prof Magdalena Sastre

The projects can be either lab-based, clinical or systematic review projects. The projects last 14 weeks and the student will present a written report and a 10 min oral presentation.

Conferences and Symposiums

During the course there are usually several opportunities for students to participate in symposiums and conferences, such as the BRAIN conference. There are also regular seminars organised by the Department of Brain Sciences that students will have the option to attend.

What do the students think of the BSc in Neuroscience and Mental Health?

"After the toils of first and second year lectures, Neuroscience becomes a bit like Marmite. You either love it or you hate it. If you're one of those people who enjoyed it, then you should definitely

consider the Neuroscience and Mental Health (NSMH) BSc. If you hated it, then perhaps it's wise to steer clear as it's not really for the faint hearted.

"The 4th year is your chance to live like a proper student; lectures instead of 8am surgical ward rounds, long lunch breaks and the occasional day off. For NSMH there are usually 2 lectures per day. Time off is seen a little less frequently than in some other courses."

"As with all BSc's, coursework makes up a proportion of your overall mark. The coursework for NSMH takes a variety of different forms; essays, lab work, pathology practical, oral presentations and group work, so there's bound to be some pieces that suit your strengths.

Overall, the NSMH BSc offers a great course to those who think they might have an interest in the field. A bit of motivation is probably quite an important requirement, but the topics covered and the lecturers who teach should make definitely make you consider it as one of your choices."

"Most importantly, the Neuroscience and Mental Health course is interesting, and fantastically rewarding. All of the material is cutting edge, and the lecturers are world-renowned in their own fields. Having said that, it is not a course for the work-shy. The lecture load is high, and the work expected from you outside of the classroom is certainly no small amount."

"There is a wide variety of material covered in the course, with bits to interest everyone. Module one ranges from molecular studies in the formation of optic pathways, to practical experiments looking at the formation of the cerebellum. One of the things to recommend the course is its incorporation of practical work. Each module has its own practical associated with it, helping you to put some of the theory into a more readily visualised practical.

Whilst module one gives you the molecular basis for understanding much of the normal development and functioning of the nervous system, module two takes a disease-based approach to things. Studying the full gamut of neurological disorders, from diseases of ageing such as Parkinson's and Alzheimer's, to genetic disorders such as Duchenne Muscular Dystrophy, this module gives you a fantastically interesting and contemporarily relevant tour of the major neurological and psychiatric pathologies.

The final module provides the majority of the mental health input to the course. It is focussed to a large extent on interpretation of research, and development of new treatments. Having said this, all of the main psychiatric illnesses such as depression, schizophrenia and dementia are looked at in detail, but with a focus on clinical aspects as opposed to their molecular or genetic basis. This module also teaches you the majority of what you need to know for psychiatry in fifth year. Not something to be sniffed at."

"Perhaps the strongest part of the Neuroscience and Mental health course is the projects on offer. These give you the opportunity to work with world-class researchers who are pushing back boundaries in the understanding and treatment of some of the most serious illnesses affecting man. All of the projects are based around vital work that needs doing, as opposed to the repeat of a tired old project as is seen in other courses. Here, you have the chance to carry out vital work on drug development for diseases that were previously thought incurable. There is no greater opportunity available to you within the study of medicine than to be involved in the potential cure for a disease.

The Neuroscience and Mental health course is rewarding, stimulating and cutting edge. There is no more fascinating area of medicine to be working or studying in at the moment and the course is one that I would recommend highly to anyone."