**BSc in Medical Sciences with ENDOCRINOLOGY**

**Introduction**

The Endocrine system provides a critical means of communication within the body and maintains a constant internal milieu in the face of an ever-changing external environment. It is thus essential for survival and adaptation throughout life and plays a key role in the balance between health and disease.

This course will comprise a two-week Introductory course, three 5-week taught modules and either a research project or a specialist course option (two 5-week modules).

**Course Director and Project Coordinator**

Dr Kevin Murphy  
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Course Administrator  
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**Overall Aims and Objectives**

- To encourage and develop the student’s motivation, originality of thought and breadth of vision.
- To provide a supportive learning environment, underpinned by world class research;
- To provide distinctive modules within appropriate areas of endocrinology, drawing on the expertise and strengths of our academic staff.
- To produce graduates well trained in laboratory and research skills;
- To foster the ability to work independently and as part of a group, and to develop presentation skills, both written and oral
- To provide an insight into the major areas of interest in Endocrinology at both the basic science and clinical levels as well as an understanding of state-of-the-art technology that is used to further research in the field.
- To ensure that students are familiar with the fundamental principles of endocrine communication within the body, the underlying molecular events which support these processes, the pathological states that emerge when these processes malfunction and opportunities for the development of novel therapeutic targets.

**Background Reading and Reference Texts**

Each lecture of the BS course is normally accompanied by some key references (reviews or original research papers) in leading scientific journals, which are freely accessible via *PubMed* using an Imperial computer or VPN connection. There is no single textbook which covers the course, but a comprehensive, general background can be found in the library in texts such as:


Content
The course will provide knowledge and understanding of:

- different scientific techniques and approaches available in molecular, cellular and whole body science;
- how to formulate hypotheses, what constitutes good experimental design and the development of a research plan;
- critical evaluation of scientific papers;
- how to use the library and literature searches to gather and organise information;
- methods available for analysing endocrine function and an appreciation of modern analytical developments;
- the basic concepts of molecular endocrinology that underpin hormone actions, how dysfunction relates to primary pathogenesis, and how this knowledge informs improvement in diagnosis and the potential for novel therapies;
- the hypothalamic-pituitary axes and their role in health and disease, including the reproductive, adrenal, and thyroid axes.
- the neuroendocrine control of food intake, energy expenditure and obesity; theories of the aetiology and pathogenesis of type 2 diabetes mellitus;
- the mechanisms behind, diagnosis and treatment of neuroendocrine tumours.

Format of Teaching
The taught part of the course will comprise seminars/lectures and small group teaching, including Journal Clubs aimed at critical appraisal of published research papers and debates. For each module a significant portion of time is allowed each week for private study and preparation of in-course assessment. A proportion of the lectures of the Introductory Course and module 1 will be given in conjunction with the Reproductive and Developmental Biology Course.

Introductory Course

Module Leader
Dr Pat Cover p.cover@imperial.ac.uk

Specific Aims
- to acquire transferable skills essential for academic success and future careers: these include writing good science; searching, storing and understanding the literature; data interpretation and critical analysis.
- to develop these skills in the context of basic and clinical science relating to endocrinology: this focuses on the essential elements of the hypothalamo-pituitary-endocrine axes and communication pathways between the brain and periphery which underpin basic endocrine concepts and their clinical significance.
Module 1: ‘Reproductive Neuroendocrinology’

Module Leader
Dr Channa Jayasena c.jayasena@imperial.ac.uk

Specific Aims
1) To explore the neuroendocrine reproductive axis as an exemplar pituitary system, including details of how the system is studied experimentally, its relevance to human disease, and its interactions with other neuroendocrine systems.
2) To confer an understanding of the physiology and pathophysiology of male and female fertility and infertility.
3) With this understanding, to explore new therapeutic approaches to reproductive disease.

Content
• Module introduction
• The neuroendocrine concept
• The mechanics of sex: introducing the reproductive axis
• Novel hypothalamic regulators of reproduction: lessons from the animal
• Novel hypothalamic regulators of reproduction: lessons from the human
• Genetic models of GnRH deficiency
• Tutorial: How can we tell if a novel hormone is important?
• Sexual dimorphism
• Reproduction and metabolism
• Tutorial: How do you write a good scientific essay?
• Male infertility: Influences of lifestyle
• Mechanisms and treatment of testosterone deficiency in chronic disease
• Male infertility: genetic disorders
• Tutorial: How can we develop novel therapies for male infertility?
• Endocrine disruptors. Do they adversely affect fertility?
• The regulation of flushing by hypothalamic peptides
• Tutorial: How to plan a great experiment?
• Current methods for IVF therapy
• Improving IVF - novel strategies
• Spermatogenesis
• Sperm transport
• Puberty
• Oestrogen receptors
• Control of gonadotrophin production
• Gonadotrophin action and resistance
• Anovulation and PCOS
• Nuclear receptors 1
• Nuclear receptors 2
• Physical and metabolic effects of cross-sex hormonal therapy

Module 2: Type 2 Diabetes Mellitus, Metabolism and Obesity

Module Leaders
Dr Kevin G Murphy k.g.murphy@imperial.ac.uk
Dr Neil Hill n.hill@imperial.ac.uk
Specific Aims
- To understand the endocrine control of intermediary metabolism, food intake and energy expenditure.
- To develop an understanding of the theories of the aetiology and the pathogenesis of Type 2 diabetes mellitus, including the molecular basis, the contribution of the intrauterine environment and diet as well as the relative roles of increased insulin resistance and deficient insulin secretion.
- To appreciate the role of signalling pathways between gut and brain in regulating feeding behaviour and obesity.

Content
- Introduction to diabetes and obesity
- History and epidemiology of diabetes
- Insulin resistance and secretion in the aetiology of T2DM
- Pancreatic development and diabetes
- Insights from T2DM prevention trials
- The molecular basis of insulin sensitivity
- Inflammation and T2DM
- Diabetic dyslipidaemia
- Diabetes and cancer
- Diabetes subtypes and classification
- The metabolic syndrome
- Insulin action and ovarian function
- Assessment of insulin secretion and insulin resistance
- The thrifty phenotype and fetal programming
- Pregnancy insulin resistance and foetal growth
- Fatty acids and diabetes
- Fatty liver and T2DM
- Central regulation of energy expenditure
- Hypothalamic nutrient and fuel sensing
- Obesity and society
- The thrifty genotype, why is T2DM so prevalent
- Polycystic ovaries clinical issues with insulin resistance
- GLP-1 and diabetes
- Hypothalamic appetite control
- The melanocortin system
- Opioids, cannabinoids and classical neurotransmitters
- The brainstem and appetite regulation
- Leptin and insulin neuropeptide signalling
- Ghrelin, PYY, PP and appetite control
- Adiponectin and the adipocytokines
- Bariatric surgery
- Hydroxy-steroid dehydrogenase, cortisol and obesity
- Anti-obesity drugs
- Foetal programming and bodyweight
- The genetics of obesity
- Neuronal effects of metabolic regulators
- Nuclear hormones and metabolism

Journal Clubs (typical examples)
1. Neuronal effects of metabolic regulators.
2. Fatty acids, metabolic and endocrine affects.
4. Polycystic ovary syndrome

Debates (typical examples)

1. This house believes in resistance is primary in the pathogenesis of type II diabetes rather than an insulin deficit.
2. This House believes that hypothalamic dysfunction is primary in the aetiology of diabetes rather than central adiposity and non-alcoholic steato hepatitis.
3. This house believes that obesity is a will power problem rather than a medical problem.

There will also be a debate between teams of students on a topical issue in obesity and diabetes.

Module 3: The pituitary, neuroendocrine health and disease.

Module Leader
Dr Amir Sam a.sam@imperial.ac.uk

Specific Aims
1) An overview of the different means of communication within the endocrine system: from hormone and receptor genes to signalling molecules and whole-body responses
2) An understanding of the underlying pathophysiology and clinical manifestation of major neuroendocrine and pituitary diseases.
3) The ability to relate abnormalities at gene, molecular and cellular levels to disruptions in endocrine function and the emergence of disease states, especially relating to adrenal, thyroid and bone disorders
4) To explain and assess the therapies used to treat major neuroendocrine pituitary diseases.

Content

Seminars/Tutorials/Lectures
- Pathogenesis and management of adrenal insufficiency
- Pathogenesis, presentation and management of congenital adrenal hyperplasia
- Adrenal tumours
- Genetics of phaeochromocytomas
- Pathogenesis of Cushing’s syndrome
- Diagnosis and management of primary hyperaldosteronism
- The TSH receptor as a model of cell signalling
- Pathogenesis and management of hypothyroidism
- Pathogenesis of Graves’ disease
- General and clinical aspects of thyroid cancer
- TSH-secreting pituitary tumours and resistance to thyroid hormones
- Genetics of Thyroid cancer
- Thyroid function in pregnancy
- Multiple endocrine neoplasias
- Non-functioning pituitary tumours & prolactinomas
- Pathogenesis and management of diabetes insipidus
- Pathogenesis and management of acromegaly
- The molecular and genetic mechanisms of pituitary tumourigenesis
- Overview of neuroendocrine tumours
- Neuroendocrine tumours, a surgeon’s perspective
• Neuroendocrine tumours, an oncologist’s perspective
• Molecular mechanisms of bone remodelling
• Pathophysiology of osteoporosis

**Modules 4-5  Projects**
A wide variety of laboratory-based, clinical and computer-based projects will be offered. Students may also elect to carry out a library project. Project descriptions for 2010-2011 can be found on the intranet.

**Society for Endocrinology**

The Society for Endocrinology offers free membership to students studying Endocrinology. All students on this course are encouraged to take up membership, and further details and benefits can be found at [www.endocrinology.org](http://www.endocrinology.org/)

In addition, the Society has awarded the Imperial College Endocrinology BSc Course grants to support the **Society for Endocrinology Undergraduate Achievement Award**. This comprises a prize of £200 for the highest scoring project, and of £100 for the second highest scoring project. The students with the highest scoring essay in each of modules 1-3 will also receive a prize of £100.

**Past BSc Project Titles in Endocrinology**

• Insulin resistance pre and post haemodialysis
• Hormonal influences on the developmental trajectories of midbrain dopaminergic populations
• Predictors of disease recurrence and morbidity in patients with treated acromegaly
• Changes in taste after bariatric surgery
• Validation of haemoglobin A1c for diagnosis of diabetes mellitus in an Asian population
• Measures of regional body fat and cardiovascular risk factors
• Long term follow up of patients with a pituitary non-functioning adenoma
• To assess whether a detectable circulating C-Peptide level in subjects with type 1 diabetes is associated with less glucose variability and fewer hypoglycaemic episodes at low HbA1c levels.
• Measures of insulin resistance-related risk factor clustering and cancer mortality
• Role of PASK in the regulation of insulin and glucagon production and secretion
• Development of peptide drugs to block Rab27 function.
• The WWOX tumour suppressor is a modulator of paclitaxel response in ovarian cancer cells.
• Clinical Audit of Hypopituitarism after Traumatic Brain Injury
• Expression of steroidogenic enzymes and steroid hormone receptors in normal and malignant breast tissues and blood
• Functional magnetic resonance imaging of appetite in obesity surgery
• Epidemiological trends: incidences of hypoglycaemia recorded by London ambulance service during Ramadan among fasting diabetes patients
• Audit of Vitamin D levels in obese women with Gestational Diabetes Mellitus and glucose tolerant women.
• Hepcidin and iron metabolism in patients starting maintenance haemodialysis.
• Clinical outcomes of controversial management areas in pregnancies affected by diabetes
• The role of CIDE proteins in Adipose tissue
• The prevalence, cost and pattern of use of Complementary and Alternative Medicine (CAM) among a multiethnic sample of individuals with diabetes mellitus.
• The role of p38 MAPK and MAPK Phosphatase-1 in mediating the pituitary response to LPS – Regulation by glucocorticoids/annexin 1
• Dual aromatase-sulphatase inhibitors for breast cancer therapy
• Structured Education for Type 1 Diabetes
• Pancreatitis- The epidemiology; The link with serum triglycerides and new diabetes drugs
• Histopathological prediction of malignancy in phaeochromocytomas and paragangliomas using tissue microarrays.
• The effects of amino acids on GLP-1 release
• Assessing the effect of Liraglutide on glycaemic control and weight in a diverse type 2 diabetes population
• White Matter Tract Changes in Obesity and Associated Metabolic and Psychological Traits
• Dual Aromatase- Sulphatase inhibitors for breast cancer therapy
• 51Cr-EDTA for assessment of alterations in glomerular renal function after bariatric surgery
• The role of different dietary fatty acids in the release of appetite hormones
• The outcomes of surgery for pituitary adenomas
• New-onset diabetes mellitus after transplantation (NODAT)-a clinical review with relevance to its clinical management
• Vitamin D deficiency in patients undergoing Bariatric Surgery
• Diurnal changes in hepcidin and circulating iron in health and in renal failure
• Impact of human polymorphic variations in miR34 on insulin secretion
• How does social isolation (an animal model of depression) influence the expression of MAP kinase phosphatase (recently identified as a key factor in the pathophysiology of depression) within the hypothalamic-pituitary-adrenocortical axis?
• Impact of diabetes on hospital admissions and ward discharges
• Effect of a Structured Community Obesity Treatment Programme on Morbid Obesity Patients
• How do amino acids inhibit appetite?
• The effect of ancient man’s diet on gut hormone release
• Free fatty acid receptor 2 and glucose homeostasis
• The diagnostic utility of the urine calcium creatinine ratio to diagnose primary hyperparathyroidism during vitamin D replacement
• Evaluation of adjuvant lithium in hyperthyroid patients receiving radioactive iodine
• Is PAS-domain containing protein kinase involved in circadian rhythm regulation in pancreatic alpha- and beta-cell?
• The role of the hypothalamic-pituitary-thyroid-axis in the adult skeleton
• A single centre assessment of pituitary radiotherapy
• A systematic review of X-linked hypophosphataemia in a single centre.
• The role of the type 2 diabetes gene, HHEX, in pancreatic beta-cell function.
• The role of follicular stimulating hormone signalling in the adult skeleton
• Survival in patients with gut Neuroendocrine Tumours
• Effect of increased propionate in the colon on glucose and lipid metabolism.
• Influences on insulin dose requirements and clinical remission after presentation with Type 1 diabetes: an ADDRESS-2 Study analysis
• Clinical Audit of Prevalence and Correlates of Vitamin D Deficiency in Adults after Traumatic Brain Injury

• Establishing thermal imaging as a method for measuring human brown adipose tissue (hBAT) activity.

• Investigating the role of vagal gut hormone receptors in gut-brain signalling

• Investigating the effects of gut hormones on appetite and behaviour

• Investigation of the diagnostic utility of Cocaine and Amphetamine-Regulated Transcript (CART) in the management of pancreatic neuroendocrine tumours (pNETs).

• Microvascular complications and obesity-comorbidities 5 years after bariatric surgery

• Investigating Magnesium Requests in the Community

• Genetic, clinical and behavioural analysis of morbidly obese patients undergoing bariatric surgery

• Examining the effectiveness of single vs. multiple sample collection strategies in sperm cryopreservation for patients with cancer

• Identification of causal genes affecting type 2 diabetes risk at the VPS13C locus.

• Pregnancy outcomes in patients who have undergone bariatric surgery

• What is the occurrence of obstructive sleep apnoea within obese Type 2 diabetes patients treated with insulin?

• Circulating markers of neuroendocrine differentiation in prostate cancer

• Biochemical, physiological and psychological changes in athletes with type 1 diabetes

• Genetic, clinical and behavioural analysis of morbidly obese patients undergoing bariatric surgery

• Comparing the effects of therapies for the treatment of Type 2 diabetes

• Does over-expression of the human variant of PASK G1117E lead to abnormal glucagon secretion?

• Skeletal role of Peptide YY (PYY)

• Role of sorcin in pancreatic beta cells viability and apoptosis
What do the students think of the BSc in Endocrinology?

‘The Endocrinology BSc combines lectures, practicals, small group tutorials and ethical debates, as well as regular student-organised events – something for everyone! ‘

‘The course is structured as 3 modules of 5 weeks each, with assessment in the form of coursework, exams at the end of the year and a 10-week project (may be laboratory or humanities based). The timetable consists of 2-3 lectures on average a day, with up to 5 tutorials per module. The course is based across St Mary’s Hospital and the Hammersmith Hospital campuses – just a short walk from Westfield shopping centre!'

‘The first module revises much of the basic sciences covered in the first and second year medical curriculum, whereas the second and third modules cover the more clinical aspects of diabetes, appetite regulation and neuroendocrinology. Most students find the more clinical aspects of the course most enjoyable, in particular the detailed study of diabetes and the implications of rising obesity rates. The course is led and taught by a mixture of clinicians and academic researchers who are leading world specialists in their respective fields. The course module leaders are also highly supportive of the students and help is just an email away if you need it!'

‘Throughout the course of the year, there is certainly scope to keep up with extra-curricular activities; I am currently President of ICSM Surgical Society and also find the time to play in the medical school lacrosse team. ‘

‘I would most definitely recommend this course to fellow students; the course material is challenging, interesting and highly relevant to later clinical practice as a physician.’

‘Endocrinology is a well-structured and taught preclinical course and this extends to the BSc pathway. The three modules (Molecular endocrinology and endocrine-related cancers/Type 2 diabetes mellitus, metabolism and obesity/Neuroendocrinology, health and disease) address important topics in day to day clinical medicine integrating both the molecular mechanisms of disease and the basis of current and future treatment. As the course is so broad there is something to suit everybody. I would urge you to consider this pathway as it provides strong scientific teaching onto which you can base future academic work as well as covering subjects which you will encounter frequently, as a future clinician, in any speciality. I have certainly found it useful for the specialty subjects covered in the 5th year curriculum.’

BMS Students

Please note that BMS Students will be required to be clinically cleared before they are able to undertake this course. Clinical clearance will take place with Occupational Health in June. More information regarding this will be sent out by the Curriculum Assistant for the BSc Programmes.