

BSc in Medical Sciences with IMMUNITY AND INFECTION

Introduction

The BSc in Immunity and Infection allows a science-based study of the immune system in health and disease; in particular that caused by infectious organisms, breakdown of peripheral tolerance and tumour formation. Building upon an understanding of the basic mechanisms underpinning microbial pathogenesis, immune activation, tolerance, inflammation and repair, the course will cover immune evasion, vaccination, immune-mediated pathogenesis, autoimmunity and the immunological aspects of transplantation.

This course comprises an initial 2-week Introductory module, followed by three 5-week taught modules and either a 10 week research project or a specialist course (two 5-week modules).

Course Director

Professor Julian Dyson peter.dyson@imperial.ac.uk

Course Administrator

Ms Deborah Jones deborah.jones@imperial.ac.uk

Aims and Objectives

The course aims to:

- Ensure that students are familiar with the fundamental elements of the molecular and cellular processes that underpin inflammation and immunological responses to infection, tissue transplants, tumours, wound healing and tissue repair.
- Provide an insight into the importance, indications and limitations of immunological and pathological testing techniques and therapies in clinical practice.
- Foster the ability to criticise and comment on scientific research, work independently and as part of a group, and to develop oral and written presentation skills.

Learning Outcomes

By the end of the course the student will:

- Have a broad understanding of how and why microorganisms cause human disease.
- Be able to discuss how the immune system recognises and responds to foreign and sometimes to self-antigens.
- Understand how disordered immunity, inflammation or repair mechanisms can contribute to human disease.
- Understand the immune challenges of transplantation and the relevance and importance of clinical organ transplants.
- Understand the principles of therapeutic immune modulation through vaccination and immunomodulation.

Content

The Introductory 2 weeks will expose the students to a variety of transferrable skills as well as providing an opportunity for students to experience first-hand the art of scientific manuscript presentation and preparation. Seminal papers will be used as spring boards for discussion in Journal clubs.

The first of the three 5-week modules will begin with an exploration of the foundations of inflammation, immunity, infection and wound repair. The module will consider the homeostatic mechanisms which maintain the physical and biological integrity of the human body at the cellular and molecular level. The pathological processes which follow from

defective or ineffective regulation will be discussed. Many aspects of the curriculum for this course reflect cutting edge research topics that are relevant for the training of future doctors.

The second module will give insight into mechanisms of the immune system that lead to specific activation of effector cells by foreign antigens encoded by viruses, bacteria and other pathogens. The various mechanisms used by pathogenic viruses, bacteria and both protozoan and metazoan parasites to establish infection and evade immune responses will be covered, as will the special circumstances of infection in immunocompromised hosts.

The final module will explore the role of the immune system in the rejection of transplanted tissues and the pathogenesis and treatment of autoimmune diseases. Novel approaches to tolerance induction and vaccination against cancer cells and leukaemia will also be considered.

Format of teaching

The course will be taught in a mixture of self-directed learning, lectures, seminars, practicals and problem solving sessions.

Introduction

Leaders:

Dr Nicola Rogers

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Dr Mick Jones

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Aims

To gain an understanding of:

- Seminal papers in the field of immunology.
- The art of scientific manuscript preparation
- A variety of transferrable skills.

Module 1: Inflammation, Immunology, Infection and wound healing

Module Leaders

Dr Nicola Rogers

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Dr Mick Jones

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Aims

To gain an understanding of:

- Diversity and characteristics of the cells and molecules that mediate inflammation, innate and adaptive immune responses and microbial pathogenesis
- Molecular and cellular interactions required to initiate, maintain and effect an immune response to infections, tumours and transplanted organs
- Mechanisms of microbial pathogenesis
- The response of various bodily tissues to tissue damage, highlighting their molecular control and the wound healing ability of the major tissues of the body, emphasising the importance of stem cells

Content

- Molecules, cells and mechanisms in immune and inflammatory responses
- Bacterial, viral and parasitic pathogenesis
- Tissue damage and repair, including the role of stem cells

Module 2: Infection and host responses

Module Leaders

Dr Graham Taylor

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Dr Samantha Sampson

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Aims

To gain an understanding of:

- The principles upon which our understanding of infection, and immunity to it, are based through study of exemplary bacterial, viral and fungal infectious diseases
- How orchestration of the cells and molecules of the immune system mediate host defence against different types of infectious organism
- Immune defects and predisposition to infection - what can we learn?

Content

- The nature of the host-pathogen interaction and immune responses to infection
- Diagnosis of infection and models of disease
- Vaccination, therapy and immunomodulation

Module 3: Autoimmunity, Tumour Immunology, Transplantation and Tolerance

Module Leaders

Professor Julian Dyson

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Dr Fang-Ping Huang

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Aims

To gain an understanding of:

- How lymphocytes are normally regulated, the mechanisms of tolerance and how tolerance breakdown leads to autoimmunity
- The concept of immunological surveillance of cancer, and the nature of immune responses against tumours.
- How transplanted organs are rejected and the therapeutic options for treatment, alongside the immunotherapeutic options for autoimmunity and cancer treatment

Content

- Immune regulation, autoimmunity, transplantation immunology
- Vaccination, immunotherapy and immunosuppression
- Host responses to tumours

Modules 4 and 5

Projects

A wide variety of laboratory-based, clinical and computer-based projects will be offered. Students may elect to carry out a library project if they wish.

Past BSc Project Titles in Immunity and Infection

- The monocyte integrated stress response in Behcet's Syndrome
- Co-stimulation blockade to increase T cell responses in ovarian cancer
- Are donor specific antibodies more likely to develop against HLA-DQ than any other HLA molecules following kidney transplantation?
- Investigation of unexpected immunomodulatory effects of tuberculosis treatments

- Comparison of ABO Columns to Remove ABO Antibodies
- The role of inflammatory genes in the interaction between tumour and mesenchymal stem cells
- Characterisation of the histological inflammatory response to nanoparticles from failed metal on metal hip replacements
- Introduction of bacterial exotoxins in serious invasive disease
- Assessment of neurocognitive function in young adults and in older adults with chronic HIV-1 infection
- The role of Stat-1 in lupus susceptibility in the BXSB mouse
- Nrf2 protects arteries from vascular inflammation – what is the molecular mechanism?
- Investigation of the interaction between *N. meningitidis* and complement system
- Understanding the influence of mycobacterial lineage on innate immune responses and extra-pulmonary dissemination
- Analysis of macrophage activation and function in the pathogenesis of experimental autoimmune glomerulonephritis
- The specialized ESX-5 secretion apparatus of mycobacteria: Interactome mapping and subcellular localization
- The influence of agonistic anti-GITR antibody treatment on tumour-specific CD4, CD8 and regulatory T cells.
- The role of CTGF in dermal wound healing
- Disconnecting cellular response and environmental signalling in the fungal model *Aspergillus nidulans* which can also be a pathogen
- Role of antibody and macrophages in endothelial dysfunction following cardiac transplantation
- In vivo migratory properties of dendritic cells in the absence of interleukin-10 and after interactions with dying cells – implications in lupus pathogenesis
- Correlation of immune activation markers and vitamin D levels in patients with HTLV-1 infection
- Effect of antiretroviral therapy in pregnancy on biochemical markers for Down's Syndrome
- Renal plasma cells (PCs) contribution to systemic autoantibody titres in a congenic model of SLE
- Identification of malaria parasite genes that putatively interact with the mosquito immune system
- Characterisation of a novel autoantibody against low density lipoprotein
- Molecular epidemiology of puerperal sepsis-lessons from the past
- Enhancing innate immune sensing of DNA to potentiate vaccine immunogenicity
- Phenotypic and functional characterisation of "regulatory" T cells expanded in vitro by dendritic cells devoid of interleukin-10

- Analyses of the effects of antivasular targeted therapies against tumours by using a double-targeted bacteriophage nanoparticle.
- Identification of the needle and inner rod proteins encoded by Salmonella pathogenicity island 2
- Determine if there is an association between presence of increased proportions of tissue like memory B cells (CD19+CD10-CD27-CD21-CD11c+FLR4+) and presence of autoimmunity in patients with HIV-1 infection and primary antibody deficiency
- Establishment of an assay to determine urinary (and plasma) Rituximab levels in nephrotic patients
- Refining the genetic boundaries of BXSB Chromosome I congenic mice
- Cellular co-factors of retroviral DNA integration
- Investigation of the metabolome of Leishmania major parasites
- Effects of kynurenine pathway intermediates on the macrophage metabolome in in vitro L.major infection
- Assessment of factors associated with CSF HIV RNA in HIV infected subjects
- TB and tissue destruction: investigating the role of matrix metalloproteinase 10
- Expression levels of HLA-C in multiple sclerosis patients
- Investigation of Factor H binding properties of different subvariants of meningococcal fHbp
- Targeted deletion of autoreactive CD8 T cells

What do the students think of the BSc in Immunity and Infection?

'Immunity and Infection is a great balance of molecular and clinical content. I have found the material useful not only for areas of medicine like pathology but also for more clinical applications seen commonly on the wards such as sepsis, transplantation and certain aspects of pharmacology. There is a lot of time for self-directed learning in the course and the recommended references at the end of lectures are really helpful. Also all the lecturers are happy to respond to questions whether via email or meeting up to discuss specific questions. Within the course there is an opportunity to perform laboratory experiments under close supervision and if this is something you are interested in, many of the projects offered are along similar lines. All the BSc courses offered by Imperial teach you to think critically and Immunity and infection is no different. You will be expected to question everything you are presented with, which may seem alien at first, but is a useful skill for every aspect of medicine. The content may seem a little more conceptually challenging than some of the other BSc options, but spending time understanding this area of medicine well has already proved rewarding in the clinical setting from my experience.'