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 diseases caused by infectious organisms, breakdown of peripheral tolerance and tumour formation. Building upon an understanding of the basic mechanisms underpinning microbial pathogenesis, immune activation, inflammation and tolerance. The course will cover host-pathogen interactions, immune evasion, vaccination, immune-mediated pathogenesis, autoimmunity and the immunological aspects of transplantation including approaches for the analysis of immune responses.

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
Dr Fiona Culley f.culley@imperial.ac.uk

Course Administrator
Mr Andrew Wright a.wright@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 and tumours.
- 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.
- Provide training in research through the project.

Learning Outcomes
By the end of the course the student will:

- Have a broad understanding of how and why microrganisms 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 and regulatory 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 provide an introduction to laboratory work in the settings of a Mini-Research Project. In pairs and in a frame environment and under an overarching scientific question, you will set and plan your own experimental aims, execute them in the lab and finally analyse and critically discuss your own data.

The first of the three 5-week modules will begin with an exploration of the foundations of inflammation, immunity and infection. 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 metazoa 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.

**Introductory Module**
**Module Leaders:**
Dr Fiona Culley  
f.culley@imperial.ac.uk
Dr Wayne Mitchell  
w.mitchell@imperial.ac.uk

**Aims**
To gain experience and practice in laboratory work.

**Module 1: Inflammation, Immunology and Infection**
**Module Leaders**
Dr Fiona Culley  
f.culley@imperial.ac.uk
Dr Wayne Mitchell  
w.mitchell@imperial.ac.uk

**Aims**
To gain an understanding of:
- Diversity and characteristics of the cells, immune receptors and other molecules that mediate inflammation, innate and adaptive immune responses and microbial pathogenesis.
- Molecular and cellular interactions required to initiate, maintain and elicit an immune response to infection, tumours and transplanted organs.
- Mechanisms of microbial pathogenesis.
- The impact of cell death on immune regulation; progenitor and stem cells and their potential in regenerative medicine.
Content
- Molecules, cells and mechanisms in immune and inflammatory responses.
- Bacterial, viral and parasitic pathogenesis.
- Immune regulation and disregulation, the potential of stem cells for tissue repair.

Module 2: Infection and Host Responses

Module Leaders
Prof. Graham Taylor  g.p.taylor@imperial.ac.uk
Dr Andrew Edwards  a.edwards@imperial.ac.uk

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
- Role of the immune response in the pathogenesis of infection

Module 3: Autoimmunity, Tumour Immunology, Transplantation and Tolerance

Module Leaders
Prof Danny Altmann  d.altmann@lms.mrc.ac.uk
Dr James Pease  j.pease@imperial.ac.uk

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
• Investigation of interactions between acute myeloid leukaemia cells and bone marrow stromal cells
• Role of Gadd45β in macrophage differentiation and function
• The interplay between chronic interleukin-8 mediated inflammation and adaptive immunity
• MHC recognition by the T cell receptor
• The role of the SOS response in phenotype-switching of Staphylococcus aureus
• Do lipoproteins influence factor H protein family complement regulation?
• Investigating the role of NK cells and their activating receptors in the development of Hepatocellular carcinoma (HCC)
• Effects of a novel autoantibody on the extracellular degradation of low density lipoprotein by macrophages
• Regulation of atherosclerosis by TPL-2 kinase
• Structural and biochemical analysis of type IV pili (Tfp) produced by Streptococcus sanguinis, a Gram-positive human pathogen
• Making and testing HPRT-specific CRISPR/Cas9 nuclease
• Purification and characterisation of complement factor H-related proteins
• Killers to the rescue – caspases in host defence.
• The role of the Streptococcal inhibitor of complement in invasive Group A Streptococcus infection
• Effect of pulsed methyl prednisolone on disease severity, viral load, inflammation in patients with HTLV-1-associated myelopathy
• HIV/HTLV co-infection
• Supression of the inflammasome by RSV SH protein
• Evolution of Streptococcus Signalling in vivo
• A project to assess three different methods to analyse cerebral metabolites measured on 1-H magnetic resonance spectroscopy

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.’

BMS Students

Please note that BMS Students will be required to be clinically cleared before they are able to undertake this course.