Biochemistry

Essentials

Taught programmes
MSc degrees
Genetic Manipulation and Molecular Cell Biology
Imaging in Biomedical Research

Research programmes
MPhil, PhD Biochemistry

Admissions requirements
For information on overseas qualifications that meet the admissions requirements, refer to pages 156-157
MSc
A first- or second-class undergraduate honours degree in a relevant science, computing or mathematics degree
MPhil and PhD
A first- or upper second-class undergraduate honours degree in a relevant subject

English language requirements
IELTS 6.5, with not less than 6.5 in Writing and 6.0 in the other sections. Internet TOEFL with 92 overall, with 21 in Listening, 22 in Reading, 24 in Speaking and 25 in Writing. For more information and alternative English language requirements, refer to page 156

Fees
Refer to pages 158-159 for information on fees

Further information
Taught programmes
Biochemistry, PG Admissions,
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University of Sussex, Falmer,
Brighton BN1 9QG, UK
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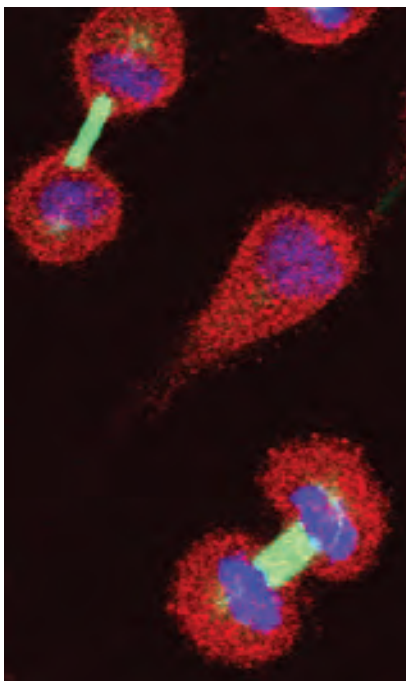
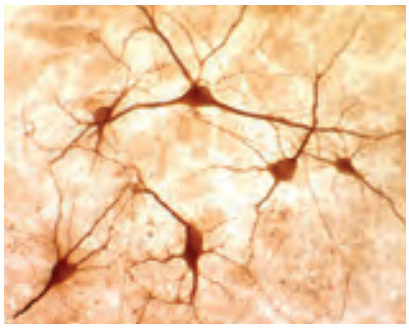
- We are a leading centre of research and were ranked 8th in the UK for 'Pre-clinical and Human Biological Sciences' research in the 2008 Research Assessment Exercise (RAE). 85 per cent of our research was rated as internationally recognised or higher, and over half rated as internationally excellent or higher.
- Sussex was ranked 8th in the UK for biosciences in *The Guardian University Guide 2012,* 15th in the UK for biological sciences in *The Complete University Guide 2011-12* and 16th in the UK in *The Times Good University Guide 2012*.
- We are proud of our distinguished faculty, past and present: the most recent of the University's 15 Fellows of the Royal Society is geneticist Alan Lehmann (refer to page 48 for his research interests).
- We offer formal taught research and study skills training to all postgraduates.
- Our collaborative links with the Genome Damage and Stability Centre, the Biomedical Science Research Centre, and the Brighton and Sussex Medical School offer exciting opportunities for our research and Masters students to experience cutting-edge research projects across a broad range of interdisciplinary areas.
- We have excellent facilities for proteomics, genetics, microarrays and robotics, biophysics, protein molecular graphics and bioinformatics, atomic force microscopy, x-ray crystallography, FACS analysis, mammalian cell culture, confocal, 2-photon and time-lapse video microscopy, cryo- and scanning electron-microscopy, mass spectroscopy and NMR.



Laser scanning confocal micrograph of synchronised HeLa cells undergoing mitosis. Green: tubulin, red: eIF4A, blue: DNA



Motor neurons in culture

Taught programmes

MSc in Genetic Manipulation and Molecular Cell Biology
1 year full time

Most biological disciplines now rely on analyses at the molecular level, and the use of molecular biology to manipulate genes and proteins. This popular MSc provides detailed training in current approaches to molecular biology, including fields such as proteomics and functional genomics that have arisen as a result of genome-sequencing projects.

The programme concentrates on experimental techniques and their applications, not only in pure scientific research, but also in medicine, agriculture and other biotechnology industries.

A significant part of the programme is an extended research project undertaken in an active research lab. For nine or ten months you will become part of a research group, and the results from these projects are often published in scientific journals.

Career opportunities
This MSc is a perfect platform for a career in research. Most of our graduates look to continue their studies as PhD students, often at Sussex, while others pursue careers as research assistants in the pharmaceutical industry or in a variety of academic research institutes.

Programme structure
The programme comprises a combination of four core MSc courses, together with a choice of several final-year undergraduate courses.

Autumn and spring terms: Advanced Methods in Molecular Research • Practicals in Molecular Biology • Skills for Research Bioscientists • Topics in Genetic Manipulation and Molecular Cell Biology. Additionally you choose one or two courses from a list of options including Biochemistry of Gene Expression • Genes and Development • Molecular Biology of Cancer • Molecular Evolution and Ecology • Molecular Genetics • Protein Form and Function. You also start work on your research project.

Summer term: examination and then continuation of your project work, including preparation of a thesis dissertation and an oral presentation.

Assessment
The main assessment for this programme is based on the research project. You are also assessed by short term papers and examinations.

MSc in Imaging in Biomedical Research
1 year full time

Watching the folding of a molecule or following the workings of the human brain, imaging life in space and time is an essential tool in medical research. This interdisciplinary degree programme enables you to develop and apply innovative techniques in biological and medical imaging. According to the Medical Research Council these skills are in great demand.

Additional admissions requirements
Applicants need to have an interest in learning elements of higher mathematics as part of the programme and must show some evidence of a mathematical ability (whether through undergraduate studies or strong performance in an earlier qualification).

Career opportunities
This MSc is designed for bioscience graduates who have demonstrated potential and interest in quantitative science and are preparing for careers in industrial, clinical or academic research. Many of our graduates have gone on to study for PhD degrees at medical institutes such as those funded by the UK Medical Research Council.

Programme structure
Autumn and spring terms: you attend lectures and practicals in life sciences, informatics and physics, learning theory and techniques in sample preparation, image acquisition, image analysis and imaging theory. You can specialise in molecular, developmental or neurological imaging by choosing appropriate options.

Summer term: you work on a research project supervised by research-active faculty in collaboration with the Sussex Centre for Advanced Microscopy and/or the Brighton and Sussex Medical School Clinical Imaging Science Centre.

Assessment
Assessment is based on problem-solving, practical reports, essays, written examinations, a dissertation and a short oral presentation based on the research project. You have to satisfy the examiners on all of the above.

Research programmes

Around 15 PhD/MPhil positions are offered annually in the overlapping areas of cellular recognition and signalling; molecular cell biology and cancer; molecular biology and gene expression; and structural biology. Projects falling within the faculty research interests in any of these areas (refer to page 48) will be considered. You are allocated a supervisor and a co-supervisor, and special courses are provided covering basic topics ranging from transferable skills, safety, career management and experimental techniques to recent developments in fast-moving areas of molecular research.

Recent thesis titles
Biochemical characterisation of a novel DNA single-strand break repair process and its defect in a neurodegenerative disease

Characterisation of a novel caspase-like activity present in proliferating lymphoid cells

Hyphal growth in the fission yeast Schizosaccharomyces pombe

Investigations into the cellular and molecular biology of acytoplasmic dynein mutation which leads into neurodegeneration

Involvement of toll-like receptor 4 and serum proteins in the recognition of Gram-negative bacterial products

N-terminal proteolytic processing of the Bacillus thuringiensis *Cry1delta-endotoxins*

Overexpression and purification of a pea mitochondrial heat shock protein

Studies on the localisation of eukaryotic initiation factors in Xenopus *kidney B3.2 cells*

Understanding and overcoming the resistance of Plutella xylostella *to the Cry1Ac* Bacillus thuringiensis *toxin*

Career opportunities
Our graduates have gone on to roles such as scientific researcher for the Medical Research Council, medical writer, postdoctoral researcher, and healthcare scientist.

Interdisciplinary research centres

Biomedical Science Research Centre

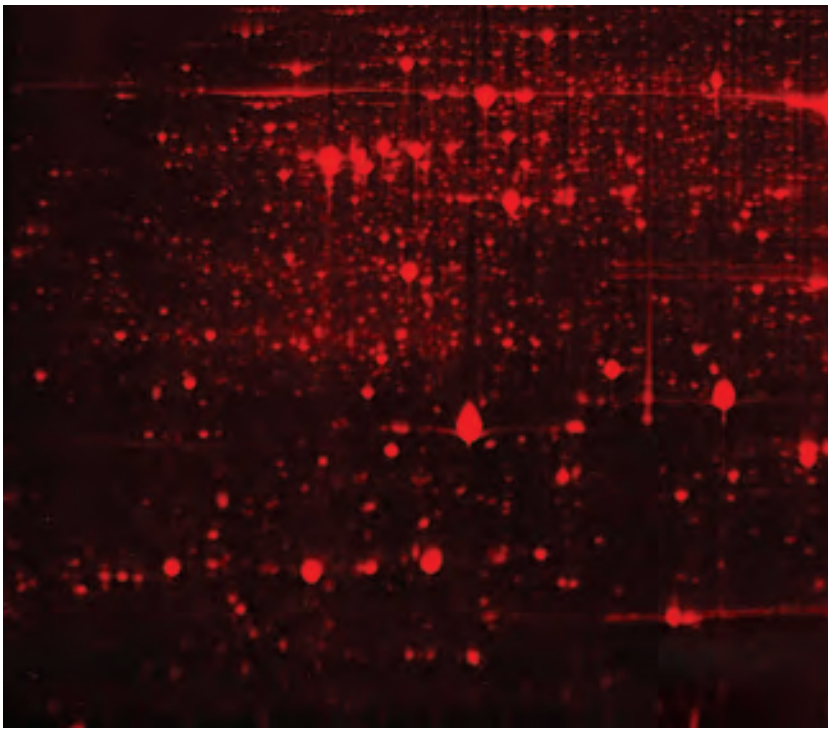
The Centre represents research groups that have diverse methodological disciplines but are linked by common interests in identifying the molecular basis of disease and the development of diagnostic tools (biomarkers) and therapies to identify and combat disease.

Disciplines of biochemistry, genetics, cell biology, proteomics, bioinformatics, structural biology and molecular biophysics are brought together to foster an interdisciplinary environment to tackle medically relevant questions in infection and immunity, neurodegenerative diseases, oncology and cancer research. The Centre has strong collaborative links with the University of Sussex Proteomics Centre, the Sussex Centre for Advanced Microscopy, the Genome Damage and Stability Centre, the Brighton and Sussex Medical School, the University of Sussex Centre for Neuroscience, the Centre for Chemical Biology, and the Brighton and Sussex Cancer Research Group.

For more information, contact Majid Hafezparast (m.hafezparast@sussex.ac.uk).

Genome Damage and Stability Centre

The Centre has been established, in a purpose-built laboratory, as a partnership between the Medical Research Council and the University. Its aim is to understand how cells and organisms respond to DNA damage and maintain the stability of their genomes. Defects in cellular responses to DNA damage result in cancer and a variety of genetic disorders. The scientists in the Centre are at the forefront of international research in this area. They exploit a multiorganism approach to understanding the responses to DNA damage. For more information, visit **www.sussex.ac.uk/gdsc**



Proteomic analysis: 2D protein analysis of the patterns of protein expression in human cells. Proteomics, functional genomics and transcriptome analysis are important tools in modern molecular cell biology and form an essential element of the MSc in Genetic Manipulation and Molecular Cell Biology

Faculty research interests

The research interests of the biochemistry faculty can be broadly divided into three main areas: gene expression, intracellular communication and cell signalling; genomics, genome stability and cancer; and structural biology. There is considerable overlap in research interests between these areas and with other areas within the University, such as the Genome Damage and Stability Centre and the Centre for Chemical Biology.

Gene expression, intracellular communication and cell signalling

This is a vibrant area of research involving a number of researchers working on the molecular mechanisms of intracellular transport and regulating of gene expression at the level of both transcription and translation. Much of this research is directed at understanding the mechanisms of disease.

John Armstrong *Functional genomics, molecular biology and development of fission yeast.* Differentiation of fission yeast into mycelia, a model for pathogenic fungi, and autophagy, an important aspect of disease processes.

Lucas Bowler *Molecular basis of bacterial pathogenesis*. Focuses on pathogenic streptococci using a wide range of DNA- and RNA-based methodologies.

Majid Hafezparast *Molecular basis of motor neuron disease.* The links between mutations in dynein, a molecular motor involved in axonal transport, and motor neuron death in motor neuron disease.

Simon Morley *Regulation of translation in eukaryotic cells.* The signalling pathways that modulate translation rates in cells and how the phosphorylation and integrity of initiation factors influence mRNA selection for translation.

Mark Paget *Stress responses in* Streptomyces. The *Streptomyces* bacteria mechanisms of sensing stress inputs and how these signals are transduced into regulatory outputs at the level of transcription and translation.

Alison Sinclair *Cancer biology and human viruses*. Disruptive molecular mechanisms following infection with the tumour-associated Epstein-Barr virus and the Kaposi's sarcoma-associated herpes virus during cancer development.

Michael Titheradge *Regulation of metabolism in sepsis and vascular disease*. Control of carbohydrate metabolism by bacterial lipopolysaccharides and proinflammatory cytokines during sepsis.

Michelle West *Regulation of transcription by viral and cellular factors*. The structure, function and mechanism of action of the latent transcriptional regulatory proteins encoded by the cancer-associated Epstein-Barr virus.

Genomics, genome stability and cancer

Much of the work in this area is carried out in the Genome Damage and Stability Centre. In addition to the overall interest in DNA repair and cancer, a centre for functional genomics of fission yeast, including microarray analysis, has been established within this group.

Alessandro Bianchi *Telomerase regulation and chromosome end protection by the telomeric complex.* Use budding and fission yeast to understand how telomeres regulate chromosome end replication and protection.

Keith Caldecott *DNA repair and replication.* Central to the repair of single-strand breaks is the XRCC1 protein, which interacts with several other interesting proteins with links to human disorders.

Antony Carr *Interplay between replication, recombination and checkpoints in fission yeast.* Using yeast models to investigate how damage response pathways control DNA repair and interact with DNA replication.

Aidan Doherty Using cellular, biochemical and structural approaches to study the function of novel protein complexes in the repair of DNA double-strand breaks.

Jessica Downs *The role of chromatin in DNA damage responses.* Using budding yeast models to examine how the organisation of chromatin structure contributes to DNA damage responses.

Sherif El-Khamisy *DNA repair and neuro-degeneration.* How defects in the repair of one-strand DNA breaks impact on human health, particularly neuronal function.

Helfrid Hochegger *Cell cycle control and genome maintenance*. Using a chemical genetic approach in vertebrate cell lines to analyse cyclin-dependent kinases' function in DNA replication and chromosome segregation.

Eva Hoffmann *Meiotic recombination and chromosome segregation.* How the repair of double-strand breaks is coupled to accurate chromosome segregation in *Saccharomyces cerevisiae* and human cell lines.

Penny Jeggo *Response to DNA double-strand breaks in mammalian cells*. We study responses to DNA damage and their contribution to human disease.

Alan Lehmann *DNA repair and human disorders*. DNA polymerases that can replicate damaged DNA; the Smc5-6 protein complex involved in DNA repair; the molecular basis of DNA-repair defects in human genetic disorders.

Johanne Murray *DNA repair and replication.* How cells coordinate repair with replication using fission yeast to study how recombination is regulated in S phase and SMC complexes.

Matt Neale *DNA repair during meiosis and mitosis.* To understand the basic mechanisms underlying DNA repair in humans, we use budding yeast as a simple surrogate model.

Mark O'Driscoll *Human DNA damage response defective disorders.* Defective responses to DNA damage and their impact on the aetiology and progression of human disorders such as Seckel syndrome.

Professor Laurence Pearl The structural basis for assembly, specificity and regulation of the multi-protein complexes involved in the recognition, repair and signalling of DNA damage, and chaperone-mediated stabilisation and activation of cellular signalling pathways.

Hideo Tsubouchi The mechanisms and regulation of homologous recombination using budding yeast as a model organism.

Felicity Watts *Maintenance of genetic integrity.* Uses fission yeast as a model system to investigate DNA damage response proteins including Crb2 and proteins required for the structural integrity of centromeres.

Structural biology

This is an expanding area at Sussex and has recently been strengthened by the inclusion of bioinformatics and x-ray crystallography within biochemistry and within the Centre for Chemical Biology. Associated faculty are very active in a range of fundamental and applied research into the structure and functions of proteins and enzymes, using a wide variety of genetic, biochemical and biophysical approaches as outlined below:

Neil Crickmore *Biochemical and genetic analysis of host-pathogen interactions.* Interaction between a pore-forming protein toxin and its insect host. Use protein engineering to create improved biopesticides.

Anthony Moore *Structure and function of alternative oxidases in plants and parasites.* Uses site-directed mutagenesis, spectrophotometric techniques, and x-ray crystallography to study the structure-function relationships of oxidases.

Professor Louise Serpell *Structure of amyloid fibrils.* Using x-ray diffraction and electron microscopy to examine the structure of the amyloid fibril, deposited in a number of diseases including Alzheimer's disease.

Darren Thompson *X-ray crystallography of proteins.* Using x-ray crystallography to determine the 3D structures of proteins. These structures also give us insights into the nature of interactions between ligands and their biological targets.