KING'S College LONDON

PROGRAMME INFORMATION

MSc / MRes

BIOMEDICAL & MOLECULAR SCIENCES RESEARCH

Note: the info provided is correct as of August 2018 and reflects the course content from previous years – it does not include any possible changes that might be deemed necessary for future years.

1. Introduction

Thanks for your interest in our MSc / MRes in Biomedical and Molecular Sciences Research, a course that is intensive, educational, inspirational but crucially also fun! Should you join, you will be allocated a personal Tutor who will be able to offer advice and guide you throughout the year.

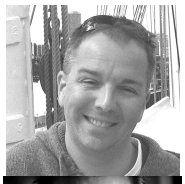
The programme is designed to offer training in theoretical and practical skills that are an integral part of a scientific research environment and prepare students for a research career. The course aims to introduce you to many modern practical approaches of biomedical and molecular sciences with a specific focus on biochemistry, genetics, molecular biology, cardiovascular biology and neurobiology. Arguably one of the most attractive features is that all students spend 6 months (MSc) or 9 months (MRes) in a research active laboratory to conduct a novel and cutting edge research project. Many students publish their work in scientific journals of international standard.

Over 90% of our past students have remained in Science with some 40-50 % progressing to do a PhD, Medicine or Dentistry. Our external examiner noted that "This course provides an ideal training for biomedical students hoping to pursue a career in research and sets a gold standard nationally in this area."

During the programme students will acquire skills in a wide range of general and specialist techniques that will include training in the extraction, isolation and analysis of nucleic acids and proteins, the cloning of genes, bacterial and mammalian cell culture, transfection and transduction, the use of antibodies and electron microscopy and imaging.

This booklet offers a snapshot of the course – we hope to welcome you coming September.

Dr Stephen Sturzenbaum
Programme Organiser / Tutor / Admissions Tutor



Dr Volker Arlt
Programme co-Organiser / Tutor

2. Holiday and Absence

To meet the criteria of *Bologna-compliancy*, this course full time with no spring or summer holiday periods and runs either for 12 months (September to September) leading to a MSc (90-ECTS) or for 16 months (September to December) leading to a MRes (120 ECTS). Note: although no teaching activity is scheduled from mid-December to early January, you will be expected to revise for the January exam during this period.

3. Programme Objectives

At the end of the programme students will be able to:

- ➔ Evaluate and assimilate the scientific literature in a given subject area and to think critically about the results and methods.
- ➔ Devise a hypothesis that can be tested experimentally.
- ➔ Analyse data, appreciate the value of reproducibility of data and draw valid conclusions.
- ➔ Collect data and apply appropriate methods to test a hypothesis.
- ➔ Develop an ability to comprehend and synthesise complex information.
- ➔ Organize a work-schedule, stick to deadlines, and prioritize activities.
- ➔ Communicate clearly and effectively, both orally and through writing.

4. Structure of the MSc Programme

The MSc /MRes is split into 5 modules

1. 7BBBM106 Advanced Laboratory Techniques in Biomedical and Molecular Sciences Research (30 credits)

- ➔ Molecular Biology Techniques (50%)
- ➔ Protein Purification (50%)

2. 7BBBM109 Topics in Biomedical and Molecular Sciences Research (30 credits)

- ➔ Genetics: written exam (20%)
- ➔ Biochemistry: Multiple Choice Questions (MCQ) and calculations (20%)
- ➔ Précis Paper (20%)
- ➔ January Exam (40%)

3. 7BBBM108 Specialised techniques workshops in Biomedical and Molecular Sciences (30 credits)

- ➔ 12 compulsory workshops (not assessed)
- ➔ 3 assessed workshops (100%)

4. 7BBBM112 Skills in Biomedical and Molecular Sciences (30 credits)

- ➔ Journal Club Presentation 1 (3%)
- ➔ Journal Club Presentation 2 (10%)
- ➔ Poster presentation (17%)
- ➔ Final oral presentation (20%)
- ➔ Laboratory (project) skill assessment (50%)

5a. 7BBBM113 Biomedical and Molecular Sciences Research Dissertation (60 credits) – <u>MSc only</u>

- ➔ Written dissertation (100%)

5b. 7BBBM114 Biomedical and Molecular Sciences Research Dissertation (120 credits) – <u>MRes only</u>

- ➔ Brevia Paper (10%)
- ➔ Written dissertation (90%)

7BBBM106
Advanced Biosciences Research Laboratory Techniques

(30 credits)

Advanced Biosciences Research Laboratory Techniques

***The aims of this module are*:**

- ➔ To develop the scientific and practical skills of the participating students.
- ➔ To develop the students' abilities to follow written instructions and carry out advanced experiments in biochemistry, molecular genetics and molecular biology and cell biology areas, and to describe, interpret and effectively present results and written laboratory reports.
- ➔ To train students to trouble-shoot, analyse results when experiments fail, and design investigative steps to determine sources of problems, and possible solutions to them.
- ➔ To train students to plan discussion for results and apply basic stats to data and express error levels.
- ➔ To train students in advanced biomedical techniques, required by typical biosciences researchers, and turn participants into highly competent laboratory workers.

***By the end of the course students should be able to*:**

- ➔ Understand and follow written experimental instructions, identify key issues & prepare summaries for multi-step experimental procedures.
- ➔ Carry out advanced biochemistry and molecular biology experiments, analyse, present, and interpret results.
- ➔ Safely use instruments found in typical bioscience laboratories.
- ➔ Apply confidence criteria to their results including reproducibility and accuracy estimates.
- ➔ Prepare experimental reports of laboratory experiments.
- ➔ Prepare discussion material and be prepared to relate results to published material.
- ➔ Describe the outcome of work done and identify the key elements in a typical procedure.
- ➔ Collect data and apply statistical analysis methods.
- ➔ Identify safety issues in a laboratory environment.

Module structure

1) Biochemistry Techniques

An extended laboratory practical 2 days a week (full-time) for 4 weeks.

2) Molecular Biology Techniques

An extended laboratory practical 2 days a week (full-time) for 4 weeks.

Assessment

You will be required to complete 2 laboratory reports. The exact form of these reports and assessment will be detailed by the academic, but typically will involve either a laboratory write-up or completion of a proforma and an experiment written in the format of a scientific paper.

7BBBM109

Topics in Biomedical Science

(30 credits)

Topics in Biomedical Science

The aims of this module are:

- ➔ To provide an in-depth knowledge recent advances in a selected number of biomedicine and biosciences topics.
- ➔ To provide a comprehensive understanding of technical advances which underpin current research in biomedicine and biosciences.
- ➔ To enable students to search and prepare critical review material in specific topics.
- ➔ To broaden the general scientific interest of participants.

By the end of the course students should have:

- ➔ A consolidated knowledge of the key areas and recent developments in cardiovascular biology, neurobiology, genetics and biochemistry and molecular biology.
- ➔ An advanced knowledge in areas of current interest to biomedicine and biosciences.
- ➔ The ability to prepare and present critical reports on topics of interest.
- ➔ A critical awareness of current & emerging tools employed by researchers in biomedicine and the biosciences.

Module structure

You will attend over 30 lectures and tutorials in the following areas: Genetic Model organisms (yeast, nematodes, flies, mice, fish), Biochemistry (steroid receptor function and evolution, endocrine disruption and metallo-biochemistry), Cardiovascular Biology (regulation of blood flow, leukocyte-endothelial cell interactions and inflammation, growth of endothelium and blood vessels, and cellular and global mechanisms of heart failure), Molecular Biology (NMR, fluorescent proteins, RNA world and epigenetics) and Neurobiology (Neurobiology of pain, DNA microarray technology and pain research, Neurobiology of Depression, and fMRI and Depression).

Module assessment

The module is primarily assessed by examination. You will sit four exams: a 1hr Genetics exam, a 1hr Biochemistry exam, a 2hr exam on Cardio Biology, Molecular Biology and Neurobiology and a Précis exam. The Biochemistry exam will include Multiple Choice Questions (MCQ) and calculations. For the Précis exam, you will be given a research paper to read and you will summarise the main points in a short (~300 word) précis. A workshop on précis writing will be held before the examination.

7BBBM108

Specialised techniques workshops in Biomedical and Molecular Sciences

(30 credits)

Specialised techniques workshops in Biomedical and Molecular Sciences

1. Specialized techniques workshops

The module aims to teach specialised technical skills in bioscience disciplines, relevant to research projects and aims to equip students with particular skills that cannot be easily taught, hands-on, in large classes: for example electron microscopy, mass spectrometry, microarray technology, *in situ* hybridization, *in vivo* electrophysiology, brain perfusion, real time PCR, and neuronal regeneration etc. These workshops are run by specialists, most are from the Schools of Biomedical Sciences and Medicine, and each workshop offers a detailed study of a research technique or concept designed to broaden your technical skills. You will gain a detailed grounding in techniques which you may want to use in your MSc research project and to make you competitive in your future scientific career. Students must attend **three** of these workshops.

In addition to the specialized workshops students will attend over 10 generalist workshops (e.g. statistics, bioinformatics, database searches, intellectual property and patenting, bioethics, risk assessments etc).

Module Assessment

Students write a report on the three workshops attended (approximately 2500 words plus figures, tables and references.

7BBBM112

Skills in Biomedical and Molecular Sciences Research

(30 credits)

Skills in Biomedical and Molecular Sciences Research

The course consists of developing presentation skills and laboratory performance competency necessary for a research career in biomedical sciences. In detail the module will:

1. Develop oral presentation skills via two journal club presentations and a final oral presentation of their research project.
2. Develop communication and visual presentation skills via an interactive poster session.
3. Develop laboratory skills within an active research environment.

By the end of the course students should have the ability to :

- present clearly their research via an oral presentation
- present clearly their research via a poster presentation
- critically discuss their research with other scientists
- time manage experimental design
- be technically competent and conduct independent research in the laboratory.
- develop problem solving and trouble shooting skills.

Module Assessment

1. Journal Club Presentation

You will prepare two journal club presentations. For each session you will be expected to distil the relevant information into a 10 minute oral PowerPoint presentation to illustrate the major points.

2. Poster Presentation

You will be expected to make and present a poster based on your research project.

3) Final Oral Presentation

You will be expected to present a (short) PowerPoint presentation to provide an overview of your project followed by questions from internal and external examiners.

4) Laboratory (project) skill assessment

Your project supervisor will assess your skills as a laboratory scientist and will judge you on your attendance and reliability, technical and intellectual competence, contribution to the project and experimental design, progression towards independence in the lab and during the write-up-phase.

7BBBM113 (MSc) / 7BBBM114 (MRes)

Biomedical and Molecular Sciences Research Dissertation

60 credits (MSc) / 120 credits (MRes)

Biomedical and Molecular Sciences Research Dissertation

The module provides a research project for this MSc / MRes programme students in laboratories of experienced and leading researchers that will be conducted over a period of 6 months (MSc) or 9 months (MRes). The student will get individual attention and learn to develop skills in laboratory practice, designing and conducting experiments, collecting and analysing results, discussing the meaning of the data obtained, critically evaluating the data in terms of the broader picture of work in the area, organising time and managing a lab book on a day-to-day basis. The student will acquire deep knowledge through the reading of primary literature relevant to their research project. This will enable the student to compile a comprehensive written report of their research findings.

At the end of the project students should be able to:

- Design and carry out appropriate experiments to test hypotheses.
- Interpret results and summarise main findings.
- Carry out statistical analysis on data.
- Synthesise a large body of literature and in combination with the results acquired through independent research compile a large report consisting of abstract, introduction, materials and methods, results, discussion, conclusion and a correctly annotated bibliography.
- Present the report in a scientific format.
- Students should have developed research skills to a postgraduate standard.

Project Supervision

The project supervisor will spend time at the start of the project discussing the suggested topic, background reading, practical considerations, and timetabling.

The project supervisors will help in the following ways:

- encourage the student to plan the protocol and draw up the design of experiments.
- give assistance with learning how to calibrate, check and use equipment. You should understand the theory behind any apparatus used for your project work, not just its method of operation.
- give practical help initially during experiments, but thereafter encourage the student to work independently as much as possible.
- provide overall supervision of the student's work, with particular attention to regulations and safety.
- give guidance on analysis and presentation of data and on the most appropriate statistical tests for the data generated.

Module Assessment

The total length of the dissertation should be 11,000 – 15,000 (MSc) or 11,000 – 25,000 (MRes) (including figures, tables and references ext but not bibliography).

MRes only: The MRes students are required to submit a “Brevia paper”, a short 800 word summary formatted in the style of a “letter” to a scientific magazine.

Projects change every year and are hosted by experts in the field. Students will be able to choose from over 60 pre-approved projects which will be conducted in research active laboratories.
Examples of previous projects have included:

Detection of leukaemia immunity after haematopoietic stem cell transplantation
Hormonal control Zn signalling in epithial cells
Gene regulation in CHARGE syndrome
Epigenetic programming of endothelial dysfunction in gestational diabetes
Evaluation of a role of MTAP in the pathogenesis of cutaneous T-cell lymphoma
Resolution of pulmonary arterial hypertension (PAH) by small molecule reagents
Functional mapping of gene deserts in inflammatory bowel disease
A study of neutrophil intracellular cytokine production in patients with acute and chronic liver failure with the goal of improving long term patients' care
Reverse genetic characterisation of a novel gene family: from defining function to proposing a new nomenclature
Nanotechnology and improving drug delivery at the blood-brain barrier
Development of anti-fibrotic drugs from Chinese Herbs
Insulin signalling in neural differentiation and proliferation
Identifying novel antibiotic targets for the treatment of Pseudomonas infections in children
Role of the Wiskott Aldrich Syndrome protein (WASP) in Chronic Myeloid Leukemia (CML)
Structural characterisation of Ataxin-1, a protein implicated in neurodegeneration
Connecting metabolism and immunity in Drosophila
The role of mitochondrial function in neuropathic pain mechanisms of class switching to IgE in human B cells
Identifying Odz3 domains important for axon pathfinding and cell-cell interactions
Tropical UV- tolerant bacteria of the Great Barrier Reef provide a human mitochondrial model for improved metabolic health and cancer protection
Providing insights into Parkinson's disease via identifying proteins that control toxicity of alpha-synuclein
Metallomics and signal transduction
Identification of an inhibitor of ZAG's fatty acid binding function structure function studies of the p53 tumor suppressor family of proteins
The role of T-bet and Gata3 target genes during T helper cell differentiation
Role of eotaxin-1, 2 and 3 in airway smooth muscle motility in asthma
Nano-encapsulation of islet cells for improving cellular delivery of Insulin in diabetes
Confirmation of novel genes which mediate thrombus resolution
Mechanism of HBCD- induced Zn2+ signalling events in neuronal cells
Regulation of neuronal maturation by the RNA processing protein SFPQ
Quantification of lipid transporter expression in endothelial cells from pre-eclamptic pregnancies
Regulation of intestinal fructose transport by artificial sweeteners in vitro

Over the past few years over 40 papers have been published that have been authored by Biomedical and Molecular Sciences Research students, for example (underlines names in bold font are students from the course):

Nucleic Acids Research	Simon Burr, Anna Caldwell, Mei Chong, Matteo Beretta, Stephen Metcalf, Matthew Hancock, Matthew Arno, Sucharitha Balu, **Valeria Leon Kropf,** Rajesh K Mistry, Ajay M Shah, Giovanni E Mann, Alison C Brewer (2018). Oxygen gradients can determine epigenetic asymmetry and cellular differentiation via differential regulation of Tet activity in embryonic stem cells. Nucleic Acids Research, 46(3): 1210–1226.
Current Biology	Matsubayashi Y, Louani A, Dragu A, Sanchez-Sanchez B, **Serna-Morales E**, Yolland L, Gyoergy A, Vizcay G, Fleck R, Heddleston J, Chew T, Siekhaus D, Stramer B (2017). A Moving source of matrix components is essential for de novo basement membrane formation. Curr. Biol. 27(22):3526-3534.
Current Biology	Baron, Olga; Boudi, Adel; **Dias, Catarina**; Schilling, Michael; Noelle, Anna; Vizcay-Barrena, Gema; Rattray, Ivan; Jungbluth, Heinz; Wiep, Scheper; Fleck, Roland Alexander; Bates, Gillian; Fanto, Manolis. Stall in canonical autophagy-lysosome pathways prompts nucleophagy-based nuclear breakdown in neurodegeneration. Current Biology 27(23):3626-3642.
PNAS www.pnas.org	Yan Y. Yip, Stefano Pernigo, Anneri Sanger, **Mengjia Xu**, Maddy Parsons, Roberto A. Steinerand Mark P. Dodding (2016). The light chains of kinesin-1 are autoinhibited *PNAS* 113(9): 2418–2423.
EMBO reports	**Starling GP**, Yip YY, Sanger A, Morton PE, Eden ER, Dodding MP (2016). Folliculin directs the formation of a Rab34-RILP complex to control the nutrient-dependent dynamic distribution of lysosomes. EMBO Rep. 2016 Jun;17(6):823-41.
nature COMMUNICATIONS	Schlomann, Koller, Conrad, Ferdous, Golfi, **Molejon Garcia**, Höfling, Parsons, Costa, Soper, Bossard, Hagemann, Roshani, Sewald, Ketchem, Moss, Rasmussen, Miller, Lauffenburger, Tuveson, Nimsky, Bartsch (2015). ADAM8 as a drug target in pancreatic cancer. Nature Commun. 6, 6175.
PLoS GENETICS	Avet-Rochex A, Carvajal N, Christoforou CP, Yeung K, **Maierbrugger KT**, Hobbs C, Lalli G, Cagin U, Plachot C, McNeill H, Bateman JM (2014). Unkempt is negatively regulated by mTOR and uncouples neuronal differentiation from growth control. PLoS Genet. 10(9):e1004624.
Oncogene	Zhai C, **Li Y**, Mascarenhas C, Lin Q, Li K, Vyrides I, Grant CM, Panaretou B (2014). The function of ORAOV1/LTO1, a gene that is overexpressed frequently in cancer: essential roles in the function and biogenesis of the ribosome. Oncogene 33(4):484-494.
eLIFE	Yu T, Meiners LC, **Danielsen K**, Wong TY, Bowler T, Reinberg D, Scambler PJ, van Ravenswaaij CMA, Basson MA (2013). Deregulated FGF and homeotic gene expression underlies cerebellar vermis hypoplasia in CHARGE syndrome. eLife 2: e01305.
Cell	Clark RI, **Tan SWS**, Péan C, Roostalu U, Vivancos V, Bronda K, Pilátová M, Fu J, Walker DW, Berdeaux R, Geissmann F, Dionne MS (2013). MEF2 is an in vivo immune-metabolic switch. Cell 155: 435-447.
ChemComm	**Wang Y**, Blanco-Andujar C, Zhi Zl, So PW, Thanh NTK, Pickup JC (2013). Multilay nanocoatings incorporating superparamagnetic nanoparticles for tracking of pancreatic islet transp with magnetic resonance imaging. Chem Comm 49, 7255-7257.