Note: the info provided is correct as of May 2019 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

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:

È Evaluate and assimilate the scientific literature in a given subject area and to think critically about the results and methods.
È Devise a hypothesis that can be tested experimentally.
È Analyse data, appreciate the value of reproducibility of data and draw valid conclusions.
È Collect data and apply appropriate methods to test a hypothesis.
È Develop an ability to comprehend and synthesise complex information.
È Organize a work-schedule, stick to deadlines, and prioritize activities.
È 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)
   È Molecular Biology Techniques (50%)
   È Protein Purification (50%)

2. 7BBBM109 Topics in Biomedical and Molecular Sciences Research (30 credits)
   È Genetics: written exam (20%)
   È Biochemistry: Multiple Choice Questions (MCQ) and calculations (20%)
   È Précis Paper (20%)
   È January Exam (40%)

3. 7BBBM108 Specialised techniques workshops in Biomedical and Molecular Sciences (30 credits)
   È 12 compulsory workshops (not assessed)
   È 3 assessed workshops (100%)

4. 7BBBM112 Skills in Biomedical and Molecular Sciences (30 credits)
   È Journal Club Presentation 1 (3%)
   È Journal Club Presentation 2 (10%)
   È Poster presentation (17%)
   È Final oral presentation (20%)
   È Laboratory (project) skill assessment (50%)

5a. 7BBBM113 Biomedical and Molecular Sciences Research Dissertation (60 credits) – MSc only
    È Written dissertation (100%)

5b. 7BBBM114 Biomedical and Molecular Sciences Research Dissertation (120 credits) – MRes only
    È Brevia Paper (10%)
    È Written dissertation (90%)
7BBM 106
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.
7BM BBM 109

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 (N eurobiology of pain, DNA microarray technology and pain research, N eurobiology 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 Cardiology, 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.
7BBB M 108

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).
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.
7B B B M 113 (M Sc) / 7B B B M 114 (M Res)

Biomedical and Molecular Sciences Research Dissertation

60 credits (M Sc) / 120 credits (M Res)
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:

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

<table>
<thead>
<tr>
<th>Journal</th>
<th>Authors</th>
<th>Title</th>
<th>Reference</th>
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<tbody>
<tr>
<td>Current Biology</td>
<td>Baron, O liga; Boudi, A del; D ias, C ataria; Schilling, M ichael; N olelle, A nna; V izcay-Barrena, G ema; R attay, Ivan; Jungbluth, H einz; W eip, Scheper; F leck, R oland A lexander; B ates, G illian; F anto, M anoils. Stall in canonical autophagy-lysosome pathways prompts nucleophagy-based nuclear breakdown in neurodegeneration. Current Biology, 27(23):3626-3642.</td>
<td></td>
<td></td>
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<tr>
<td>EMBO reports</td>
<td>Y an Y, Y ip, Stefano Pernigo, Anneri Sanger, M engjia X u, M addy Parsons, Roberto A, Steinerand M ark P. D dodding (2016). The light chains of kinesin-1 are autoinhibited PNAS 113(9): 2418-2423.</td>
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We currently offer two competitively awarded scholarships which provides the means to enhance the project. Details are provided on the following two pages.
The Savile Club Scholarship

The Savile Club was established in 1868 by a group of the most distinguished writers and artists of the time. Its home is a fine 18th Century house in the heart of Mayfair, whose air of elegant exclusivity reflects the uniquely creative ambiance which continues to flourish in the Savile Club of today. Whilst membership remained varied the Club established itself at the heart of literary London having gathered Robert Louis Stevenson, Thomas Hardy, HG Wells, Rudyard Kipling, Compton Mackenzie, Max Beerbohm and WB Yeats amongst others, around the Club table. Music was represented with equal lustre over the years by Charles Villers Stanford, Arthur Bliss, William Walton and Edward Elgar and our scientist members have included Lord Kelvin, John Cockcroft and Lord Rutherford (https://www.savileclub.co.uk/).

The Savile Club is full of history and a haven of tranquillity set within the hectic buzz of Central London. Having said this, it is equally current, dynamic and forward looking. We are fortunate to have received generous support from the Savile Club who have established and funded a superb scholarship scheme. The recipient of the annual Savile Scholarship (valued at £5000) benefits from additional support which can be spent on costly experiments that would not be possible otherwise or travel abroad to use a specialist piece of equipment. The competition is open to students enrolled in one of the following Master-level courses taught at King’s College London: the MSc/MRes in Biomedical and Molecular Sciences Research, the MSci in Biochemistry and the MSci in Molecular Genetics). The work conducted by our scholars is a testament to how the Savile Scholarship has played an instrumental role in supporting and enhancing scientific discovery.

Prof Stephen Sturzenbaum, Director of the MSc

<table>
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<tr>
<th>Year</th>
<th>Savile Scholar</th>
<th>Project title and Savile &quot;add on&quot;</th>
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</table>
| 2019 | Yang Liu       | **Is ZIP9 a target for endocrine disruption?**  
The Savile Scholar carried out part of the project at the TU University of Dresden in the laboratory of Prof Günter Vollmer, a world leading authority on endocrine functions of environmental chemicals. |
| 2018 | Krystyna Broda | **Investigating Mitophagy Mechanisms in the Immature Brain**  
The Savile Scholarship provided an unrivalled placement opportunity in Prof Henrik Hagberg’s lab (University of Gothenburg) taking advantage of unique mitophagy models (the mito-Keima mouse) and cutting edge equipment (live imaging via the Airyscan super resolution and ELYRA-SIM microscopy). |
| 2017 | Segen Negash   | **Defining molecular drivers of brain regeneration**  
The Savile Scholarship funded a secondment to Prof Molnar’s laboratory (University of Pécs, Hungary) providing an opportunity to complement the molecular biological techniques of the project with histochemical techniques. |
| 2016 | Rajinthan Rasiah| **Identification of Teneurin-interacting proteins and protein domains crucial for synaptic localisation**  
The Savile Scholarship gave the student the unique chance to carry out a high throughput interaction screen using a state-of-the-art robot-assisted platform in the laboratory of Prof. Igor Stagljar, an expert in membrane protein interactions at the University of Toronto, Canada. |
| 2015 | Tze Shin Teoh  | **Isolation and characterisation of human cardiac stem cells from aged and diseased hearts**  
The Savile Scholar worked at the Center for Regenerative Medicine at the Mayo Clinic, Rochester, USA in Prof. Deursen’s lab, a pioneer in cellular senescence and the ageing phenotype of different organs. |
Matt worked in my laboratory for six months. His research was performed with the best of diligence and the highest degree of intellectual engagement and this provided remarkable novel insights into the mode of inhibition of protein tyrosine phosphatases. Matt participated in all steps of preparing the manuscript we published as a Report in the Journal of Biological Chemistry the following year (M. Wilson, C. Hogstrand, W. Maret (2012) Picomolar concentrations of free zinc(II) ions regulate receptor protein-tyrosine phosphatase β activity. J. Biol. Chem 287, 9322-6). The publication criteria requires exceptional novelty, significance and broad interest and the quality of an article must fall within the top 5 percent of all articles published in the journal. Testament of Matt’s contribution to science is the fact that his paper has, to date, been cited over 120 times by the research community.

Prof Wolfgang Maret, Matt’s Project Supervisor

Matt was an incredibly modest person who did not want classmates and colleagues to know about his ongoing Cancer treatment during his MSc. Following the impressive performance in his MSc, he moved to Germany to study for his PhD in Virology but unfortunately had to return to the UK for further treatment. Despite being ill, his determination was unshaken, and he inquired whether he could continue to work with Prof Maret whilst being treated. Unfortunately, this second period of work did not come to fruition due to the untimely loss of his life. He will be remembered for his equanimity under the worst circumstances, his friendliness, and his true dedication to the course and meaning of scientific work.

Prof Stephen Sturzenbaum, Director of Matt’s MSc

In memory of Matt’s exemplary contributions, we initially set up the Matt Wilson Prize, awarded annually to the “best overall performing” Biomedical and Molecular Sciences Research MSc student. Past recipients were:

<table>
<thead>
<tr>
<th>Year</th>
<th>Matt Wilson Prize</th>
<th>MSc Project</th>
</tr>
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<tbody>
<tr>
<td>2018</td>
<td>Bethany Sinclair</td>
<td>The role of MITD1 in primary cilia formation</td>
</tr>
<tr>
<td>2017</td>
<td>Lauren Dawson</td>
<td>Therapeutic use of regulatory T cells in liver disease</td>
</tr>
<tr>
<td>2016</td>
<td>Julia Taylor</td>
<td>The impact of TP53 mutations on the cellular response to Nutlin-3a and chemotherapeutics</td>
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<tr>
<td>2015</td>
<td>Alexandra Willis</td>
<td>The influence of p53 status on chemotherapeutic drug-induced expression of CYP1A1</td>
</tr>
<tr>
<td>2014</td>
<td>Pascale Eede</td>
<td>The role of RANK, RANKL and OPG in perinatal brain injury</td>
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In addition, and thanks to a generous donation from Matt’s family, we were able to establish a scholarship scheme in 2018 to enhance one Biomedical and Molecular Sciences Research project. Valued at £2500 per annum, the award provides added-value to a research project by enabling costly experiments to be performed that otherwise would not be possible. The scholarship is a wonderful way to ensure that Matt’s legacy lives on! It is our pleasure to introduce Noor Siksek, the first Matt Wilson Scholar!

Noor Siksek graduated with a BSc in Chemistry from the University of Leicester. As an undergraduate, Noor specialised in biotechnology researching how molecular imprinted polymers can be used for drug delivery to cancer cells.

Noor began her MSc at King’s College London in 2018, during which she had the opportunity to conduct a 6-month research project in the field of radiobiology. Her research aims to assess the safety of the imaging radiopharmaceutical $^{99m}$TcO$_4^-$ for non-invasive SPECT imaging. Thanks to the scholarship, she was able to expand her project to include in-vivo imaging and radionuclide therapy and has submitted her work for presentation at the Auger Symposium in Oxford to be held in August 2019. Noor intends to start her PhD in the same field and pursue a career in academic research.

Noor Siksek, recipient of the 2018 Matt Wilson Scholarship