#UROS2018

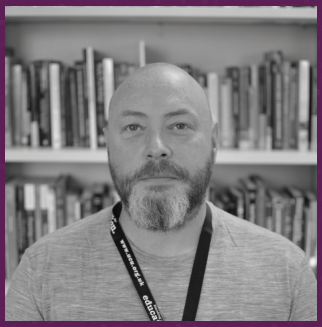
PROJECT SHOWCASE

UNIVERSITY OF LINCOLN

Lincoln Academy of Learning and Teaching

Undergraduate
Research
Opportunities
Scheme

FOREWORD



Fundamentally universities are places where new knowledge is discovered. All of the participants in higher education are in a sense explorers, and the most rewarding and exciting activities that we can undertake lead us to further our understanding of the world.

Here at the University of Lincoln, staff and students are all part of a shared academic community, with the discovery of new information as our collective goal. The Student as Producer philosophy, whereby students are not merely the recipients of 'received wisdom' but are rather the creators and co-creators of new knowledge, is a fundamental part of every course's design.

The Undergraduate Research Opportunities Scheme (UROS) is both a celebration and perhaps the most explicit manifestation of this ethos, providing staff and students with the support and time to work together on joint projects. This enables the development of skills for students by providing them with a deeper understanding of the research process, and benefits staff by providing them with an opportunity to deepen or broaden their research activities and to expand their research network to include new student members.

The number and standard of applications for UROS bursaries has been growing year upon year, and I was extremely impressed with the high standard of research projects for 2018.

Dr. Garry Wilson
Dean of LALT

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> Applying for a UROS bursary

The Undergraduate Research Opportunities Scheme (UROS) is designed to encourage undergraduates to become actively involved in the research work of the University. UROS embodies the principle of 'Student as Producer', which underpins the Lincoln approach to teaching, learning and student engagement.

UROS offers a unique opportunity for students to work alongside academic researchers to engage and gain hands-on research experience on projects covering all disciplines across the University.

Successful projects are awarded a bursary of up to £1000 to support students with their research projects which would normally be completed during the summer break. Students taking part in the scheme are required to produce a blog report and poster to showcase their research at an exhibition event.

Applications are invited from both academic schools and professional services departments for stand-alone projects, or form a subsidiary part of larger scale research work, that could be completed by an undergraduate student working under the supervision of a member of academic staff. The completed application form must be submitted collaboratively by the staff and students participating in the project.

> How to apply

The application window for UROS opens each year on the 1st September, and closes on the 31st January.

Applications are invited from both academic schools and professional services departments for stand-alone projects and be separate from curriculum work. Applications should be jointly completed by the supervising academic and collaborating research student.

As a competitive programme, all applications will be scored by reviewers against key criteria, and successful applicants will be notified in March.

Find out more:

uros@lincoln.ac.uk

lncn.eu/UROS

Will Ash Dieback Alter the Future Direction of an Ancient Woodland

by Abbie Edwards (BSc Biology) (Supervised by Dr. Michael Gillman)

Our eight-week project was dedicated to finding out if ash dieback (a fatal fungal disease of ash trees) would change the future direction of an ancient woodland. We carried out our research in Treswell Wood in Nottinghamshire, which is dominated by ash and oak trees. Interestingly, in 2013, a unique experiment at the wood began, to observe how rapidly components of the woodland could recolonise a neighbouring area of arable land. We recorded ash saplings in the piece of arable land and in the woodland to investigate the effects of ash dieback.

Data collection was carried out at the beginning of each week and data processing and sharing of the findings would be done by the end of each week. Regular meetings at Treswell took place to discuss and review how the project was progressing. Deciding on our sampling methods was a brilliant opportunity for me to understand how field research is conducted. Gauging what was possible to complete in a relatively short time was challenging and constant reviewing of the project was essential to ensure we chose to collect the most meaningful data.

What I loved most about this project was its uniqueness. Collecting data in the wood that hadn't been looked at before gave me a great feeling of excitement and drive to discover something unknown. I hope our findings can be used to predict the future direction of this ancient woodland and further afield across the UK where ash tree populations are threatened. Ash is a keystone species in many ecosystems and its loss will disrupt many environments; from species dependent on ash to survive to industries that produce sports equipment from ash timber.

"Taking part in a summer research project has given me the experience I needed to decide whether a career in field research is for me; and it definitely is."

Developing Therapies for Migraine

by Alex Sharp (BSc Psychology) (Supervised by Louise O'Hare & Andrea Pavan)

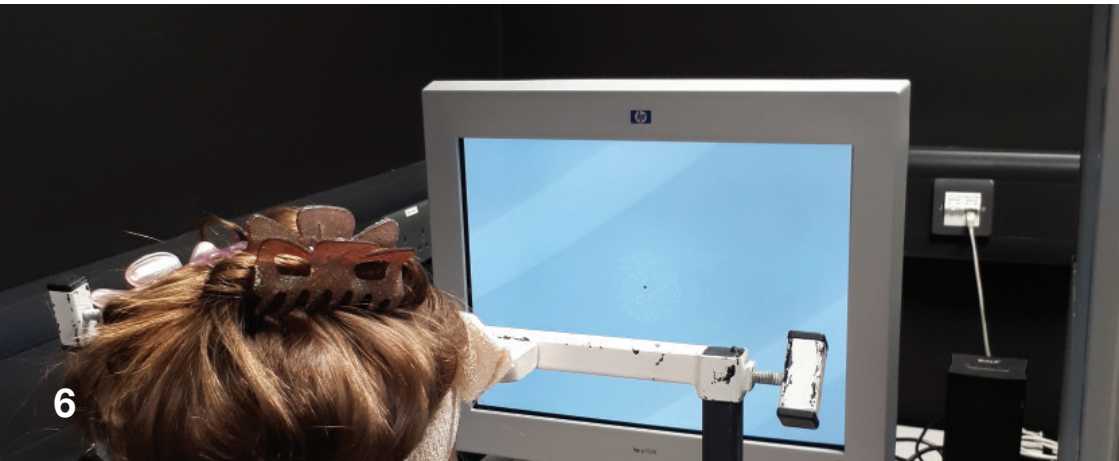
For my project, I had the opportunity to investigate whether transcranial electrical stimulation can enhance participant performance on a motion discrimination task, which in the past has been found to be a difficult task for migraine sufferers. If this is the case, then this stimulation may be able to stop the build-up of neural activity in the brain, and hence may be able to stop a migraine attack before it happens.

Over the summer I had the chance to use new equipment and learn new skills that I can take with me post University. The project threw some challenges my way, but I managed to overcome them and complete the project successfully. I originally aimed to complete the testing within one month, however, with these challenges I soon realised this was overly optimistic and this ended up lasting two months.

This experience has taught me many things about myself, including my ability to work with others as a team, communicate complex information to others, and to adapt to different situations to make sure I overcome any challenges thrown my way.

I believe I can take this knowledge with me in the future into my third year, and hopefully into postgraduate study and beyond.

"I have learnt many more research skills in addition to the core skills incorporated into the course, and have made some staff contacts which I believe will be valuable in the future."



Exploring Young Women's Fear of Terrorism and Attitudes Towards Extremism and Terrorism

by Amy Gibbons (BSc Criminology) (Supervised by Dr. Joshua Skoczylis)

This project attempts to explore how and why young women may experience fear towards terrorism and extremism differently to men, and to also explore respondents' political attitudes towards extremism and terrorism in general.

This project involved collecting quantitative data through an online survey and analysing it using SPSS, as well as conducting an in-depth literature review to help situate the findings.

The focus on women comes from looking at the literature and finding there is a lack of research on gender differences and research has shown that women are more fearful of crime in general. This is thought to be due to the "shadow of sexual assault", and this fear is thought to 'shadow' other fears, like terrorism. From our findings we hope to highlight any improvements to counter terrorism policy and to also discuss and make more people aware of how such policies impact women.

The project began delayed due to ethical approval taking most of June, followed by slow responses to the survey, so data collection lasted most of July. We predicted to get over 300 responses but a more educated prediction would have been around 100 and this is one important aspect of conducting research that I have learnt for next time. We were also unable to get any participants for the semi-structured interviews, but in hindsight, due to delays, it would have been hard to conduct them, transcribe and analyse them all within the time frame.

Working with my supervisor, Joshua, was great as he gave so much time helping with the more difficult aspects of the project such as the ethics form and creating the survey on Qualtrics, which I had not used before. He also gave me more responsibilities and independence when it came to analysing and making my own conclusions from the data, as well as giving me the opportunity for an A-level student to shadow me for the week. I was able to help her understand the research process as well as what it is like studying criminology and university life in general. We also had the opportunity to observe at the magistrate's court for a day which was insightful.

Precision Agriculture - A Key to Climate Change Resilience in Farming

by Bartholomew Hill (BSc Geography) (Supervised by Dr. Iain Gould, Dr. Joseph Harwood, Dr. Daniel Magnone & Dr. Dilkushi de Alwis Pitts)

This project involved collecting quantitative data through an online survey and analysing it using SPSS, as well as conducting an in-depth literature review to help situate the findings.

The methods involved three steps, the first being fieldwork where moisture content, GPS data and 39 soil samples were taken. A drone was used as well to get a topographical view. The moisture content was re-measured at each point over a four-week period to get temporal data. Next was lab work where the samples were sieved multiple times to different seizes down to 63 microns for processing and multiple tests were run. These included XRF, Mastersizer Grainsizing, Loss On Ignition giving us multiple parameters and an extensive dataset.

Finally, in the data analysis stage we gathered the COSMOS probe data to compare to the data we collected, and we used to T-Test (R-Values) and Pearson Regressions Coefficients to check for relationships between two parameters and then reviewed literature to see if this had been looked at.

We found that there are lots of interlinked factors affecting each other within soils making it complicated to assess. However, moisture content was found to be directly linked to organic matter and this link was especially strong during dry periods meaning it affects soil water retention specifically. We also found there is a link between water gain after precipitation and the original moisture content.

Overall, I found the experience very useful as it gave me an insight into academic research and allowed me to become independent in my work and thought processes. I found it challenging to sort all the data and find good ways to describe the data I had along with time management as some processes took a long time to complete making it hard to get it finished in time.

The Acquisition of Pitch Identification Abilities in Autism Spectrum Conditions

by Ben Handysides (BSc Psychology) (Supervised by Dr. Niko Kargas)

For many people, the phrase 'autistic savant' conjures up images from the iconic film 'Rain Man', of extraordinary talents such as calendar calculation, lightning arithmetic and the ability to draw complex scenes from memory.

As far back as I can remember I have always been drawn to research, particularly in psychology, and being diagnosed with ASC myself has naturally lead me towards autism research, which I hope to pursue as an academic career.

Naturally then, when I first heard about UROS, I jumped at the opportunity. I was part way through my undergraduate dissertation at the time, gathering data from a neurotypical sample, with the intention of continuing the study at master's level using a clinical sample.

I decided to change this plan, bringing my masters project forward, when I found out about the UROS bursary. A decision I am glad I made, as it meant that I would be gaining experience working with people with ASC in a research capacity for the first time, with a sense of security that I could use the funding to overcome any obstacles.

I worked with several people to overcome this, but most notably my supervisor, Niko Kargas, who invited me to attend an autism group forum where I could tell potential participants about my study in person. I also worked alongside another researcher, sharing participants as our projects made use of some of the same data.

UROS has been an incredibly rewarding experience for me. I feel like this summer has passed in the blink of an eye, yet in such a short space of time I have gained new skills and developed existing ones. I have learned the importance of networking and self-reflection in psychological research, and most importantly I have had a taste of the world of academia, and realised the path I have chosen is the right one.

"In such a short space of time I have gained new skills and developed existing ones. I have learned the importance of networking and self-reflection."

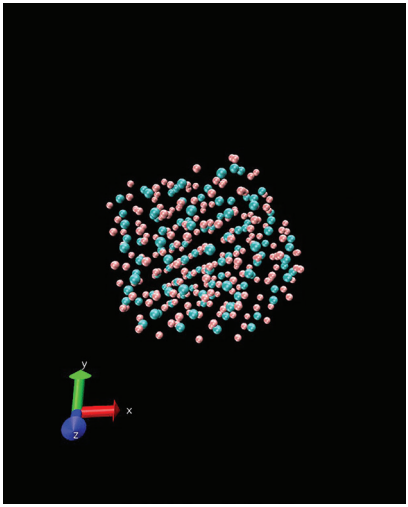
Docking and Encapsulating - Building an ad-hoc Supercomputer

by Ben Kendrick (BSc Mathematics) (Supervised by Dr. Matt Watkins)

Suppose you want to run a simulation of the universe in its initial expansion. The explosion of the big bang is a random process in the program you have created, so you want to run it many times. The problem is that each simulation takes hours to run so it's incredibly impractical to do each run back to back on your computer. What if instead we could run the simulations on a whole room of computers at once, how much time would this save? How energy efficient is this system? How do we even do it? These questions and many more were the basis of my research project.

The project itself was split up into two main parts. Firstly, to set up the system of computers, or cluster, that could talk to each other and more importantly, send a job from one machine to all the others. For this step we looked to HTCondor. This software was used to sort out the networking side of the project.

The second half of the project was to create and run a full-scale production job on the cluster to really investigate its capabilities. For this we used a program called GROMACS, which is a molecular dynamics simulation software, mainly used for protein simulations but in our case, we used GROMACS to run simulated annealing on different clusters of Calcium Fluoride. The idea being that the heating and cooling of the atoms would be a random process and the final positions and energies would be interesting to analyse.
To do this we used VMD, a program which visualises data from molecular dynamics.



VMD program visualisation of data from molecular dynamics

I have learnt an incredible amount of new skills throughout this project, more than I ever thought I would. Firstly, I had never used Linux before, so learning this new operating system as well as other skills such as bash scripting has been very useful, as well as being a lot of fun too. To be given the opportunity and time to learn how to use this range of programs and coding languages has been wonderful, and I thoroughly thank Matt Watkins for this as well as his continued support and enthusiasm. Looking ahead to the future I can already tell how useful the UROS project scheme will prove to be.

"I feel incredibly happy with the work and research we have done, and lucky that I had the chance to be part of it."

Influence of Lecture Start Times on the Sleep Behavior of University Students

by Carly Mann (BSc Psychology) (Supervised by Dr. Michael Mireku)

My UROS research project was conducted to find out whether class start times influence student sleep behaviours the previous night, such as bed time, sleep time and sleep duration. This data was collected using a questionnaire with demographic, lifestyle, sleep behaviour and class time questions for students who had a lecture that same day. When being asked to conduct a study over the summer with a supervisor, I was eager to take the opportunity as it is a good experience for a future in the field of Psychology.

At the beginning I was slightly worried about data collection as I had to collect 160 questionnaires within a 10-day period during exam season, however, I made it possible by managing my time and building the confidence to approach multiple students a day; something I thought I wouldn't have been able to accomplish.

After collection, I spent a couple of weeks cleaning data which enabled me to learn a variety of new skills regarding statistics; the majority of which are not taught in Research Skills lectures, such as creating new variables in SPSS with formulas and coding.

Despite how challenging and daunting the data analysis was, this project gave me the opportunity to learn essential statistical skills that will be extremely beneficial during my third-year dissertation and in postgraduate study.

In addition, whilst writing the research paper, it was a different experience compared to writing a Research Skills assignment due to the vast amount of feedback from my supervisor regarding corrections and how to make the paper sound more professional.

"I have gained important skills required in order to conduct a research project fairly independently, hopefully benefitting my experience with my dissertation in the final year."

Raising Educational Aspirations of Students from Deprived Backgrounds: An Evaluation of a Student-Mentoring Scheme

by Elena Gaschino (BSc Criminology) (Supervised by Dr. Anna Tarrant & Gary Saunders)

The educational under-achievement of working-class boys, which remains a key public and policy challenge in the UK, is what inspired a senior member of staff at a school in Lincoln to establish a student-mentoring scheme.
The scheme aims to promote the educational aspirations and successes of these boys in the school. Volunteer undergraduate students from the University of Lincoln were recruited and trained to act as mentors for the boys taking part in this scheme.

Through UROS, I was given the opportunity to work as part of a research team, tasked with evaluating the student-mentoring scheme. The evaluation sought to establish whether the scheme had benefitted the boys it had engaged, and to identify areas of improvement.

From the very beginning of this project I have learnt how to work with research partners, write an ethics form, conduct research, analyse qualitative findings and write a research report and blog.

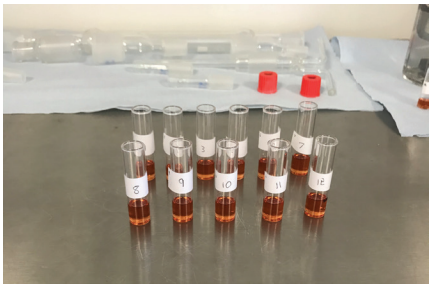
I was inspired to read academic books that I may not have chosen to this summer and my knowledge and understanding of the challenges faced by boys from a working-class background has grown. I have also gained insights about societal issues including social mobility and gender identity, which I know will benefit me in my future studies and career.

Investigating the Effects of Ligand Exchange on $CuInS_2$ Quantum Dots

by Ewan Pickersgill (BSc Physics) (Supervised by Dr. Matthew Booth)

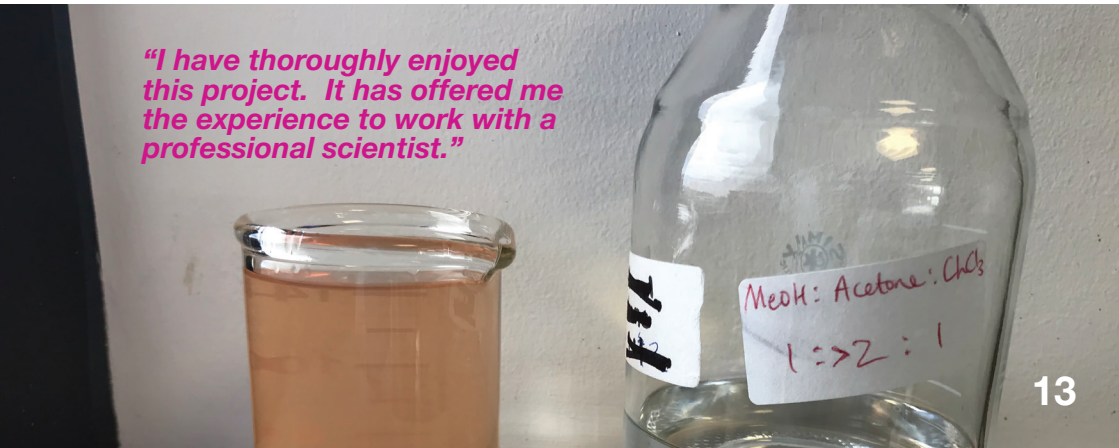
The aim of this project was to investigate the effects of ligand exchange on $CuInS_2$ (CID) quantum dots (QDs). QDs are semiconductor nanocrystals, made up of central metal atoms surrounded by molecules called ligands, that are showing great potential for applications in photovoltaic devices and biomedical labelling and imaging mainly because of their tuneable band gap. CID QDs are particularly promising because of their small size and relatively low toxicity. By exchanging longer ligands for shorter ones, we aim to form a superlattice of periodic structure and improve the conductivity of the material.

We began by synthesising the CID QDs and heating them to allow nucleation and growth of the crystals. We then let them cool, so we could put them into test tubes. After the initial synthesis the QDs will have dodecane thiol (DDT) as their passivator. We then cleaned them, using centrifugation, to remove any unwanted waste products from the synthesising process, after which we performed spectroscopy to measure the photoluminescence (PL) and absorption as a function of wavelength.



This allowed us to determine the concentration of QDs in the sample, so we knew how much mercaptopropionic acid (MPA) to add to get a QD to MPA ratio of 1:50 and 1:100. MPA is the shorter ligand we aimed to exchange DDT for. We did this in two solvents, chloroform and methanol and tested the effects of copper iodide to see if it would improve the ligand exchange.

Once we have verified the ligand exchanged was successful, we will use NMR to determine the contents of the sample and the local structure. We will then deposit the sample onto a surface.



"I have thoroughly enjoyed this project. It has offered me the experience to work with a professional scientist."

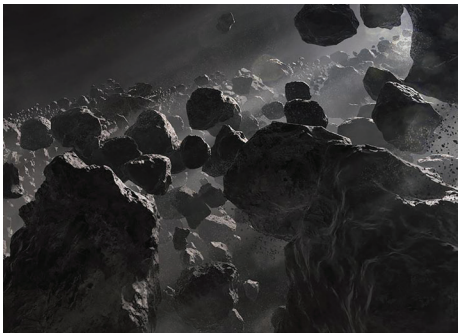
Numerical Constraints on a Potential Embedded Exomoon in the J1407b Exoring

by Felicity Levett (BSc Physics) (Supervised by Dr. Phil J. Sutton)

The aim of the project was to calculate details on a satellite orbiting around an exoplanet in another solar system. J1407b, a planet over 20 times the size of Jupiter, is situated around 433 light years from earth.

Using C++, a program was made to calculate how the mass of the planet would affect the potential moon that carving I's way through the planetary rings. This gap within the rings, also gives clues as to what the size of the moon is, which was the second task completed in C++. The data determined by the programs on the orbital period of the moon and its mass, was then compared to the theorised data already published.

Computational work is prominent within my course, and so this research offered me a chance to code, in what I find a difficult language. However, by completing the programs, I am now able to take this knowledge forward into my final year at university and feel more confident in my own skills.



A personal challenge for me was time management and trying to complete the work independently. Though, my supervisor Phil was amazing and always offered continuous support if I need.

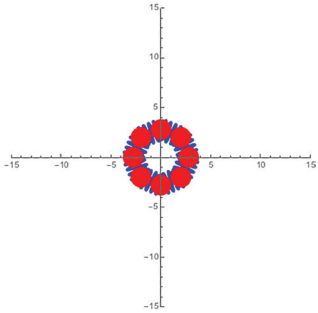
"So, did I find UROS helpful? Yes. Yes I did."

Simulating Quantum Mechanics: The Ring Polymer Method

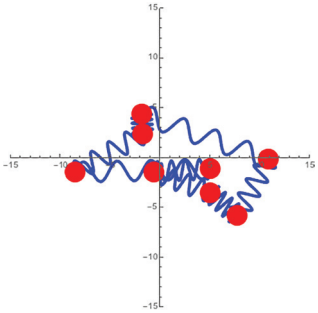
by Jago Whale (BSc Mathematics & Physics) (Supervised by Dr. Fabien Paillusson & Dr. Bart Vorselaars)

In light of the seemingly extremely counter-intuitive nature of quantum mechanics and the peculiar behaviour of quantum particles, it can be extremely difficult, if not impossible, to envisage what is actually happening on the length scales involved. The topic I chose to adopt would be the ring polymer method of modelling quantum behaviour. The Ring Polymer Method successfully allows us to simulate quantum mechanical behaviour in a way that lends extra perspective when it comes to trying to envisage quantum behaviour that we would otherwise have little intuitive comprehension of.

The Ring Polymer Method provides a versatile tool for doing this in that there exists an isomorphism, or a mathematical "mirror image", between the mathematics of a quantum particle in a heat bath and a particular classical ensemble.



Over the projects course, I researched various advanced areas of mathematics and physics such as Lebesgue integration, functional calculus, statistical mechanics, Langevin dynamics and most crucially the path integral formulation of quantum mechanics.



I then wrote up the body of code of the simulation in the language 'Python' for the computational portion of the project. By this method we transform mathematically the task of having to compute the contributions to the path integral by having a computer calculate explicitly the classical actions of a large number of possible paths and summing over their complex exponentials, into a task of simply sampling the configurations of an isomorphic classical system. The specific classical ensemble I simulated then exhibits the same statistics as the quantum particle to be modelled.

"The UROS scheme has been hugely enriching. The knowledge I have acquired will aid me in my final year of university and perhaps provide me with a great platform from which to plunge into scientific academia should I so choose."

Sequence Analysis of Violence in Forensic Youth Populations

by James Starritt (BSc Psychology with Forensic Psychology) (Supervised by Dr. David Keatley)

The purpose of this study was to explore the sequence of behaviours exhibited by a perpetrator prior to an act of violence.

The study used Behavioural Sequence Analysis (BSA), which is a novel method of mapping behaviour over time. This has been successfully used in prior research to understand the temporal chain of events that lead to violent episodes.

BSA was completed on ex-post facto CCTV footage of violent incidents from a Secure Children's Home in England.

The first challenge to be overcome was satisfying the School of Psychology Research Ethics Committee of the appropriateness and feasibility of the research, due to the age and status of the subjects.

The second challenge was developing a qualitative screening criteria for samples, and ensuring that a sufficient number of samples which met this criteria were collected. Ultimately, nearly 50% of samples were screened out, which increased the length of time that the data collection took, but ensured integrity.

As a first year undergraduate, participation in UROS has given me significant insight into the requirements of research, specifically regarding the acquisition of underpinning knowledge through reading and consultation with academic staff.

As a mature student, being able to immediately apply knowledge to a practical project has improved my understanding and application of BSA principles.

Finally, it is the ambition of my research supervisor and I to publish our findings; I felt substantial responsibility for justifying every decision made. I therefore ensured critical evaluation of the methodology I used.

A Study into Lameness in Sheep at Riseholme Farm

by Logan Newstead (BSc Bioveterinary Science) (Supervised by Dr. Simon Clegg)

Footrot is an infectious disease that affects sheep and other livestock. Caused by the bacteria Dichelobacter nodosus, it is typically treated with antibiotics. However, the growing threat of antimicrobial resistance increases the need to find alternative treatments.

As part of my UROS project I carried out a clinical trial testing a new product targeted to treat footrot. This involved both field and laboratory work, from herding and handling sheep to culturing microorganisms and carrying out DNA extraction and PCR.

My UROS project has allowed me to develop vital skills that will benefit me as I progress through my degree and subsequent career; I was involved in project design and had to work independently and efficiently.

I also found it incredibly useful to have the chance to work in the Joseph Banks Laboratories, following the correct protocols and learning my way around, as this is where I will be carrying out my third year project.

"Overall, the UROS experience is very well organised and supported, allowing students to get a taste for independent research."

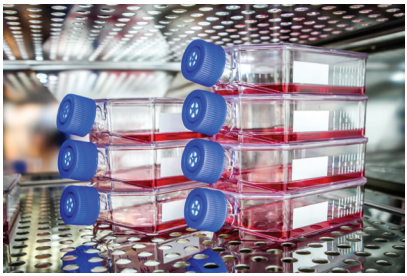
Characterising the Effects of Disease-Associated Single Nucleotide Polymorphisms in AdipoR1 on Protein Distribution and Function

by Peter Fell (BSc Biomedical Science) (Supervised by Prof. Jon Whitehead)

My project focussed on the disease Retinitis Pigmentosa (RP) – a genetic condition that causes a breakdown and loss of cells in the retina, ultimately resulting in blindness. The research aimed to characterise key properties of single nucleotide polymorphisms (Y310C and M309R).

The project was carried out across a period of six weeks in the university laboratories, performing various experiments and developing reams of results to interpret.

I found the experience of learning dozens of new, interesting protocols very exhilarating, and I found myself learning more in a week of hands-on work than I ever would have learnt in a lecture or timetabled laboratory session.



As the work continued, I found myself learning and using scientific language frequently, and it felt rewarding, yet surreal, to be able to use phrases I had learnt in lectures within the professional working environment.

This project has prepared me for after my undergraduate degree in many ways; I feel that my knowledge of my subject has been deepened immensely, and that my passion for science is greater than ever. The project also gave me a taste of the world of research, and has made my path after University much clearer. Overall, I feel that UROS has made the end of University much less frightening, and has given me the chance to gain vital experience that will help after graduation.

The Effect of Soy Protein and Yeast on the Sensory Quality of Beef Meatballs

by Sophie Bowers & Gabrielle Smith (BSc Food Science and Technology) (Supervised by Dr. Oluyesi Moses Ajayi)

When developing a new food product, it is important to not just focus on a single factor, but encompass all quality aspects. It is essential for the product to be accepted by the target market. The organoleptic qualities including the aroma, appearance, texture and taste are all therefore important, however the nutritional quality is equally as significant. When substituting an ingredient, this is even more imperative.

The research project that we worked on looked at the effect of texturised soy protein (TSP) and nutritional yeast on the instrumental and sensory quality of hybrid beef meatballs. By substituting quantities of beef and replacing it with TSP and yeast, analyses was carried out to evaluate the effect and determine the most desirable and best meatball recipe.

In conclusion, the evidence suggested that partial substitution could be successful in beef meatballs. The meatballs prepared with 15% TSP and nutritional yeast were the most preferred organoleptically and also positively benefitted the nutritional composition by reducing the fat content and increasing the protein content.

From completing the UROS project, we have gained an invaluable insight into the planning stages of a project as well as the continuous management required throughout to ensure its completion.

After completing the project on substitution of beef in meatballs, it has made us want to research further into this topic of interest as we feel that it would be beneficial to the food industry, both in the meat industry and general food industry through principle. It is also an area that we have great awareness of and interest in.

"When working with researchers, we have been able to gain knowledge and develop our own skillset from their experience."

Loading Sputtered Porous TiO_2 Thin Films with $CuInS_2$ Quantum Dots

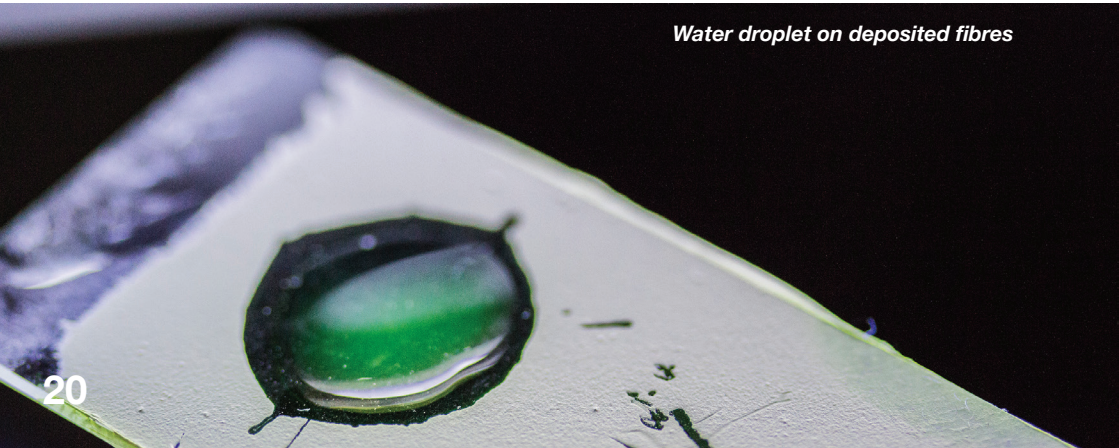
by Sorcha Hulme (BSc Physics) (Supervised by Dr. Matthew Booth)

My project has changed much since its conception, as during the course of the research new facets for exploration were discovered, some with very exciting prospects. One such facet was electro spinning, a well-known and well-used technique within engineering. This process involves subjecting a small meniscus of polymer to a very high voltage. This causes the polymer to form a tiny strand, which dries into a nano-fibre. This then forms a candy-floss-like material, which can be manipulated and used in a myriad of ways.

A phenomenon observed within this process was that fluorescein, a fluorescent dye, stops being fluorescent at a specific point in the spinning. As this had never been researched before, a couple of questions arose; firstly, why does the fluorescein stop being fluorescent, and secondly, can the quenching point be used to determine the drying point of the fibre, something previously unknown in the process.

This new line of research came with its own new challenges; namely, how do we collect the data needed as accurately as possible whilst preserving the process. Also, due to the nature of the process there were several small hurdles with perfecting the set-up, and fortunately all of these were passed.

One of the biggest skills I will be taking away from this project is learning how to collaborate with lots of different people over lots of disciplines, and also learning how to pull everything together to achieve the best outcome.



Water droplet on deposited fibres

Hybridisation Between Wolves and Dogs in Europe

by Thomas Jones (BSc Biology) (Supervised by Dr. Malgorzata Pilot)

My research project aimed to assess the extent of hybridisation between Canis lupus and Canis lupus familiaris in Europe. By analysing mitochondrial DNA sequences, fifty-seven individual haplotypes were identified, the majority of which were found in both wolves and domestic dogs; some haplotypes were found in only in domestic dogs. No haplotypes were identified that were exclusive to wolves. The data acquired does suggest that hybridisation is occurring, but this could be confirmed through analysing bi-parental DNA markers in future research.

The DNA was extracted by following one of two protocols depending on whether it was to be isolated from saliva or tissue, the saliva protocol was mainly centred around incubation and the tissue protocol was mainly centred around centrifugation. The DNA was then quantified, purified and duplicated using PCR. Gel electrophoresis was then used to check that the previous steps were all successful.

The DNA was sent to an external laboratory for mitochondrial sequencing, the resulting sequences were then aligned and only one of each unique sequence was retained to include in the median-joining network. The sequences were compared to an online database to identify the subspecies in which they were found.

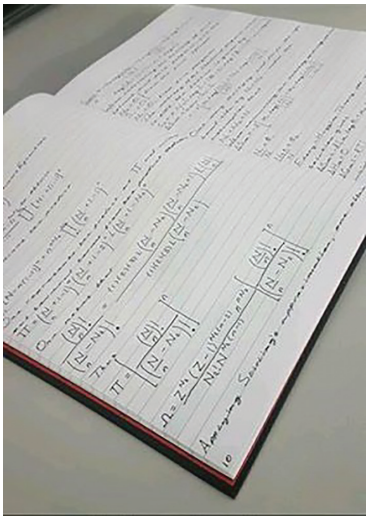
I spent the first week of my project acclimatising to working independently in a laboratory, and though I was familiar with many of the molecular techniques I used over the duration of my project, the protocols were complex and the learning curve quite steep.

A Statistical Model of Hydrogen Bonding

by Thomas Vale (BSc Physics) (Supervised by Dr. Martin Greenall)

An analytical study of hydrogen bonding was carried out in the work described below. The motivation for this work was to understand the physics behind the phenomena of hydrogen bonding in polymer-static systems with equilibrium conditions. Hydrogen bonding is ubiquitous in nature, from holding individual molecules of water to one another, to holding the helices of DNA together, and the systems in consideration in this work between the molecules that form polymers such as acrylamide (prop-2-enamide, C3H5NO).

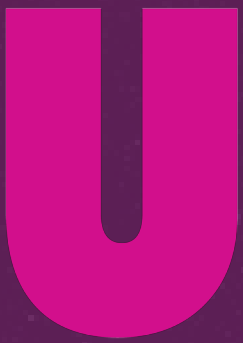
This research project has taught me how to form a mathematical model from first principles, and how to tell when a mathematical model is physically inaccurate. I have also learnt more about combinatorics, the physics of hydrogen bonding generally, polymer physics, particularly polymer statics, and statistical mechanics than is generally taught within the standard undergraduate physics course.



The opportunity to work with Martin and Elena was greatly appreciated, as well as the conversations with the School of Mathematics and Physics throughout the project. The insights provided, and even the paper the project was based on, showed the importance of collaborative work, with the experimentalists carrying out an experiment and the theorists fitting a model to the data provided.

This experience has assured me that continuing on the path of academia is the correct thing for me going forward, showing me what a research collaboration may be like on a larger project may be like.

I was also lucky to attend the 3rd Edwards Symposium, Turing Gateway to Mathematics: New Horizons in Soft Matter conference at the University of Cambridge and present my work as a part of my supervisors' larger poster on the aforementioned paper.



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