Biotechnology and Biological Sciences Research Council

2023 UG Summer Studentship Programme - Project List

SoCoBio DTP

Project ref	SoCoBio DTP partner	Faculty/School/Department	Supervisor's full name	Start Date	End Date	Project Title	BBSRC Theme	Project overview including objectives (Max 300 words)
2023_01	NIAB at East Malling	Crop Science and Production Systems	Dr Trevor Wignall	8/21/2023	9/29/2023	Monitoring fertiliser nutrient inputs to substrate-grown raspberries to inform fertigation system decision-making	Bioscience for sustainable agriculture and food;	Soft fruit growers know that a sub-optimal supply of nutrients will limit marketable yields and berry quality, but most guidelines on fertiliser inputs are very outdated. These formulations are often adjusted based on anecdotal observations, but there is little scientific basis to these amendments and many unneeded nutrients accumulate in the substrate. Growers apply irrigation flushing events to remove these ion accumulations which wastes water, can result in lowered berry quality, and the run-off poses a risk to local groundwater. Excessive N inputs result in elevated emissions of N2O as a result of denitrification. Reducing N inputs in agriculture and horticulture by more closely matching demand with supply should help to reduce N2O emissions, but growers need guidelines and monitoring sensors are not available. Our nutrient demand modelling work in previous years showed that N input to substrate-grown raspberry could be reduced by 32% without affecting marketable yields and berry quality, and overall water and fertiliser demand was lowered by 20% due to a reduction in plant biomass (less luxuriant growth). In 2022 we worked with a partner to develop prototype nitrogen / phosphorous / potassium (NPK) real-time sensors that growers can use to determine NPK availabilities in irrigation input to inform their fertigation decision making. One objective of this project is to test these sensors under commercial conditions in 2023. Here, we propose to combine new variety-specific N demand models with the prototype sensors to estimate NPK substrate availabilities in real time, and use the outputs to inform fertigation system decision making. This approach will aim to maintain coir NPK availabilities within a narrow optimum range during each plant developmental stage thereby maximising resource use efficiency and sustainability.
2023_02	NIAB at East Malling	Crop Science and Production Systems	Eleftheria Stavridou	7/3/2023	9/29/2023	Improving the nutritional value of tomatoes	Bioscience for sustainable agriculture and food;	Project objective: To supply the UK market with nutrient-dense tomatoes, enhance iron bioavailability, and improve productivity and sustainability of UK tomato production by combining ascorbic acid (AsA) and iron tomato biofortification. Providing healthy, sustainable diets to feed a growing global population, as well as addressing food inequalities, is a major challenge. As climate change, diminishing natural resources, and increased affluence change dietary habits, this challenge becomes more pressing. Micronutrients deficiencies such as AsA, iron, selenium, etc. are common in the UK. Plant-based supply is the majority source for AsA and iron. Plant-based iron bioavailability is low, but enhancing factors like AsA can improve absorption. Enhancing the levels of AsA and iron in tomatoes can improve both bioavailability and nutrition insecurity as well as the UK micronutrient self-sufficiency. However, tomatoes have a narrow range of optimal growing temperatures. Even when grown in fully controlled glasshouse environments, heat stress can trigger flower abscission, limit fruit yield, and affect fruit development and maturity. Increasing the AsA content in plants can have several positive effects such as: · producing highly nutritious food with a high content of AsA and improved bioavailability of non-heme iron · improving postharvest shelf life and reducing waste · increasing the tolerance of plants to various kinds of stresses. A series of experiments will be conducted at NIAB at East Malling between July-September. Over the course of the placement, you will learn how to set up randomised controlled environment experiments, record plant physiological responses, harvest fruit and assess fruit quality, prepare samples for analysis, and carry out chemical analysis (ascorbic acid, iron). You will be part of a dynamic team and you will have the opportunity to shadow other teams in NIAB to get a wider view of horticulture research.

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2023_03	NIAB at East Malling	Crop Science and Production Systems	Eleftheria Stavridou	7/3/2023	9/29/2023	Boosting the nutrition of microgreens in personal vertical farms	Bioscience for sustainable agriculture and food;	Growing food where it will be eaten, and only growing the amount of food required, could help to reduce both food waste and emissions. Vertical farming technology, such as growing with LEDs and hydroponics, integrated with machine learning and image processing, could help to improve indoor growing systems. Personal vertical farms for hospitality operators and homes use the same technologies as industrial vertical farms, but scaled down to appliance size. This project investigates how new technologies can help to grow microgreens and leafy salads with higher nutritional value to support healthy diets. Young brassica plants as offering particular potential because of their high levels of nutritionally-beneficial phytochemicals, including glucosinolates, and their responsiveness to various fortification strategies including targeted mineral fertigation, lighting spectrum manipulation and stress manipulation. A series of experiments will be conducted at NIAB at East Malling between July-September. Over the course of the placement, you will learn how to set up randomised controlled experiments in personal vertical farms, record plant physiological responses, compare and evaluate the phytochemical content and antioxidant capacities of culinary microgreens, assess the sensory quality and consumer acceptance. You will be part of a dynamic team and you will have the opportunity to shadow other teams in NIAB to get a wider view of horticulture research.
2023_04	NIAB at East Malling	Crop Science and Production Systems	Flora O'Brien	7/10/2023	8/18/2023	Cover cropping and soil health in Vineyards	Bioscience for sustainable agriculture and food;	The UK wine industry has expanded rapidly over the past 10 years, with an estimated total vineyard area of 3,800ha. This has generated a sharp growth in sales of British wines, with the market now valued at £292m. As a relatively young industry, there is still much to be learnt in terms of optimal management of vineyards in the UK in order to maximise the quality and consistency of yields while using the most sustainable practices. There is a strong bias in the viticulture research sector towards traditional wine regions such as the Mediterranean, but this has limited relevance to UK vineyards given the contrasting climate and soil types. The relationship between the vineyard soil environment and the quality of the resulting wine is referred to as the terroir concept which infers that a change to the soil environment will have a noticeable effect on the attributes of the wine produced. Cover crops could play a significant role here, by enhancing various parameters of soil health such as soil carbon (C) content, hydraulic conductivity and soil structure. In this project we are investigating the impact of cover crops on vineyard soil health parameters, and the project outcomes will include recommendations on cover crop species selection, their establishment and management. During this placement the student will: •Learn about vineyard cover crop management and the challenges faced. •Utilising dataloggers and manual sensors to monitor plant and soil health indicators. •Coordinate soil sample collection from the vineyard. •Conduct laboratory analysis of soil samples including assays for the determination of soil microbial biomass carbon, water holding capacity, organic matter content and permanganate-oxidisable carbon (active carbon). •Conduct pollinator surveys in cover cropped alleyways in the vineyard •Manage data sets and conduct analysis using Excel and R.

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2023_05	NIAB at East Malling	Genetics and Breeding	Felicidad Fernandez	7/10/2023	8/18/2023	Evaluation of detached-tissue inoculation techniques in Phytophthora spp in raspberry germplasm.	Bioscience for sustainable agriculture and food;	The UK raspberry industry is worth £147.5M per annum. In 2021, slightly over 30% of this fruit (~15,700 tonnes) was produced by UK farms where nearly all berries are grown under tunnels in substrate, mainly coir. A key driver to move production away from soil has been the avoidance of soil-borne pathogens. The most damaging of these is Phytophthora root rot. Unfortunately, the zoospores of these oomycetes can travel in the irrigation water and disease is still affecting production in many farms. There is no effective chemical control available to growers so the development of resistant cultivars is essential for sustainable production. Traditionally, root rot in red raspberry (Rubus idaeus) has been attribute to P. rubi and P. idaei and resistance breeding has focussed on virulent strains of the former. However, recent research at NIAB has identified several other species in diseased raspberries across the UK. In order to breed resistance to these species into new cultivars, extensive phenotyping is needed to identify immune germplasm to each of them that can be used as donors of resistance. Full plant inoculations are the gold standard for assessing both virulence of isolates and susceptibility or resistance in germplasm but they are time consuming and very costly. Multiple detached-leaf or detached-stem inoculation methods have been described and some have been tested at NIAB. This studentship will evaluate a small range of germplasm of interest to the breeding programme at NIAB against four to six Phytophthora spp isolates using at least two different detached-tissue methodologies to identify the most consistent and cost-effective method. Data produced in these experiments will be compared with full plant responses to assess their reliability. Both the methodology development and the phenotyping arising from this project will be fed into the commercially-funded breeding programme at NIAB and future proposal development. The successful candidate will be supported by NIAB staff from the plant pathology and fruit breeding teams and will gain microbiology and plant pathology skills and general understanding of breeding and commercial berry production systems.
2023_06	UKent	Biosciences	Helen Cockerton	7/10/2023	8/18/2023	A new method of gene introduction using plant plasmids	Bioscience for sustainable agriculture and food;	Inserting beneficial genes into crops can help improve yield and quality. However, existing technologies rely upon inserting desirable genes into chromosomes which can lead to disruption of native gene function. We propose a novel alternative for crop modification through developing a plant plasmid-based method of gene introduction. This project will generate laboratory made plasmids containing a “hook” and “catch” for transfer into plants. We will use a reporter gene that is able to turn plants blue to check that plasmids are able to transfer to daughter plants and remain operational over multiple generations.
2023_07	UKent	Biosciences	Anastasios Tsaousis	7/3/2023	8/13/2023	Using a holistic and multidisciplinary approach to investigate the effects of regenerative agriculture on the soil microbiome and CO_2 emissions	Bioscience for sustainable agriculture and food;	There are approximately 9.3 million hectares of farmland in England and through a move to regenerative farming practices agriculture can sequester a significant amount of the CO_2e emitted annually in England, helping to achieve agriculture’s net zero goal by 2040. Healthier soils are more climate resilient, can hold more water; for example a single teaspoon of healthy soil sustains more organisms than there are humans on earth. Soils with higher organic carbon levels are more productive, require less fertilizer, improve plant and animal health, and reduce flooding. To investigate the role and effect of soil in farming, the aim of this project is to integrate a set of multidisciplinary approaches to evaluate the success of range of regenerative management practices that will be incorporated in a farm setting. As such, we will be joining forces with Re-Generation Earth, that has already established a living laboratory in a farm. This infrastructure combines agroforestry and biochar to the introduction of grazing livestock into a crop rotation. The student will investigate the effect of all these settings on the biology, diversity, ecology and biochemistry of the soil and animals’ gut, while also investigating the gas emissions from the soil. Through this multi-disciplinary project, we intend to display how regenerative agriculture can contribute to England's net zero goal. Consequently, we will establish a set of measuring, reporting and verification protocols that ensure carbon credits can be created providing farmers with a new income stream and consumers, availability of credits from natural, UK projects.

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2023_08	UKent	Biosciences	Helen Cockerton	7/10/2023	8/18/2023	Developing a novel gene insertion technology	Bioscience for sustainable agriculture and food;	Plasmids are increasingly recognised as a component that assists the evolution and adaptation of plants. Indeed, “plant plasmids” have evolved in the wild species where they were found to contain functional genes that assisted survival after chemical weed control. Crucially, these circular DNA structures are stably inherited across multiple generations. Exploiting these plant plasmids could provide a novel method of inserting desirable genes into plants.
2023_09	UKent	Biosciences	Jerome Korzelius	6/26/2023	8/7/2023	Novel genetic tools for studying stem cell-niche interactions	Understanding the Rules of Life;	Background Adult intestinal stem cells (ISCs) play a critical role in the maintenance of our intestine and dysregulation of stem cells is one of the main causes of diseases such as cancer. An understudied mechanism is the role of the surrounding epithelial cells and their function as a niche for the stem cells and which signals either promote or inhibit ISC proliferation. Understanding the role of the ISC micro-environment will help us better understand the regulation of adult stem cells in both healthy and diseased tissues.The Drosophila intestine has been a cost-effective and genetically tractable model for studying ISCs. The Drosophila intestine, like its mammalian counterparts, is maintained by a population of Intestinal Stem Cells (ISCs) that divide and maintain the intestinal epithelium. Major signaling pathways controlling ISC division and differentiation such as EGFR/Ras/MAPK and Notch are conserved between flies and mammals. Aim and objectives In this project we will separately manipulate stem cell overgrowth and the surrounding epithelium to address the role of the surrounding epithelium as a niche for ISC proliferation. To this end, we will employ both Gal4 and LexA transgenic expression systems to separately manipulate both ISCs and niche tissues. The student will test these Gal4 and LexA transgenic induction systems for activity in their respective cell types by crossing the transgene drivers to fluorescent reporters and assessing their localisation using a combination of Drosophila genetics, immuno-staining and imaging of ISCs and niche cells in the intestine. Students will learn techniques such as fly handling and genetics, immuno-histochemistry and microscopy as well as basic molecular biology techniques such as PCR and cloning.
2023_10	UPort	Biology	Matt Guille	7/10/2023	8/18/2023	Measuring epilepsy in Tadpole models of rare genetic disease	Bioscience for an integrated understanding of health;Understanding the Rules of Life;	As part of a successful project using tadpoles to diagnose and model rare genetic diseases (RGD) we aim to test whether they can be used to identify and understand seizures in models of disease. It has been shown that tadpoles have seizures, but this has not yet been applied to diagnosis/modelling. Objectives: 1. Test a range of known pro-convulsant compounds on normal tadpoles. 2. Develop a method to quantify seizures (supported by Zantiks Ltd) 3. Compare the activity of the chosen pro-convulsants on control tadpoles and those gene edited to mimic rare diseases. Together these data will inform whether RGD-dependent epilepsy can be analysed using the frog model. If so, it will enable the longer term use of specific tadpole disease models for high throughput testing of drugs to mitigate this symptom.
2023_11	UPort	Biological Sciences	Dr Binuraj Menon	7/1/2023	8/20/2023	Development of novel halogenase enzymes for biopharmaceutical applications	Understanding the Rules of Life;Bioscience for sustainable agriculture and food;Bioscience for renewable resources and clean growth;	Identification of new halogenated synthetic, natural and non-natural compounds; and further exploitation and synthesis of these compounds are of extreme importance in this modern era. This is due to the profound role of organo halides as pharmaceuticals, agrochemicals and valuable synthons in various reactions. Biosynthetic halogenation can occur over simple to extremely complex ring structures of natural compounds and in some cases it initiates the formation of complex structures and scaffolds. These reliable, facile and cleaner biosynthetic routes have potential utility and greater demand over traditional nonenzymatic halogenation chemistry that requires deleterious reagents. In the past few years we have identified a number of pharmaceutically important halogenases by genome mining in natural product pathways. In this project, we are planning to explore their structure, substrate scope along with their potential applications. This will be via purifying these enzymes, setting up different enzymatic assays and analysing them using various biophysical characterisation techniques. The ultimate aim is to incorporate these enzymes in to synthetic and biosynthetic pathways and into various natural product pathways for biotechnological and pharmaceutical applications.

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2023_12	UPort	School of Biological Sciences	Frank Schubert	7/3/2023	8/11/2023	The role of Sonic Hedgehog as a regulator of neurogenesis	Understanding the Rules of Life;	This project aims to investigate the role of Sonic Hedgehog signalling in positioning the differentiation of neurons in the developing vertebrate brain. Neurogenesis during embryonic development needs to be tightly controlled to ensure that correct number and type of neurons are produced. While the progression of neuronal differentiation through a series of proneural transcription factors is well understood, what triggers the onset of neurogenesis is far less clear. In the early embryonic brain, neurogenesis is limited to three distinct locations that are marked by the expression of the proneural transcription factors Neurog2 and Ascl1. Previous work in our lab has identified Fgf signalling as a key regulator to define the rostro-caudal positioning of these neurogenic regions. What controls their position along the dorso-ventral axis is currently unknown. The first neurons, which form the medial longitudinal fascicle (MLF) that pioneers the longitudinal connection in the central nervous system, are differentiating in the ventral part of the diencephalon. Sonic Hedgehog (Shh), a well-established ventral determinant, is a prime candidate to control the location of the MLF neurons by inducing Neurog2 expression. In this project we will test this hypothesis in the chicken embryo model, using pharmacological and genetic approaches. Our specific objectives are: 1. Test if Shh is sufficient to induce Neurog2 expression by (a) treating embryos with the SAG agonist, and (b) misexpressing Shh. 2. Test if Shh is necessary to induce Neurog2 expression by (a) treating embryos with the cyclopamine antagonist, and (b) misexpressing the dominant-negative Patched1 receptor. The outcome of the gain- and loss-of-function experiments will be tested by in-situ hybridisation for Neurog2. This research project will clarify if Shh is involved in regulating neurogenesis in the early embryonic brain.
2023_13	UPort	School of Biological Sciences	Dr Steven Dodsworth	7/3/2023	8/11/2023	Investigating repeated evolution of nectar spurs: a key evolutionary innovation	Understanding the Rules of Life;	Nectar spurs represent novel floral organs, typically outgrowths of petal or sepal tissue, that collect nectar at their base. These organs are tightly linked to pollinator interactions, as the nectar is a sugary reward for pollinating animals. Perhaps the most famous example being Darwin's orchid Angraecum sesquipedale with its foot-long nectar spur. He predicted a hawkmoth as pollinator, and was instantly ridiculed, until such a moth with a long proboscis was found many years later (Xanthopan morganii praedicta). Nectar spurs are often referred to as a key evolutionary innovation, as they have been shown to increase diversification rates, presumably via the potential for coevolution with pollinators that spurs plant speciation. Many groups of angiosperms possess nectar spurs. One such group includes the familiar garden snapdragon, Antirrhinum. Snapdragons do not themselves possess spurs, but nectar spurs have evolved independently at least four times in related species (tribe Antirhinneae; Plantaginaceae). Previous results from the genus Linaria (toadflax) showed that two KNOX transcription factor genes were highly expressed in developing flowers, including ventral petals where the nectar spur forms. Mutant and heterologous expression in Antirrhinum and Nicotiana, respectively, resulted in novel floral outgrowths in these species. This project will therefore investigate the potential for repeated, parallel molecular evolution of nectar spurs across independent evolutionary events, by analysing the expression of orthologous KNOX genes. Objectives: Using molecular approaches (RNA extraction, cDNA synthesis, RT-PCR) on different developmental stages of different tissues (e.g., leaves, flower buds, mature flowers), we will investigate whether orthologous KNOX genes are expressed in flowers across multiple independent evolutionary events. The outcome of this project would give us a first glimpse at whether evolution has repeated itself in the evolution of nectar spurs in this group of plants, by using the same molecular mechanisms to give rise to a key morphological innovation.

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2023_14	USoton	School of Biological Sciences	Fatima Cardoso Pereira	7/3/2023	8/11/2023	Evaluating the role of antidepressants in the spread of antimicrobial resistance in the gut	Bioscience for an integrated understanding of health;	Antimicrobial resistant bacteria claim approximately 1.27 million lives worldwide annually. Antimicrobial resistance is therefore considered a major global challenge. While it is well established that the inappropriate use of antibiotics increases antibiotic resistance, less is known about the role of non-antibiotic drugs on the evolution and dissemination of antimicrobial resistance. Many non-antibiotic pharmaceuticals are taken orally and reach the large intestine where they interact with thousands of microorganisms - termed the gut microbiome - in many cases inhibiting their growth. Indeed, many antidepressants and antipsychotics have been shown to act as antimicrobials, and a strong correlation between resistance to antibiotics and resistance to these drugs is observed in most tested microbes. In the model bacterium Escherichia coli, antidepressant treatment promotes mutations that result in increased antibiotic efflux pump activity, as well as dissemination of antimicrobial resistance genes via horizontal gene transfer. These results emphasise the need to further investigate the potential risks of psychotropic use in the spread of antibiotic resistance among gut microbes. The gut microbiome is dominated by members of the Bacteroidetes and Firmicutes phyla, known to regulate key aspects of host health. This project aims to investigate whether long term exposure to commonly used psychotropics increases resistance to antibiotics in the anaerobe Bacteroides fragilis, a common and prevalent gut microbiome member that nevertheless retains pathogenic traits. Resistance to the top most prescribed antibiotics in the clinic will be evaluated after subculturing B. fragilis in the presence of sub-inhibitory concentrations of fluoxetine or amitriptyline. If increased resistance is observed, genomic DNA from strains representing subsets of each group of resistant mutants will be isolated for subsequent whole genome sequencing and genomic analysis. The project will provide training in basic microbiology and molecular biology techniques such as anaerobic cultivation, determination of minimum inhibitory concentrations, and genomic DNA isolation.
2023_15	USoton	FELS/SOBS	Mark Chapman	7/3/2023	8/11/2023	Genetic variation in genes related to adaptation in wild rice	Bioscience for sustainable agriculture and food;	Recent analysis in the lab has identified regions of the wild rice genome that are associated with local adaptation (due to precipitation and temperature). These regions sometimes span a few or dozens of genes, so we haven't pinpointed which gene in these regions is responsible. In this project the student will: 1. Grow wild rice and extract DNA 2. Sequence some candidate genes from wild rice from warm/cool, wet/dry locations 3. Identify polymorphisms and determine if these are likely to change the protein sequence and/or be involved in local adaptation. The project will be largely lab-based but will require some relatively light computer analysis.
2023_16	USoton	School of Biological Sciences	Jorn A Cheney	7/17/2023	8/27/2023	The convergent form of gliding mammals	Understanding the Rules of Life;	We typically expect when evolution converges, it is upon an effective solution. Gliding in mammals has evolved at least seven times and not just in squirrels (rodents), but in marsupials, and a group closely related to primates. All of these animals look similar in shape and have wings composed of skin, but none of these gliders are effective flyers. All gliding mammals evolved flight with wings composed predominantly of thin sheets of skin to support their body weight. One hypothesis is that the shape of their wings and composition of their skin allows for the capacity to fly but also produces a limit (local optimum) as to how well that they can fly. To examine this hypothesis, we will examine museum specimens and document the properties of their wings and skin. The student would be exposed to evolutionary ideas and some unusual aerodynamic concepts, while also developing some skills in imaging, coding in Matlab (a not too difficult language), and will better understand concepts in measurement and dealing with uncertainty.

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2023_17	USoton	FELS/Biological Sciences/Microbiology	Sandra Wilks	7/3/2023	8/18/2023	Understanding biofilm formation in the urinary system	Understanding the Rules of Life;Bioscience for an integrated understanding of health;	The long-term use of urinary catheters has been found to result in an almost permanent colonisation of urine. Urinary tract infections are the second most frequent cause of healthcare associated infections in hospitalised patients in England. In long-term patients, catheter blockages often occur, causing trauma for the individual and high demands on healthcare resources. Biofilms are known to have an important role in both infections and blockages but we still do not understand fully how polymicrobial communities survive and co-exist in the urinary system and catheters. Recent microbiome studies have revealed the presence of emerging pathogens such as Aerococcus urinae but little is known about their biofilm forming potential and interactions with other key uropathogens such as Escherichia coli or Pseudomonas aeruginosa. In this project, a laboratory model will be used to track stages of biofilm formation in an artificial urine medium, with analysis of culturable bacteria, measurement of pH, and direct imaging of biofilm structures. Using a simple static 6-well plate method, biofilm development of single and dual species populations will be investigated over time. Biofilms will be analysed by standard culture techniques, using general and selective agars, and by advanced, direct, non-contact imaging. To visualize biofilms on the catheter surface, episcopic differential interference contrast microscopy will be used. In parallel, epifluorescence microscopy will be used to measure labelling of selected bacterial stains and labels for the EPS surrounding the cells. This study will improve our understanding of cooperation and competitiveness between different bacterial species under the specific environmental conditions provided in a urine medium. Main objectives: 1.Track biofilm development of two known uropathogens over 5 day time course. 2.Track biofilm development of emerging pathogen species over 5 day time course. 3.Run co-culture experiments to determine dominance between species, and impact for a dual species biofilm.
2023_18	USoton	School of Biological Sciences	Salah Elias	7/10/2023	8/14/2023	How do oriented cell divisions build and maintain a structured and functional mammary gland?	Understanding the Rules of Life;	A key hallmark of breast carcinogenesis, the process in which breast epithelial cells progressively evolve into cancer cells, is disruption of tissue architecture. Oriented cell divisions (OCDs) are crucial to maintain structured epithelia, and increasing evidence shows that imbalance in OCDs in the mammary gland (MG) contributes to carcinogenesis. Yet, the functional requirement of OCDs for normal MG organogenesis remains unknown. Our research vision is to unveil the mechanisms underpinning the role of OCDs in controlling MG structure and function during differentiation and test whether loss of OCD regulation is a key initiating oncogenic event. The student will join a project that aims to evaluate how OCDs influence MG architecture and functional maturation during development (Aim I) and carcinogenesis (Aim II), using a cutting-edge combination of lineage tracing, whole-organ and intravital microscopy (IVM) as well as spatial transcriptomics (STx) in newly developed mouse models. In this project, we collaborate with physicists/computational scientists to develop mathematical/computational models to quantitatively infer the causal relationship between OCDs and cell fate and behaviour, and cell heterogeneities that initiate aberrant morphogenesis and carcinogenesis (Aim III). This comprehensive research programme will provide unprecedented insights onto the contribution of OCDs to epithelial tissue dynamics, maturation, and integrity. Our work will have considerable implications for understanding how breast cancer arises, guiding us to potential preventive medicine strategies.

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2023_19	USoton	Biological Sciences	Philip Williamson	8/25/2023	9/30/2023	Role of S100A9/alpha-Synuclein Interactions in the onset of Parkinson's Disease.	Understanding the Rules of Life;Bioscience for an integrated understanding of health;	Alpha-synuclein (aSN) plays an important role on the pathogenesis of Parkinson's Disease, forming fibrillar structures that progress through the brain leading to a loss of dopaminergic neurons and motor and cognitive defects. Despite intensive research our exact understanding of the mechanisms that drive aSN deposition remain unclear. Recently however, it has been shown by our collaborators, that increased levels of the neuroinflammatory protein S100A9 may initiate and drive the formation of aSN deposition. S100A9, is an intrinsically amyloidogenic protein and early studies suggest that its misfolding can lead to cross-seeding of aSN fibrils. This project seeks to dissect the nature of these interactions to ascertain how S100A9 promotes this process. Both proteins are routinely expressed in Williamson's group, and this project will seek to characterize how soluble monomeric, oligomeric and fibrillar S100A9 influence the kinetics of aSN aggregation. These studies will be conducted using fluorescence based assays that monitor ThT aggregation. These will be supported by NMR based studies that identify the regions of S100A9 and aSN that interact to drive aSN deposition. It is envisaged that a clearer understanding of these interactions may provide insights into ways to modulate the onset and progression of Parkinson's Disease.
2023_20	USoton	FELS/School of Biological Sciences/ Southampton	Joern M. Werner	6/19/2023	7/2/2023	A new function for RNA binding RRM domains: Molecular characterisation of the phosphoinositol interaction with SRSF2	Understanding the Rules of Life;	Overview: SRSF2 is a member of the serine arginine rich family of pre mRNA splicing factors and key player in controlling the splicing of introns. Importantly SRSF2 is mutated in a number of cancers and is highly mutated in leukaemia and myelodysplastic syndrome (MDS). In MDS the mutation is primarily found at proline 95 and mutation of this residue alone is able to drive particular characteristics of MDS in mice probably through altered RNA specificity and subsequent altered regulation of other spliceosomal components effecting a broad range of downstream targets. While we know that phosphoinsoitides such as PtdIns(4,5)P2 can be made in the nucleus, the specific localisation of PtdIns(4,5)P2 at the nuclear speckles suggest that they may play a role in regulating splicing. Recently the Divecha lab found that SRSF2 interacts specifically with PtdIns(4,5)P2 via its RNA binding RRM domain and is dissecting the cellular control- and regulatory implications of this interaction. (This is subject of a pending BBSRC application by Divecha (PI) and Werner (CoI). The question for this project will be how exactly nuclear PtdIns(4,5)P2 binds to SRSF2 and how we can manipulate this interaction through knowledge of the molecular interactions in order to understand the functional role in vivo for this interaction. Of particular interest and functional relevance will be whether the PtdIns(4,5)P2 interaction is dependent of RNA binding or competing with it. Establishing PtdIns(4,5)P2 binding would be the first demonstration of a new function for RRM domains. Objectives: 1.Expression and purification of isotope labelled SRSF2 RRM domain and mutants. 2.Determination of PtdIns(4,5)P2 binding in the presence and absence of RNA and PtdIns(4,5)P2 using NMR. 3.Determination and analysis of mutant proteins unable to bind to PtdIns(4,5)P2 by NMR.

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2023_21	USusx	Life Sciences	Leon Lagnado	7/3/2023	8/14/2023	Modulation of visually-driven behaviours	Understanding the Rules of Life;	The interaction of an animal's nervous system with the environment is flexible and adapts to changing conditions. We will analyze the neural basis of this flexibility by quantifying the flow of information from sensory input, through the brain, to the final behavioural output. The overarching aim will be to understand how neuromodulatory processes adjust the signals transmitted through a neural circuit to alter behaviour. Our focus will be visually-driven behaviours and the animals we will use are larval zebrafish, in which half of all the neurons in the brain are involved in vision. We will focus on two behaviours: prey capture and the optomotor response (OMR) that adjusts the animals position in space. Similar behaviours are found throughout the animal kingdom and are fundamental in guiding an animal interactions with the visual world. Crucially, these behaviours also adapt to changes in the environment and we will investigate how this occurs in response to diurnal changes in light levels (Moya-Diaz et al., 2022) and information arriving from the olfactory system (Esposti et al., 2013). The project will involve experimental work based on recording of behaviour using a high-speed camera, followed by analysis based on Information Theory in which we will quantify the linkage between the information arriving in the stimulus and the behaviour it drives. We will determine how this link is modulated as a function of diurnal time and by olfactory stimuli. Esposti, F., Johnston, J., Rosa, J. M and Lagnado, L. (2013). Olfactory stimulation selectively modulates the OFF visual pathway in the retina of zebrafish. Neuron, 79: 97-110. Moya-Díaz J, James B, Esposti F, Johnston J, Lagnado L (2022). Diurnal changes in the efficiency of information transmission at a sensory synapse. Nature Communications 12;13(1):2613.
2023_22	USusx	School of Life Sciences, Evolution, Behaviour and Environment Department	Dr Beth Nicholls	7/3/2023	8/18/2023	How do bees deide which flowers to visit?	Bioscience for sustainable agriculture and food;	One third of all crops grown worldwide benefit from pollination by insects such as bees, therefore plant-pollinator interactions are of huge importance to food production and the diversity and nutritional quality of human diets. Bees visit flowers to collect pollen and nectar and while we know they use nutritional cues such as sugar concentration to assess the value of nectar rewards and guide their foraging decisions we still know very little about how insects assess reward quality during pollen collection and the factors that shape their flower choices when foraging for this resource. In this project you will use 3D-printed artificial flowers to manipulate both flower shape and reward value and examine how these factors affect bees flower choices and the efficiency with which they can collect pollen within an artificial flower patch. As well as gaining overall experience in a research laboratory setting, in this project you will develop skills in designing and conducting behavioural assays with insects. You will also have the opportunity to learn how to use artificial intelligence (AI) to extract key behavioural data from high-speed video recordings. No prior experience is needed and training in all techniques will be provided by the lab team. The data collected in this project will help us to build more accurate models of bee foraging behaviour and predict how pollinators move within a landscape. Since pollination is ultimately dependent on the flower choices of individual insects, by improving our understanding of the cues guiding bees' foraging choices we can make better recommendations for the management of agricultural landscapes for wild bees, with the potential to sustainably enhance crop pollination and yields and mitigate the risks posed to global food security by a lack of insect pollinators.

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2023_23	USusx	School of Life Science/EBE	Valentina Scarponi	7/3/2023	8/14/2023	Coastal restoration and food security: understanding restoration processes using baited remote under water videos (BRUVs) and environmental DNA (eDNA)	Understanding the Rules of Life;Bioscience for sustainable agriculture and food;Bioscience for renewable resources and clean growth;	Kelp habitats along the Sussex coast used provide numerous ecosystem services: they acted as nursery grounds for ecologically and economically important fish and invertebrates, enhance local biodiversity, act as carbon sinks, and protect the coastline from storms. The great storm of 1987 damaged a significant part of the historic kelp beds allowing entry to bottom trawlers, which disturbed the ocean floors even further and halted the regeneration of such an important ecosystem. In 2021, the Sussex Inshore Fisheries and Conservation Authority (IFCA) introduced a bylaw to ban trawler activity and protect ~300 km of sea-bed along the Sussex coast. This is a unique opportunity to observe and document ecosystem regeneration after the removal of a destructive fishing practice. Our team at the University of Sussex has been involved in collecting the necessary data to further support the need for marine protected areas that fully protect our oceans from destructive fishing practices, to allow ecosystem restoration and promote sustainable fisheries. Since 2021, every year the team spends 4-6 weeks in summer collecting data from 28 sites in Sussex using baited remote underwater videos (BRUVs) and environmental DNA (eDNA). These non-invasive sampling techniques provide key information on the presence and abundance of marine vertebrate and invertebrate species, which we use to investigate changes in community composition and overall ecosystem health. The objective of this study is to collect data in 2023 using these sampling techniques, make comparisons to the data collected in 2021 (baseline) and in 2022, and continue to monitor ecosystem recovery. The project is fully funded, providing a unique opportunity to students to be involved in a local and exciting research project. This research project is even more important now that further calls have been made to the UK government to ban trawling from other marine protected areas.
2023_24	USusx	LifeSciences/EBE	Paul Graham	7/3/2023	9/1/2023	Individuals within a collective: How do ants balance personal and social information when foraging?	Understanding the Rules of Life;	To control adaptive behaviour in complex environments, animals can learn information about the world for themselves. Or they can get information from other individuals via social interactions. This dichotomy is particularly interesting in social insects where colonies of closely related workers cooperate to provide food, defence and brood care for the colony. For instance, wood ant colonies forage over large areas of woodland collecting honeydew and invertebrates. Each individual forager can learn the route it needs to take to get to a profitable foraging area, but also large odour-marked trails provide social information about the foraging routes from the nest. In the lab and field, we will explore the interactions between the individual strategies that foragers use and the social information that is available from the colony. In the laboratory, wood ants have been shown to use simple visual and odour information to guide navigation over short routes, however, this knowledge is insufficient to explain how this species, and insects more generally, navigate through complex natural terrain. For instance, we do not know the role of olfaction in wood ant navigation or how odour-guided behaviours interact with visual navigation in natural woodland habitats. This project would suit students interested in social insects, ecology and/or animal cognition and students will gain a range a skills in animals tracking, field and lab work and basic video and data analysis. No specific prior experience required.