School of Biosciences

Example PhD Projects

Agricultural & Environmental Sciences

Interactions between anionic radionuclides (^{129}I, ^{79}Se and ^{99}Tc) and geocolloids.
This work forms part of the 'TREE' (Transfer-Exposure-Effects) project funded by NERC under the RATE programme (http://www.nerc.ac.uk/research/funded/programmes/rate). Our overall aim is to develop models describing the fate of the radioisotopes ^{129}I, ^{79}Se, ^{238}U and ^{99}Tc in soils and aquatic systems by resolving underlying mechanisms and reaction rates. From such models we shall be able to predict time-dependent changes in radioisotope mobility and reactivity.

The impact of zero tillage on soil quality and potential for climate change mitigation.
This work will examine the impact of zero tillage (i.e. not ploughing) on a range of soil properties that can be used to assess soil quality. Zero tillage is gaining in popularity among farmers but the effects of this on important soil functions such as water infiltration and carbon conservation remain poorly understood. The aim is to understand how such changes in soil tillage influence the soil characteristics that control release of greenhouse gases.

Tropical forest methane emissions: root regulation of soil processes and greenhouse gas fluxes.
This research project will investigate how trees influence greenhouse gas emissions from tropical wetlands. The background to the project is the large contribution of tropical wetlands to atmospheric methane concentrations and the aim of the project is to understand the biotic and abiotic conditions which control emission rates. Ultimately this research will enable us to understand how manage these ecosystems in a changing climate.

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Animal Sciences

Studies of central sensitization in the monosodium iodoacetate (MIA) model of osteoarthritis pain
Osteoarthritis (OA) is a degenerative joint disease and is the leading cause of chronic severe pain in both domestic animals and humans. By electrophysiologically measuring spinal reflex responses in a pre-clinical rat model of OA pain, this project will study mechanisms underlying increased central nervous system excitability (known as 'central sensitization) that contribute to the pain associated with OA. Understanding these mechanisms is essential for developing better analgesics and improving animal welfare.

Growth factor regulation of limb muscle development
During development muscle precursor cells migrate into the limb buds and, only once they have formed the dorsal and ventral muscle masses, will they begin to differentiate. We are

studying growth factors that regulate this process and have shown that interactions between FGF and retinoic acid can affect the expression of the genes required for muscle development.

The Impact of Uterine Disease on Dairy Cow Fertility
This is a multifaceted PhD involving epidemiological analysis of the impact of uterine disease at a herd level, detailed in vivo analysis of the impact of uterine disease on ovarian function at an individual cow level and the use of in vitro culture systems to study the mechanisms through which uterine disease affects ovarian function.

Using animals to benefit animals: how should the UK animal professions manage the social and ethical implications of the clinical use of donated companion animal blood and tissues.

This study examines the ethical nature of the human relationship with companion animals and in particular explores the ethical limits to companion animal use and treatment.

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Food Sciences

Production of Taxanes in wild type bacteria (BBSRC DTP)
Taxol remains one of the most potent anti-cancer drugs yet discovered with annual sales exceeding $1.6 billion. Its complex structure means that a full synthetic synthesis is not feasible and the market for taxol is currently supplied by extraction of either taxol itself or a late intermediate from yew tree bark or needles. The limited availability of mature yew trees, the slow growth rate of cultivated plants and the low yields of the extracted products limit the supply of taxol, resulting in high prices and raising environmental concerns about the harvesting of yew trees. Some of the genes encoding enzymes of the taxol pathway have been successfully expressed in bacteria, but the yield of the valuable taxanes has been low because standard bacterial laboratory strains only produce very low levels of the precursor compounds. We have identified wild bacterial species capable of synthesising and accumulating high levels of the precursor molecules, which is normally a bottleneck in taxane production and have developed synthetic biology systems for these organisms. We are exploiting the basic biochemistry of these bacteria and their genetic tractability to redirect the pathway for the high yield production of taxol and other, high value, medicinal compounds.

Inhibitors of staphylococcal sortase as novel anti-infective agents (MRC DTP)
To circumvent the cycle of ‘antibiotic introduction–resistance development’, new approaches for treating bacterial infections are urgently needed. As an alternative to antibiotics that kill the infecting organism, the invading bacteria could be ‘disarmed’, reducing their pathogenicity, and allowing the innate and adaptive immune system to clear them. For an MRSA infection to develop, the bacteria need to interact with the host via surface-anchored proteins. Sortase A (SrtA), a cysteine peptidase, is responsible for the anchoring mechanism required to locate these proteins on the bacterial cell surface and is therefore a suitable target for inhibition to prevent the establishment of bacterial infections. We are screening chemical libraries to identify novel SrtA and/or secretion inhibitors with a newly developed bioassay, test the ability of active'hit' compounds to abrogate SrtA-mediated anchoring, affect bacterial cell growth and virulence gene expression.

Structural and biophysical studies on SilE.
SilE is the major biomarker for bacterial silver resistance. It is an intrinsically disordered protein that folds to an alpha-helical conformation upon binding silver ions. We wish to understand (a) how silver mediates this coupled folding and binding process and (b) the biological role of SilE in the cell. The project involves collaborations with Chemistry and also the Research Complex at Harwell (Oxfordshire).

Role of intrinsic disorder in the regulation of human Exonuclease I (hEXO1).
hEXO1 is a FEN1 type nuclease that binds to DNA overhangs and produces a single stranded intermediate that is a vital intermediate in homologous recombination. The protein is 800 amino acids long, however the C-terminal 500 are intrinsically disordered. Genetic studies has identified this stretch of residues as vital to the regulatory role of the protein. Using a combination of biophysical techniques we seeking to understand how regulation is mediated by this region.

Structure/Function of STAT2. This protein is part of the Jak-STAT pathway central to eukaryotic cell signalling and involved in interferon regulation.
We are working with the School of Life Sciences in order to understand the structure/function relationships involved in this important signalling pathway crucial to health and disease in humans

Characterisation and role of microflora in the fermentation of ogi an indigenous Africa cereal food.

Application of High Resolution fMRI Studies to Map Taste Perception (BBSRC & Unilever Case Studentship)
This project combines expertise in sensory science and brain imaging to understand where and how different tastants are processed in the brain. Both prototypical tastes (sweet, sour, bitter, salt and umami) and purported taste (e.g Fatty acid and metallic) are under investigation. How different individuals vary in their sensory and brian response to these compounds will also be investigated.

Interfacial design of emulsions
The interfacial properties of emulsions impact on many of their functional properties such as flow behaviour, digestive behaviour, sensory properties, release properties, … Thus, targeted design of emulsion interfaces enables control over these properties. In addition to interfacially active materials already available for commercial product design, new materials or new functionality of existing materials is part of this research stream.

Oral processing of foods
The sensory properties of foods are at least in part driven by the food microstructure evolving during mastication. There is little knowledge relating the physico-chemical properties of foods and how these evolve in the oral cavity to sensory perception.

A range of projects that focus on the use of bacteriophage (bacterial viruses) to detect Mycobacterial pathogens of cattle; currently investigating the detection of M. paratuberculosis (Johne's disease) in milk and blood samples and also M. bovis (bovine TB) in the blood of cattle, badgers, llamas and companion animals. The projects require students to understand the ecology and physiology of the Mycobacteria, as well as understanding phage replication and mastering PCR-based amplification of signature sequences for cell identification.

Studies of the food borne bacterial pathogen, Listeria monocytogenes.
Current projects focus on the transmission of the organism through the food chain associated with fresh produce and also understanding genetic factors that affect infection of both humans and animals, the latter through joint research projects with staff in the School of Veterinary Sciences. Students need to understand the physiology and pathogenicity of Listeria, and use a range of different culture-based and molecular methods to study the biology and behaviour of this organism.

Salt reduction in foods through enhanced delivery rate (various model food systems)
We consume sodium to excess in our diet, therefore it is important to reduce our sodium intake; one approach is to increase the accessibility of sodium in the mouth by minimizing the chemical and physical interactions of sodium the bolus (chewed food material). Through the development of a true understanding of the physics and chemistry sodium-bolus interaction we can redesign of food materials to achieve this goal.

Aroma release from model, semi-model food systems
A true understanding of aroma perception in foods requires a mechanistic explanation of aroma release. Through the use of model and semi-model foods we can explain the impact of food structure, food chemistry, and processing on aroma release kinetics. This is achieved in real-time using high speed MS-NOSE2 technology to track the release of volatile organic compounds during processing and mastication.

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Nutritional Sciences

Detailing the mechanisms responsible for the positive impact of metabolic modifiers on feed efficiency and muscle hypertrophy in livestock.
Utilising a mixture of large-animal growth studies and in vitro cell culture approaches to investigate the molecular and cellular events that underpin known physiological and metabolic adaptations to growth hormone and beta-agonists agents. Involves the use of a wide range of molecular biology techniques including qPCR, western blotting and enzyme-linked immunosorbent assays.

The effectiveness of food and nutrition policies in developing countries.
Incorporating qualitative methods to critically assess the impact of global and regional initiatives to reduce malnutrition in developing nations. Data collection is in the form of validated survey-based approaches.

The impact of reducing meat intake on cardiovascular risk factors.

Assessing in a healthy human adult population the benefit of reducing meat consumption on various cardiovascular risk factors. Requires the execution of longitudinal human trials with the assessment of temporal changes in blood lipid profile using gas-chromatography approaches.

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Plant & Crop Sciences

Is there a gas sensing degradome?
Based on our recent discovery of oxygen and nitric oxide (NO) sensing in plants via targeted proteolysis, this project uses molecular genetics and biochemical approaches to identify proteins that are used by plants to sense gases.

Understanding the mechanism and evolution of gas sensing
In collaboration with School of Chemistry this project is taking a biological chemistry approach to understand the mechanism of amino-terminal cysteine oxidation in proteins. This mechanism controls plants responses to environmental stress (including drought and flooding). The project will also investigate the evolution of this mechanism in land plants.

Identifying genes controlling nutrient uptake and distribution in oilseed rape (Brassica napus)
Genome wide association mapping is being used to identify key genes involved in nutrient uptake in *Brassica*. The function of these genes is being tested using induced mutants and controlled physiological experiments.

Identifying ancestral wheat introgressions and traits for improved tolerance to hostile soils
Multi-site field trials in India, combined with high-throughput phenotyping of root morphology and leaf/grain compositional traits, are being conducted on wheat to support the development of improved varieties of crops.

Dietary micronutrient supplies in Malawi
This highly multidisciplinary project is exploring the roles of soils, crops, land management and cultural practices on dietary micronutrient supply. The project involves collaborative work with soil and crop scientists, geochemists, geographers, economists, and human nutritionists.

Can inter-cultivar variation in caesium and strontium accumulation by forage grasses be used to reduce contamination of cows' milk in radiologically contaminated areas?
The extent of inter-cultivar variation in trace-element uptake in forage grasses is being determined in advanced breeding lines of grass, using the latest techniques in inorganic chemical analysis combined with geospatial modelling

Malaysia Campus

Developing new approaches to transcriptomics and genomics
Using data from major crops to develop markers for breeding in minor crops.

Developing novel technologies to reduce postharvest losses and enhance quality of tropical fruits and vegetables.

Evaluation of peat soil structure and hydrological variation with land use conversion and the implications to greenhouse Gas emissions.
Investigating how the laterally complex structure of peat changes with agricultural conversion using MRI technology. Consider changes to water movement, storage and carbon leaching with changes to structure. Relate changes to peat structure to the potential increase of gaseous (CH4, CO2) and fluvial carbon losses (e.g. Dissolved Organic Carbon) and implications to global climate change.

Proteomic analysis of somatic embryogenesis in tissue culture of oil palm (Elaeis guineensis Jacq)
This project investigates the proliferation level of tissues culture samples in oil palm using proteomic technology). Influence of rock phosphate and liming on the nitrogen fixation of Bambara groundnut landraces on a tropical acidic soils of Malaysia.

Development of a strategy to improve the growth and health of fish fed with prebiotic plant-based diet
This study highlights the development of a method applicable to determine the suitability of plant material to be applied as prebiotics in fish, taking into consideration the health and growth of fish, as well as the nutritional content of the fish as a result of the modified diet.

Molecular Pharming of Consensus E Protein Domain III (EDIII) of Dengue Viral Serotypes in planta
The project is aimed at developing vaccine candidates against dengue disease in safer and more cost effective plant system.