



2026-2027 PROJECT BOOKLET

- » DATA & INFORMATION SCIENCE
- » ECOLOGY, EVOLUTION & ENVIRONMENT
- » ENGINEERED SYSTEMS
- » MOLECULAR SCIENCES & TECHNOLOGY



ABOUT US

At the College of Science and Engineering, we believe in the power of science and engineering to solve real world problems.

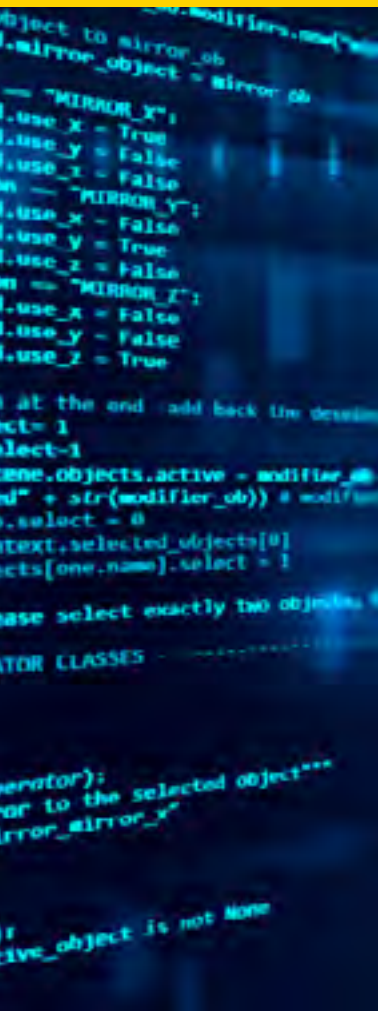
We strive to advance fundamental science, to create new technologies, and to work across discipline boundaries. Our interests scale from the sub-atomic through to entire oceans, forests and beyond. We seek to understand the past, but also to create the world of the future.

Our researchers seek to discover new understandings in fields as diverse as groundwater hydrology, forensic science and medical devices, while our teaching offers training in areas of biological sciences, chemical and physical sciences, computer science, information technology, engineering, mathematics and the environment.

Our college is an exciting place to research, study and work, supported by best practice teaching methods, practical work-related learning and advanced facilities.

RESEARCH SECTIONS

Our talented researchers span across all spheres of science and engineering and bravely pursue solutions to some of the biggest questions of our time. With a broad focus on sustainability, security and health, our research advances knowledge, addresses real world problems, and promotes sustainable development. Our multidisciplinary research sections provide areas of foci for our research community.



DATA & INFORMATION SCIENCE

In today's data driven world, our data and information science, computer science and mathematics researchers are at the forefront of creating practical solutions to real-world challenges. By embracing the rapidly changing technological environment, our research takes fundamental science and applies it to areas including agriculture, healthcare, and defence.

We focus on the integration of cybersecurity, machine learning and advanced data analytics to solving important and wide-reaching industry, government, and defence problems.

Our mathematicians and computer scientists are conducting world-leading research in artificial Intelligence, knowledge discovery, medical image processing, neuroscience, and cybersecurity. Our experts in digital health are making significant contributions to healthcare service delivery world-wide, creating new systems for data security, virtual care and digital infrastructure.

Conducting inter-disciplinary and collaborative research, we translate our research into tangible outcomes with broad impact for the benefit of the professions and the community.

ECOLOGY, EVOLUTION & ENVIRONMENT

We do broad and interdisciplinary research in ecology, evolution and the environment and are committed to producing world-class scientists through our Honours and PhD programs. Our work addresses questions at a range of spatial and temporal scales, from microhabitat to global and from generations to millennia. We study a variety of terrestrial and aquatic environments and organisms, ranging from the arid-zone to the deep sea and from bacteria to whales.

We do world-leading research in several areas of biodiversity and environmental sciences, including palaeontology, evolutionary biology, global ecology, molecular ecology, animal behaviour, groundwater and coastal geomorphology.

Our research is expanding knowledge about the history of life and the potential of organisms to adapt to environmental change. We are also interested in improving water management and understanding the impact of human activities on the physical environment, biodiversity and natural resources.



ENGINEERED SYSTEMS

We are dynamic critical thinkers and problem solvers who are undertaking research across diverse fields of engineering, including medical devices, defence and maritime capabilities for the future.

By combining fundamental research with the application of state-of-the-art engineering principles, we are developing new technologies and making new breakthroughs in Biomedical, Civil & Environmental, Electrical & Electronic, Control, Mechatronics & Robotics, and Materials, Mechanical & Manufacturing Engineering.

Based at Tonsley, Australia's first Innovation District, our research incorporates strong collaborations with industry, across Australia and internationally.

MOLECULAR SCIENCE & TECHNOLOGY

From the smallest units of matter to the molecular systems of life, we are growing knowledge and developing technology to answer some of the world's biggest challenges.

Our research in physics, chemistry, molecular biology, and plant science is world-leading and dedicated to expanding our understanding of the physical and biological world.

We are also committed to translating this fundamental research into a wide array of real-world applications and impact. Our chemistry and physics discoveries have led to new nanotechnology for environmental remediation, energy production and storage, and advanced materials. Our biochemical research has made an impact on how we view and treat disease. Our forensic science research has provided innovative solutions for fighting crime. Our plant science research has made advances to support the future of food production.

We are forward-thinking and aim for scientific and technological advances for solutions spanning health, development, security and sustainability.

AI-BASED ECG PREDICTION FOR EARLY DETECTION OF CARDIAC ABNORMALITIES

This project focuses on the implementation of an Artificial Intelligence (AI) system for analysing electrocardiogram (ECG) signals and predicting cardiac abnormalities. The project will investigate how machine learning and deep learning techniques can identify patterns within ECG recordings that distinguish normal cardiac activity from abnormal cardiac rhythms or conditions.

The research will utilise a publicly available ECG dataset and implement an end-to-end prediction pipeline, including ECG signal preprocessing, segmentation, feature extraction or representation learning, model development, training, and evaluation. Different AI approaches may be investigated and compared to determine their effectiveness in ECG classification.

The project will result in a functional AI-based ECG prediction prototype and an experimental evaluation of its predictive performance. The findings will provide an initial assessment of the feasibility of using AI for automated ECG analysis and establish a foundation for future research into more advanced cardiac condition prediction and personalised digital health applications. The system developed in this project is intended as a research prototype and not as a clinically validated diagnostic system.

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DESIGN OF A PERSONALISED ATHLETE DIGITAL TWIN: A DESIGN SCIENCE RESEARCH APPROACH

This project uses a Design Science Research (DSR) approach to design a conceptual Athlete Digital Twin for representing and monitoring an athlete's physiological, wellness, and performance state. The Digital Twin will integrate key data sources, including heart rate variability (HRV), sleep, training load, fatigue, motivation, and other relevant indicators.

The research will identify the components, relationships, data sources, and functional requirements needed to represent an individual athlete within a Digital Twin. These requirements will inform the development of a conceptual architecture and prototype design demonstrating how athlete data can be integrated into a dynamic representation of the athlete.

The proposed artefact will explore how individual baselines and changes over time can be modelled to identify deviations in physiological and recovery patterns. Where feasible, a small proof-of-concept using sample or available athlete data will demonstrate the design.

Following the DSR methodology, the project will involve problem identification, objective definition, artefact design, prototype development, and preliminary evaluation. The outcome will be a conceptual Athlete Digital Twin architecture and initial assessment, providing a foundation for future predictive modelling, anomaly detection, and personalised training support.

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FROM FIRST ENCOUNTER TO FAMILIAR TERRITORY: COMPARING STUDENT OUTCOMES ACROSS TWO COHORTS

The increasing use of generative artificial intelligence (AI) in higher education has prompted universities to explore assessment approaches that better evaluate student understanding and maintain academic integrity. Interactive Oral Assessment (IOA) has emerged as an authentic assessment method that allows students to demonstrate their knowledge through a genuine, unscripted conversation with an assessor while also developing communication, critical thinking, and professional skills.

This project will investigate the experiences of students enrolled in BIOL2701 Biostatistics 2 who completed an IOA in either 2025 or 2026. Students in 2025 generally completed the assessment without prior experience of IOA, whereas many students in 2026 had previously encountered this assessment format in a first-year topic. The project will examine whether prior exposure to IOA influences student performance, perceptions of the assessment, preparation strategies, confidence, and anxiety.

The successful student will analyse existing assessment and survey data to compare outcomes between the two cohorts and identify factors that may influence student success and engagement. Findings will contribute to a broader research program examining the impact of IOA on learning outcomes, academic integrity, student experience, and assessment practices across the sciences.

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VIRTUAL CHARACTERS USING GENERATIVE AI

Generative language models such as ChatGPT, Gemini and Claude are revolutionising how humans interact with AI on a regular basis. Beyond their use as personal assistants, tutors, editors and technical support, this cutting-edge AI technology also provides new creative opportunities. Several prominent entertainment companies (Nvidia, Ubisoft, Electronic Arts, Xbox, Sony, etc.), alongside high-profile academic researchers, are already exploring generative AI's potential to create dynamic characters that respond authentically to users.



This project will develop an interactive character conversation demonstrator, able to interpret a variety of input modalities. This demonstrator will utilise existing Generative AI technology to produce a virtual character capable of taking both audio and visual inputs (from microphones and cameras) and producing its own generated speech and actions in response. These functions can then be combined with real-time animation and lip-syncing software to create a fully realised virtual character, able to seamlessly interact with human users.

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VIRTUAL HISTORICAL DIORAMA EXPERIENCES IN MIXED REALITY

Imagine being able not only to read a historical story (e.g., from an archived newspaper or on a website) but also to experience it unfold in our own physical spaces, akin to a diorama. This project seeks to explore how Mixed Reality could be used to develop virtual miniature dioramas to educate and deliver unique South Australian historical narratives to students and the wider public. The student will work with a Meta Quest 3 headset in the Unity game engine to build a virtual diorama experience that is spatially anchored in the real world and visible while wearing the headset. Students will be situated in the Interaction Lab on the Tonsley Campus with access to state-of-the-art VR technology and high-performance gaming machines. Students will also learn how to program for MR experiences in tandem with using game assets and programming animations. Students will also conduct usability testing with lab members to iterate on their prototypes.

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A MULTIDISCIPLINARY IMMERSION IN GROUNDWATER RESEARCH: FIELDWORK, EXPERIMENTATION AND MODELLING

This summer research activity will engage in a variety of investigative techniques to explore a targeted research question in the topic of groundwater. The student will have access to expertise and world-class facilities in laboratory experimentation, numerical modelling activities, and field investigation. Our projects cover questions related to discharge of nutrients to bays where large aquaculture industries require pristine water quality conditions, the protection of wetlands affected by nutrient discharge and altered flow regimes in both agricultural and mining areas, the investigation of saltwater intrusion in important coastal aquifers, amongst a broad range of other research topics. The student will partner with an Honours and/or PhD student to get hands on experience in the leading practices of hydrogeological investigation.

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BIODIVERSITY RECOVERY IN FLINDERS' CAMPUS RESTORATION LIVING LABORATORY

Flinders University has established 34 ecosystem restoration plots within the nationally threatened grey box grassy woodland on the Bedford Park campus. This project will quantify early biodiversity recovery and identify factors associated with restoration success.

Working as a coordinated research team, up to three students will develop hypotheses, undertake standardised field sampling and analyse complementary indicators of ecosystem condition.



Depending on student interests and seasonal feasibility, projects could examine changes in native plant and animal communities, soil health and biodiversity, habitat condition, or responses to restoration interventions. Each student will gain hands on experience in study design, field methods, data management, statistical analysis, scientific interpretation and research communication.

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HEALTH IMPACTS OF FOREVER CHEMICALS (PFAS)

Per and polyfluoroalkyl Substances (PFAS) are critical environmental pollutants because of their persistence, bioaccumulation potential, mobility and toxicity. There are over 14,000 PFAS chemicals and toxicity of the majority of them are still unknown, particularly the toxicity of mixed PFAS. You will investigate ecotoxicity of PFAS mixture in earthworms using a multi-omics approach.

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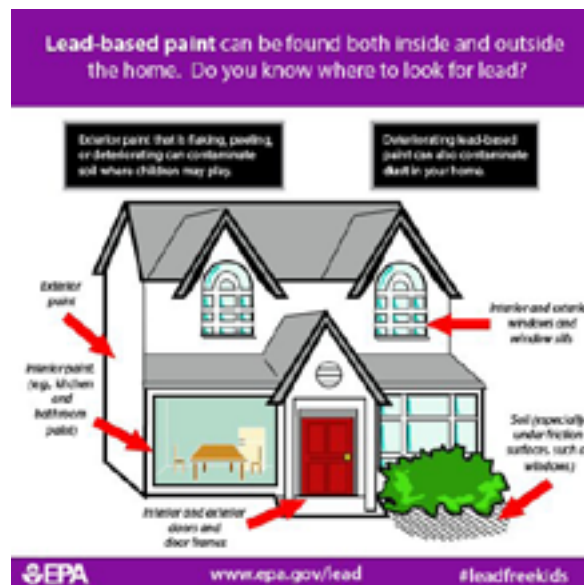
REDUCING CHILDHOOD EXPOSURE TO LEAD

No level of lead exposure is safe for children because it may damage neurological development, cause ADHD or lower IQ. World's largest lead-zinc smelter at Port Pirie (SA) has significantly contaminated soil for over 150 years. Health impacts include high blood lead levels in more than 50% of the children under 5. We are working on a novel soil remediation strategy to reduce lead exposure by over 90%. You will be doing ecotoxicity assays with earthworms and native Australian plant species (like Kangaroo grass) to make sure that the treatment is safe for industrial adoption.

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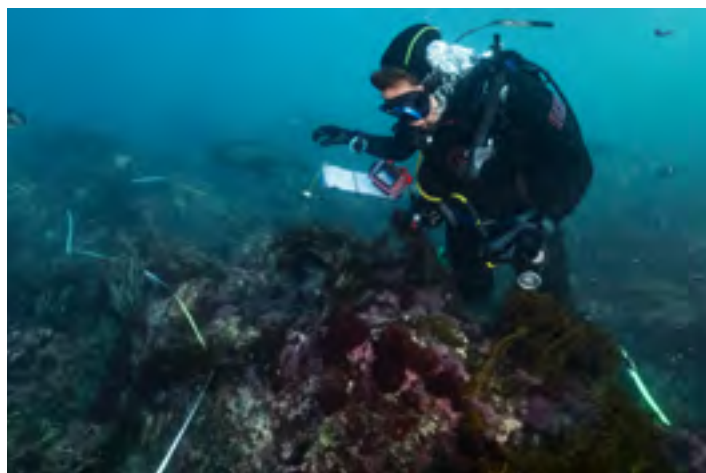
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IMPACTS OF THE 2025–2026 SOUTH AUSTRALIAN HARMFUL ALGAL BLOOM ON SEAWEED COMMUNITIES

This project will investigate how the 2025–2026 South Australian harmful algal bloom (HAB) affected seaweed community composition and place these impacts within the context of long-term ecological change. Activities may include annotating historical and post-HAB underwater imagery, digitising legacy survey data, and assisting with seaweed field surveys. Field participation may involve boat support or, where students have appropriate qualifications and experience, snorkelling or diving.



Students may also contribute to a systematic review of published research on HAB impacts on seaweed communities. Using search terms and screening criteria developed by the supervisory team, students will assess papers for inclusion, document exclusion decisions, and extract relevant ecological data. Where sufficient comparable information is available, students may digitise results from figures, locate published datasets and compile data for a future meta-analysis.

The project is suitable for one to three undergraduate students, with tasks divided into complementary imagery, data, fieldwork and literature-review components.

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METAGENOMIC ANALYSIS OF THE HARMFUL ALGAL BLOOM HOLOBIONT

The Harmful algal holobiont project will use genomics to understand the interactions between harmful algal blooms (HABs) and the microbial and viral community. The research focuses on the dynamic holobiont formed by bloom-forming Dinophyceae, bacteria and viruses, asking how these interactions influence bloom initiation, persistence and collapse. A spatial and temporal monitoring program will combine environmental DNA (eDNA), metagenomics, flow cytometry and environmental measurements to quantify changes in marine organisms, microbial communities and metabolic functions, identifying genomic signatures that provide early warning of bloom development.

The project will discover and culture bacteria and viruses capable of suppressing or killing *Karenia*, establishing biobanks of potential biological control agents. Viromics and host-infection experiments will determine how viruses regulate bloom dynamics and identify candidates for targeted mitigation. In parallel, genomic and transcriptomic analysis of *Karenia mikimotoi* will identify genes involved in toxin production and interactions with microbes and viruses. Students will be able to conduct research on a section of this research and learn genomic and metagenomic skills.

Professor Elizabeth Dinsdale

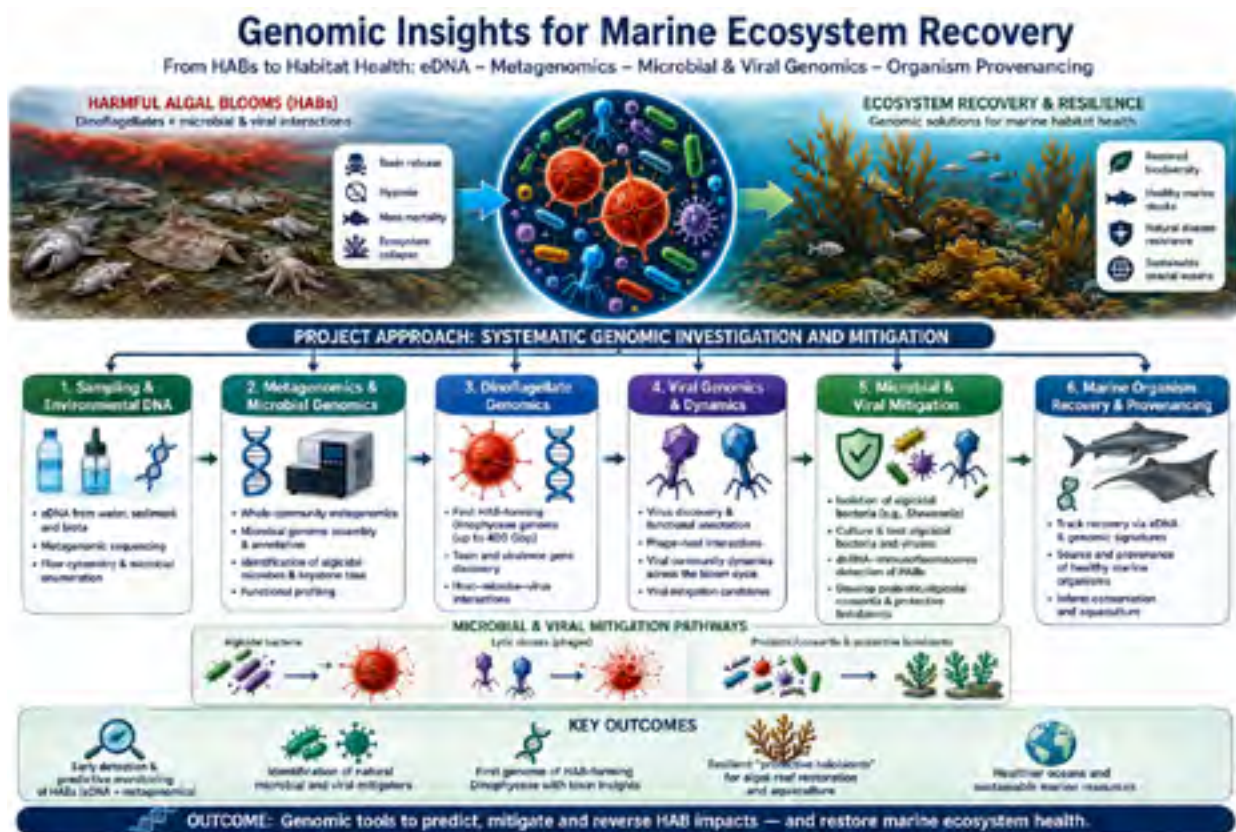
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AN ANALOG SENSING UNIT FOR THE X2 EXOSKELETON

Stroke recovery can require significant physical effort on the part of a patient and therapist in re-learning effective limb motions. The X2 Exoskeleton is used in research to test different control paradigms that might better promote rehabilitation outcomes, and to provide mechanical aid to a therapist.

As part of a campaign of upgrades for the exoskeleton, we would like to replace the Analog Sensing Unit (ASU) sensor board that is present at each joint. This will allow for upgrades in the future to facilitate more advanced control techniques including self-balancing that relies on inverse kinematics.

This project will involve developing and testing a new microcontroller solution, including:

- documenting current operation, Sensor ID's, and codes,
- receive and transmit information across a CAN bus ,
- receiving currently unspecified analog signals and converting these digital ,
- providing calibration capability, and
- allow the specification of additional sensors in an existing network.

This project uses the ExoMotus X2 lower limb exoskeleton and the CORC platform: <https://github.com/UniMelbHumanRoboticsLab/CANOpenRobotController>

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COMPUTATIONAL FLUID DYNAMICS SIMULATIONS OF SUPERSONIC NOZZLES FOR WIND TUNNEL DESIGN

This project will involve development of new nozzle geometries for supersonic exit flow in a wind tunnel. Students will be exposed to, and participate in, computational fluid dynamics using both commercial and open source software. Students will have the opportunity to design their own nozzles and analyse the performance using fluid dynamics to build a better understanding of compressible flow and high-speed aerodynamics.

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DESIGN OF A DIGITAL FLOW CONTROL SYSTEM FOR AN INTERMITTENT SUPERSONIC WIND TUNNEL

This project will involve participation in the design of a mass flow controller for a supersonic wind tunnel. Students will be exposed to a multidisciplinary design process for a practical output. The mass flow controller will require integration of multiple sensors with fluid dynamics theory, error estimation, and PID control to ensure accurate set-point control from an external source. In particular, the flow controller will achieve desired stagnation pressure and mass flow rates to achieve accurate Mach numbers in the test section of the supersonic wind tunnel.

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SHOCKWAVE VISUALISATION IN UNDEREXPANDED JETS

Students will have the opportunity to participate in an experimental campaign visualising the flow structures produced from an underexpanded jet. There will be capacity to assist in the set up of the experimental apparatus, optical configuration, and be involved in the collection of data.

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VACUUM CHAMBER DESIGN AND DEVELOPMENT FOR INTERMITTENT SUPERSONIC WIND TUNNELS

This project involves the design and development of a vacuum chamber and pump system for low pressure supersonic flow. Students will be exposed to the principles of high enthalpy flows, pressure recovery, and pump sizing for a practical flow system. Under guidance, students will have the opportunity to conduct fluid dynamics analysis using CFD of compressible pipe flow, as well as stress analysis of internally pressurised vessels.

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NUMERICAL MODELLING AND ANALYSIS OF LATERALLY LOADED PILES

Laterally loaded piles are widely used to support infrastructure such as bridges, retaining structures, offshore facilities, transmission towers and other structures subjected to horizontal loading. Their behaviour is strongly influenced by nonlinear interaction between the pile and surrounding soil.

This research project will use optimisation constrained approach to investigate the behaviour of laterally loaded piles under different pile, soil and loading conditions. The student will undertake systematic numerical analyses and compare the results with established analytical solutions, published case studies and, where available, commercial pile-analysis software. A particular emphasis will be placed on understanding how different soil models influence the predicted pile response and identifying the conditions under which simplified models provide reliable engineering predictions.

The project will introduce the student to the fundamental mechanics of soil–structure interaction while providing practical experience in computational modelling, numerical verification and interpretation of engineering results.

The project would suit an undergraduate student in Civil Engineering, particularly a student interested in geotechnical engineering, structural engineering, numerical modelling or computational mechanics. Some previous study of mechanics of materials and geotechnical engineering would be desirable. Experience with Excel is useful, but programming experience is not essential.

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CONCEPT OF PHOTO-RECHARGEABLE POLYMER BATTERIES

This project focuses on photo-rechargeable batteries that utilize photoredox reactions on polymer-based electrode materials. It involves preparing two polymer electrodes: one with organic radicals as cathodes and another with anthraquinone as anodes. Additionally, water-soluble metalloporphyrin catalysts will be tested in aqueous environments to facilitate the redox processes of these electrodes.

The aim is to develop a method that uses light as an energy source to directly recharge the battery. The results are expected to demonstrate the feasibility of metal-free photo-rechargeable batteries, confirming their potential as sustainable energy solutions.

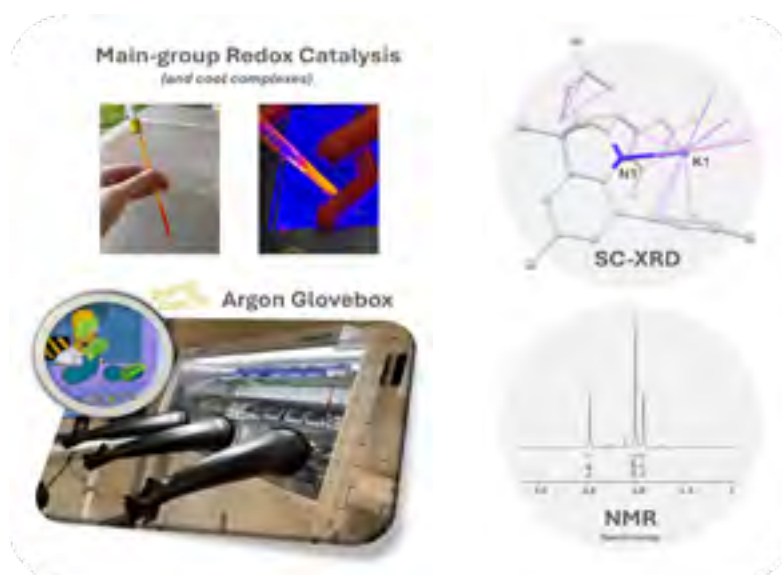
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DEFYING ALL ODDS: MAIN-GROUP REDOX CATALYSIS

Traditionally, redox catalysis has been dominated by transition metals that can readily navigate multiple stable oxidation states. Recent work has shown that the main-group elements, which were previously thought incapable of facilitating redox catalysis, can achieve this task when equipped with a suitable ligand. This project builds on existing work in the Evans lab to design redox-active main-group complexes derived from environmentally benign main-group elements.



Students will (i) use a glovebox to prepare new materials, (ii) analyse samples through single crystal X-ray diffraction and heteronuclear NMR spectroscopic measurements, and (iii) identify structure-reactivity trends to enable redox catalysis. Results obtained will contribute directly towards cutting-edge research in main-group chemistry and be published in due course.

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DEVELOPING POLYMER SOLAR CELLS

This project focuses on the development of high-performance polymer solar cells with a particular emphasis on improving device stability and operational lifetime. A key objective is to investigate the stability of different active materials and material combinations, and to understand how these influence solar cell performance over time.

The long-term stability of polymer solar cells is often limited by factors such as material properties, morphology, and device architecture. This project will examine how these factors interact and affect both efficiency and durability. Through systematic studies of material selection, film morphology, and device performance, participants will gain insights into the mechanisms governing solar cell degradation and stability.

The project offers an excellent opportunity to learn about conjugated polymers and organic photovoltaic materials while gaining hands-on experience in the fabrication, optimisation, and characterisation of polymer solar cells. Students will develop practical skills in materials processing, device fabrication, optoelectronic measurements, and data analysis, providing valuable training in advanced materials research and renewable energy technologies.

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ENVIRONMENTALLY FRIENDLY ANTIFOULING METHODS

Fouling (the growth of marine organisms) on ships is a serious problem that dramatically increases fuel costs, reduces manoeuvrability, causes damage, and spreads invasive species. To address this problem, current methods use biocides such as copper compounds in antifouling paint. The problem is that this method increases copper levels in harbours and marinas. High copper levels in water are a serious environmental concern, and such coatings are now banned in various parts of the world. This project focuses on studying and developing new coatings that can prevent the growth of unwanted marine organisms using electrochemistry. This research is currently being performed in collaboration with a company in South Australia

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DEVELOPMENT OF NEW CATALYSTS FOR SYNTHETIC CHEMISTRY

Aim 1. Design, synthesise, and characterise new gold catalysts

Novel Au(I) complexes will be synthesised using known processes to allow access to a small library of these complexes. The reaction conditions will be optimised to maximise yield and purity. The resulting complexes will be extensively characterised using methods such as NMR, and IR, spectroscopies, as well as mass spectrometry, elemental analysis, and X-ray diffraction.

Aim 2. Ligand substitutions to incorporate chromophores to the Au(I) complexes

The Au(I) complexes produced in Aim 1 will undergo ligand substitution reactions to incorporate chromophores such as naphthalimide or carbazole ligands. These complexes will additionally be characterised by UV/vis spectroscopy and cyclic voltammetry to determine their suitability as photoredox catalysts.

Aim 3. Development of photocatalytic methodology using Au(I) complexes

Au(I)-photocatalysed synthetic methodology will be developed. Inner- vs outer-sphere electron transfers will be compared in an atom transfer radical addition (ATRA).

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NANOPLASTICS DETECTION, CAPTURE AND CHARACTERISATION

Micro- and nanoplastics (MNPs) are emerging contaminants of concern due to their potential toxicity and ability to translocate into human tissues. The project focuses on the development and optimisation of sample pre-treatment protocols for complex biological fluids such as blood and/or environmental samples (sediment, wastewater). Tasks will include methodical digestion of samples to remove background material without compromising plastic particles, and sequential filtration using lab-grade glassware to isolate different size fractions of MNPs. Flow cytometry, spectroscopy and nanoparticle tracking analysis (NTA) will be used to determine particle concentrations and plastic identification.

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PHAGE ISOLATION AGAINST PSEUDOMONAS

Pseudomonas is a type of bacterium that lives on grapevines. When the weather gets very cold, these bacteria can help ice form on plants, which can damage vines and grapes.

We are looking for tiny viruses called phages that can kill Pseudomonas bacteria. Our goal is to find phages that are safe for plants while removing harmful bacteria. We will then test whether these phages can help protect grapevines from frost damage in the Clare Valley and Barossa wine regions.

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NOMINATE A BESPOKE PROJECT

Applicants for the CSE Student Research Experience Award have the opportunity to develop a bespoke research project tailored to their interests, academic background, and future career aspirations. Projects are developed in partnership with an academic staff member and are subject to negotiation and mutual agreement, ensuring a meaningful, achievable, and rewarding research experience. This flexible approach enables students to pursue areas they are passionate about while contributing to innovative research and discovery within the College.

To explore potential research areas and connect with academic staff who may be able to supervise your project, visit: flinders.edu.au/college-science-engineering/our-research.

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