UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	*Pilot-scale optimisation of sidestream enhanced biological phosphorus removal processes*
Project duration:	6 weeks
Description:	Biological wastewater treatment is a highly dynamic process subject to frequent disturbances during operation, particularly in regards to the composition of wastewater influents. Conventional enhanced biological phosphorus removal (EBPR) processes are particularly difficult to control effectively for these reasons. Instability can be caused by rainfall events, for example, causing dilution of organic carbon and reduced retention time in the anaerobic zone, which is critical to EBPR success. One process configuration that can be superior in stabilising EBPR is by operating the anaerobic zone as a sidestream bioreactor. This retrofitting approach is a cheaper solution to implement EBPR than the mainstream process and is also hypothesised to be more effective and stable. Nevertheless, little is known about how sidestream EBPR can be controlled effectively. This study investigates how operational conditions impact sidestream EBPR in a pilot-scale study fed with real wastewater, with bioreactors >1m^3 and an online control and monitoring system. The student will work side by side process engineers in a pilot-scale facility at the Innovation Centre of the Luggage Point wastewater treatment plant. They will thus get experience with process engineering research during scale-up from small-scale to large-scale.
Expected outcomes and deliverables:	The student will gain valuable industry contacts, learn how to conduct an applied research project and appreciate the challenges and perspectives associated with industry-focussed research. The student will be expected to produce a report and oral presentation at the end of their project about their work.
Suitable for:	Chemical engineering, chemical+bioprocess engineering and chemical+environmental engineering UQ students
Primary Supervisor:	Adrian Oehmen
Further info:	a.oehmen@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	*Immobilisation of cells for enhanced denitrification from recirculating aquaculture systems*
Project duration:	6 weeks
Description:	This project investigates the production and application of immobilized microbes for use in aquaculture water treatment. Pure and enriched cultures of microbes known to be able to reduce nitrate will be encapsulated in polymeric biobeads. These biobeads will then be applied in a lab-scale aquacultural water treatment process, with the aim of understanding the benefits encapsulation can bring to recirculating aquaculture systems. The project will involve experimental work in a laboratory where bioreactors are being operated for denitrification. The student will work side-by-side with a mentor to operate and monitor the bioreactors with the immobilised microorganisms. The biobeads will then be tested in order to evaluate their denitrification kinetics, as well as their comparative kinetics with free cells. The student will gain a wide range of relevant practical experiences including bioreactor operation, bacterial cell culturing and process analysis and optimisation. The techniques involved centre on environmental bioprocess engineering, but also incorporate chemical analytical procedures to analyse solid, liquid, and gaseous-phase components, and microbial analyses to characterize the organisms present in the cultures.
Expected outcomes and deliverables:	The student will gain valuable industry contacts, learn how to conduct an applied research project and appreciate the challenges and perspectives associated with industry-focussed research. The student will be expected to produce a report and oral presentation at the end of their project about their work.
Suitable for:	Chemical+bioprocess engineering UQ students.
Primary Supervisor:	Adrian Oehmen
Further info:	a.oehmen@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Co-culturing the growth of Microbiome strains for disease prevention
Project duration:	6 weeks
Description:	The use of more than one strain, commonly called a consortia, for the treatment of disease as a function of microbiome dysbiosis is an expanding field in the live bioactive product (LBP) field. Current processes involve the individual manufacture of single strains that are then blended as powders before encapsulation. By developing an understanding of how to reproducibly grow consortia as a single batch through metabolic modelling, bioreactor control and media development, a systematic approach can be established for developing a co-culture growth system to meet the pharmaceutical industry requirements for good manufacturing practice (GMP) of LBPs. This research program will investigate a number of common LBP strains to gain an understanding of their metabolic maps, how they interact and what information is needed to develop a lab-based process for their co-culture
Expected outcomes and deliverables:	This is an industry-facing research project, with high involvement and mentorship from Sacco System Australia. Students are expected to conduct research at both UQ's School of Chemical Engineering and Sacco System Australia facility at Yeerongpilly. Students will gain skills in various aspects of bioprocess engineering, including metabolic modelling, and their link with bioreactor operation. Students will be expected to produce a report and oral presentation at the end of their project.
Suitable for:	This project is open to applications from UQ enrolled students in chemical engineering, with a background in bioprocess or biomedical engineering (preferably 3rd or 4th year students).
Primary Supervisor:	Adrian Oehmen (UQ) and Jason Ryan (Sacco System Australia)
Further info:	Further info can be obtained by contacting Adrian Oehmen at a.oehmen@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	*Optimising the bioproduction of biodegradable plastics from sugar*
Project duration:	6 weeks
Description:	Polyhydroxyalkanoates (PHAs) are plastics that present attractive mechanical properties for numerous industry applications, and have the benefit of being biodegradable in the environment. The bioproduction of PHAs is often constrained by the challenges associated with maintaining a pure culture of PHA accumulating organisms. This project considers the use of halophiles – organisms with high salt tolerance – allowing for bioproduction in highly saline conditions, which precludes contamination without the requirement for sterilisation. This technology may be able to lower the production costs of PHA substantially, making it more competitive in the market with cheaper, non-biodegradable petroleum-based plastics. This project investigates how operational conditions, such as nutrient and oxygen supply, impact PHA production in order to optimise the bioproduction process. Methods of extraction of the PHA bioplastic will also be studied, where halophilic cells can be ruptured using fresh water in order to extract the bioplastic from cells. it is expected that this step can lead to lower extraction costs, another process bottleneck at present. The student will get experience with bioreactor operation, process control and optimisation, and the production and recovery of materials through circular economy approaches.
Expected outcomes and deliverables:	The student will learn how to conduct an applied research project and appreciate the challenges and perspectives associated with industry-focussed research. The student will be expected to produce a report and oral presentation at the end of their project about their work.
Suitable for:	Chemical engineering, chemical+bioprocess engineering and chemical+environmental engineering UQ students
Primary Supervisor:	Adrian Oehmen
Further info:	a.oehmen@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Recycling of Waste Electrical and Electronic Equipment (WEEE)
Project duration:	*6 weeks*
Description:	The issue of treatment of end-of-life manufactured devices is becoming increasingly important as the volume of these materials continues to increase. These devices contain valuable critical metals such as Au, Ag, Ni, Sn, Cu, Co, platinum group metals, and rare earth elements. In addition, they typically contain >20 other elements. This issue is the key in progressing towards circular net zero economy and has significant environmental aspect. The race is on to identify more efficient ways to recycle these complex materials. The large number of different elements and the dispersion of the elements between small components makes pyrometallurgy a preferred option for recycling. Most successful electronics recyclers, such as Umicore (Belgium), use integrated primary copper, secondary copper, primary lead and secondary lead smelting, primary nickel and hydrometallurgical treatment. Recycled products can enter the process at different stages depending on the type of material. Through the optimization of process conditions in every smelting unit and by redirecting internal streams, the whole plant can achieve higher utilization of energy and production of valuable goods. For an integrated plant, the main source of losses of valuable metals is discarded slag. The Pyrometallurgy Innovation Centre (PYROSEARCH) is undertaking research program for a number of leading international metallurgical and recycling companies. The Centre has developed new experimental and theoretical modelling techniques to enable the chemical equilibria and elemental distributions in multi-component multi-phase systems to be accurately measured and predicted. The project will build on existing research and provide new experimental data on a range of conditions relevant to possible recycling process and will complement existing research currently being undertaken at the Centre. ***://pyrosearch.chemeng.uq.edu.au***
Expected outcomes and deliverables:	Student will work with an existing research team, obtain practical experience in high temperature laboratory and thermodynamic computer modelling advanced research techniques, familiarise with industrial recycling process and is expected to produce a professional quality report at the end of their project. During the project one of the existing processes will be evaluated, high temperature equilibrium experiments will be performed to reproduce complex chemistry at controlled conditions, experimental results will be compared to the predictions of the FactSage thermodynamic software, the e-scrap co-treatment recycling process will be proposed, modelled and results will be analysed and presented in a report.

Suitable for:	This project is open to applications from students with a background in chemical engineering, chemical and materials engineering, chemical and environmental engineering, chemical and metallurgical engineering 3-4 year students, UQ enrolled students only. Location: Banksia Building, Long Pocket Campus.
Primary Supervisor:	Dr Maksym Shevchenko
Further info:	m.shevchenko@uq.edu.au 0432397852

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Recycling of Waste Electrical and Electronic Equipment (WEEE)
Project duration:	*6 weeks*
Description:	The issue of treatment of end-of-life manufactured devices is becoming increasingly important as the volume of these materials continues to increase. These devices contain valuable critical metals such as Au, Ag, Ni, Sn, Cu, Co, platinum group metals, and rare earth elements. Overall, they typically contain >20 other elements. This issue is the key in progressing towards circular net zero economy and has significant environmental aspect. The race is on to identify more efficient ways to recycle these complex materials. The large number of different elements and the dispersion of the elements between small components makes pyrometallurgy a preferred option for recycling. Most successful electronics recyclers, such as Umicore (Belgium), use integrated primary copper, secondary copper, primary lead and secondary lead smelting, primary nickel and hydrometallurgical treatment. Recycled products can enter the process at different stages depending on the type of material. Through the optimization of process conditions in every smelting unit and by redirecting internal streams, the whole plant can achieve higher utilization of energy and production of valuable goods. For an integrated plant, the main source of losses of valuable metals is discarded slag. The Pyrometallurgy Innovation Centre (PYROSEARCH) is undertaking research program for a number of leading international metallurgical and recycling companies. The Centre has developed new experimental and theoretical modelling techniques to enable the chemical equilibria and elemental distributions in multi-component multi-phase systems to be accurately measured and predicted. The project will build on existing research and provide new experimental data on a range of conditions relevant to possible recycling process and will complement existing research currently being undertaken at the Centre. ***://pyrosearch.chemeng.uq.edu.au***
Expected outcomes and deliverables:	- Perform 5-10 high-temperature equilibrium experiments aimed at one of the valuable metals (under supervision). - Compare equilibrium results with FactSage thermodynamic software and literature - Simulative the e-scrap recycling process using FactSage + Excel model template Student will work with an existing research team, obtain practical experience in high temperature laboratory and thermodynamic computer modelling advanced research techniques, familiarise with industrial recycling process and is expected to produce a professional quality report at the end of their project. During the project one of the existing processes will be evaluated, high temperature equilibrium experiments will be performed to reproduce complex chemistry at controlled conditions, experimental results will be compared to the predictions of the FactSage thermodynamic

	software, the e-scrap co-treatment recycling process will be proposed, modelled and results will be analysed and presented in a report.
Suitable for:	This project is open to applications from students with a background in chemical engineering, chemical and materials engineering, chemical and environmental engineering, chemical and metallurgical engineering 3-4 year students, UQ enrolled students only. Location Banksia Building Long Pocket Campus.
Primary Supervisor:	Dr Denis Shishin
Further info:	d.shishin@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Recycling of Waste Electrical and Electronic Equipment (WEEE) by ISA smelting technology
Project duration:	*6 weeks*
Description:	The issue of treatment of end-of-life manufactured devices is becoming increasingly important as the volume of these materials continues to increase. These devices contain valuable critical metals such as Au, Ag, Ni, Sn, Cu, Co, platinum group metals, and rare earth elements. In addition, they typically contain >20 other elements. This issue is the key in progressing towards circular net zero economy and has significant environmental aspect. The race is on to identify more efficient ways to recycle these complex materials. The large number of different elements and the dispersion of the elements between small components makes pyrometallurgy a preferred option for recycling. Most successful electronics recyclers, such as Umicore (Belgium), use integrated primary copper, secondary copper, primary lead and secondary lead smelting, primary nickel and hydrometallurgical treatment. Recycled products can enter the process at different stages depending on the type of material. Through the optimization of process conditions in every smelting unit and by redirecting internal streams, the whole plant can achieve higher utilization of energy and production of valuable goods. For an integrated plant, the main source of losses of valuable metals is discarded slag. The Pyrometallurgy Innovation Centre (PYROSEARCH) is undertaking research program for a number of leading international metallurgical and recycling companies. The Centre has developed new experimental and theoretical modelling techniques to enable the chemical equilibria and elemental distributions in multi-component multi-phase systems to be accurately measured and predicted. The project will build on existing research and provide new experimental data on a range of conditions relevant to possible recycling process and will complement existing research currently being undertaken at the Centre. ***://pyrosearch.chemeng.uq.edu.au*** **This project will investigate the smelting chemistry of e-scrap recycling process by ISA smelting technology.**
Expected outcomes and deliverables:	Student will work with an existing research team and an industry counterpart, obtain practical experience in advanced high temperature laboratory and thermodynamic computer modelling research techniques, familiarise with industrial recycling process and is expected to produce a professional quality report at the end of their project. During the project one of the existing processes will be evaluated, high temperature equilibrium experiments will be performed to reproduce complex chemistry at controlled conditions, experimental results will be compared to the predictions of the FactSage thermodynamic software and industry data, the e-scrap co-treatment recycling process will be proposed, modelled and results will be analysed and presented in a report.

Suitable for:	This project is open to applications from students with a background in chemical engineering, chemical and materials engineering, chemical and environmental engineering, chemical and metallurgical engineering 3-4 year students, UQ enrolled students only. Location Banksia Building Long Pocket Campus.
Primary Supervisor:	Dr Jeff Chen
Further info:	uqjchen7@uq.edu.au

UQ Summer Research Project Description

Project title:	**Numerical investigation of a hydrogen pre-reduction process of lump iron ores in an integrated metallurgical system.**
Project duration:	6 weeks
Description:	Producing steels from conventional Blast Furnace - Basic Oxygen Furnace (BF-BOF) route generates massive carbon dioxide emissions (around 7% of the total emissions all over the world) due to the coke-based reduction reactions. Alternatively, hydrogen has been tested as a reductant that can replace coke in laboratory and smaller scales. However, there remain safety, cost and technical challenges when applying hydrogen-based steel production in industrial scale. To reach a compromise, we proposed an integrated system, at which the hydrogen will be used for the pre-reduction of lump iron ores in a shaft furnace connected to a conventional blast furnace. This project aims to develop a multiscale numerical model through computational fluid dynamics (CFD) and discrete element method (DEM) to investigate the macroscopic and microscopic dynamics of the metallurgical process, including the optimization of thermal energy system for the process. Thermodynamic models will also be coupled with the CFD-DEM model to evaluate the carbon dioxide emission reduction and overall energy efficiency.
Expected outcomes and deliverables:	*Students could improve their skills in literature survey, numerical model establishment, fundamental knowledge of fluid dynamics, data analysis, and report writing, etc. They are expected to deliver an oral presentation at the end of the project.*
Suitable for:	1. UQ enrolled 3 or 4-year students in relevant discipline areas, including Chemical Engineering, Mechanical Engineering, Computational Modelling, Physics or Mathematics. 2. Proven strong desire to learn new skills and demonstrated initiative. 3. Knowledge in modelling of physical systems using CFD, DEM or other methods is desirable.
Primary Supervisor:	*Dr. Yuchen Dai*
Further info:	Please contact yuchen.dai@uq.edu.au for further information. Getting in touch prior to applying is welcome.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Exploring the impact of synthetic biomolecules on therapeutic properties of human mesenchymal stem cells**
Project duration:	6 weeks
Description:	Mesenchymal Stromal/Stem Cells (MSCs) are multipotent cells with capacity for self-renewal and differentiation and have emerged as a highly promising avenue for advanced cell therapy. Their unique properties, including potent immunomodulation and angiogenic capabilities, hold remarkable potential for medical and regenerative medicine applications. Despite these advantages, the clinical application of MSC-based therapies faces challenges stemming from replicative senescence and declining functionality during prolonged *in vitro* expansion. Our interdisciplinary team is dedicated to not only preserving but also augmenting the therapeutic effectiveness of MSCs, with a specific focus on their immunomodulatory and pro-angiogenic attributes during extended cultivation periods, utilising novel synthetic as well as naturally occurring biomolecules. Within this comprehensive initiative, summer research student will have the opportunity to culture MSCs, conduct precise protein isolation and quantification, and primarily investigate the expression profiles of immunomodulatory and pro-angiogenic proteins in MSCs subjected to both mimetic and naturally occurring biomolecules utilising western blot analysis. Understanding the intricate biology and molecular mechanisms underlying MSCs' immunomodulatory and pro-angiogenic functionalities is pivotal to shaping the design and implementation of robust, effective and scalable strategies aimed at enhancing the therapeutic potential of MSC-based interventions.
Expected outcomes and deliverables:	Applicants will gain skills in laboratory techniques for extracting protein samples and advanced analytical techniques including western blot. Applicants may also have the opportunity to produce an oral presentation on their research at the end of the project.
Suitable for:	A background in cell culture and molecular biology is desirable, but not necessary for applicants, with 3rd-4th year students preferred.
Primary Supervisor:	*Dr Ali Shokoohmand*
Further info:	Hours of engagement must be between 20-36hrs per week. Applicant will be required on-site. Applicants do not need to contact the supervisor before submission, but if they would like more information on the project, please email a.shokoohmand@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**The development of Glyco-therapeutics to alleviate inflammatory responses**
Project duration:	6 weeks
Description:	Coronavirus disease 2019 (COVID-19) has affected the world in a devastating way. In serious cases, clinical deterioration is often rapid, and in a large proportion of such cases the severe disease course is caused by systemic hyper-inflammation, the so called “cytokine storm”. Cytokine storm refers to a set of clinical conditions caused by excessive immune reactions and has been recognized as a leading cause of severe COVID-19. Among various cytokines, IL-6 has been described as a key cytokine related to cytokine storm; A previous study showed that IL-6 was more elevated in non-survivors than survivors of COVID-19. Many therapeutic drugs and interventions have been attempted to treat severe COVID-19 including antiviral treatment to inhibit SARS-CoV-2 replication and anti-inflammatory treatment to reduce systemic inflammation. Rapid cytokine removal has shown clinical benefits. Our group is looking for bio-materials to aid this process, which may reduce the likelihood of progressive organ damage and COVID-19 mortality.
Expected outcomes and deliverables:	Successful applicants will gain bio-chemistry laboratory skills, including high performance liquid chromatography and other lab techniques. Applicants also have a chance to develop presentation and scientific writing skills.
Suitable for:	Major in biochemistry or related fields.
Primary Supervisor:	Dr Alex Smith
Further info:	Please contact Dr Alex Smith for queries.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Developing AI tools for measuring sustainability**
Project duration:	6 weeks
Description:	This summer research project aims to develop innovative AI models for assessing the sustainability of diverse industrial processes, focusing specifically on hydrogen production with carbon capture. The project's scope encompasses development of AI algorithms that can analyse and predict environmental impact, efficiency, and feasibility of industrial operations. The student will begin by conducting an extensive literature review to gain an in-depth understanding of existing AI methodologies and sustainability metrics related to industrial processes. Subsequently, the student will design, implement, and train AI models that integrate machine learning techniques to evaluate the environmental performance and economic viability of hydrogen production coupled with carbon capture techniques. To ensure the models' accuracy and applicability, a comprehensive dataset containing historical and real-time process data will be collected and curated. The student will work on preprocessing and feature engineering to enhance the models' predictive capabilities. Model performance will be rigorously assessed through cross-validation, and iterative refinements will be made to optimize results.
Expected outcomes and deliverables:	*The project's outcome will consist of a suite of AI models capable of quantitatively assessing the sustainability of various industrial processes, prominently highlighting the hydrogen production process with carbon capture. The project not only contributes to advancing AI applications in sustainable practices but also offers valuable insights for industries seeking environmentally responsible production methods. The research findings will be documented in a comprehensive report, and the AI models will be made available for future studies and applications.*
Suitable for:	*Both undergraduate and postgraduate students with engineering background*
Primary Supervisor:	*Dr Muxina Konarova*
Further info:	Please contact Dr Muxina Konarova for queries.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Investigate the impacts of microbial community on GHG emissions from wastewater treatment plants**
Project duration:	6 weeks
Description:	This project aims to comprehensively analyze the role of microbial communities in influencing greenhouse gas (GHG) emissions within wastewater treatment systems. Wastewater treatment facilities play a vital role in mitigating environmental pollution, but they can also contribute to GHG emissions particularly nitrous oxide. This research project seeks to unravel the intricate connections between microbial populations and GHG emissions, with the goal of informing more efficient and sustainable wastewater management practices.
Expected outcomes and deliverables:	*By shedding light on the intricate interplay between microbial communities and GHG emissions in wastewater treatment facilities, this project strives to contribute to the development of sustainable practices that enhance both wastewater treatment efficiency and environmental stewardship. The outcomes of this research hold the potential to shape future policies and technologies in the domain of wastewater management, fostering a greener and more ecologically responsible approach to waste treatment.* *This project aspires to provide valuable insights for scientists, policymakers, and practitioners engaged in environmental conservation, wastewater treatment, and climate change mitigation, ultimately fostering a better understanding of how microbial communities impact GHG emissions and paving the way for a more sustainable future.*
Suitable for:	*Fourth year chemical engineering student, or master student with knowledge in wastewater treatment processes*
Primary Supervisor:	*Haoran Duan h.duan@uq.edu.au*
Further info:	*Haoran Duan h.duan@uq.edu.au*

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Understand seasonal emission dynamic of GHG emissions from wastewater treatment facilities**
Project duration:	6 weeks
Description:	The goal of this project is to comprehensively understand the seasonal variation in greenhouse gas (GHG) emissions from wastewater treatment facilities (WWTFs) and to identify the underlying factors contributing to these fluctuations. The project will utilize correlation analysis to establish relationships between different parameters and GHG emissions, shedding light on the intricate interplay of variables affecting emissions.
Expected outcomes and deliverables:	*This project will provide a detailed understanding of the seasonal patterns of GHG emissions from WWTFs, revealing the critical factors influencing these variations. The correlation analysis will yield valuable insights into the relationships between emissions and operational/environmental parameters, aiding in the development of targeted mitigation strategies. The project outcomes will contribute to advancing sustainable wastewater treatment practices and support efforts towards reducing GHG emissions in the context of wastewater management.*
Suitable for:	*Thrid, fourth or fifth year chemical engineering student with basic knowledge in wastewater treatment processes*
Primary Supervisor:	*Liu Ye l.ye@uq.edu.au*
Further info:	Kaili Li Kaili.li@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Bioplastics and biocomposites for thermoforming applications**
Project duration:	6 weeks
Description:	Biodegradable plastics offer a potential solution to some of the issues related to plastic waste. Among various biopolymers, polyhydroxyalkanoates (PHAs) stand out as excellent candidates for the next generation of truly biodegradable material, being bacterially derived and biodegradable in natural environment. However, the primary challenges are their high cost and inherent brittleness. One of the recent advances in this field is the development of biocomposites and toughening strategies. These toughened formulations could potentially expand their applications and processing possibilities. The processability of these toughened PHA formulations remain our key research focus. Thermoforming is a widely used plastic manufacturing process for packaging materials, which have remained underexplored in the context of biopolymers. This project aims to bridge this gap by investigating the potential of utilising PHA and PHA-based biocomposite for thermoforming processes. The specific objectives are to: • Review the properties required for thermoforming processes and identify a suitable PHA formulation. • Produce biopolymer sheets using compression moulding. • Optimise the process parameters for thermoforming PHA through conducting thermoforming trials and characterising the resulting thermoformed products.
Expected outcomes and deliverables:	Students will work in a research team within the ARC Industrial Transformation Training Centre for Bioplastics and Biocomposites, where they will be expected to attend weekly meetings with the team and present concise verbal updates. During their time in the program, students will develop transferable skills in research communications, experimental design, and basic laboratory techniques. They will also have the opportunity to learn about industry-relevant polymer processing (compression moulding, vacuum forming etc.) and characterisation equipment (mechanical testing, DSC etc.), and will be expected to operate independently. Additionally, students will be expected to submit a final project report and deliver an oral presentation to the research group at the conclusion of their project.
Suitable for:	This project is open to applications from students with a background in chemical engineering, material engineering or mechanical engineering 3-4 year students. It is most suited for students who are interested and have a background on polymer materials, and particularly bioplastics and sustainability aspects.
Primary Supervisor:	Dr Clement Chan

Further info:	To learn more about the Centre for Bioplastics and Biocomposites: https://centreforbioplastics.org.au/ If you would like to know more about the project and discuss suitability, feel free to contact Clement Chan (c.chan@uq.edu.au).

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Characterization of biodegraded biopolymer samples**
Project duration:	6 weeks
Description:	This project will explore the properties of biodegradable bioderived polymers retrieved from the marine environment in Moreton Bay. Using Differential Scanning Calorimetry (DSC) and Fourier-Transform Infrared Spectroscopy (FT-IR), we will map the changes in properties over time and relate them to changes in mechanical and chemical properties over time, giving insight into the mechanism of biodegradation of these samples.
Expected outcomes and deliverables:	*1) Characterization of the degradation outcomes for a range of biodegradable biopolymers retrieved from the Bay* *2) Training in DSC and FT-IR analysis – fundamental polymer characterisation techniques* *3) Insight into biodegradation mechanisms for biodegradable polymers*
Suitable for:	*Undergraduate students – must have completed year 2. Will need good academic outcomes.*
Primary Supervisor:	*Bronwyn Laycock*
Further info:	Please contact Bronwyn Laycock (b.laycock@uq.edu.au) for more detail

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**D**irect Lithium Adsorption from unconventional resource
Project duration:	6 weeks
Description:	Currently, demand for lithium (Li) is expected to continue to increase sharply with the growing worldwide deployment of electric vehicles, and prices is continuing to rise. There are two major conventional resources of lithium by extraction: conventional lithium brine extraction and mineral spodumene lithium extraction. However, as lithium–rich deposits are scarce and their demand is increasing, unconventional sources of lithium are required, such as low–grade minerals, brines from oil &gas and recycled lithium-contained electronics. Various technologies that enable recovery of Li from unconventional source have been tested in order to provide the large markets with Li from more diverse and often geographically closer sources by utilizing Li recovery technologies such as adsorbents, membrane-based processes, and electrolysis-based systems. This project follows on the previous research projects on synthesis of low-cost adsorbents from mine tailings and clay minerals for critical metal recovery. In this study, we will extend the investigation on using high performance adsorbents to treat the brine water from oil& gas industry and the solution from Li-battery recycling process. We aim to conduct proof-of-concept study on adsorption and desorption performance and also technical-economic analysis.
Expected outcomes and deliverables:	The student will gain skills in experimental skills in sample synthesis and adsorption test. There will likely be liquid and solid sample characterisation by in-house ICP and XRD. The student will present project outcomes to the hydrometallurgy research group.
Suitable for:	This project is most suited to metallurgical/chemical/environmental engineering students with an interest in the environmental engineering and critical metal recovery.
Primary Supervisor:	Dr Hong Peng (h.peng2@uq.edu.au)
Further info:	If you are interested, please meet with Dr Hong Peng (h.peng2@uq.edu.au) to discuss the project.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Plant proteins for stable emulsions**
Project duration:	6 weeks
Description:	The change to plant-based foods for sustainable nutrition requires extensive characterisation of plant proteins. While commonly used animal proteins such as casein, whey and gelatine have been well characterised, the characterisation of plant protein isolates is an emerging area. This project will use the homogeniser and rheometer in the food lab 46-439 and lab 46-641, respectively to evaluate emulsions created using the soluble and insoluble fractions of a range of commercial plant proteins under different pH and salt conditions.
Expected outcomes and deliverables:	Students will gain practical research skills in planning and conducting experiments, collecting and analysing data, and interpreting the results. The work conducted by the student may also be published. Students will be asked to deliver a brief report and oral presentation at the end of their project.
Suitable for:	Students with a background in chemical engineering, protein chemistry, food science, food engineering or food technology. Students who are engaged by industrially relevant real-world applications of fundamental science and engineering.
Primary Supervisor:	Dr Heather Shewan
Further info:	h.shewan@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	Hydrogenation of organic compounds with water electrolysis
Project duration:	6 weeks
Description:	Hydrogenation is a frequently used transformation in industry. This summer research project will investigate hydrogenating organic compounds coupling with water electrolysis, to avoid the use of cylinders for hydrogen storage and flammable hydrogen gas.
Expected outcomes and deliverables:	Learn how water electrolysis works at a lab scale. Organic compounds characterization and data analysis. The applicant is expected to give a presentation at the end of this project.
Suitable for:	Students have basic knowledge of chemistry and material science, Year 3-4
Primary Supervisor:	Ping Chen
Further info:	Please contact Dr Ping Chen for queries.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**DEM modelling of particle flow in 3D shaft furnace in HYL III process**
Project duration:	6 weeks
Description:	Applying the discrete element method (DEM) to modelling the particle flow (typically based on Australian iron ore) behaviour in a shaft furnace for hydrogen ironmaking process, which leads towards a renewable energy powdered sustainable ironmaking future
Expected outcomes and deliverables:	*Understand the basic theory of the DEM modelling. Applying the DEM modelling to the HYL III process and using open-source software to conduct serval case studies on the particle flow phenomena in the shaft furnace (Considering Australian iron ore properties). Conduct data analysis on the generated data for size distribution and segregation analysis. Provide useful information for the on-site industrial operator.*
Suitable for:	*Final year undergraduate student and graduate student from chemical, mining, metallurgy, mechanical, material engineering and science*
Primary Supervisor:	*Yinxuan Qiu*
Further info:	It requires some basic knowledges about physics, metallurgy, computational programming, and data analysis. Please contact Dr Yinxuan Qiu for queries.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Greenhouse Effect Remove in Australia’s Livestock Industry**
Project duration:	6 weeks
Description:	Methane released from livestock has become one of the major sources for greenhouse gas emission in Australia. To meet the Australia’s Net-Zero target, it is significant to develop effective strategy to eliminate the low concentrated methane. This project will target on effective photocatalysts development for methane abatement. The newly developed photocatalysts can decompose the methane under sunlight illumination and reduce the greenhouse effect of methane.
Expected outcomes and deliverables:	Via the engaging of this project, the applicant will gain a serials of benefits which cannot be delivered by other pathways. 1. Cutting-edge knowledge of renewable energy. This project is focused on the most challenging and most active research frontier. Engaging into this project, the applicant can accumulate new knowledge about materials science, catalysis and advanced characterizations. It will largely expand the marginal of the applicant’s knowledge. 2. Data collection and analysis. The applicant will get the chance to handle the advanced instrument and collect data. Further data analysis training will be provide to extra useful information from the raw data. 3. Potential paper. The applicant is expected to give a presentation at the end of this project.
Suitable for:	Year 3-4
Primary Supervisor:	*Zhiliang Wang*
Further info:	Zhiliang.wang@uq.edu.au

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Texturisation of vegetable protein via extrusion processing**
Project duration:	6 weeks
Description:	The global demand for protein and changing consumer preferences are driving factors for the recently intensified focus on innovations in the protein industry. In this space, plant-based meat analogues have shown great potential as a sustainable alternative for meat products. Generally, extrusion processing is the preferred method for texturisation of vegetable proteins (TVP) for use as meat analogues. However, the existing TVP products are costly and mainly based on heavily processed vegetable protein isolates. To reduce the cost of TVP products and minimise the impact of processing on the protein structure, we propose to use whole beans (such as soybeans or peas) in place of their protein isolates. The aim of this study is investigating the impact of processing conditions on the properties and performance of the TVP, including measuring the Tensile strength of the extrudates and their Water-holding capacity, as well as the determining the change of viscosity, gelation, solubility.
Expected outcomes and deliverables:	Students will gain knowledge and practical experience in food processing technology for TVP production, working with a twin-screw extruder machine. In addition to the preparation and processing of whole beans, characterisation of the protein and products (Particle size, Solubility, pH, and conductivity) maybe included in this project. They may acquire knowledge on different methods of characterisation for microstructural properties of protein, as well as general data collection and analysis techniques. A written report and an oral presentation are required at the end of the project. Results from this project may directly or partly contribute to a publication. Therefore, there may be an opportunity of an authorship or co-authorship of a general paper.
Suitable for:	This project is suitable for 2nd to 4th year undergraduate student or course work post-graduate student majored in Chemical Engineering or Food Science/Technology.
Primary Supervisor:	Dr. Samira Siyamak
Further info:	Please contact Dr. Samira Siyamak for application or queries.

UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Fluid retention property of plant-based meat analogues**
Project duration:	6 weeks
Description:	Meat analogues made from plant proteins are considered a potential solution to the growing demand for food globally, as well as the increasing awareness on animal welfare and environmental-friendly diet. To produce such kind of product, it is important to create functional properties similar to meat, such as nutrition, meanwhile maintaining desirable material properties such as elasticity, viscosity, and the ability to hold fluid phases within the "meat" structure. This retention of fluids (including aqueous solutions and oil) is deemed to be closely related to the "juiciness" which is the key to achieve a satisfactory sensory property of plant-based products. This project is to investigate the fluid retention property of solid mixtures consists of plant-based proteins, and obtain ground knowledge in the behaviour of our newly proposed textured vegetable protein (TVP) made from extrusion of whole beans (such as soybeans or peas) instead of their protein isolates. The use of whole beans as raw material in extrusion will gain significant economic benefits in producing plant-based products for meat analogues. Specifically, the student will measure the water and oil holding capability of several formulations consists of TVPs made from whole bean recipes, and potentially characterise the microstructures of final products. The student will be further encouraged to investigate the fundamental mechanism of water/oil-protein interaction, mechanical properties of plant-based protein mixture, and control over fluid retention in TVP mixtures. Student will document a literature review and conduct experimental works under supervision of a senior lab user. Experimental will be completed in "Rheology, Tribology and Bio-interfaces Laboratory" led by Prof. Jason Stokes.
Expected outcomes and deliverables:	Students may gain knowledge/skill in concepts/measurement of rheology, microstructures and particulate properties, and general data collecting and analysis techniques. A written report and an oral presentation are required at the end of the project. Results from this project may directly or partly contribute to a publication. Therefore, there may be an opportunity of an authorship or co-authorship of a general paper.
Suitable for:	This project is suitable for 2nd to 4th year undergraduate student or course work post-graduate student majored in Chemical Engineering or Food Science/Technology.
Primary Supervisor:	Dr. Yuan Xu
Further info:	Please contact Dr. Yuan Xu for application or queries.