School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Nanobubble-assisted nucleation of aqueous precipitation process**
Project duration:	10 weeks
Description:	Crystal nucleation from inorganic salt solutions is an important physio-chemical phenomenon which is at the centre of a wide range of industrial processes, for example for producing soda ash and fertilizers (NaCl and KCl) and for precursor materials used in critical products (e.g. Li and Ni salts for batteries). Australia is a major exporter of inorganic salts, predominantly obtained by dehydration and crystallisation. This project aims to explore the application of nanobubble to control the nucleation process during aqueous precipitation process. Nanobubbles can persist in water for long periods of time. Those with radii of 200–500 nm has been shown to remain stable for over days. Because of their long lifetime in aqueous system, nanobubbles can migrate with the solvent flow and provide continuous gas supply for the dissolution phase.
Expected outcomes and deliverables:	Summer scholars will gain skills in teamwork, lab techniques, equipment operation, data collection and analysis, presentation skills, and may have an opportunity to generate publications from this research. Students will be expected to produce an oral presentation at the end of their project.
Suitable for:	This project is most suitable for students with a background in metallurgical engineering, chemical engineering and materials engineering.
Primary Supervisor:	Dr Hong (Marco) Peng
Further info:	If you are interested, please meet with Dr Hong Peng (h.peng2@uq.edu.au) to discuss the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Recovery of metal salts from mine waste by solvent displacement crystallization**
Project duration:	10 weeks
Description:	Recently, we have developed a novel process to fully utilise bauxite residue as feed for functional materials by selective acid leaching. This project aims to explore the application of solvent displacement crystallization (SDC) to separate the metal slats from acid leaching solution of bauxite residue. SDC provides an energy-efficient way to traditional evaporative crystallization in terms of particle size and products purity.
Expected outcomes and deliverables:	Summer scholars will gain skills in teamwork, lab techniques, equipment operation, data collection and analysis, presentation skills, and may have an opportunity to generate publications from this research. Students will be expected to produce an oral presentation at the end of their project.
Suitable for:	This project is most suitable for students with a background in metallurgical engineering, chemical engineering and materials engineering.
Primary Supervisor:	Dr Hong (Marco) Peng
Further info:	If you are interested, please meet with Dr Hong Peng (h.peng2@uq.edu.au) to discuss the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Energy efficient copper electrowinning**
Project duration:	10 Weeks
Description:	This project aims to use electrochemical methods to recover copper from hydrometallurgical leaching solution/slurry, supporting sustainable copper production. Experimentation will test the effect of cell voltage, current density, copper concentration, and impurity concentration.
Expected outcomes and deliverables:	Summer scholars will gain skills in team work, lab techniques, equipment operation, data collection and analysis, presentation skills, and may have an opportunity to generate publications from this research. Students will be expected to produce an oral presentation at the end of their project.
Suitable for:	This project is most suitable for students with a background in chemical-metallurgical engineering, chemical engineering, materials engineering, or chemistry.
Primary Supervisor:	Associate Professor James Vaughan
Further info:	If summer scholars would like contact us for further information. A/prof. James Vaughan: james.vaughan@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Rare earth elements recycling from mine tailings**
Project duration:	10 Weeks
Description:	This project aims to use hydrometallurgical methods to recycle rare earth elements from Queensland mine tailings, supporting sustainable rare earth production. Experimentation will test the effect of oxidant types, pH, solid loading, reaction time and temperature.
Expected outcomes and deliverables:	Summer scholars will gain skills in team work, lab techniques, equipment operation, data collection and analysis, presentation skills, and may have an opportunity to generate publications from this research. Students will be expected to produce an oral presentation at the end of their project.
Suitable for:	This project is most suitable for students with a background in chemical-metallurgical engineering, chemical engineering, materials engineering, or chemistry.
Primary Supervisor:	Dr Weng Fu
Further info:	If summer scholars would like contact us for further information. Dr. Weng Fu: w.fu1@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Mathematical modelling of Thermal Plasma jets**
Project duration:	10 weeks
Description:	A wonderful opportunity is available for a student to learn computational fluids dynamics and mathematical modelling to develop a model of Thermal Plasma device. A thermal plasma devise is used for generating high energy plasma jet. The plasma jet technology has diverse application such as plasma jet engines, thrusters for spacecraft, chemical reaction in plasma zone, high temperature incineration, metal melting etc. The plasma energy field is mainly composed of an arc zone and a plume zone. The temperature within the arc zone ranges from 8,000-12,000 deg C, whereas the temperature on the plume zone ranges from 1,200-5,000 deg C. The extremely high temperature within the plasma jet results in some interesting physical behaviour with varied functionality. In this project, the student will learn about the developing mass, momentum and energy conservation equations within the plasma devise as well as learn about the electromagnetic phenomenon within the arc and plume. The learnings from this project will prepare the student to model and deal with any complex physical processes in industries. This project is suitable for students who have done a course in CFD and/or has keen interest in numerical method and mathematical modelling. The student will be provided with fast processing computing facility and also will be given access to multi-core processing clusters.
Expected outcomes and deliverables:	The student will learn computational fluid dynamics modelling using Ansys Fluent or OpenFoam. The student will generate a working model of 3-D plasma arc model and investigate the mixing of hot plasma plume with atmospheric gas. There may also be an opportunity to participate in the testing of a real plasma jet and do high speed video recording.
Suitable for:	Suitable for 3rd or 4th year graduates in Mathematics, Physics, Chemical Engineering, Mechanical Engineering, Electrical Engineering and related discipline. Student who have done a course in CFD will be preferred but this requirement is not essential. A **strong background** in numerical methods and understanding of solving ODE's and PDE is essential.
Primary Supervisor:	Dr Pradeep Shukla
Further info:	The student is requested to contact the principal supervisor before applying for the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Removal of hydrophobic pollutants from groundwater using foam fractionation technology**
Project duration & delivery	10 weeks and applicant will need to work from Long pocket campus laboratory.
Description:	The research project entails the investigation of foam fractionation-based separation technique to treat contaminated groundwater containing AFFF. AFFF is aqueous fire-fighting foam that have been historically used for fire-fighting exercise. Due to the recent discovery of harmful health effects of certain chemicals found in AFFF (for e.g. PFAS), the use of AFFF containing such chemical has been banned. However due to the long-term use of such foams over past several decades, the PFAS and associated chemicals have now seeped into the groundwater and soil, resulting in legacy issues. The current project is to investigate the efficacy of foam-fractionation technology to treat the polluted groundwater by removing the PFAS chemicals from water. The foam-fractionation system is a column separation unit where the polluted water is fed into the unit and then air is bubbled through the liquid. The hydrophobic bind to the air bubbles and moves to the top of the column as a light foam which can be then extracted out. The project work will include laboratory based experimental work to prepare artificial groundwater containing PFAS and then measuring pollutant removal rate. The work will be followed by preparing a mathematical model to describe the separation of the pollutant molecules though the water media into the air media.
Expected outcomes and deliverables:	• The experimental program will provide training in basic laboratory skills and conducting experiments. • Students will get to learn and operate state of the art analytical instrument for measuring low concentration of pollutants in water • Students will gain skills mathematical modelling of pollutant transport though foam and liquid • Have an opportunity to generate publications from their research or present in a conference.
Suitable for:	• UQ enrolled students only. • Candidates with a background in Analytical chemistry, chemical engineering and mathematics. • 3rd or 4th year Bachelor degree students or master students. • While prior laboratory experience is favourable but not mandatory. • Student who plans to extend this vacation work research later as part of individual inquiry & Thesis in the following semester will be viewed favourably, but it is not a mandatory requirement. • Students will strong background and interest in advance mathematics will be viewed favourably.
Primary Supervisor:	Dr Pradeep Shukla
Further info:	The student is requested to contact the principal supervisor before applying for the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Treatment of AFFF contaminants from groundwater using advance oxidation**
Project duration & delivery	10 Weeks
Description:	The research project entails the investigation of Advanced oxidation technique to treat contaminated groundwater containing AFFF. AFFF is aqueous fire-fighting foam that have been historically used for fire-fighting exercise. Due to the recent discovery of harmful health effects of certain chemicals found in AFFF (for e.g. PFAS), the use of AFFF containing such chemical has been banned. However the long-term use of such foams over past several decades, the PFAS and associated chemicals have now seeped into the groundwater and soil, resulting in legacy issues. The current project is to investigate the efficacy of cobalt based catalytic chemical oxidation technique to destroy PFAS chemical present in ground and surface water. Cobalt together with peroxymonosulphate is a chemical catalytic reagent that produces active sulphate radical which is a potent oxidant. The oxidant is capable of destroying/mineralising several recalcitrant pollutants. The project work will include laboratory based experimental work to prepare artificial groundwater containing PFAS and then measuring pollutant destruction rate using several analytical techniques.
Expected outcomes and deliverables:	• The experimental program will provide training in basic laboratory skills and conducting experiments. • Students will get to learn and operate state of the art analytical instrument for measuring low concentration of pollutants in water • Students will gain skills in mathematical modelling of pollutant transformation and reaction • Have an opportunity to generate publications from their research or present in a conference.
Suitable for:	• UQ enrolled students only. • Candidates with a background in Analytical chemistry, chemical engineering and mathematics. • 3rd or 4th year Bachelor degree students or master students. • While prior laboratory experience is favourable but not mandatory. • Student who plans to extend this vacation work research later as part of individual inquiry & Thesis in the following semester will be viewed favourably, but it is not a mandatory requirement. • Students will strong background and interest in advance mathematics will be viewed favourably.
Primary Supervisor:	Dr Pradeep Shukla
Further info:	The student is requested to contact the principal supervisor before applying for the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Modelling and data analysis of aquatic systems for sustainability**
Project duration:	*10 weeks*
Description:	The purpose of this project is to undertake data analysis, data visualization and simple modelling as needed to support a collection of socio-ecological modelling projects in aquatic applications, including: • Assessing the sustainability of global seaweed farming • Quantifying how catchment water extract impacts the health of estuaries in the Gulf of Carpentaria • Case-studies of discrepancies between models and monitoring data in the Great Barrier Reef Catchment.
Expected outcomes and deliverables:	Scholars will develop their skills in data analysis and modelling across a range of applications in aquatic systems. They will develop skills in taking a systems approach to environmental modelling. The scholar will attend weekly meetings with the team, presenting concise verbal and written updates on their work each week. The scholar will share any code developed during the project, and provide suitable documentation so that others can use and modify that code subsequently.
Suitable for:	The applicant must be confident in using matlab, python or other programming languages in basic data analysis, presentation of data and simple modelling. The successful applicant will be working in an interdisciplinary team. Excellent written communication skills, and the capacity to work effectively both independently and as part of a team are required.
Primary Supervisor:	Associate Professor Kate O'Brien
Further info:	Contact Kate O'Brien k.obrien@uq.edu.au for further information

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Next generation batteries with microporous glasses**
Project duration:	10 Weeks
Description:	Conventionally glass materials are considered dense, brittle and heavy. The 5000-year-old material still suffers some of the oldest problems of its kind. One of the recent advances in this field is the discovery of metal-organic framework glasses, formed by melting a microporous crystalline framework materials. The new glass is considered the very first paradigm of the fourth generation of melt-quenched glass, on top of the inorganic, organic and metallic glasses. The new glass materials enable significant application opportunities in the application of separation, sensing and optics. The microporous nature offers great opportunity to engineer the transport of Li+ ions as the protective layer for a cathodic materials, and the molten phase of the glass enables its processing into devices. This project will develop a new generation of glass based cathodic materials for Li batteries, which aims to enhance the capacity, charging rate and more importantly safety of the widely applied ionic battery system.
Expected outcomes and deliverables:	This project will be performed with a highly dynamic research team. Scholars may gain skills in data collection, battery assembly and testing, and will have an opportunity to generate publications from their research. The candidate would also have opportunity to understand the separation, catalysis and sensing projects running parallel within the team. Students will be expected to produce a report and oral presentation at the end of their project.
Suitable for:	This project is open to students with a background in Chemical Engineering or Materials Science.
Primary Supervisor:	Dr. Jingwei Hou
Further info:	Please contact Dr. Jingwei Hou prior to lodging an application for this project

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Printed thin-film batteries for Internet-of-Things devices**
Project duration:	10 Weeks
Description:	The advent of the era of electronics has witnessed increasingly booming trends in developing printed electronics and the Internet of Things (IoT) devices, with broad applications in next generation of flexible sensors, photovoltaics, medical devices, wearable/implantable electronics, paper-like displays, active RFID devices and ultra-thin electronic skins based on highly stretchable organic transistors, etc. In most of these printed electronics, the flexible thin-film battery is an integral component with a predicted market of USD 1.72 billion by 2025 (Grand View Research, Inc.). These large emerging markets have attracted tremendous attention from industries, leading to companies such as Imprint Energy (USA), Enfucell (Finland), Semiconductor Energy Laboratory (Japan) and Printed Energy (Australia), etc. Among these companies, developing low-cost, non-toxic and roll-to-roll printable thin-film batteries is strategically important for taking leadership in the emerging markets in printed electronics. *Aim of the project: Develop printed rechargeable Zn-MnO_2 thin-film batteries for powering IoT devices (flexible temperature sensors with credit card size with functions of sending real-time temperature information to mobile phone).* *Hypothesis: Selection and optimization of battery inks are one of the key steps for achieving high-performance Zn-MnO_2 batteries with decent cycling stability. Different combinations of Zn-MnO_2 battery components with particular focus on the electrolyte chemistries will be prioritized in this project to achieve targeted battery performance.*
Expected outcomes and deliverables:	The applicants will learn how the procedure of assembling a thin-film batteries on your own. In addition, problem-solving in battery research as well as the use of most important battery research facilities can be learned throughout the project. By the end of the project, a demo of printed batteries with integration of temperature sensor will be developed. *Students will be expected to produce a report and oral presentation at the end of their project.*
Suitable for:	T*his project is open to applications from students with a background in chemical engineering, material engineering or mechanical engineering 3-4 year students.*
Primary Supervisor:	Dr. Miaoqiang Lyu You are more than welcome to contact the supervisor prior to submitting an application (m.lyu@uq.edu.au).
Further info:	Further information: https://researchers.uq.edu.au/researcher/21555 https://stories.uq.edu.au/research/bending-the-rules-with-flexible-batteries/index.html impact story on UQ Central Research Platforms-'Running' into the future with printable batteries https://research.uq.edu.au/research-infrastructure-impact

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Development of lead-free metal halide perovskites for high-performance optoelectronic devices**
Project duration:	10 Weeks
Description:	Metal halide perovskites are an extremely large family of crystalline compounds with a generic chemical formula ABX3, where typically A=CH3NH3+, HC(NH2)2+, Cs+ and/or other monovalent cation, B=Pb2+ and/or other divalent metal cation, and X=I, Br and/or Cl. In addition to the ABX3-type halide perovskite, there are several other types of halide perovskites depending on the diversity in the crystal structures and connectivity of the octahedron, where some of the trivalent metal cations can also form perovskite structure. This project aims to address the key challenges (i.e. stability and toxicity) in lead halide perovskite research fields by rational design low-toxic metal halide perovskites for high-performance optoelectronic devices.
Expected outcomes and deliverables:	The applicants will essential knowledge and skills for developing new semiconducting materials and their applications in solar cells and other optoelectronic devices. By the end of the project, a demo of perovskite-based optoelectronic device such as solar cell and memory device will be developed. *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 students with a background in chemical engineering, material engineering or mechanical engineering 3-4 year students.*
Primary Supervisor:	Dr. Miaoqiang Lyu
Further info:	You are more than welcome to contact the supervisor prior to submitting an application (m.lyu@uq.edu.au).

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Simulation of electrolyte solution using Deep Learning**
Project duration:	10 Weeks
Description:	This project involves using state of the art deep learning and molecular dynamics software to perform molecular simulations of electrolyte solutions on Gadi, the largest supercomputer in the southern hemisphere. Electrolyte solutions are one of the most important substances on earth, playing a central role in energy storage, carbon capture and conversion and essentially all of biology. Until recently, however, we have been unable to predict even their most basic properties. It has recently become possible to combine new deep learning and quantum chemistry software to accurately simulate these solutions for the first time. This project will use these techniques to simulate simple electrolyte solutions and calculate their key properties that are relevant for energy storage and other applications.
Expected outcomes and deliverables:	Students will gain skills in deep learning, programming, high performance computing and electrolyte solution modelling. There will also be the opportunity to generate publications from the research. Students will be expected to produce a report at the end of their project.
Suitable for:	This project is open to third- or fourth-year students with some experience with computer modelling, simulation, or programming.
Primary Supervisor:	Dr Tim Duignan
Further info:	Please contact Tim Duignan (t.duignan@uq.edu.au) if you have any questions or to discuss suitability for the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**The effect of electrolytic area of gas diffusion electrode on electrochemical CO_2 reduction**
Project duration:	10 weeks
Description:	**Aim: This project is expected to generate new knowledge to understand the dependency of CO2RR performance at electrolytic area of gas diffusion electrode (GDE).** Electrochemical CO_2 reduction reaction (CO_2RR) to value-added fuels and chemicals powered by renewable electricity, provides a means to seasonal energy storage and to close the carbon cycle as a process of achieving carbon-neutral. GDE-based flow cells enable CO_2 electrolysis working at conditions relevant to industrial electrolyzers. Current density is a crucial parameter to represent the rate of the electrochemical process, which is a function of the varying cross-sections of the catholyte, namely electrolytic area. A larger electrolytic area and a higher selectivity of desired productivities are essential to achieve satisfied productivity towards industrialization of the technology. However, we observed that the GDEs with the same current density but different electrolytic areas performed different selectivity. The difference of selectivity rises abruptly at high current density. The fundamental mechanism under the phenomenon is still hidden, while it is necessary to make out for further development of CO_2RR.
Expected outcomes and deliverables:	Applicants can learn the whole processes of CO2RR as a current research hotspot, and obtain skills in catalyst spraying and preparation of GDEs with different areas. Moreover, they can participate in DIY of gaskets facilitated by the fancy laser engraver in UQ Innovate workshop. The project is a great way to kick-start a brand-new topic. Our group is focusing on CO_2RR and welcome every student to present their ideas and data during our weekly seminar. Our latest summer project produced a first-author paper by the summer research student in *ChemSusChem* (https://doi.org/10.1002/cssc.202100954).
Suitable for:	This project is open to applicants with a background in chemical engineering or materials science, 3-4-year students, UQ enrolled students only.
Primary Supervisor:	Associate Professor Tom Rufford and Yuming Wu (PhD student)
Further info:	Email: yuming.wu@uq.edu.au Please don't hesitate to contact me if you have interest in the project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Dopant selection for improving semiconductor charge separation and transfer**
Project duration:	*10 weeks*
Description:	This program is targeted on improving the charge separation and transfer (CST) in semiconductor by selecting suitable dopant. Our previous research based on machine learning reveals that the metal-oxygen bond and radius of dopant are the most critical dopant selection criteria. Herein, we will investigate this hypothesis based on CuO based photocatalyst. The success of this program will provide a solid evidence to our previous understanding, and benefit the whole field by clarifying the dopant selection criteria in metal oxide based semiconductors.
Expected outcomes and deliverables:	The applicant can acquire (1) the logic thinking of scientific research, (2) the sophisticate skill of semiconductor materials synthesis, (3) the first-hand access to advanced structure charaterizations, and (4) great opportunity to publications. The students will be expected to produce an oral presentation at the end of their project.
Suitable for:	*This project is open to applications from students with a background in chemical engineering, 3-4 year students.*
Primary Supervisor:	Dr Zhiliang Wang
Further info:	Please email Dr Zhiliang to discuss the project further. zhiliang.wang@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Application of novel immobilized microbial enrichment for intensified removal of nutrients and micropollutants from water**
Project duration:	10 weeks
Description:	In close collaboration with Novozymes, 2 projects are available to investigate the production and application of immobilized microbes for use in wastewater treatment processes. For the first time, an enriched culture of microbes known to be able to remove nitrogen and phosphorus will be encapsulated in a proprietary polymeric biobead from Novozymes. These biobeads will then be applied in a lab-scale water treatment process, with the aim of understanding the benefits encapsulation can bring to a wastewater treatment process. The project will involve experimental work in a laboratory where bioreactors are being operated for nitrogen and phosphorus removal. The students will work side-by-side with their mentors to operate and monitor bioreactors, which are used to enrich microorganisms to be immobilised in the biobeads. The biobeads will then be tested in order to evaluate their capacity for nitrogen, phosphorus and micropollutant removal from wastewater, as well as modelling the pollutant removal processes. The students will gain a wide range of relevant practical experiences. 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 students 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 students will be expected to produce a report and oral presentation at the end of their project about their work.
Suitable for:	Chemical engineering, chemical+bio (or bioprocess) engineering and chemical+environmental engineering UQ students in 3-4 year.
Primary Supervisor:	Dr Adrian Oehmen and Nicholas Gueriff
Further info:	a.oehmen@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Exploring social licence to operate (SLO) issues for hydrogen**
Project duration:	10 weeks
Description:	*Hydrogen has been identified as an important energy source to help the world decarbonise. However, the scale of renewable energy required to produce hydrogen is unprecedented. We anticipate there will be several concerns that emerge from regional communities in relation to the co-existence requirements of renewable energies and agriculture.* *This project aims to identify* • *key stakeholder concerns surrounding the introduction of large-scale renewable energy projects across Queensland's regions.* • *How findings may inform the development of SLO in context?* • *How findings may apply to hydrogen industry more broadly?*
Expected outcomes and deliverables:	*Scholars will develop their skills in* • *literature review and analysis* • *Interviewing skills* • *Qualitative data analysis using software packages such as NVIVO and Leximancer.* • *Presentation and networking.* *It is expected that by the end of the project, students will successfully generate a written report and oral presentation. Through the support of their supervisor, they will be asked to present their findings and recommendations to a number of government and industry stakeholders.*
Suitable for:	*This project is seeking students who have excellent communication skills – both oral and written.* *Knowledge or interest in social science methodologies is an advantage. The successful applicant will be keen to engage with a range of stakeholders.* *This project is open to applications from UQ enrolled students.*
Primary Supervisor:	Professor Peta Ashworth
Further info:	p.ashworth@uq.edu.au or Dr Amrita Kambo a.kambo@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**International perspectives towards hydrogen**
Project duration:	10 weeks
Description:	Are you interested in decarbonisation? There is growing international interest in hydrogen and associated compounds to decarbonise the world's energy system. In addition to Australia - Germany, Canada, and the UK are three countries that have expressed a strong interest in hydrogen. However, each are taking a different approach towards the projects that they consider low carbon i.e. blue versus green hydrogen. This project aims to explore key international stakeholder perspectives on the emergent hydrogen industry and the various production processes to investigate what are the key priorities, opportunities and challenges that are emerging from across various geographical regions. Working with your supervisory team, tou will undertake a stakeholder analysis to identify key individuals and organisations to interview, undertake the data collection and analysis. The end result will be either a report or journal article which highlights the similarities and differences across countries and implications for Australian industries and policy makers.
Expected outcomes and deliverables:	Scholars will be involved in a range of research activities including: • Literature review • Stakeholder analyses • Operationalising interviews (Emails, contact details, time, ethics information etc.) • Participating in interviews • Coordinating transcription and data analysis • Report writing
Suitable for:	*This project is open to students with an interest in the interaction of science and technology in society. Maybe in the Social Sciences, Communications and the Arts or those in Engineering with an interest in Hydrogen.*
Primary Supervisor:	Professor Peta Ashworth
Further info:	Students can contact p.ashworth@uq.edu.au or Dr Franzisca Weder f.weder@uq.edu.au prior to applying.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Cleaning efficiency of a Novel Surface Cleaner**
Project duration:	This is a 10-week project
Description:	This project will probe the cleaning efficacy of Novel surface cleaning formulations by investigating the removal of model 'soil' such as soap scum from surfaces. We hypothesise that our novel cleaner, which renders surfaces more hydrophilic, will prevent deposition and aid subsequent removal of hydrophobic soils. The student will learn to use the Quartz Crystal Microbalance with Dissipation to probe the thickness and removal of these soils. Chemical and rheological properties of the soil and cleaners will also be investigated.
Expected outcomes and deliverables:	Students may gain knowledge/skill in concepts/measurement of rheology and surface science, 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 contribute or partly contribute to a publication and/or presentation to industry partners. Therefore, there may be an opportunity of an authorship or co-authorship of a general paper. Student will attend weekly meetings with Prof Jason Stokes' group
Suitable for:	This project is suitable for 2nd to 4th year undergraduate student or course work post-graduate student majoring in Chemical Engineering or its varieties. *It is expected that undergraduate applicants have finished all compulsory courses listed for their program up to the year of their study.*
Primary Supervisor:	Dr Heather Shewan
Further info:	h.shewan@uq.edu.au prior to applying.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Bunya nut fermentation and flour gelatinisation as a tool to improve dough and bread properties**
Project duration:	10 weeks
Description:	The demand for low-gluten and gluten-free products is increasing, which makes it necessary to utilise new raw materials in the food industry. Bunya nut flour has potential for use in gluten-free bakery products. Bunya nut is an interesting Indigenous Australian food, rich in starch. The production of flour from the nut could be an interesting way to partially or totally substitute wheat, rice or corn flours in bakery products in Australia. The aim of the project will be to investigate the effect of nut fermentation prior to flour production and pre-gelatinisation of flour on the pasting and rheological properties of the flour and the dough. Different percentages of pre-gelatinised flour and flour made with fermented nuts will be added to the raw flour. The hypothesis is that the addition of pre-gelatinised flour will provide improved final product texture by trapping air bubbles in the dough. Regarding fermentation, although in some types of products it decreases paste viscosity, preliminary studies show that for bunya nut the opposite happens, which in turn will produce an increase in cohesiveness and elasticity. Preliminary experiments will include fermenting the nut for 9 days, processing the nut into flour using different unit operations and preparing pre-gelatinised flour. Later experiments will include measuring the pasting properties of the flour and rheological properties of the dough and bread. Experimental work will be completed in "Rheology, Tribology and Biointerfaces Laboratory".
Expected outcomes and deliverables:	Student will gain skill in concepts of many different unit operations, important properties of flours and starch, food product development, the use of different equipment for analysis (e.g. rheometer) and general data collection. Students may also gain insight on indigenous knowledge regarding nuts from Australia. A written report and an oral presentation are required at the end of the project. Results from this project may contribute or partly contribute to a publication. Therefore, there may be an opportunity for authorship or co-authorship of a general paper. Student will attend weekly meetings with Prof Jason Stokes' group.
Suitable for:	This project is open to applications from students with a background in chemical engineering (UQ enrolled students) and interest in Food Science and Technology.
Primary Supervisor:	Professor Jason Stokes and Jaqueline Moura Nadolny (PhD student)
Further info:	j.mouranadolny@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Thixotropic Properties of Australian Jelly Bush Honeys**
Project duration:	10 weeks
Description:	A recent Australian invention – the Flow® frame (BeeInventive) – has been a game-changer for the apiary hobbyist as it allows for easy honey extraction from hives with minimal disturbance to the bees achieved by turning a key to release honey from the frame (see honeyflow.com.au). An additional benefit of this patented extraction method is that it allows for honeys to be harvested without heat, vibration (spinning) nor exposure to oxygen, resulting in pure honey, free from artefacts generated during typical commercial extraction conditions. Recent research demonstrates the sensory quality of Flow® honeys are superior as the unique botanical qualities are preserved during extraction. To date, jelly bush honeys – a bioactive Australian honey which is famous for its medicinal qualities – have not been produced in the Flow® frame as the unique thixotropic properties of jelly bush honey prevent extraction using the simple turn-key design. Jelly bush honeys are thick and viscous and do not flow as do other botanical honeys. As such, it is not known what additional benefits to jelly bush honey may be achieved through the gentler extraction method. Consequently, the hive design is not commonly used by jelly bush honey apiarists in production of this high value honey. The objective of this research is to study the physical flow properties of Australian jelly bush honey (including rheological behaviour). Ultimately, the findings of this research project will assist BeeInventive to develop an optimised technique for extraction of bioactive honeys from their Australian innovation - the Flow Frame®. The project target will be to measure the mechanical properties of honey from various geographical origins and with varying bioactive contents. Additionally, it may be a project target to understand what limits the flow properties of honey and define the minimal specifications of honeys that suit the Flow® frame design.
Expected outcomes and deliverables:	Students will be expected to produce a report and oral presentation at the end of their project. There may be an opportunity to generate publications from their research.
Suitable for:	A third- or fourth-year chemical engineering undergraduate student.
Primary Supervisor:	Dr. Rebecca Forster Associate Professor Heather Smyth Professor Jason Stokes
Further info:	Please email rebecca.forster@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Viscoelastic Lubrication**
Project duration:	10 weeks
Description:	Lubrication is critical for functionalities of many biological systems including mussel, joint and tongue. The relative sliding motion between two soft (viscoelastic) substrates is often encountered in those systems, at which surfaces/substrate deform during the sliding. Sliding between viscoelastic substrates causes a dynamic entrainment lubricant into the interfacial separation, as such properties of lubricant and the interfacial deformation fundamentally determine the overall lubrication behaviour. Lubricants involved in most biological systems are complex fluids with non-Newtonian behaviours, and that the contact substrates have unique viscoelasticity, which makes it challenging to characterise the lubrication between viscoelastic contacts. The aim of this project is to characterise the interface friction and mechanics (termed 'tribology'), fluid/soft matter mechanics (termed 'rheology') and soft contact mechanics, from which it is deemed to form a correlation between friction, fluid rheology and mechanical property of contact material. Specifically, the student will measure the tribology between soft contacts using a range of lubricants, and will be encouraged to further investigate the effect of lubricant rheology and material mechanical property on the overall frictional behaviour. Student will document a literature review and conduct experimental works under supervision of a senior lab user. Experimental work including rheology and tribology measurement 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, tribology and contact mechanics, 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 contribute 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 its varieties. *It is expected that undergraduate applicants have finished all compulsory courses listed for their program up to the year of their study.*
Primary Supervisor:	Dr. Yuan Xu Professor Jason Stokes
Further info:	y.xu5@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Phase behaviour of Nanocellulose particles in salt solution**
Project duration:	10 weeks
Description:	Colloidal biopolymers, like DNA, peptides and polysaccharides, spontaneously form liquid crystal phase in aqueous conditions, primarily with nematic or chiral nematic ordering. The liquid crystallinity of these systems is important to enable unique biological and mechanical functions e.g. mass transfer, light transmission or lubrication. Cellulose, a most abundant polymer material in nature, has the ability to form ordered phase both in plant and in aqueous dispersion of colloidal cellulose. The aim of this project is to obtain ground information of our newly discovered liquid crystal hydroglass (LCH), a soft gel-like material with ab ordering of liquid crystallinity. This includes to investigate the phase behaviour of the Nanocellulose system (NCC) as a function of solution environment e.g. added polymers, clay nanoparticles, solution salinity and types of salt. The student will be using rheometer and scattering techniques to study the rheology and stability of nanocellulose suspension at varied solution environment.
Expected outcomes and deliverables:	Students may gain knowledge/skill in concepts/measurement of rheology and surface science, 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 contribute or partly contribute to a publication. Therefore, there may be an opportunity of an authorship or co-authorship of a general paper. Student will attend weekly meetings with Prof Jason Stokes' group
Suitable for:	This project is suitable for 2nd to 4th year undergraduate student or course work post-graduate student majoring in Chemical Engineering or its varieties. *It is expected that undergraduate applicants have finished all compulsory courses listed for their program up to the year of their study.*
Primary Supervisor:	Dr. Yuan Xu and Jing En (Kenneth) Wong (PhD student)
Further info:	Please email for further information jingen.wong@uq.net.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Analysis of Teamwork Practices in UQ Chemical Engineering – a Student Perspective**
Project duration:	**8 weeks**
Description:	This project is part of a wider research study into the teamwork pedagogy practices in the School of Chemical Engineering and the EAIT Faculty. Effective teamwork is an essential skill for all graduates and UQ is committed to helping students to develop effective teamwork skills. In practice however, learning teamwork skills and undertaking team-based assessment at university can be problematic. We believe that there is an opportunity to enhance teamwork related teaching and assessment across many courses in Chemical Engineering, EAIT, and UQ. This summer project would aim to capture the student perspective on teamwork and its assessment in the School of Chemical Engineering. The scope of this project is likely to include: - mapping teamwork teaching material and assessment in UQ Chemical Engineering courses, - analysing existing student survey data from a 2021 survey on teamwork, - reviewing online platforms for teamwork, - reviewing relevant literature on current best practice in teamwork skill development.
Expected outcomes and deliverables:	By participating in this project, the student will gain experience in conducting an educational research project. The student will be asked to present their work in a final written report and oral presentations during and at the end of the project. Depending on commitment and quality of analysis performed, there could be an opportunity to co-author a conference or a journal manuscript.
Suitable for:	This project is suited to someone who is: - interested in student teamwork, - interested in educational research, - 3rd or 4th year chemical engineering student, - UQ enrolled students only.
Primary Supervisor:	Ms Bev Coulter
Further info:	b.coulter@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Develop biodegradable packaging**
Project duration:	10 weeks
Description:	Packaging, particularly thin films, represents more than 50% of the global plastics market, and there is a serious issue with contaminated films that cannot be effectively recycled and are sent to landfill or escape into our environment. Therefore, one of the key areas of global interest is in the **development of flexible films for packaging that are truly biodegradable under ambient conditions**. Polyhydroxyalkanoate (PHA) is one the few classes of polymers that can achieve this property – but mechanical properties need to be modified to give the desired performance for this application. Objectives and approach: The aim is to produce a truly biodegradable and flexible film product with commercially relevant material and processing properties based on PHA.
Expected outcomes and deliverables:	The successful applicant will participate in polymer processing, with the view to writing a short report on the properties of the novel materials.
Suitable for:	This project is open to applications from students with a background in chemical or materials engineering, 3-4 year students, UQ enrolled students only.
Primary Supervisor:	Team: Associate Professor Steven Pratt, Professor Paul Lant and Associate Professor Bronwyn Laycock
Further info:	Please contact Associate Professor Steven Pratt (s.pratt@uq.edu.au) if you are interested in this project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Tackle Plastic Pollution**
Project duration:	10 weeks
Description:	Plastics are excellent materials in their own right with a very wide and increasing array of applications, delivering many benefits for society. As a result, the global production of plastics has grown to over 300 Mt/a. However, this benefit has come at a cost of increasing environmental impacts. Plastic pollution is now a widely recognised global issue. In this project you will review strategies for addressing plastic sustainability and mitigating plastic pollution, considering behavioural change and policy as well as technological actions.
Expected outcomes and deliverables:	The successful applicant will participate in Department of Foreign Affairs and Trade (DFAT) funded project to identify critical research and capacity development needs, and regionally relevant insights to inform Southeast Asia's rapid transition to a strategic leader in a global zero plastic waste future. The main deliverable will be a review and critique of strategies to address plastic pollution.
Suitable for:	This project is open to applications from students with a background in chemical or environmental engineering, 3-4 year students, UQ enrolled students only.
Primary Supervisor:	Team: Associate Professor Steven Pratt, Professor Paul Lant and Associate Professor Bronwyn Laycock
Further info:	Please contact Professor Paul Lant (paul.lant@uq.edu.au) if you are interested in this project.

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Sustainable models to deliver energy access: evidence in India and Timor-Leste**
Project duration:	10 weeks
Description:	Background: Electrification's effects on poverty alleviation have been examined in a number of academic investigations, but a reflection and categorisation across socio-economic dimensions remains lacking. Furthermore, as governments and the private sector increasingly engage in opportunities to increase energy access, there is a lack of clarity with regards to how they can leverage the value of electrification technologies to enhance the viability and sustainability of their delivery model. Approach: This project will examine data from Timor-Leste (semi-structured interviews) and India (panel data representative of rural areas in six of India's poorest states). In Timor-Leste, responses to interview questions will create a narrative of the electrification journey of that country since nationhood. In India, data will prove or disprove the long-term sustainability of delivery model by growing consumers' willingness to pay (WTP). The research aims to answer: what aspects of energy access and the socio-economic settings are associated with increased WTP? Ensuring that energy interventions are supported by systems that promote productive use can enhance the income generating potential of energy and develop value and WTP. This work is intended to create new insights into sustainable pathways for energy and community engagement in these markets.
Expected outcomes and deliverables:	Scholars may gain skills in processing of qualitative and quantitative social data from diverse cultures and contexts. The research will contribute to academic papers, which may result in co-authorship opportunities. 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 students with a background in engineering -related disciplines with a focus on sustainable energy and humanitarian engineering. It is suitable for 3rd-4th year undergraduate students, and postgraduate students. Maximum 2 students.
Primary Supervisor:	Dr Tony Heynen
Further info:	Dr Tony Heynen (a.heynen@uq.edu.au)

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Laboratory experimental and thermodynamic modelling characterisation of complex pyrometallurgical critical metals smelting and recycling processes**
Project duration:	*10 weeks*
Description:	Optimisation of modern pyrometallurgical smelting and recycling processes of critical metals in circular economy requires deep understanding of high-temperature chemistry observed in the reactors. Introduction of new complex recycling materials shifts the process conditions and requires additional in-depth control. The Pyrometallurgy Innovation Centre (PYROSEARCH) has developed new integrated experimental techniques to enable the chemical equilibria and elemental distributions in multi-phase systems to be accurately measured. Experiments are integrated together with the advanced thermodynamic modelling. The project will build on existing research and provide new experimental data on a range of slag compositions and will complement existing research on this topic currently being undertaken at the Centre supported by many leading international metallurgical and recycling companies. ***https://chemeng.uq.edu.au/pyrosearch***
Expected outcomes and deliverables:	Student will work with an existing research team, obtain practical experience in high temperature laboratory-based research, simulate the observed results using advanced computational tools and is expected to produce a professional quality report and oral presentation at the end of their project.
Suitable for:	This project is open to applications from students with a background in chemical engineering, chemical and materials engineering, chemical and metallurgical engineering and science 2-5 year students, UQ enrolled students only. Location Banksia Building Long Pocket Campus *The preference is given to students interested in future University or industry-based research career*
Primary Supervisor:	Professor Evgueni Jak
Further info:	Please contact via email e.jak@uq.edu.au (Prof. Evgeni Jak)

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Artificial leaf: photocatalysts for low-concentration gaseous CO_2 reduction**
Project duration:	10 weeks
Description:	The development of efficient strategies for CO_2 capture and conversion is of great importance and urgency to reach zero carbon emission by mid-century. Photocatalytic CO_2 reduction reaction (CO_2 RR) using semiconductor-based catalysts in gas-phase reactors presents an elegant solution to global problems of climate change and energy exhaustion. In this process, gaseous CO_2 is converted to fuels (e.g. CO, CH_4) and valuables chemicals (e.g. formic acid) using sunlight and water, which closes the carbon cycle. Generally, the concentration of CO_2 in exhaust gases from human beings and industries is relatively low (~13 % in car exhaust). Considering the energy-consuming process of CO_2 capture and condensation, the direct conversion of low-concentration CO_2 is imperative to achieve a cost-effective CO_2 recycling economy, namely the artificial leaf. Therefore, the development of efficient photocatalysts for low-concentration CO_2 reduction in gas-phase reactors to desirable products is of great significance. *Aim of the project: Develop a kind of low-cost, efficient and reliable artificial leaf for low-concentration gaseous CO_2 photoreduction to fuels.* *Hypothesis: The design and optimization of photocatalysts are one of the key steps for achieving highly efficient solar to fuel conversion (convert CO_2 into CO/CH_4) with decent stability. Different combinations of cocatalyst-semiconductor components with a particular focus on the development of cocatalysts will be prioritized in this project to achieve targeted photocatalytic performance.*
Expected outcomes and deliverables:	The applicants will learn how the procedure of designing a catalyst and measuring its photocatalytic activity for the CO_2 reduction reaction on their own. In addition, problem-solving in catalysis research, as well as the use of most important catalysis research facilities, can be learned throughout the project. By the end of the project, a demo of the artificial leaf for low-concentration gaseous CO_2 photoreduction will be developed. *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 students with a background in chemical engineering, material engineering or mechanical engineering 3-4 year students.*
Primary Supervisor:	Dr Mu Xiao
Further info:	You are more than welcome to contact the supervisor before applying (m.xiao@uq.edu.au).

UQ Summer Research Project Description

Project title:	**Energy from wastewater: photocatalysts for solar to hydrogen conversion**
Project duration:	*10 weeks*
Description:	Conventional photocatalytic water splitting reaction aims at producing H_2 from sunlight and H_2O with the assistance of appropriate photocatalysts. However, the four-electron involved process of water oxidation reaction and the high energy barrier (1.23 V) lead to sluggish kinetics, which is the main reason for remarkably low solar-to-hydrogen conversion efficiency (~1%). The combination of water reduction and pollutant degradation has been emerging as a possible strategy to purify wastewater and simultaneously produce valuable H_2. Urea-rich wastewater from livestock and industry, has been considered to cause environmental problems (e.g. nitrate contamination of groundwater). It is therefore economically and environmentally important to degrade urea in wastewater for energy production. A possible strategy is to integrate the urea oxidation reaction with the water-splitting reactions, considering the similarity between urea electrolysis and water electrolysis (**Figure 1**). Notable, the replacement of ordinary water oxidation reaction with urea oxidation reaction can lower the thermodynamic potential from 1.23 V to 0.37 V, which is expected to enhance the solar hydrogen conversion efficiency. Nevertheless, the possibility of photocatalytic hydrogen evolution from urea-rich wastewater by using semiconducting photocatalysts has rarely been explored, mainly due to the lack of efficient photocatalysts. Therefore, this project proposes to demonstrate such a new photocatalytic hydrogen evolution reaction, which produces hydrogen together with wastewater purification. It is expected that this work will open new avenues for green and cost-effective hydrogen production and pave the way towards a cost-efficient and environment-friendly waste recycling economy. **Urea Electrolysis** Reduction: $H_2O + e^- \rightarrow \frac{1}{2}H_2 + OH^-$ $E^0 = 0$ V vs. SHE Oxidation: $CO(NH_2)_2 + OH^- + h^+ \rightarrow \frac{5}{2}H_2 + N_2 + CO_2$ $E^0 = 0.37$ V vs. SHE Total: $CO(NH_2)_2 + H_2O \rightarrow 3H_2 + N_2 + CO_2$ $E = 0.37$ V, $\Delta G = 214$ kJ mol^{-1} **Water Electrolysis** Reduction: $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ $E^0 = 0$ V vs. SHE Oxidation: $2OH^- + 2h^+ \rightarrow O_2$ $E^0 = 1.23$ V vs. SHE Total: $H_2O \rightarrow H_2 + O_2$ $E = 1.23$ V, $\Delta G = 237$ kJ mol^{-1} Figure 1. Equations for urea electrolysis and water electrolysis. *Aim of the project: Conceptual demonstration of solar-driven hydrogen production from urea-rich wastewater using semiconductor-based heterogeneous photocatalysts.* *Hypothesis: The design and optimization of photocatalysts are one of the key steps for achieving highly efficient solar to fuel conversion (convert CO_2 into CO/CH_4) with decent stability. Different combinations of cocatalyst-semiconductor components with a particular focus on the development of cocatalysts will be prioritized in this project to achieve targeted photocatalytic performance.*

Expected outcomes and deliverables:	The applicants will learn how the procedure of designing a catalyst and measuring its photocatalytic activity for the hydrogen production from wastewater on their own. In addition, problem-solving in catalysis research, as well as the use of most important catalysis research facilities, can be learned throughout the project. By the end of the project, a demo of the artificial leaf for the hydrogen generation from urea-rich wastewater will be developed. *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 students with a background in chemical engineering, material engineering or mechanical engineering 3-4 year students.*
Primary Supervisor:	Dr Mu Xiao
Further info:	You are more than welcome to contact the supervisor before applying (m.xiao@uq.edu.au).

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Scaling up Cellular Agriculture – Biomanufacturing of Cell-Based Meats**
Project duration:	10 weeks
Description:	Cellular agriculture is a process in which animal-derived cells are grown *in vitro* to ultimately replace animal-derived skeletal muscle or meat. Current meat production contributes to 14.5% of total GHG emissions, with cattle, pig and poultry farming responsible for 57% of these. By 2050, current farming practices will be unable to meet the 'meat' demand of our growing global population. Cell-based meat (CBM) provides an alternative slaughter-free option to traditional farmed meat and may become an economically viable food source in the future. However, realisation of this future requires us to overcome the current most significant challenges of CBM production, including renewable cell sources and significant limitations surrounding scalability and quality of these products, at reasonable cost. The aim of this project is to address one of the roadblocks that will enable the scalable biomanufacturing of cellular agriculture, so that maybe one day, CBM becomes a reality on supermarket shelves, that being media and culture substrate optimisation. The successful candidate will join a project aimed at optimising culture and differentiation (skeletal muscle) outcomes from animal stem cells using a high-throughput (HTP) liquid handling robotic automation system and novel biomaterial-media combinations.
Expected outcomes and deliverables:	Scholars will gain skills in stem cell culture and differentiation, inclusive of associated characterisation and property measurement, along with biomaterial characterisation and media formulation. They will also learn how to operate HTP automation systems and associated imaging capabilities. They will be a part of a larger team investigating different parts of the pipeline to effective scale-up of CBM. The successful applicant will have the opportunity to contribute to the generation of publications from their research. 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 students with a background in chemical engineering, biomedical engineering, or related disciplines.
Primary Supervisor:	Professor Justin Cooper-White
Further info:	If you require further information, please email Professor Justin Cooper-White: j.cooperwhite@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**3D printing of tissue engineered scaffolds.**
Project duration:	10 Weeks
Description:	The successful applicant will become familiar with additive manufacturing workflow, from design to 3D printing of tissue engineered implants. They will learn the different parameters involved in 3D printing processes, and how to optimize them based on the complexity of scaffold geometry and printing resolution. They will work with different polymers using the state-of-the-art BioAssemblyBot 400 - the worlds only six-axis 3D bioprinter. They will work with team members to develop and test methodologies for 3D printing Intervertebral disc scaffolds for tissue engineering applications.
Expected outcomes and deliverables:	The successful applicant will gain skills in 3D printing and slicing, biomaterials characterisation and data collection, teamwork, equipment operation and analysis, and may have the opportunity to get involved in a range of different tissue engineering projects currently underway in the JCW lab group. The successful applicant will have the opportunity to contribute to the generation of publications from their research. At the end of the program, the student will be expected to submit a report and present their findings to the lab group.
Suitable for:	This project is most suitable for students with a background in chemical engineering and bio/biomedical engineering – particularly with an interest in additive manufacturing technology, 3D modelling and polymer sciences.
Primary Supervisor:	Professor Justin Cooper-White
Further info:	Contact: j.cooperwhite@uq.edu.au For more information on the Bioassembly Bot please visit: https://www.advancedsolutions.com/bioassemblybot-400

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Novel Biomaterial Culture Substrates for Stem Cell Expansion**
Project duration:	10 weeks
Description:	The aim of this project is to synthesise and characterise a panel of novel glycan-binding polymers that support stem cell adhesion, spreading, and expansion in the multipotent state on substrates mechanically matched to the tissue niche they are derived from, the perivascular niche. The successful candidate will learn how to apply our rapid one-pot RAFT-based (rosa- RAFT) copolymer synthesis methodology, coupled with a high-throughput liquid handling automation system, to produce a range of terpolymers that have *targeted* interactions with human stem cell surface glycans.
Expected outcomes and deliverables:	Scholars will gain skills in biomaterials synthesis, biomaterials characterisation, and basics of cell biology, including stem cell culture and data collection. The successful applicant will have the opportunity to contribute to the generation of publications from their research. 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 students with a background in chemical engineering, biomedical engineering, or related disciplines.
Primary Supervisor:	Professor Justin Cooper-White
Further info:	If you require further information, please email Professor Justin Cooper-White: j.cooperwhite@uq.edu.au

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Recycling of Metallurgical Slags**
Project duration:	10 weeks
Description:	Over 1.3 billion tonnes of primary iron from iron ore are made each year around the world, producing approximately 300-400 million tonnes of discard slag. Each tonne of primary iron requires approximately 22GJ/tonne of thermal energy input. International efforts are now underway to address the global challenges of reducing greenhouse gas emissions and environmental footprint across the whole production cycle, this includes current sintering and pelletising processes, blast furnace and shaft-based reactors for the reduction of iron ores, and importantly the use of solidified and metastable oxide (slag) as products rather than discard wastes. The Pyrometallurgy Innovation Centre (PYROSEARCH, ***https://chemeng.uq.edu.au/pyrosearch***) focuses on providing key fundamental knowledge and predictive tools to assist in the optimisation of the whole of the current iron making cycle. This research project aims to provide i) new experimental phase equilibria data on a range of metallurgical systems based on existing research topics currently undertaken at the Centre; and ii) leachability data of heavy metals from metallurgical slag and understand releasing behaviour of these elements using advanced quantitative micro-analysis technique.
Expected outcomes and deliverables:	Student will work with an existing research team, obtain practical experience in high temperature laboratory-based research and understanding of pH-dependent releasing behaviour of heavy elements from metallurgical slags, and is expected to produce a professional quality report and oral presentation at the end of their project.
Suitable for:	This project is open to applications from students with a background in chemical engineering, chemical and materials engineering, chemical and metallurgical engineering and science 2-5 year students, UQ enrolled students only. Location Banksia Building Long Pocket Campus *The preference is given to students interested in future University or industry-based research career.*
Primary Supervisor:	Professor Evgueni Jak
Further info:	Please submit CV and academic record to e.jak@uq.edu.au (Prof. Evgeni Jak)

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Net Zero Carbon Water Cycle**
Project duration:	10 weeks
Description:	The Victorian Climate Change Act 2017 (Victoria) establishes a legislative framework to drive action to achieve a net zero emissions, climate-resilient Victorian community and economy by 2050. The Act requires the Victorian Government to set five yearly interim greenhouse gas emissions reduction targets, starting in 2021, to set the State on a pathway to net zero greenhouse gas emissions by 2050. Against this backdrop, the Victorian water sector has committed to reducing its emissions by 42% by 2025 and to net-zero by 2050. These targets are formalised in the Statement of Obligation that sets out the water sector's emissions reduction priorities, affordability priorities, and rules for calculating emissions. Beyond these targets, Victoria's four Melbourne metropolitan water corporations are exploring whether they can achieve net-zero emissions by 2030, 20 years ahead of schedule. The Victorian Department of Environment, Land, Water and Planning (DELWP) has partnered with the Monash Sustainable Development Institute (MSDI) and the University of Queensland (UQ) to undertake the Net Zero Carbon Water Cycle Program (NZCWC). The NZCWC aims to comprehensively and systematically identify factors that will lead to sustainable reductions in water-related energy and greenhouse gas emissions from the use of water in the entire water cycle across Metropolitan Melbourne. UQ's focus is on the technical analysis including modelling quantification of energy and greenhouse gas emissions through the urban water cycle and evaluation of options. The first project in this program focusses on the Residential Sector. The overall aim of Project 1 is to identify the technical, behavioural and enabling factors that will lead to sustainable reductions in water related energy (electricity and gas) and associated GHG emissions from residential households. A critical output of Project 1 will be regulatory recognition in the enabling environment, specifically the Victorian Energy Efficiency Certificate scheme to recognise GHG emission reductions associated with reduced household water use in targeted applications. The outputs of Project 1 will also include a set of clear and proven technical and behavioural intervention opportunities for water related GHG abatement and water efficiency together with guidance and recommendations that relate to enabling policy and regulatory reforms; and policy and program opportunities for supporting vulnerable individuals and households who are disadvantaged by the cost of water related energy use. A detailed project plan is available. The broad aim of Project 1 Phase 2 is to progress the findings and recommendations from Phase 1 (Completed in April 2021) to identify the most favourable options to progress to Phase 3. This will be done by:

	• Identifying high impact, low cost intervention options, that are evidence based, • Identifying drivers and barriers to behaviours to support interventions, with a view to matching behaviour change tools to variables that influence behaviour, • designing trials of key interventions for implementation in Phase 3, • progressing analysis of enabling environments to support reduction of water-related energy and GHG emissions in residential properties particularly with respect to VEET scheme opportunities and institutional arrangements, and • designing next steps to support progression of enabling environments opportunities. The key research question, which will be progressively developed and addressed throughout Project 1, is: *What options exist for residential water efficiency installations and behaviour change (affected by showers, hot water systems, clothes washers, dishwashers and related losses) to cost-effectively influence energy and GHG savings? While being cognisant of impacts on load profiles (energy demand) and the dynamic GHG-signature of the grid.* This research project is primarily a data analysis and modelling project. It includes compiling, analysing and presenting diverse data compiled from utilities (including water end use, electricity and gas data in diverse formats (eg ARC GIS, XL). Data preparation for modelling using Mathematical Material Flow Analysis (MMFA, static and potentially dynamic), and spatial analysis. Support in the deployment and data recovery from shower flow and energy meters (Amphiro B1). Some use of Matlab may be included. Literature and data review and report preparation.
Expected outcomes and deliverables:	Scholars will gain skills in data collection, analysis and presentation. They will have the opportunity learn and apply spatial and other modelling techniques for assessment of the energy effect of water in households. Students will be expected to create outcomes in a specific area of the project and will have an opportunity to generate publications from their research. 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 students with a background in chemical and/or mechanical engineering, 3-4 year and/or masters students. Interest and experience in data analysis, modelling and report preparation is desired.
Primary Supervisor:	Professor Steven Kenway
Further info:	To discuss the project please contact s.kenway@uq.edu.au 0419979468

School of Chemical Engineering

UQ Summer Research Project Description

Project title:	**Leaching behaviour of gold from electronic waste**
Project duration:	10 weeks
Description:	In primary production of gold, leaching is usually carried out in cyanide solution because of the excellent selectivity for gold over gangue minerals. For recycling gold from post-consumer electronic waste, alternative lixiviant systems may be advantageous. This summer research project a systematic leaching study will be carried out considering a series of alternative leaching chemistries.
Expected outcomes and deliverables:	Summer scholars will gain skills in teamwork, lab techniques, equipment operation, data collection and analysis, presentation skills, and may have an opportunity to generate publications from this research. Students will be expected to produce an oral presentation at the end of their project.
Suitable for:	This project is most suitable for students with a background in metallurgical engineering, chemical engineering and materials engineering.
Primary Supervisor:	Dr Ummul Sultana
Further info:	If you are interested, please meet with Ummul via email in the first instance (u.sultana@uq.edu.au) to discuss the project.