# Faculty of Science, Engineering & Technology

**Department of Chemistry and Biotechnology**

**BSc HONOURS INFORMATION FOR FEBRUARY 2019**

*Biochemistry, Biotechnology,*

*Chemistry & Environmental Science*

**PREFACE**

*If we knew what it was we were doing, it would not be called research, would it?*

*Albert Einstein*

Honours is an intellectually rewarding and personally fulfilling experience. Intellectually, you will undertake study at a higher level than in your undergraduate degree both in your honours units and when you carry out research for your thesis, report or dissertation. The report allows you to focus on an area of particular interest and provides the opportunity to make contribution to knowledge and wider debates in your discipline.

On a personal basis, the skills acquired during this period will enhance your future career prospects in a broad range of occupations, in both the public and private sectors, giving you an edge compared with a straight undergraduate pass degree. While your bachelor’s degree provides you with fundamental knowledge underpinning the scientific principles related to real-life applications, during your honours year you will have an opportunity to develop soft and transferable skills.

Research is about discovery, the proposal of new ideas and the assessment of new hypotheses. It is about the establishment of facts through enquiry and exploration, and its outcome is new knowledge, leading to deeper understanding of mechanisms and the development of new and improved procedures. To ensure that the use of research results is maximised, it must be disseminated in a suitable format, and you will learn a lot about scientific writing (abstract, poster, journal article, thesis, etc.)

The purpose of this guide, intended for students completing their bachelor’s degree in Science, is to provide a list of research projects available to those planning to pursue an Honours year in **Biochemistry, Biotechnology, Chemistry or Environmental Science**.

Interested students are strongly recommended to meet with the respective academic to discuss details of projects. Should you need any information about application process, please contact me directly.

Dr Huseyin Sumer

Honours Coordinator (Science)

School of Science

[**http://www.swinburne.edu.au/study/course/bachelor-of-science-honours/**](http://www.swinburne.edu.au/study/course/bachelor-of-science-honours/)

**FOR PERSONAL USE ONLY**

**PLEASE DO NOT PRINT, COPY, DISTRIBUTE OR SHARE**

**TABLE OF CONTENTS**

## Preface…….………………………………………………………………………....2

## Table of Contents .….……………………………………………………………....3

## Contact Details of Staff …..…………………………………………………….......4

## Summary of Application Process ………………………………………………...5

## Course Structure and Streams …………………………………………………....6

## Draft Timetable for 2018 …………………………………………………………7

## Project Supervisors ………………………………………………………………...8

**CONTACT DETAILS OF STAFF**

## Contact details for staff in the Department of Chemistry and Biotechnology can be found on the Swinburne website: <http://www.swinburne.edu.au/science-engineering-technology/schools-departments/science/chemistry-biotechnology>

|  |  |  |
| --- | --- | --- |
| **Name** | **Contact** | **Location** |
| [Professor Mrinal Bhave](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=mbhave) | +61 3 9214 5759 mbhave@swin.edu.au | AS228 |
| Doctor Vito Butardo Jr | +61 3 9214 3715 vbutardo@swin.edu.au | AS211 |
| Doctor Brett Cromer | +61 3 9214 8893 bcromer@swin.edu.au | AS217 |
| [Doctor Daniel Eldridge](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=deldridge) | +61 3 9214 5681 deldridge@swin.edu.au | AS227 |
| Doctor Rosalie Hocking | +61392145840 rhocking@swin.edu.au | AS212 |
| [Professor Peter Kingshott](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=pkingshott) | +61 3 9214 5033 pkingshott@swin.edu.au | AS-224 |
| [Doctor Ajay Krishnamurthy](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=akrishnamurthy) | +61 3 9214 5129 akrishnamurthy@swin.edu.au | PD193 |
| Professor Steven Langford | sjlangford@swin.edu.au  |  |
| [Doctor Peter Mahon](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=pmahon) | +61 3 9214 4880 pmahon@swin.edu.au | AS219 |
| [Doctor Francois Malherbe](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=fmalherbe) | +61 3 9214 5361 fmalherbe@swin.edu.au | AS210 |
| [Professor Enzo Palombo](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=epalombo) | +61 3 9214 8571 epalombo@swin.edu.au | AS226 |
| [Patricia Rich](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=prich) | prich@swin.edu.au |  |
| [Doctor Huseyin Sumer](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=hsumer) | +61 3 9214 8687 hsumer@swin.edu.au | AS 211 |
| [Doctor Chenghua Sun](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=bzaferanloo) | chenghuasun@swin.edu.au | AS208 |
| Doctor Vito Butardo | +61 3 9214 5939 vbutardo@swin.edu.au | AS211 |
| [Professor Feng Wang](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=fwang) | +61 3 9214 5065 fwang@swin.edu.au | AS206 |
| [Doctor Hayden Webb](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=hkwebb) | +61 3 9214 5183 hkwebb@swin.edu.au | AS229 |
| [Associate Professor Aimin Yu](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=aiminyu) | +61 3 9214 8161aiminyu@swin.edu.au | AS 214 |
| [Doctor Bita Zaferanloo](http://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=bzaferanloo) | +61 3 9214 8214 bzaferanloo@swin.edu.au | AS229 |

**SUMMARY OF APPLICATION PROCESS**

# Basic Eligibility

**Bachelor of Science in relevant field with an overall Credit Average or above**

🡫

# Introspection

**What is my preferred field of research? What do I like/am passionate about? What are my research strengths/skills?**

**Am I interested in a PhD?**

🡫

# Approach Academic Staff

**Browse through the list of Supervisors and research areas**

**Following your choice of topic(s), contact and arrange a meeting with the respective academic(s) to discuss their offerings and your credentials**

🡫

# Secure a Project

**Once you are offered a project, make sure you and your supervisor agree on the modalities of attendance, course components, etc…**

🡫

# Submit an application

[**https://www.swinburne.edu.au/study/course/bachelor-of-science-honours/**](https://www.swinburne.edu.au/study/course/bachelor-of-science-honours/)

**COURSE STRUCTURE AND STREAMS**

To qualify for a Bachelor of Science (Honours), a student must complete 100 credit points comprising coursework and thesis units within ONE area of specialisation: Biotechnology/ Biochemistry; Chemistry; Environmental Science; Physics. A unit of study can only be counted once.

An overall Honours Grading is based on a weighted average of all units, with each unit’s

contribution weighted by its credit point value.

* BSc (Hons) with First Class Honours (H1): 80%-100%
* BSc (Hons) with Upper Second Class Honours (H2A): 70% – 79%
* BSc (Hons) with Lower Second Class Honours (H2B): 60% – 69%
* BSc (Hons) with Third Class Honours (H3): 50%-59%

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit****Code** | **Unit Name** | **Credit****Points** | **Outcome****Unit** |
| **Biotechnology/Biochemistry** |
| Students must complete the following five units (100 credit points): |
| BCH40002 | Honours Lectures Part A | 12.5 | Y |
| BCH40003 | Honours Lectures Part B | 12.5 | Y |
| NPS40010 | Research and Professional Skills | 12.5 | Y |
| NPS40007 | Honours Project A | 12.5 | Y |
| NPS40009 | Honours Project C | 50 | Y |
| **Chemistry** |
| Students must complete the following five units (100 credit points): |
| CHE40003 | Chemistry Honours Lectures Part A | 12.5 | Y |
| CHE40004 | Chemistry Honours Lectures Part B | 12.5 | Y |
| NPS40010 | Research and Professional Skills | 12.5 | Y |
| NPS40007 | Honours Project A | 12.5 | Y |
| NPS40009 | Honours Project C | 50 | Y |
| **Environmental Science** |
| Students must complete the following five units (100 credit points): |
| CHE40003 | Chemistry Honours Lectures Part A | 12.5 | Y |
| CHE40004 | Chemistry Honours Lectures Part B | 12.5 | Y |
| NPS40010 | Research and Professional Skills | 12.5 | Y |
| NPS40007 | Honours Project A | 12.5 | Y |
| NPS40009 | Honours Project C | 50 | Y |

**DRAFT TIMETABLE FOR 2019**

Semester 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** |
| **Sem 1** | AM | **Project**  | **Project**  | **BCH40002/ CHE40003** | **BCH40003****CHE40004** | **Project**  |
| PM | **Project**  | **Project**  | **NPS40010** | **Project**  | **Project**  |

Semester 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | AM | **Project**  | **Project**  | **Project**  | **Project**  | **Project** |
| PM | **Project** | **Project**  | **Project**  | **Project**  | **Project**  |

 Core Lectures : 12.5 CP - BCH40002, CHE40003 (generic, common)

 Advanced Lectures : 12.5 CP - BCH40003, CHE40004 (discipline specific)

 R&P Skills : 12.5 CP - NPS40010 (common)

 Research Project A : 12.5 CP (topic specific)

 Research Project B : 50 CP (topic specific)

 Science Colloquia : Built-in Project B and is common to all streams (TBC)

#### **Notes:**

 Total research hours for each component is topic specific

 Lab attendance is normally Mon-Fri 9am-5pm, unless otherwise agreed with the

supervisor

 The above timetable is for illustration only

**Department of Chemistry and Biotechnology Supervisor list**

**Prof Mrinal Bhave - Molecular biology and Biotechnology**

Mrinal has an extensive research profile in molecular biology and biotechnology, focussing on selected areas of priority in agriculture, environment and human health.  For example, in the agricultural context, wheat and barley are among the world’s largest cereal crops, and have significant contribution to human health and nutrition.  Mrinal’s projects focus on molecular and biochemical analysis of various factors determining grain quality, nutraceutial value, adaptations to environmental stresses such as salinity and drought, and assessing the potential applications of certain agricultural waste-products.  In the infection control context, there is a significant need to develop novel biocidal agents to control persistent infections such as drug-resistant microorganisms, biofilms and spores.  Mrinal’s projects involve design of novel antimicrobial peptides and testing their activity against diverse bacterial and fungal pathogens, and determining the mechanisms of action. In the context of environmental issues, heavy metal contaminants and methods of their early detection and bioremediation are key areas.  A number of projects are available, e.g., (i) identifying diverse biochemical compounds, genes and alleles related to grain quality and composition e of wheat and barley, which are major cereals and export crops of Australia; (ii) studying the effects of salt and/or drought stress on lines of native and crop plants, by analysing selected biochemicals, whole metabolomes, gene structures, expression and/or stress response pathways; (iii) studying the effects of peptides we have developed on bacterial and fungal pathogens, analysing the mechanisms of action by diverse microscopy and staining techniques and assays, and testing for development of resistance against the peptides; (iv) expression of antimicrobial proteins and synthetic genes expressing antimicrobial peptides; (v) identifying the genetic systems of environmental bacteria involved in resistance to heavy metals such as cadmium and mercury, for developing applications.  The work will involve a selection of biochemistry, chemistry, molecular biology, microbiology and/or bioinformatics theory and techniques, and may also involve contributions of co-supervisors, depending on the project.  Some projects may be supported by a small performance-based scholarship; please contact M Bhave to enquire.

**Dr Vito Butardo – Biochemistry and Biotechnology**

Malnutrition is a health condition characterised by insufficient, unbalanced, impaired assimilation, or excess intake of energy or nutrients. My major research goal is mitigating the impact of malnutrition by enhancing food security and nutritional value of cereal grains. I would also like to understand the impact of climate change on the yield, quality and nutritional properties of grains. In the past, I screened for low digestibility rice grain phenotypes from diverse wild, cultivated and mutant rice varieties. I then developed low digestibility rice grains by genetic engineering to alter the storage starch biosynthetic pathways in rice endosperm. This was accomplished by endosperm-specific RNA silencing of major starch branching enzymes and starch synthases in rice singly and in various combinations. I demonstrated that shifting the synthesis of amylose and amylopectin to elevate the proportion of long-chain amylopectin results in reduced starch hydrolysis and lowered glycemic impact. More recently, I used grain quality genomics and systems genetics approaches to understand grain quality and nutrition phenotypes using diverse core collections of world rice accessions. Interested honours students who are keen to establish a career in food and agricultural biotechnology can work with me on the following prospective research topics: (1) enzyme kinetic modelling of the synergistic and/or antagonistic effects of alpha-amylase and amyloglucosidase in the digestion of cooked starch granules; (2) metabolomic and biochemical characterisation of phytochemicals from coloured cereals and pseudocereals; (3) cloning and characterisation of selected genes related to rice grain quality and nutrition, (4) micronutrient mobilisation of developing and germinating cereal grains using non-destructive surface imaging techniques such as x-ray fluorescence microscopy (XFM), and (5) microorganisms associated with decomposing agricultural wastes in rice such as hay, hulls and bran.

 **Dr Brett Cromer - Biotechnology**

Ion channels are responsible for rapid electrical signalling in nerves and muscle. The first step of these electrical signals is activation of ligand-gated ion channels (LGICs), by synaptically-released neurotransmitters. Dependent on LGIC ion selectivity, the signal initiated may be excitatory of inhibitory. We are particularly interested in inhibitory channels as they act as controllers of neuronal function and are major targets of many neuroactive drugs. We use a variety of techniques, including molecular modelling and simulations, molecular biology and mutagenesis, protein expression and purification, electrophysiology and fluorescent measurements to investigate the molecular mechanisms of these channels and how they are modulated by drugs. A range of projects are available, including: 1. Understanding general anaesthetic action on ion channels to improve future anaesthetics. 2. Investigating convergent evolution of neurotransmitter selectivity. 3. Defining LGIC specificity of marine cone-shell neurotoxins. 4. Identifying antiparasitic drug targets in Scabies. 5. Fluorescent tracking of LGIC assembly and synapse formation in cell lines and stem cells. 6. Using novel antibodies to define the role of inhibitory channels in muscle fatigue.

**Dr Daniel Eldridge – Chemistry**

Surface and colloid chemistry is critical to understanding the function of a myriad of scientific processes, and improving our quality of life. In conjunction with key analytical techniques, there is great scope for research in both fundamental aspects and the development of new applications. Colloids can be used as adsorbents in the treatment of drinking water and wastewater. There is great scope for the study of how this interaction occurs, as well as the application of novel materials including 2D materials and mesoporous silica based adsorbents, exploring their ability to target a host of recalcitrant pollutants. Colloids also find applications in the development of drug delivery vehicles. Recent developments in the creation of a new microwave-synthesised solid lipid nanoparticle (SLN) drug carrier have opened up a host of questions involving the study of the carrier’s capabilities, structure and efficacy. Some colloids have the potential to photocatalytically degrade pollutants, prevent bacterial growth and potentially even kill bacteria. Study of such antimicrobial properties is still of great interest. These sciences also make up a key component of the multidisciplinary study of microbiologically influenced corrosion, a phenomenon costing billions of dollars every year. There is still much to be understood regarding the corrosion process itself, and both the chemical and biological factors that play a role in this accelerated corrosion. Finally, there is lots to be done regarding the more fundamental nature of colloids, including how to more accurately determine aqueous surface area, the role that electrokinetic behaviour plays in microbial activity and more. If you are potentially interested in any of these areas, please get in touch with me to find out more about your specific area of interest.

**Dr Rosalie Hocking– Chemistry**

One of the biggest challenges of the 21st century will be to develop ways to generate and store energy without releasing carbon dioxide into the atmosphere.  One promising strategy is to use solar-derived electricity to make fuels, called solar fuels and other commodity chemicals.  Our research is focussed on the development of catalysts for these conversions.  We particularly interested in developing new materials that can harvest sunlight to make hydrogen, reduce nitrogen to ammonia and the chemical reduction of CO2.  We use a number of tools in the design of our materials including electrochemistry, synthesis and range of spectroscopic techniques including Raman and Synchrotron based spectroscopies. In addition to our work in catalysis we also have related projects in sensing (we are working with a company to develop a sensor for Asbestos) and in understanding the origins of life.  Please do not hesitate to contact Rosalie if you want further details.

**Professor Peter Kingshott – Biointerface Science, Cell/Bacteria-Surface Interactions, Colloid and Surface Chemistry, Nanobiotechnology**

Our research has a strong emphasis on controlling the interfacial interactions of advanced material surfaces with biological systems such as mammalian cells such as stem cells and bacteria. The main aims are to generate new surfaces that: 1) can either optimise the behaviour of cells on surfaces, e.g. for using stem cells in tissue engineering and regenerative medicine; or 2) design surfaces to prevent bacteria from attaching to medical devices, thus preventing infections and antimicrobial resistance build-up. The research focus includes using of surface modification and advanced surface characterisation combined with the development of new 1, 2 and 3D surface micro- and nanopatterning approaches. We aim to improving our understanding of how biology and man-made materials interact with each other in order to manufacture the next generation of coatings for use in the medical sector.

**Dr Ajay Krishnamurthy- Microbial pathogenesis/Host-microbe interactions/Biotechnology/3D Bioprinting and microbial biofilms**

Dr Krishnamurthy’s research interests and expertise focusses on providing novel contributions towards developing polymicrobial infection model systems (both animal and cell culture) and understanding mechanisms of bacterial interactions with each other and the host, microbial biofilms-production and eradication, dynamics of bacterial colonisation patterns and host immune responses, and develop therapeutic approaches against respiratory infections.

Lower respiratory tract infections like pneumonia, bronchitis, exacerbations of chronic obstructive pulmonary disease, and influenza are some of the leading infectious lung disease with high mortality and morbidity in humans. As the lung is the main portal of entry for aerosols and despite of the existence of host defence mechanisms, respiratory diseases are frequent and increasing. Moreover, antibiotic resistant organisms are increasing in frequency, both due to the evolution of antibiotic resistance and biofilms on medical devices used in surgical intervention of lung diseases. The prevention of the initial bacterial attachment and bacterial biofilm growth is critical to develop a strategy to target persistent and recurring infections. Advances in nanotechnology are providing potential for modifying medical devices to improve certain clinical settings by the usage of nanoparticles against biofilm-mediated and drug-resistant infection issues.

An exciting research project that will have potential for subsequent bigger projects is available that focusses on developing a realistic 3D in vitro host-microbe interaction model using 3D bioprinting technology. This project will also involve designing targeted antimicrobial systems with increased efficiency using Solid Lipid Nanoparticle (SLN’s) to efficiently interact with specifically targeted cells (or groups of cells), with remarkable precision. With the incorporation of 3D bioprinting approach, it will provide an excellent tool to engineer an advanced 3D lung model for understanding the dynamics of how microbial interactions contribute to chronic and persistent lung diseases. The integration of SLN will allow us to develop novel therapeutic approach against biofilm-mediated persistent infections.

**Prof Steven Langford - Chemistry**

Supramolecular chemistry takes the best of the bio-inspired science disciplines and uses them to study the development of emerging technologies in the materials sciences and related disciplines. My group’s research focuses on organic-based supramolecular systems.  We combine the elegance of *organic synthesis* with state-of-the-art *physical and analytical techniques* to make new and exciting systems that function as a result of some form of stimulus.  These techniques include electrochemistry and fluorescence spectroscopy.  If you are interested in combining your chemistry knowledge for a well-rounded research training experience, come and talk to me about what might be possible.  Our projects reflect the creativity and innovation of modern chemistry and aim to solve significant problems in the following areas of science: Bioinspired systems for photosynthetic mimicry; disease detection using genetic sensing; synthesis and characterization of novel arenes for OFET application; new host-guest chemistry; designing natural polymers for new applications; molecular sensing.

**Dr Peter Mahon – Chemistry**

Electrochemistry involves understanding how chemistry and electricity interact and electron transfer is a fundamental process for the transference of chemical energy. (i) Energy storage is very topical and in collaboration with CSIRO, there are a range of projects that address important issues in the development of improved battery technology. (ii) Bioelectrochemical systems are also of interest with the Microbial Fuel Cell being able to generate electricity from biomass due to microbial activity – there are still many questions regarding the way that electrons are able to be transferred between a microbe and the electrode. (iii) Molecular electron transfer can generate structural instability that causes fragmentation and the combination of an electrochemical flow cell with a mass spectrometer enables these processes to be characterized. This approach seeks to mimic metabolic processes with drug metabolism being of particular interest.

**Dr François Malherbe - Chemistry/Materials Science**

Dr Malherbe’s research interests are broad and encompass the development, characterisation and application of novel materials and composites, tailor-designed to alter their morphologies and enhance other physico-chemical characteristics. From inorganic materials like zeolites or hydrotalcites, used as adsorbents or in clean technologies, to polymer composites tuned with specific properties, the overall objective is to provide smart solutions using functional materials. The targeted areas are: technological challenges (micro/nano devices, biosensors), sustainable alternatives (renewable sources) and clean processes (environmentally responsible manufacturing). Dr Malherbe favours a multidisciplinary and collaborative approach, providing a holistic environment for personal and professional developments, and is a fierce proponent of independent research and guided learning. Examples of research projects are: Improving the exfoliation of graphite to graphene; Inorganic materials for CO2 sequestration; Conductive biocompatible polymers; Thin film micro-batteries by RF sputtering; Valorisation of biomass wastes; Or … Do you have a burning relevant research idea you would like to explore?

**Prof Enzo Palombo – Biotechnology/microbiology/natural products**

Microbes play vital roles in most aspects of our everyday lives. Although infectious agents receive much attention, microbes also bring many benefits and are influential to the food industry, environmental science and biotechnology. Many traditional foods are produced by microbial fermentation although much of the underlying microbiology remains a mystery. Other microbes are detrimental to food production and can cause a safety issue if contamination occurs. A number of projects are available to examine the microbiology of natural systems and industrial processes (including food manufacture) and to discover new ways to control or eliminate microbes from these environments. Other projects are focussed on the foods themselves and the compounds present that may have wider applications, including their ability to influence microbial growth. Additional projects will explore new and rapid ways to identify and characterise microbes from foods and other sources.

**Dr Stephen Poropat – Palaeontology**

The Cretaceous Period (145–66 million years ago) was one of the warmest stages in Earth’s history. In Australia, the Cretaceous vertebrate fossil record is only informative within a relatively narrow window (125–95 million years ago) of the Cretaceous as a whole. However, despite this temporal restriction, the fossil record from rocks of this age in Australia has steadily improved over the last three decades. In the last ten years in particular, the discovery of abundant vertebrate fossils in the Eromanga Basin in Queensland, and the Otway and Gippsland basins in Victoria, representing all sorts of extinct vertebrates, have provided a wealth of information. By assessing the phylogenetic positions of each specimen attributed to each vertebrate group, it should be possible to determine the palaeobiogeographic signal of the Australian mid-Cretaceous vertebrate fauna. Disentangling this signal is of great interest because it will no doubt reflect the response of the various components of the vertebrate fauna to climate change through time, since this 30 million year window was fairly cool by Cretaceous standards, but bookended by exceedingly warm periods. Furthermore, Australia’s increasingly restricted connection with Antarctica should become increasingly evident in the fauna towards the end of this temporal window—i.e. Australia and Antarctica’s vertebrate faunas would presumably becoming increasingly dissimilar through time. The potential for future discoveries of Cretaceous vertebrates in Australia is staggering in the light of the sheer abundance and relatively easily accessible nature of Cretaceous sedimentary rocks. Field work in these areas, coupled with collections based research at the Queensland Museum and Melbourne Museum, will hopefully augment the records of those vertebrate groups already known to have existed in the Australian Cretaceous. The potential for the discovery of records of previously unrecognised groups is also high, since many groups which theoretically should be present are unknown.

**Dr Huseyin Sumer – Biotechnology**

Embryonic/pluripotent stem cells have the unique ability to differentiate into all cell types and tissues of the body making them ideal for the use in cellular therapies. However, the transplanted cells need to be matched to the patient as they may be rejected by the hosts immune system. One of the most exciting advances in cell biology has been the ability to wind back the developmental clock of an adult cell back to an embryonic state restoring pluripotency. The process of reprogramming a differentiated adult cell to a pluripotent state involves the forced expression of a number of pluripotency genes. A number of projects are available to generate, analyse and explore the use of pluripotent stem cells or adult stem cells for applications in biotechnology including; 1. Baculovirus gene delivery for production of induced pluripotent stem (iPS) cells. 2. Analysis of human mesenchymal stem cells (MSCs) obtained from adipose tissue cultured in different media. 3. Analysis of pluripotent stem cells grown and differentiated on novel surfaces. 4. Differentiation of pluripotent stem cells into functional neurons.

**Dr Chenghua Sun – Chemistry**

 With the development of high performance clusters (HPC), computational simulation and calculations become very powerful. Under this context, computer-aided materials design has become quite approachable. Dr Sun’s group focuses on the development of high performance catalysts based on computational calculations, including three directions: (i) Catalysts for ammonia synthesis at room temperature – This is to remarkably reduce the cost and carbon emission associated with ammonia production; (ii) catalysts for better methane oxidation – This project aims to provide better options to use methane and reduce potential pollution related to methane emission; and (iii) catalysts for biomass conversion – This project is to make use of biomass to produce high-value chemicals. The basic idea is to screen large amount of potential catalysts using HPC, followed lab-based validation.

**Prof Feng Wang – Computational Chemistry/Molecular Modelling**

The world is changing and we are now entering a digital age. The nature presents us a cohort of very complex and interconnected phenomena which require theory guided smart experimental design. Computational chemistry has played a role with increasing importance in all areas of chemical science, spectroscopy, biochemistry, energy and materials science etc. It serves modern science and technology as if we need GPS when we are exploring a new territory---it does not merely tell us the route to the destinations, it also suggested the optimal route to avoid traffic and road work etc. Computational chemistry studies molecules which are the smallest particle exhibiting properties of materials. A large number of measurements, such as synchrotron sourced spectroscopic experiments, measure properties of materials, which should be predictable, in principle, by solving the quantum-mechanical equations governing their constituent electrons. Such calculations require only a small number of chemical elements in appropriate positions through forces. Often experiments without theoretical guidance can be blind. Projects in computational chemistry offer a broad spectrum of quantum mechanical driven discoveries in molecular spectroscopy (IR, XPS, EMS, NMR etc.) for a wide range of organic molecules, drugs, isomers, dyes, and other function molecule studies and their design, such as molecular switches and molecular machines etc. There are possibilities to collaborate with (international) experiments, other organisations and industry. Your project results may also lead to peer refereed publications like other students in the group.

**Dr Hayden Webb –Chemistry/Biotechnology**

Nanotechnology is the study of materials that have at least one dimension in the range of 100 nm or less. Objects at this size can perform all sorts of interesting functions, such as exhibiting catalytic, antimicrobial and electroactive properties. One of the main factors behind these interesting and often unusual properties is the increased surface area to mass ratio. Nanotechnology frequently overlaps with biotechnology, as many cells and cell components also lie within the same size range. Many key applications of nanotechnology fall within these overlapping areas, such as microbial fuel cells and bioelectrochemistry, biocorrosion, antimicrobial materials, biosensors, drug delivery technologies and more. Some available projects in this field include: 1. Generation of bioelectricity using redox active microbial communities, 2. Investigation of biocorrosion of metals, and 3. Development of liposome-based antimicrobial therapies. Other projects may be possible on discussion, ranging from chemical science (esp. physical and analytical chemistry) through to biological science (esp. microbiology and biotechnology) and anywhere in between. It is, however, encouraged that potential projects of interest span both disciplines.

**A/Prof Aimin Yu – Synthesis and Application of Nanostructured Materials and Coatings**

Nanomaterials are types of advanced materials with structure at the nanometer scale.  Nanomaterials often have unique optical, electronic, or mechanical properties which have find wide applications in various research fields. One research focus of the group is to synthesize materials with well controlled composition, size, morphology and porosity.  These include various nanoparticles and nanotubes, 2D materials (graphene and BN), and nanocomposites. As the properties of materials (for example, wettability, charge, reactivity, toxicity and adsorption behaviour) are majorly determined by their surface chemistry, another research focus is to develop surface coating strategies to functionalize materials, so that the properties of materials could be tuned for a range of different applications.

**Dr Bita Zaferanloo – Microbial Biotechnology**

Endophytic bacteria and fungi are untapped sources of microorganisms which live as symbionts in the intercellular spaces of plant tissues. They are becoming increasingly recognized as sources of novel secondary metabolites with potential applications in modern medicine, industry and environment. Novel antibiotics, antimycotics, immunosuppressants, anticancer, bio-protective, biofuels and biodegradation promoting compounds are only a few examples of what has been found after the isolation, culture, purification, and characterization of some choice endophytes in the recent past. A number of projects are available to explore different bio-prospecting for microbial endophytes and their bioactive natural products isolated from Australian native plants including: 1. Metabolic mining of endophytic fungi for bio-protective agents. 2. Extracellular metabolic profiling of endophytic fungi: an alternative solution to control aquaculture pathogens. 3. Exploring the potential of endophytes from Australian medicinal plants: an alternative sources to control drug-resistant bacteria. 4. Metabolites of endophytic fungi from Australian native plants as potential anticancer agents.