CBMS389

Advanced Chemistry III

FY1 Day 2016

Dept of Chemistry & Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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F7B232
any time ... for you guys

Credit points
3

Prerequisites
39cp including CBMS188

Corequisites

Co-badged status

Unit description
In this full-year unit students undertake a research project, involving weekly research focused seminars and discussions, and mentor first year advanced chemistry students. This unit caters for students who are strong in chemistry and/or science and who are interested in pursuing a scientific career. It aims to encourage well qualified students to reach their full potential among their peers. In addition, students review the scaffolding of the degree, including: integrating major unit material; reflecting on the development of the graduate capabilities and how these have been achieved within the degree; and preparing a portfolio of achievements and future goals. This gives students an opportunity to synthesise their understanding of chemistry through the knowledge they have gained throughout their degree, reflect on the graduate capabilities they have acquired and consider their integration into the workforce. The weekly one hour discussion group/tutorials is based around recent advances in the molecular sciences. Student discussions are led by research scientists of the Department of Chemistry and Biomolecular Sciences. In addition, students are required to participate in the activities of at least one research group within the department over the long vacation. Students write up their results in the form of a report.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

mentor junior advanced sciences students in laboratory and literature-based projects
Show the ability to use the chemical database SciFinder Scholar to retrieve information on specific chemicals, find methods for the synthesis of specific chemicals and find literature on chemistry topics generally and teach these skills to CBMS188 students
Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project
Be able to write up the results of a laboratory-based research project in the form of a journal article

General Assessment Information

The majority of the CBMS389 mark relates to your laboratory attachment ("vacation scholarship"), for which you are not paid but receive credit. This is to be 4 weeks full time with a minimum of 40 h/week research work. You will write up your results outside of this time in the form of a scholarly article. This will be graded, and returned for editing if required, and is worth 55% of your overall mark. A further 35% is based on your supervisors assessment of your work in his/her lab according to a rubric, which you will be given.

Assessment Tasks

Name	Weighting	Due
Modules 1-3	15%	week 13
Research Report	55%	before Easter
Supervisor Assessment	30%	End of S1
SciFinder Scholar	0%	Week 1, S2

Modules 1-3

Due: **week 13**
Weighting: **15%**

Mentor students in Modules 1, 2 and 3 of CBMS188

On successful completion you will be able to:

- mentor junior advanced sciences students in laboratory and literature-based projects

Research Report

Due: **before Easter**
Weighting: **55%**

Write a report of your 4 week research attachment in the form a research paper using a journal template of your choice

On successful completion you will be able to:

- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project
- Be able to write up the results of a laboratory-based research project in the form of a journal article

Supervisor Assessment

Due: **End of S1**
Weighting: **30%**

Supervisor to write a report and grade your laboratory work based on a template.

On successful completion you will be able to:

- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project
- Be able to write up the results of a laboratory-based research project in the form of a journal article

SciFinder Scholar

Due: **Week 1, S2**
Weighting: **0%**

Mentor CBMS188 students in learning the use of SciFinder

On successful completion you will be able to:

- Show the ability to use the chemical database SciFinder Scholar to retrieve information on specific chemicals, find methods for the synthesis of specific chemicals and find literature on chemistry topics generally and teach these skills to CBMS188 students

Delivery and Resources

no required text. Background reading will be required for the laboratory attachment so contact your lab supervisor well before the attachment.

Unit Schedule

Summer vacation (Dec-Feb)

4 weeks full-time (minimum 40 h/week) lab attachment to carry out closely supervised real research.

Write up your results in the form of a scholarly article (journal) using a template of your/ supervisor's choice

Semester 1

Wk 1:No Lecture. Download unit guide, familiarise yourself with the curriculum and expectations and participate in virtual meeting on the CBMS188/389 web site.

Wk 2-5 LB

This four-week section will introduce you to the chemistry of biological macromolecules, particularly proteins. You will gain an understanding for why the bigger a molecule becomes, the more difficult it is to determine its structure. We will look at several novel approaches at the forefront of determining structures of biological macromolecules. We will also focus on several classes of proteins including molecular motors, light receptors and channels. We will dissect mechanisms behind how and why proteins can move and change shapes to perform their required functions.

Wk 2: Introductory remarks and overview of the unit. Introduction to properties of amino acids and protein folding. Explore conventional structural methods, including X-ray crystallography and NMR spectroscopy. Discussion on several notable biomacromolecules including examples of molecular motors, fluorescent proteins, membrane proteins Pick your own 'biomacromolecule'.

Wk 3: Introduction to primary literature for researching your chosen biomacromolecule. Group Task - Plan your YouTube video for filming in week 12.

Wk 4: Group task– film your YouTube video in small groups

Wk 5: Group presentations of your YouTube videos of your selected biomacromolecule. Discussion/Debate of the definition of chemistry and whether 'structural biology' can indeed be classified as chemistry.

Wk 6: Hand in your individual written report

Wk 6-9 DW

In this section, we will firstly extend principles of redox reactions already developed in high school chemistry, followed by their applications to analytical detection. More specifically, we will direct our attention to how electrochemistry is applied to modern development of sensitive and selective sensing technologies. This section build on Brown Ch 19 and involves some theory and a laboratory experiment will be conducted, led by your third year mentor, to enhance understanding of principles presented in this section, as well as to gain hands-on experience of

some advanced electroanalytical detection techniques. Students will then be required to deliver a verbal presentation of their independent research on selected sensor development and a formal lab report, which is graded.

Wk 6: Review of basic electrochemistry; Hand in your individual written report for LB

Wk 7: Laboratory work

Wk 8: Discussion of results

Wk 9: Oral presentation and hand in lab report

Wk 10-13 IJ

Chemical gardens are the plant-like structures formed when a soluble metal salt in the form of a seed crystal is placed in an aqueous solution, typically, sodium silicate. Tubular structures form, rising up from the seed crystal. This process has some parallels with other precipitation processes, such as the huge black “smokers” that grow up to 30 m tall at hydrothermal vents on the ocean’s floor. At smaller length scales, it causes the growth of beautiful “soda-straw” stalactites in limestone caves. We will explore the chemistry of the formation of these crystal gardens and use the technique of “slowmation” to document the process. The topics covered are an extension of CBMS102 (co-requisite) and cover; transition metal salts (colours of as arising from electronic transitions, bonding of, geometry of), precipitation reactions, diffusion, osmosis and semi-permeable membranes. These are extensions of Brown Ch 1 (Modern Atomic Theory), Ch 3 (Stoichiometry) Ch 5 (Chemical Bonding), Ch 9 & 10 (Chemical Equilibrium; particularly "Ionic Equilibria" & solutions/solubility) and Ch 13 (Coordination Chemistry) presented in an integrated, holistic fashion.

Wk 10: Lecture on dissolution, precipitation, diffusion and osmosis with regards to the crystal gardens and electronic structure, including crystal field theory, of transition metal salts

Wk 11: Grow Crystal Gardens in the lab. Make photographic record

Wk 12: Class discussion. Construct webpage

Wk 13: Presentation of web page and 1st draft of essay

Wk 14: Hand in your essay

Wk 15: Examination week (CBMS389 has no mid-year exam)

Semester 2

Wk 16: introduction to SciFinder Scholar by your 3rd year mentors (in 200/300-level chem labs)

Week 2-5 FL

This section of the course will provide you with an overview of more advanced concepts in

chemical bonding and structure, chemical and physical principles behind molecular recognition, and their applications in fundamental discoveries. This section is an extension of CBMS103 as it deals with more advanced theories on bonding, structures, conformations, H-bonds, and reaction energy controls. These are extensions of McMurry Ch. 1, 2, and 3 (Structure and bonding, nature of organic molecules, and nature of organic reactions). Specific topics include:

Wk 17: Localised and delocalised bonding: From Lewis to Schrödinger

Wk 18: Weak bonding interactions behind strong networks

Wk 19: Recognition motifs of the molecular world

Wk 20: Time-dependent chemical complexity

Wk 21 *hand in take-home exam*

Week 6-9 PK

This section of the course will provide you with an overview of Chemical Diversity, Combinatorial Chemistry and more advanced aspects of organic chemistry mechanisms that can lead to Diversity Orientated Synthesis. Topics covered are extension of McMurry Ch. 1 (structure and bonding), 2 (the nature of organic molecules) and Ch. 3 (the nature of organic reactions)

Wk 21: Introduction and history of chemical synthesis, chemical space, medicinal chemistry, natural products and combinatorial chemistry; Hand in your take-home exam for FL

Wk 22: *Advanced mechanistic chemistry + pick your research topic related to CombiChem*

Wk 23: Combinatorial Chemistry and Diversity Orientated Synthesis + prepare for your presentation

Wk 24: Oral Presentation on CombiChem

Wk 25: Hand in your CombiChem essay

Week 10-13 NP

This section of the course will provide an overview of the modifications that occur to a protein between the translation of a gene and the functional gene product. These "post-translational modifications" will be related to the functional groups you learn about in CBMS103 and the mechanisms of functional group transformations. For example, serine phosphorylation can be related to reaction of acid anhydrides (or esters) with alcohols, ATP being a phosphoric acid anhydride or "phosphodiester". Alkylation with SAM can be related to the reaction of alkyl-halides (eg MeI, which you learnt about from a chemical perspective in Ch 7 and Ch 8 and Ch 12). Acetylation with acetylCoA can be related to esterification (Ch 10) and amide bond formation (Ch 12). Emphasis will be on sugar chemistry (see Blackman, Ch22; McMurry Ch14 & 15), the addition of the many types of different carbohydrate structures to the proteins, and how their chemical properties modify the behaviour of the protein.

Wk 25: Discussion of the known modifications that occur to proteins and how their chemical properties may affect the behaviour, structure and localisation of the proteins. (plus hand in essay for PK)

Wk 26: Introduction to the types of oligosaccharide modifications that are found on proteins, with examples of the many different isomeric sugar structures found. Choice of a particular glycoprotein to review.

Wk 27: Exploration of the methods used to characterise glycoproteins and the basis behind the methods used.

Wk 28: Oral (10 min. + 5 min for questions)

Wk 29: study break and hand in written report for NP (2 pages max)

Wk 30: Examination week (CBMS389 has no final exam)

Learning and Teaching Activities

lectures

24 lecture/discussion groups

workshop

teach first-years how to use SciFinder Scholar

lab attachment

4 weeks full-time supervised research

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcome

- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project

Assessment tasks

- Research Report
- Supervisor Assessment

Learning and teaching activities

- 4 weeks full-time supervised research

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- mentor junior advanced sciences students in laboratory and literature-based projects
- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project

Assessment tasks

- Modules 1-3
- Research Report
- Supervisor Assessment
- SciFinder Scholar

Learning and teaching activities

- 24 lecture/discussion groups
- teach first-years how to use SciFinder Scholar
- 4 weeks full-time supervised research

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships

with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcome

- Show the ability to use the chemical database SciFinder Scholar to retrieve information on specific chemicals, find methods for the synthesis of specific chemicals and find literature on chemistry topics generally and teach these skills to CBMS188 students

Assessment task

- Research Report

Learning and teaching activity

- 24 lecture/discussion groups
- 4 weeks full-time supervised research

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Show the ability to use the chemical database SciFinder Scholar to retrieve information on specific chemicals, find methods for the synthesis of specific chemicals and find literature on chemistry topics generally and teach these skills to CBMS188 students
- Be able to write up the results of a laboratory-based research project in the form of a journal article

Assessment tasks

- Research Report
- Supervisor Assessment

Learning and teaching activities

- 24 lecture/discussion groups
- teach first-years how to use SciFinder Scholar

- 4 weeks full-time supervised research

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- mentor junior advanced sciences students in laboratory and literature-based projects
- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project

Assessment tasks

- Modules 1-3
- Research Report
- Supervisor Assessment

Learning and teaching activities

- 4 weeks full-time supervised research

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcome

- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project

Assessment tasks

- Research Report
- Supervisor Assessment

Learning and teaching activities

- 4 weeks full-time supervised research

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- mentor junior advanced sciences students in laboratory and literature-based projects
- Be able to write up the results of a laboratory-based research project in the form of a journal article

Assessment tasks

- Modules 1-3
- Research Report
- Supervisor Assessment
- SciFinder Scholar

Learning and teaching activities

- teach first-years how to use SciFinder Scholar
- 4 weeks full-time supervised research

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning and teaching activities

- teach first-years how to use SciFinder Scholar

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcome

- Carry out a lab-based research project (at least 4 weeks at 40h/week) with minimal supervision and attend/present at research group meetings during the 4 week project

Assessment tasks

- Research Report
- Supervisor Assessment

Learning and teaching activities

- 4 weeks full-time supervised research

Changes from Previous Offering

CBMS389 material is the same as the last offering. Access to the CBMS188 material is made through the CBMS188 iLearn page. CBMS389 is only available to students who have completed CBMS188(S) and have a GPA >3.2 or D/HD grades in 100-level chemistry units.