CBMS880

Molecular and Medical Biotechnology

S2 Day 2014

Chemistry and Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
Helena Nevalainen
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Credit points
4

Prerequisites
Admission to MBiotech or MBiotechMCom or MRadiopharmSc

Corequisites

Co-badged status
The lectures and practicals in this unit are co-taught with CBMS331 and CBMS731. The specific postgraduate learning outcomes for CBMS880 are aimed at gaining an understanding of scientific literature and current practices in the relevant fields of modern biotechnology. Students are required to research the questions presented in the practical manual in depth, and make this additional inquiry evident in the answers. In addition, the practical laboratory reports are expected to show ability to interpret the results, i.e. the ability and curiosity to move beyond 'what was done' to explaining 'what does it mean'. The essay measures individual thinking and ability to communicate a controversial biotechnology topic in writing.

Unit description
This unit is composed of lectures, a significant hands-on laboratory component, student debate, tutorials, assignments and reports. A visit to local industry will be arranged. We will discuss examples of cutting-edge research and biotechnology-related recent developments and how these relate to our personal lives, society and industry. Visiting lecturers from industry and various academic disciplines will lead discussion on their area of expertise.

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:

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You will understand the interdisciplinary nature of biotechnology and the breadth of

underlying sciences. You will learn contemporary laboratory techniques and develop good skills in collecting and recording data by measurement or observation and how to use appropriate tools to present different types of data. You will learn the format for writing scientific documents.

Within this unit you will develop skills in critical evaluation of your own data in analysing experimental data, deducing the meaning of results and reasons for any deviations from the expected. You will gain confidence in thinking critically and independently as well as learn to think in an interdisciplinary and holistic manner. The tasks you will do in this unit will teach you how to extract key messages from published research papers and how to paraphrase the information using your own words

In both the theory and the laboratory component of this unit you will have several opportunities to develop your problem solving skills and research capabilities. Through the set assignment and practical write-ups, and by performing the laboratory experiments, where procedures, data collection and data analysis will require you to make various decisions, you will be deeply involved in problem solving and research processes in the biotechnology context. Importantly, you will be dealing with results obtained from your own experiments with living microorganisms, which may not always perform in the expected manner; therefore, you will be facing real-life research problems and learning how to negotiate them. This is excellent preparation for a real job situation.

: CBMS880 will help you to develop both oral and written communication skills. This will be achieved through writing a free-style essay targeting general public, compilation of formal practical reports and interactions with your lecturers, demonstrators and class-mates. You will learn the skills of working independently as well as a team member. Part of your assessment will be concerned with your performance in the Great Debate where two student groups will argue over a topical question in the area of modern biotechnology such as ‘Should genetically modified foods be labelled’? Here you learn to effectively take part in arguments and debates in front of a live audience

Engaged and ethical behaviour will be addressed in the professional context. This means that you will be concerned with collecting data and information with appropriate acknowledgement of sources, learn ways of performing experiments and recording outcomes in a manner that conforms to the expectations of the profession and community at large. You will be working with people from a variety of cultural, economic and educational backgrounds and you will be expected to be able to form cohesive and effective teams with anybody in your class. In the lecture section of the course and the Great Debate we will touch upon issues of interest to contemporary science and society,

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Especially during your laboratory work, you will be expected to develop discernment and logic in your professional and personal judgement. This will be reflected in critical analysis and presentation of your own data. Completing and handing in the reports by the due date will teach you how efficiently manage your time, recognise your strengths and weaknesses in this respect and take responsibility of your learning outcomes.

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Assessment Tasks

Name	Weighting	Due
Final examination	42%	TBA
“You decide” essay	9%	7 October
Practical reports	30%	19.9, 14.10 and 28.10
Primer design quiz	5%	9 September
Continuing assessment	5%	end of semester
Fluorescence quiz	5%	7 October
The Great debate	4%	various

Final examination

Due: **TBA**
Weighting: **42%**

The final course examination will be 3 hours plus 10 min reading time. The examination will cover **all sections of the unit** and consist of short answers, problem solving tasks and essay questions. In their answers the students are encouraged to practise critical thinking and expanding on ideas rather than just listing facts and figures with no discussion. Dot point-style answering is not allowed. Take a calculator to the examination.

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"You decide" essay

Due: **7 October**
Weighting: **9%**

You decide" essay: This essay will be written in the "newspaper style", *i.e*. to a broader audience. The available topics are introduced in the Thieman and Palladino textbook in "You decide" boxes placed across different chapters and shortlisted below. Please pick one topic you find especially intriguing. You can take a strong standing on the topic you are writing about in order to engage the reader and prove the value of your point of view. Expected length of the paper is about 5-10 double spaced typewritten pages. Use illustrations and references if applicable. The essay will be submitted to turnitin as above.

Essay topics:

1. Genetically modified foods- to eat or not to eat? Should these foods be labelled?
2. Should Biotech companies be forced to produce generic drugs? How would we benefit from this?
3. When and what to patent? Should DNA sequences from naturally living organisms be patentable? Would we see drug development without patents?
4. Would you like to have your genome sequenced and access to the resulting information?
5. Who should pay for the testing for the best product? Would you pay higher prices for better products?
6. Should recombinant microbes be released into the environment?
7. Should pathogen genome sequences remain in public database?
8. Monkey gene knock-outs, are they necessary? Are primates too close to humans?
9. Should pets be cloned?
10. DNA analysis, a crime-fighting tool or invasion of privacy?
11. Are genetically engineered species a risk to biodiversity?
12. Should reproductive cloning of humans be banned?

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Practical reports

Due: **19.9, 14.10 and 28.10**
Weighting: **30%**

Formal reports on practical work: These are major reports describing the laboratory experiments in detail with references to literature. The reports must be submitted to iLearn for checking in turnitin by the due date (see below).

The three separate reports (P1, 2 and 3) should follow the format:

Introduction (stating aims in the last paragraph)
Materials and Methods (main points and procedures)
Results (with tables and graphs where applicable)
Discussion (reflecting on the results)
References (choose one style and stick to it)
Answers to questions (separate from other text)

Results should consist of tables, diagrams and **words in between to tie them together.** Presenting tables, graphs, etc. without any explanation is not acceptable. Every table, graph and diagram should be numbered and have a caption, and you should refer to them in the text by their number. Expected length for an average report is about 10 double spaced typewritten pages plus figures and tables. Please answer the questions after the actual report text under a heading ‘Answers to questions’ and number your answers.

Practicals 1 and 2 are interconnected and the students are requested to provide **one page** executive summary linking them together. The summary will be handed in together with the

detailed report on Practical 2.

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Primer design quiz

Due: **9 September**
Weighting: **5%**

Primer design quiz: The ability to design oligonucleotide primers for DNA amplification is one of the most essential skills in molecular biology. Your brief is to design primers for the isolation of a specific gene. You will be given material to work with and specific questions to answer. This quiz will require some literature research and must be returned by the due date (see below).

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Continuing assessment

Due: **end of semester**
Weighting: **5%**

Continuing assessment: A continuing assessment that involves providing a brief answer to 20 questions (from the total of 26 lectures) is set up on iLearn. You are expected to listen to each of these lectures and submit a brief answer to a particular question arising from the lecture, posted on iLearn by the convener by 5 pm on the day of the lecture. Your answers to each week's lectures must be in by the following Mon 5 pm. Best answers will be displayed on iLearn.

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Fluorescence quiz

Due: **7 October**
Weighting: **5%**

Fluorescence quiz: This quiz will feature questions addressing matters discussed in the lectures and a tutorial conducted during Practical 2. You are expected to find and record most of the

answers to these questions during the time allocated to the tutorial. The completed paper must be returned by the due date (see below).

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The Great debate

Due: **various**
Weighting: **4%**

The Great Debate: For this Debate, the students will be divided into groups of 3-5 people (depending on the total student number) who will be given a topic in the area of biotechnology (drawn out of a hat) which they either have to defend or oppose. The topics will be chosen from

those suggested by the students and teaching staff. The groups will know their topic in the previous week so that they can plan ahead their debating strategy. Each debate, chaired by the course convener, will last for 10 minutes followed by questions from the audience. The audience will participate in the assessment by voting for the winning team after each debate. This is a good opportunity to practise ethical voting, *i.e.* voting based on a successful argument and not *e.g.* because you are good buddies with some individuals in one of the debating teams. There will be no individual marks but the collective mark goes to everyone in the group.

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Delivery and Resources

Technology Used

Ability to access the Internet is necessary. General use computers are provided by the University, but it would be advantageous to have your own computer and internet access.

It would be helpful to have a (scientific) calculator to carry out various calculations during practicals. They are also needed when preparing reports and in the final examination. Text-retrieval calculators are not allowed in the final examination. Laboratory reports and essays can be produced using standard Microsoft Office software.

Classes

Timetable: Please check http://www.timetables.mq.edu.au/ for the official timetable of the unit.

Lectures: The material presented in the lectures is examinable. **Please note that there is no text book coverage for a fair amount of the material presented.** Therefore, regular attendance to the lectures and careful listening of the recordings is highly recommended. Lecture topics and dates can be found at the end of this guide. Lectures will be recorded and made available on iLearn. A continuing assessment that involves providing a brief answer to 20 questions (from the total of 26 lectures) is set up on iLearn.

Tutorials and Industry exposure: Attendance at the tutorials and the Industry visit is compulsory, a medical certificate or other relevant documentation will be required for any absences. Previously announced locations for these activities may change so stay tuned. Tutorial material, which forms part of the material submitted for assessment and/or examination,

will be distributed at the beginning of the class.

Laboratory work: Laboratory sessions commence in **Week 2**; Practical topics and the timetable are listed at the back of this guide. The 4-hour practical sessions will be offered on Tue afternoon from 2-6 pm (Group 1) or Wed morning 9 am-1 pm (Group 2) in E7B349-50. Each student should enrol in **one** of these sessions and stay within that group throughout the entire semester. Practical laboratory sessions are compulsory and a medical certificate or other relevant documentation will be required for any absences. It should be noted that missing any practical will make the reporting very difficult since some of the practicals continue over several weeks and plenty of data will be generated every week.

Laboratory procedures: This course will involve laboratory work with microorganisms, DNA samples, proteins and sugars. The experimental techniques feature molecular biology, microbial cultivation, fluorescent microscopy, biochemical analyses and mass spectrometry. Note that there are safety requirements concerning the use of these techniques. All students are required to adhere to the guidelines for safe laboratory conduct as detailed below.

1. Study the practical notes so that you understand the experimental procedures. Reading the notes beforehand is highly recommended and will speed up your work.

2. **Wear a decent laboratory coat and safety glasses** at all times within the laboratory area. Preferably bring your own.

3. Tie back long hair before starting laboratory work.

4. Do not wear open-toe shoes in the laboratory.

5. No eating, drinking, smoking, listening to music, chatting on a mobile phone, surfing the net for fun or applying makeup is allowed in the laboratory.

6. No children, friends or spouses are allowed in the laboratory.

7. Wash your hands and disinfect your work space before commencing work and repeat this after finishing the experiments.

8. Dispose of all microbiological waste in the autoclave bags and place sharps (needles, scalpels etc.) in the sharps container. How to dispose of all other materials is instructed by the tutor.

9. **Report ALL accidents and spills immediately.**

10. If you don't know, ASK! We love to explain.

11. Treat all chemicals and reagents with respect and read the labels. Also label your plates, test tubes etc.

12. You will need full concentration in the lab, so do not drink alcohol or use other substances that may interfere with your ability to carry out experiments safely in the classes.

It is recommended that you carry a marking pen (permanent), spatula, scissors and tweezers and a calculator. Perform the experiments in an orderly fashion and clean up afterwards.

You will be required to keep a laboratory book in which the details, results and conclusions of experiments will be recorded. The best format is an A4 ruled notebook that opens flat. This book is to be used in the practicals and notes should allow you to repeat the experiment. You are also expected to write three formal reports on the practical work, which will be a lot less painful experience with good notes in hand. In addition to handing in a hard copy of the reports, all practical reports must be submitted to turnitin available at the unit iLearn site. Submission dates are found on p. 11. Using an iPad, tablet or any other electronic device for making lab notes is not recommended.

Practical manual containing instructions for the laboratory experiments can be downloaded from iLearn.

The Great Debate: Attendance to the debate is compulsory. The debate will be carried out at the time slot allocated for a laboratory class (*i.e*. 2-6 pm on Tue or 9 am- 1 pm on Wed) in F7B346.

UNIT WEB PAGE

Lecture graphics will be uploaded on CBMS880 iLearn (http://ilearn.mq.edu.au) the daybefore each lecture. The site also provides you with lecture recordings, videos and pictures generated in the practicals.

We will have a **General discussion forum** with a standing invitation to the students to suggest topics for the great debate and "**What's on your mind'** where students can leave messages and post videos and images related to biotechnology, for further discussion amongst fellow students. We will also set up a small reference library. **Announcements** will be used to communicate information from the unit convener.

Follow the instructions on the page to log in. If you have trouble logging in, please contact the academic staff, who may then refer you to the University Library Information technology help desk: Phone: 9850-HELP (4357); Freecall: 1800 063 191; Email One Help at ilearn.help

@mq.edu.au.

Unit Schedule

CBMS880 Molecular and Medical Biotechnology, lecture topics 2014

Two one-hour lectures per week, on Tue at 12-1 pm and Fri from 1 -2 pm in E6A102

The many faces of biotechnology- the big picture

1. Course introduction - contribution of biotechnology to modern life (HN) Tue 5.8

Molecular aspects of biotechnology revisited

2 The toolbox for genetic engineering- making a recombinant protein (HN) Fri 8.8

3. Genetic engineering- power tools and considerations (HN) Tue 12.8

4. Biotechnology pipeline- linking the 'omics' (HN) Fri 15.8

1. Protein secretion and quality control (HN) Tue 19.8

6. Protein secretion, the way out (HN) Fri 22.8

7. Basic concepts in Synthetic biology (LB) Tue 26.8

8. Modern approaches into protein engineering (AS) Fri 29.8

Making recombinant products

9. Microbes as cell factories (HN) Tue 2.9

10. Cell cultures and transgenic animals (HN) Fri 5.9

11. What about transgenic plants (HN) Tue 9.9

12. The art of making a biotech product on a large scale (HN) Fri 12.9

Fluorescence in biotechnology

13. Fluorescence instrumentation and applications in biotechnology (DB) Tue 16.9

14. Flow cytometry as a tool in biotechnology (MO) Fri 19.9

BREAK 20.9. – 6.10.

Sweet biotechnology

15.	Basic aspects of protein glycosylation (NP)	Tue	7.10
16.	Biological functions of protein glycosylation (NP)	Fri	10.10

Medical biotechnology

17.	DNA as evidence in forensic science (HN)	Tue	14.10
18.	The promise of biopharmaceuticals (HN)	Fri	17.10
19.	Bioinformatics and combinatorial chemistry in drug design (SR)	Tue	21.10
20.	Basics of stem cells (BH)	Fri	24.10
21.	Application of stem cell technology to joint repair (BH)	Tue	28.10
22.	Medical biotechnology and bioengineering (MM)	Fri	31.10
23.	Application of proteomics to cancer research (MM)	Tue	4.11

Nanobiotechnology

24.	A quick peak into nanotechnology (HN)	Fri	7.11
25.	Development of nanoparticles (JD)	Tue	11.11
26.	Course summary (HN)	Fri	14.11

Please note that there may be changes to the visiting lecturers; these changes will be announced on iLearn Announcements.

Lecturers:

HN- Prof Helena Nevalainen, MQ CBMS (helena.nevalainen@mq.edu.au)

LB- Dr Louise Brown, MQ CBMS (louise.brown@mq.edu.au)

AS- Dr Anwar Sunna, MQ CBMS (anwar.sunna@mq.edu.au)

DB- Ms Debra Birch, MQ, Biological Sciences (debra.birch@mq.edu.au)

MO- Dr Martin Ostrowski, MQ, CBMS (martin.ostrowski@mq.edu.au)

NP- Prof Nicolle Packer, MQ CBMS (nicki.packer@mq.edu.au)

SR- Prof Shoba Ranganathan, MQ CBMS (shoba.ranganathan@els.mq.edu.au)

BH- Dr Ben Herbert, Regeneus Ltd (benjamin.herbert@mq.edu.au)

MM- A/Prof Mark Molloy, MQ CBMS and APAF (mark.molloy@proteome.org)

JD- A/Prof Jin Dayong, MQ CBMS (jin.dayong@mq.edu.au)

Practical sessions

The 4 hour practical sessions will be offered on Tue afternoon from 2-6 pm in E7B349-50 (Group 1) or Wed morning 9 am-1 pm in E7B350 (Group 2). Each student should enrol in **one** of these sessions and stay within that group throughout the entire semester. Please note that **practicals and tutorials are compulsory** and you will need a Doctor's certificate or other relevant documentation to justify an absence.

Practicals: 1. Genetic transformation of the filamentous fungus *Trichoderma reesei*

1. Fluorescent labelling of fungal cell membranes and cellular localisation of the recombinant DsRed 1 protein
2. Analysis of N-linked glycans on native human lactoferrin glycoprotein isolated from human and bovine milk

Practical 1 Genetic transformation of the filamentous fungus *Trichoderma reesei*

Tue 12.8. Plate conidia for bombardment

Wed 13.8. Coat microparticles with DNA and shoot

Tue 19.8. Count transformants and restreak on PDA-HygB plates

Wed 20.8. Streak transformant conidia for DNA isolation

Codon optimisation tutorial

Tue 26.8. Isolate chromosomal DNA from transformants for PCR

Wed 27.8. Design primers for PCR to check the transformants

Tue 2.9. Check the quality of chromosomal DNA

Wed 3.9. Run PCR on transformants

Primer design quiz handed out and discussed in the class

Tue 9.9. Check PCR products by agarose gel electrophoresis and take
Wed 10.9. photographs

Wrapping up Practical 1

Practical 2 Fluorescent labelling of fungal cell membranes and cellular localisation of the DsRed1 protein

Tue 16.9. Staining of the DsRed-expressing transformants and the
Wed 17.9. non-transformant with an ER specific dye

Inspection of specimens using confocal microscopy

Fluorescence quiz and tutorial

Executive summary tutorial

Practical 3. Analysis of N-linked glycans on the native human lactoferrin glycoprotein isolated from human and bovine milk

Tue 7.10. Sample preparation of native and recombinant lactoferrin
Wed 8.10. Release of oligosaccharides by enzyme treatment

Wrapping up Practical 2

Tue 14.10. Purification and analysis of oligosaccharides by liquid
Wed 15.10. chromatography-mass spectrometry and interpretation of data

Wrapping up Practical 3

Tue	21.10.	**The Great Debate I,** CBMS Tea room
Wed	22.10.	
Tue	28.11.	**The Great Debate II,** CBMS Tea room
Wed	29.11.	
Tue	4.11. **or**	**Industry exposure,** CBMS Tea room
Wed	5.11.	

Note that the dates of the above activities are interchangeable

For CBMS731 only (audience welcome)**:**

Tue	11.11.	**Seminar presentations,** E7B 346
Wed	12.11.	

Attendance to the lectures is not compulsory but is strongly encouraged. Some lectures will be supported by video material also made available on iLearn.

All practicals, the industry exposure and the Great Debate are compulsory to all students; the student can be failed for non-attendance.

Learning and Teaching Activities

Lectures

There are 26 lectures delivered by various experts

Laboratory practicals

There are three laboratory practicals that require writing formal reports

You decide essay

The students will compose a major essay on one of the 12 proposed topics

Quizzes

The two quizzes are introduced in the class but will also require work at home

Groupe debate

Two student groups will debate against each other

Continuing assessment

The students are answering questions from 20 of the 26 lectures on line

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

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

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

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.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/

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://informatics.mq.edu.au/help/.

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

Graduate Capabilities

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- The topics explored in CBMS880 are integral to the broad discipline of biotechnology. You will understand the interdisciplinary nature of biotechnology and the breadth of underlying sciences. You will learn contemporary laboratory techniques and develop good skills in collecting and recording data by measurement or observation and how to use appropriate tools to present different types of data. You will learn the format for writing scientific documents.
- Within this unit you will develop skills in critical evaluation of your own data in analysing experimental data, deducing the meaning of results and reasons for any deviations from the expected. You will gain confidence in thinking critically and independently as well as learn to think in an interdisciplinary and holistic manner. The tasks you will do in this unit will teach you how to extract key messages from published research papers and how to

paraphrase the information using your own words

- In both the theory and the laboratory component of this unit you will have several opportunities to develop your problem solving skills and research capabilities. Through the set assignment and practical write-ups, and by performing the laboratory experiments, where procedures, data collection and data analysis will require you to make various decisions, you will be deeply involved in problem solving and research processes in the biotechnology context. Importantly, you will be dealing with results obtained from your own experiments with living microorganisms, which may not always perform in the expected manner; therefore, you will be facing real-life research problems and learning how to negotiate them. This is excellent preparation for a real job situation.
- Engaged and ethical behaviour will be addressed in the professional context. This means that you will be concerned with collecting data and information with appropriate acknowledgement of sources, learn ways of performing experiments and recording outcomes in a manner that conforms to the expectations of the profession and community at large. You will be working with people from a variety of cultural, economic and educational backgrounds and you will be expected to be able to form cohesive and effective teams with anybody in your class. In the lecture section of the course and the Great Debate we will touch upon issues of interest to contemporary science and society, such as the safety of recombinant gene products (e.g. biopharmaceuticals) and organisms (eg. plants), and ethical questions concerning stem cell research, just to mention some.
- Especially during your laboratory work, you will be expected to develop discernment and logic in your professional and personal judgement. This will be reflected in critical analysis and presentation of your own data. Completing and handing in the reports by the due date will teach you how efficiently manage your time, recognise your strengths and weaknesses in this respect and take responsibility of your learning outcomes.
- We hope that you will have your enquiring minds and curiosity extended by CBMS880, and that the topics covered and skills developed will inspire you to continue to pursue learning as a way of life. You will have opportunities to reflect on your experiences, learn from them, and grow personally, professionally and socially. We hope that you will develop a personal and committed approach towards active lifelong learning.

Assessment tasks

- Final examination
- “You decide” essay
- Practical reports

- Primer design quiz
- Continuing assessment
- Fluorescence quiz
- The Great debate

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

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- : CBMS880 will help you to develop both oral and written communication skills. This will be achieved through writing a free-style essay targeting general public, compilation of

formal practical reports and interactions with your lecturers, demonstrators and class-mates. You will learn the skills of working independently as well as a team member. Part of your assessment will be concerned with your performance in the Great Debate where two student groups will argue over a topical question in the area of modern biotechnology such as 'Should genetically modified foods be labelled'? Here you learn to effectively take part in arguments and debates in front of a live audience

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Assessment tasks

- Final examination
- "You decide" essay
- Practical reports
- Fluorescence quiz
- The Great debate

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- The topics explored in CBMS880 are integral to the broad discipline of biotechnology. You will understand the interdisciplinary nature of biotechnology and the breadth of underlying sciences. You will learn contemporary laboratory techniques and develop good skills in collecting and recording data by measurement or observation and how to use appropriate tools to present different types of data. You will learn the format for writing scientific documents.
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Assessment tasks

- Final examination
- Practical reports
- Primer design quiz
- Fluorescence quiz

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different

social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- The topics explored in CBMS880 are integral to the broad discipline of biotechnology. You will understand the interdisciplinary nature of biotechnology and the breadth of underlying sciences. You will learn contemporary laboratory techniques and develop good skills in collecting and recording data by measurement or observation and how to use appropriate tools to present different types of data. You will learn the format for writing scientific documents.
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Great Debate we will touch upon issues of interest to contemporary science and society, such as the safety of recombinant gene products (e.g. biopharmaceuticals) and organisms (eg. plants), and ethical questions concerning stem cell research, just to mention some.

- You will be working in pairs or small teams for much of the laboratory component of the course, which gives you the opportunity to develop your skills in working with others as a leader and a team player, and to have a sense of connectedness and mutual obligation with others. You will collate and share information with your team mates but write reports independently, with your own conclusions. Environmental and safety issues will be addressed in the laboratory work.
- Especially during your laboratory work, you will be expected to develop discernment and logic in your professional and personal judgement. This will be reflected in critical analysis and presentation of your own data. Completing and handing in the reports by the due date will teach you how efficiently manage your time, recognise your strengths and weaknesses in this respect and take responsibility of your learning outcomes.

Assessment tasks

- Final examination
- “You decide” essay
- Practical reports
- Primer design quiz
- Continuing assessment
- Fluorescence quiz
- The Great debate

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcomes

- The topics explored in CBMS880 are integral to the broad discipline of biotechnology. You will understand the interdisciplinary nature of biotechnology and the breadth of underlying sciences. You will learn contemporary laboratory techniques and develop good skills in collecting and recording data by measurement or observation and how to

use appropriate tools to present different types of data. You will learn the format for writing scientific documents.

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Assessment tasks

- "You decide" essay
- Continuing assessment

- Fluorescence quiz
- The Great debate

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

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- Fluorescence quiz
- The Great debate

Changes from Previous Offering

Some material has been modified in the theory and laboratory components. Lectures have been updated and new lectures brought in. The lecture timetable has changed