CBMS731

Molecular and Medical Biotechnology

S2 Day 2017

Dept of Chemistry & Biomolecular Sciences

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General Information

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Credit points
4

Prerequisites Admission to MRes
Corequisites
Co-badged status CBMS331 and CBMS731
Unit description The unit explores particular areas of contemporary molecular and medical biotechnology building on students' existing knowledge and importantly, showing how science is translated to applications in health, industry and the environment. Lecture topics range from the production of recombinant biomolecules in various cell factories, applications of stem cells to joint repair, and applications of nanoparticles for diagnostics. We will look into recent technical and conceptual 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 areas of expertise. A special feature for the 700-level students is an exercise on science communication. The unit also has a significant hands-on laboratory component with tutorials and assignment tasks.

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:

At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond 'this is what we got' to 'how can I explain and/or improve on this'. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to

recombinant DNA technology.

General Assessment Information

Practical Reports

These are major reports describing the laboratory experiments in detail with references to literature. The reports must be submitted to iLearn by the due date (see below) for checking in turnitin. In addition to the electronic copy, a hard copy is to be submitted to the Science Student Centre, temporarily located on the ground floor of the MUSE building, where a submission box will be set up. Campus maps are available at http://www.bgo.mq.edu.au/maps_campus.htm. The Centre is open from 8.30 am to 5.30 pm from Monday to Friday.

The reports 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 5-10 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. Marks allocated to each component are given in the class.

Submission

All reports and assignments must be submitted by 5.30 pm on the due date.

Late Submission

There are no written tasks worth 10% or less with a deadline. Continuing assessment will be marked unit the end of the unit.

Written tasks above 10% - No extensions will be granted. There will be a deduction of 10% of the total available marks made from the total awarded mark for each 24 hour period or part thereof that the submission is late. This penalty does not apply for cases in which an application for disruption of studies is made and approved. In case of approved disruption of studies the student will be given an extension for the assignment(s) in negotiation with the unit convener. No submission will be accepted after solutions have been posted.

What is Required to Complete the Unit Satisfactorily

Students should attend lectures, tutorials and laboratory classes with active participation. This

means that you are encouraged to ask questions during lectures, and particularly at tutorials and laboratory classes. Do not be afraid to ask questions – your classmates will probably wonder about the same thing. There are no stupid questions, really.

The lectures and practicals link together to support the overall learning. The questions related to the practicals are formulated so that you will have the opportunity to use the information acquired in the class and provided in the lectures. You are expected to consult scientific literature for additional information and inspiration. The students will have plenty of time for hands-on laboratory work and opportunities to discuss any practical problems with the demonstrator and class mates. **It is important to keep in mind that experiments with living organisms can produce surprising results or sometimes no results at all!** If that should happen, your task would be to find reasons for the unexpected outcome(s). There are no pre-set 'correct' results to the laboratory work and it is important to learn how to continue with the experiment in the face of the unexpected. Similarly, there may be modifications or additions to the instructions printed in the practical notes provided, depending on the course the experiments may take.

Attendance to practicals is compulsory. Returning all written assignments (practical reports and the Namesake peptide task) is required for satisfactory performance. You will also need to pass the final exam with 40% of the marks available. Participation in the Great Debate is required to pass the unit satisfactorily.

Assessment Tasks

Name	Weighting	Hurdle	Due
Practical report 1	12%	No	15-09-2107
Practical report 2	8%	No	23-10-2017
Practical report 3	10%	No	06-11-2017
Namesake peptide task	10%	No	Due: 11-09-2017
The Great Debate	5%	No	Week 11 or 12
Continuing assessment	5%	No	Weekly
Communication Seminar	10%	No	07 and 08-11-2017
Final examination	40%	No	November 2017

Practical report 1

Due: **15-09-2107**
Weighting: **12%**

Written report on practical 1, composed of the results from the practical work carried out over five weeks. The report will be marked over **the mid-semester break** to provide early feedback on the

skills and style in report writing and extracting relevant information from various paper and electronic sources. The report provides an indication of the student's ability to interpret, analyse and explain experimental results. Related approaches have been discussed in lectures 1-14. There are two additional questions for the students to answer and explore as part of the report.

On successful completion you will be able to:

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond 'this is what we got' to 'how can I explain and/or improve on this'. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Practical report 2

Due: **23-10-2017**
Weighting: **8%**

Written report on practical 2. The students have received feedback on their first report and thus should take the advice on board when compiling report 2. This report involves presenting confocal microscopy image material produced in the practical and discussing the observations in detail. Also, the students are requested to answer three additional questions on the topic of fluorescence and produce an executive summary linking together practicals 1 and 2, as part of the report.

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conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond ‘this is what we got’ to ‘how can I explain and/or improve on this’. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Practical report 3

Due: **06-11-2017**
Weighting: **10%**

Written report on practical 3. The report concerns detailed analysis using results obtained in the class. There are two additional questions for the students to answer and explore as part of the report.

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Namesake peptide task

Due: **Due: 11-09-2017**
Weighting: **10%**

In this exercise, you will design your namesake peptide end express it in a designated host organism. The task sources from the lectures, codon optimisation tutorial and teaches you to

design oligonucleotide primers for DNA amplification, which is one of the most essential skills in molecular biology. During the tutorial, you will be given a brief, material to work with and specific questions to answer. This assignment will be completed at home and requires some independent literature/web research. Submission on iLearn.

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The Great Debate

Due: **Week 11 or 12**
Weighting: **5%**

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 10-20 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 practice ethical voting, *i.e.* voting based on a successful argument and not *e.g.* because you are good friends 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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experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond 'this is what we got' to 'how can I explain and/or improve on this'. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Continuing assessment

Due: **Weekly**
Weighting: **5%**

Continuing assessment involves providing a brief answer to a weekly question appearing on iLearn each Wednesday by 5 pm. The question concerns a topic discussed either on the Mon or Tue lecture. You are expected to attend lectures/listen to the lecture recordings and submit a brief answer to the question on iLearn. Your answers must be in by 5 pm on the following Monday. There will be 12 questions overall. The mark will be calculated according to the number of questions answered. Answering all questions will give you the full 5%. This exercise is voluntary; however, it is great practice for the final exam.

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recombinant DNA technology.

Communication Seminar

Due: **07 and 08-11-2017**
Weighting: **10%**

You are given a task to introduce and explain a product made by biotechnology (already on the market or designed by you) in a seminar presentation targeted to a wider non-specialist audience. You will also prepare a snappy A4 Press release to go with the product to be handed to the audience at the seminar. You can choose your product and confirm the choice with the convener at any time during the course.

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Final examination

Due: **November 2017**
Weighting: **40%**

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

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Delivery and Resources

Technology used

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

All calculations during practicals can be carried out using a smart phone. It is also recommended that you will take pictures from the cultivation plates etc to be included in the prac report. Do not use gloves when handling the phone. Laboratory reports 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: There are two one-hour lectures per week, Mon at 12-1 pm in EMC G240 and Tue from 12-1 pm in E6A102. The material presented in the lectures is examinable. Please note that there is no text book coverage for a fair amount of the presented material. Therefore, regular attendance to the lectures and careful listening of the recordings is highly recommended. Lecture topics and dates can be found on the unit webpage on iLearn (CBMS331 http://ilearn.mq.edu.au). Lectures will be delivered as scheduled with eCHO recording available through iLearn.

Lecture graphics will be uploaded on CBMS331 iLearn (http://ilearn.mq.edu.au) the day before each lecture. The site also provides you with lecture recordings, videos, images and general data generated in the practicals, and material required for the assignment(s). Announcements facility will be used to communicate information from the unit convener.

Laboratory work: Please note that **laboratory sessions commence in Week 2**; Practical topics and the timetable are available on iLearn. 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, fluorescence 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 provided on iLearn.

Instructions for the laboratory experiments can be downloaded from iLearn. It is essential that you bring the notes with you to each class. Additional material may be provided in the class.

The Great Debate: Attendance to the debate is compulsory. The debate will be carried out in the CBMS Tea room F7B322 at the time slot allocated for the laboratory class (*i.e*. 2-6 pm on Tue or 9 am-1 pm on Wed).

Tutorials: Tutorials (codon optimisation, namesake peptide and fluorescence) are run as part of the practical sessions, thus attendance is compulsory. Previously announced locations for these activities may change so stay tuned (please consult iLearn). Tutorial material, which forms part of the material submitted for assessment and/or examination, will be made available on iLearn.

Required Materials and/or Recommended Readings

Biotechnology draws from different disciplines and technologies. The recommended textbooks will give you a good general introduction to (Thieman and Palladino) or deeper knowledge on (Clark and Pazdernik) these areas and provide further reading as well as useful websites for more in depth studies. The books also provide good questions at the end of each chapter to test your learning.

Textbooks:

William J. Thieman and Michael A. Palladino (2012): Introduction to Biotechnology, 3rd edition. Pearson Benjamin-Cummings Publishing Company, San Francisco CA.

David P. Clark and Nanette J. Pazdernik (2016): Biotechnology, 2nd edition. Elsevier, China. This book also provides an online study guide available with the textbook.

The books is available at the University Bookshop. Please note that while the books provide an anchor for the studies, plenty of **additional and examinable information** will be provided in the lectures.

Almost every issue of the mainstream biotechnology journals will contain scientific papers related to the lecture material. Journals such as ‘Biotechnology’ and ‘Trends in Biotechnology’ are subscribed by the MQ Library and a good amount of the relevant journals are accessible through electronic databases such as PubMed (http://www.ncbi.nlm.nih.gov/pubmed/). Please take some time to browse through the journals for papers that you find interesting. Getting familiar with the format in which scientific papers are presented will be of great help in your own report writing.

In the laboratory:

You are required to wear a decent labcoat and safety glasses whenever in the lab. Preferably bring your own. It is recommended that you carry a marking pen (permanent), spatula, scissors and tweezers (and a phone).

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 the notes taken should allow you to repeat the experiment. Tablets and laptops may be used for note-taking put using them may be tricky as you should not wear gloves when typing notes. You are required to write three formal reports on the practical work, which will be a lot less painful experience with good notes in hand.

Unit Website

The official CBMS731 website is: **ilearn.mq.edu.au**

You will be asked for a username and password. Your username is your student number. If you have trouble logging in, please follow the help instructions given on the web page before contacting your lecturer academic staff. You may also contact the

Help Desk:

Phone: 9850-HELP (4357)

Freecall: 1800 063 191

Email: http://help.mq.edu.au/

Unit Schedule

CBMS731 Molecular and Medical Biotechnology, lecture topics 2017

Two one-hour lectures per week, on Mon at 12-1 pm in EMC G240 and Tue from 12-1 pm in E6A102

The many faces of biotechnology- the big picture

1. Course introduction - contribution of biotechnology to modern life (HN) -31.7

Molecular biotechnology:

Molecular aspects of biotechnology revisited

2. The toolbox for genetic engineering-making a recombinant protein (HN) -1.8
3. Genetic engineering- power tools and considerations (HN) -7.8
4. Biotechnology pipeline- linking the ‘omics’ (HN) - 8.8
5. Protein secretion and quality control (HN) -14.8
5. Protein secretion, the way out (HN) -15.8
7. Modern approaches into protein engineering (AS) -21.8
8. Basic concepts in synthetic biology (LB) -22.8

Making recombinant products

9. Microbes as cell factories (HN) -28.8
10. Cell cultures and transgenic animals (HN) -29.9
11. What about transgenic plants (HN) -4.9
12. The art of making a biotech product on a large scale (HN) -5.9

Fluorescence in biotechnology

13. Fluorescence instrumentation and applications in biotechnology (LP) -11.9
14. Flow cytometry as a tool in biotechnology (MO) -12.9

BREAK 16.9. – 2.10.

Medical biotechnology:

15. Bioinformatics and combinatorial chemistry in drug design (SR) -3.10

Sweet biotechnology

16. Basic aspects of protein glycosylation (MA) -9.10
17. Biological functions of protein glycosylation (MA) -10.10

Nanobiotechnology in action

18. Application of nanoparticles in cancer diagnostics (AC) -16.10
19. Surface nanofabrication towards smart sensing interfaces (GL) -17.10

Biomolecules and their applications

20. Making a synthetic yeast chromosome (HG or HK) -23.10
21. The promise of biopharmaceuticals (HN) -24.10
22. Cancer and biotechnology (MM) -30.10
23. DNA as evidence in forensic science (HN) -31.10
24. Quick guide to stem cells and their applications (HN) -6.11
25. Course summary (HN) -7.11

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)

LP- Dr Lindsay Parker, MQ, Biological Sciences (lindsay.parker@mq.edu.au) ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP)

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

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

MA- Dr Morten Thaysen-Andersen, MQ CBMS (morten.andersen@mq.edu.au)

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

AC- Dr Andrew Care, MQ CBMS (andrew.care@mq.edu.au) ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP)

GL- Dr Guozhen Liu, MQ CBMS (guozhen.liu@mq.edu.au)

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

Pratical 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*

2. Fluorescent labelling of fungal cell membranes and cellular localisation of the recombinant DsRed 1 protein.

3. 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 8.8.	Plate conidia for bombardment
Wed 9.8.	Coat microparticles with DNA and shoot
Tue 15.8.	Count transformants and restreak on PDA-HygB plates
Wed 16.8.	Streak transformant conidia for DNA isolation
	Codon optimisation tutorial, CBMS Tea room F7B322

Tue 22.8. Isolate chromosomal DNA from transformants for PCR

Wed 23.8. Design primers for PCR to check the transformants

Tue 29.9. Check the quality of chromosomal DNA

Wed 30.9. Run PCR on transformants

Namesake peptide task handed out and discussed in the class

Tue 5.9. Check PCR products by agarose gel electrophoresis and take

Wed 6.9. photographs

Wrapping up Practical 1

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

Tue 12.9. Staining of the DsRed-expressing transformants and the

Wed 13.9. non-transformant with an ER specific dye

Inspection of specimens using confocal microscopy

Imaging show by Denitza D, E7B 346

Executive summary, fluorescence clinic and refreshments, CBMS Tea room F7B322

No prac on 3 or 4 Oct

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

Tue 10.10. Sample preparation of native and recombinant lactoferrin

Wed 11.10. Release of oligosaccharides by enzyme treatment

Wrapping up Practical 2

Tue 17.10. Purification and analysis of oligosaccharides by liquid

Wed 18.10. chromatography-mass spectrometry and interpretation of data

Wrapping up Practical 3

Tue 24.10. **The Great Debate I**, CBMS Tea room F7B320

Wed 25.10.

Tue 31.11. **The Great Debate II**, CBMS Tea room F7B320

Wed 1.11.

For CBMS731 only: **Seminar presentations**, E7B 346

Tue 7.11. **or** Wed 8.11. TBA

Note that the dates of the above activities are interchangeable. All practicals and the Great Debate are compulsory to all students.

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_2016.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 (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

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

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 outcome

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation,

production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond 'this is what we got' to 'how can I explain and/or improve on this'. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical report 1
- Practical report 2
- Practical report 3
- Namesake peptide task
- The Great Debate
- Continuing assessment
- Communication Seminar
- Final examination

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 outcome

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond 'this is what we got' to 'how can I explain and/or improve on this'. 4. Work in a group as well as well as an

individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical report 1
- Practical report 2
- Practical report 3
- Namesake peptide task
- The Great Debate
- Continuing assessment
- Communication Seminar
- Final examination

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:

Learning outcome

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond ‘this is what we got’ to ‘how can I explain and/or improve on this’. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to

recombinant DNA technology.

Assessment tasks

- Practical report 1
- Practical report 2
- Practical report 3
- Final examination

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 outcome

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond ‘this is what we got’ to ‘how can I explain and/or improve on this’. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical report 1
- Practical report 2
- Practical report 3
- Final examination

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 outcome

- At the end of this unit, the students will be able to: 1. Describe key concepts and explain the impact of biotechnology, and discuss its interdisciplinary nature and how it has affected modern society. 2. Conduct hands-on laboratory work using contemporary experimental techniques including microbial culture, DNA mediated transformation, production of recombinant proteins in fungi, confocal microscopy and glycan analysis. 3. Collect and synthesize experimental data in the form of a scientific report which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing. At Masters level students are expected to go beyond ‘this is what we got’ to ‘how can I explain and/or improve on this’. 4. Work in a group as well as well as an individual. 5. Pursue individual topics of biotechnology by consulting relevant scientific literature and write a news and views type essay on a selected topic in biotechnology. 6. Document and demonstrate the biotechnology skills relevant for employment in industry or progressing into higher degree studies. 7. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical report 1
- Practical report 2
- Practical report 3
- Namesake peptide task
- The Great Debate
- Continuing assessment
- Communication Seminar
- Final examination

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:

Assessment tasks

- The Great Debate
- Communication Seminar
- Final examination