CBMS331

Molecular and Medical Biotechnology

S2 Day 2018

Dept of Chemistry & Biomolecular Sciences

Contents

General Information

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Credit points
3

Prerequisites 6cp from CBMS units at 200 level including (CBMS215 or CBMS224 or CBMS202 or CBMS201)
Corequisites
Co-badged status CBMS731 and CBMS880
Unit description This unit provides an overview of contemporary biotechnology, emphasising the molecular aspects of this growing field. Several examples will be provided to demonstrate how the basic molecular sciences translate into environmental and industrial applications as well as to better health and wealth. We will discuss functional genomics and proteomics, the use of surrogate hosts for protein production, and the roles of sugars on proteins and cells. Other topics include forensics, stem cells and applications of fluorescence in biotechnology. Students will carry out hands-on laboratory work applying recombinant DNA techniques, visualise organisms and molecules using confocal fluorescence microscopy, assess production capabilities of an industrially exploited fungal cell factory, and analyse the sugars on a commercially available recombinant product.

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:

1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
4. Work in a group as well as well as an individual.
5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
6. Discuss the ethical aspects related to recombinant DNA technology.

7. Critically evaluate work by others and learn from it.

General Assessment Information

Practical Reports

These are major reports describing the laboratory experiments in detail with references to literature. An electronic copy of the report must be submitted to iLearn by the due date for checking in turnitin. In addition to this, a hard copy is to be submitted to the Science and Engineering Student Centre MUSE, where a submission box will be set up. Campus maps are available at https://www.mq.edu.au/about/contacts-and-maps/maps. The Centre is open from 8.30 am to 5.30 pm from Monday to Friday.

Submission

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

Late Submission

Written tasks 10% or less - Students who have not submitted the task by the deadline will be awarded a mark of 0 for the task, except for cases in which an application for Special consideration is made and approved (see below).

Written tasks above 10% -There will be a deduction of 10% of the total available marks made from the total awarded mark for each 24 hour period the submission is late. This penalty does not apply for cases in which an application for Special consideration is made and approved. **No submissions will be accepted after marked reports have been returned to the students**.

Non-attendance of assessment

Non-Attendance for Assessable Tasks: If you are unable to attend a practical class, tutorial class or exam due to short-term, serious and unavoidable circumstances, **you must submit a Special consideration request at ask.mq.edu.au** no later than five (5) working days after the assessment task date or due date. Please also immediately contact the Unit Convenor, Prof Helena Nevalainen (helena.nevalainen@mq.edu.au).

Information on Supplementary Exams: If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a re-sit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

The unit expectation is that you will:

- Attend all lectures or when not possible listen to the recorded lectures
- Attend all practicals and set exercises during the practical hours

- Actively engage in the practical and coursework assessment tasks
- Hand in all practical reports and assessment tasks
- Attend to the Great debate

Assessment Tasks

Name	Weighting	Hurdle	Due
Practical reports 1-3	33%	No	Various, see below
Primer crafting task	12%	No	14.9.2018
The Great Debate	5%	No	Various
Continuing assessment	5%	No	Various
Final examination	45%	Yes	Nov 2018

Practical reports 1-3

Due: **Various, see below**
Weighting: **33%**

Weekly practicals

Report 1

Due: 17-09-2108

Weighting: **13%**

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 developing skills 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 1-15. There are two additional questions for the students to answer and explore as part of the report.

Report 2

Due: 15-10-2018

Weighting: **10%**

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.

Report 3

Due: 05-11-2018

Weighting: **10%**

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

If not requested otherwise, 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 and published literature

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 the story 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.

On successful completion you will be able to:

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific

referencing.

- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.

Primer crafting task

Due: **14.9.2018**
Weighting: **12%**

Primer crafting task

Due: 14-09-2018

Weighting: **12%**

In this exercise, you will look into “turning” peptides to a DNA sequence and design oligonucleotide primers for various purposes in the laboratory such as “catching” a gene and DNA sequencing. This is one of the most essential skills in molecular biology. You will also learn the ropes for peer-assisted marking as you will be marking your classmates work. During the tutorial, you will be given a brief, material to work with and specific questions to answer. Rubric and instructions for peer-assisted marking will also be presented and explained. This assignment will be completed at home and returned before the mid-semester break so that the students will mark each others work over the mid-semester break.

On successful completion you will be able to:

- 7. Critically evaluate work by others and learn from it.

The Great Debate

Due: **Various**
Weighting: **5%**

The students will be divided into groups of 4-5 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 including 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.

On successful completion you will be able to:

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the modern society.
- 4. Work in a group as well as well as an individual.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 6. Discuss the ethical aspects related to recombinant DNA technology.
- 7. Critically evaluate work by others and learn from it.

Continuing assessment

Due: **Various**
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.

On successful completion you will be able to:

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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.
- 4. Work in a group as well as well as an individual.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 6. Discuss the ethical aspects related to recombinant DNA technology.

Final examination

Due: **Nov 2018**
Weighting: **45%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

This is a hurdle assessment task (see https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/assessment for more information on hurdle assessment tasks).

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 go deeper 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.

The final exam is a hurdle assessment and you will need to get >= 40% of the marks available to meet the hurdle. In the event that you make a serious first attempt at the final exam, you will be provided with an opportunity to sit a new final exam. The Faculty defines a serious attempt as a mark of 10% below the hurdle, which in this instance is a mark between 30-40%. **You will NOT be given a second attempt to pass the exam if you get below 30% in your first attempt.**

On successful completion you will be able to:

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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.

Delivery and Resources

Technology Used

Access to the Internet is necessary for efficient communication and research. 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 9-10 am and Tue from 12-1 pm, both 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 sessions: 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 (Labs 1-2) or Wed morning 9 am-1 pm (Labs 3-4) in E7B349-50. Each student should enrol in **one** of these sessions and stay within that group throughout the entire semester. Students are required to attend 80% of the laboratory/tutorial sessions although 100% attendance is recommended. 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. Should a student miss a practical for a valid or unavoidable reason, he or she should consult their working pair and other class mates for results and other information generated and shared during the missed session in order to be able to produce a report. The student can also join the other weekly prac class as a temporary guest (in consultation with the convener) and then return to his or her allocated class.

In 2018, a block practical option is offered for up to 30 students over the mid-semester break (Week 39). The labs will be run on 24-28 September from 10 am to 3 pm (Mon-Fri). Some days may go a bit over. Students wishing to attend the block practicals are requested to contact the unit convener in the first week of teaching.

In the laboratory: This course will involve 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.

You will not be allowed to enter he laboratory unless you are wearing enclosed footwear. When in the lab, wear a laboratory coat and safety glasses - preferably bringing your own. It is recommended that you carry a marking pen (permanent), spatula, scissors and tweezers (and a phone for taking photos).

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.

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 be good enough to allow you to repeat the experiment. Tablets and laptops may be used for note-taking but 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, a task that will be a lot less painful experience with good notes in hand.

The lectures and practicals link together to support the overall learning. 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 their findings and potential 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.

The Great Debate: The debates will be carried out at the time slot allocated for the laboratory class (*i.e*. 2-6 pm on Tue or 9 am-1 pm on Wed). The venue will be announced later.

Tutorials: Tutorials (codon optimisation and namesake peptide) are run as part of the practical sessions. 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 of these areas (Clark and Pazdernik) 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 made 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 '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.

Unit Schedule

CBMS331/731/880 Molecular and Medical Biotechnology, lecture topics 2018

Two one-hour lectures per week, on Mon in E6A102 at 9-10 am and on Tue from 11 am -12 pm.

The many faces of biotechnology- the big picture	

1. Course introduction - contribution of biotechnology to modern life (HN)	Mon 30.7
Molecular biotechnology	
Molecular aspects of biotechnology revisited	
1. The toolbox for genetic engineering- making a recombinant protein (HN)	Tue 31.7
2. Genetic engineering- power tools and considerations	Mon 6.8
3. Biotechnology pipeline- linking the 'omics' (HN)	Tue 7.8
5. Protein secretion and quality control (HN)	Mon 13.8
6. Protein secretion, the way out (HN)	Tue 14.8
7. Modern approaches into protein engineering (AS)	Mon 20.8
8. Basic concepts in synthetic biology (LB)	Tue 21.8
9. Making a synthetic yeast chromosome (HG)	Mon 27.8
Making recombinant products	
10. Microbes as cell factories (HN)	Tue 28.8
11. Cell cultures and transgenic animals (HN)	Mon 3.9
12. What about transgenic plants? (HN)	Tue 4.9
Fluorescence in biotechnology	
13. Fluorescence instrumentation and applications in biotechnology (LP)	Mon 10.9

14. Flow cytometry as a tool in biotechnology (MO)	Tue 11.9
BREAK 15.9. – 1.10.	
15. Making products on a large scale (HN)	Tue 2.10
Medical biotechnology	
Sweet biotechnology	
16. Selected aspects of protein glycosylation (MA)	Mon 8.10
17. Biological functions of protein glycosylation (MA)	Tue 9.10
Nanobiotechnology applications in biomedicine	
18. Microfluidics in cell separation (ML)	Mon 15.10
19. Leading concepts and applications of nanotechnology (AC)	Tue 16.10
20. Nanobiotechnology in cancer diagnostics (AC)	Mon 22.10
Biomolecules and their applications	
21. Bioinformatics and combinatorial chemistry in drug design (SR)	Tue 23.10
22. DNA as evidence in forensic science (HN)	Mon 29.10
23. The promise of biopharmaceuticals (HN)	Tue 30.10
24. Quick guide to stem cells and their applications (HN)	Mon 5.11
25. Course summary (HN)	Tue 6.11

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)

ML- Dr Ming Li, MQ, School of Engineering (ming.li@mq.edu.au)

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

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

Practical sessions

The 4 hour practical sessions will be offered on Tue afternoon from 2-6 pm in E7B349-50 (Groups 1, 2) or Wed morning 9 am-1 pm (Groups 3,4). Each student should enrol in **one** of these sessions and stay within that group throughout the entire semester. Attendance to all sessions allocated to your group is recommended.

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 7.8. Plate conidia for bombardment

Wed 8.8. Coat microparticles with DNA and shoot

Tue	14.8.	Count transformants and restreak on PDA-HygB plates
Wed	15.8.	Streak transformant conidia for DNA isolation

Codon optimisation tutorial TBA

Tue	21.8.	Isolate chromosomal DNA from transformants for PCR
Wed	22.8.	Design primers for PCR to check the transformants
Tue	28.8.	Check the quality of chromosomal DNA
Wed	29.8.	Run PCR on transformants

Primer crafting task handed out and discussed in the class

Tue	4.9.	Check PCR products by agarose gel electrophoresis and take
Wed	5.9.	photographs

Wrapping up Practical 1

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

Tue	11.9.	Staining of the DsRed-expressing transformants and the
Wed	12.9.	non-transformant with an ER specific dye
		Inspection of specimens using confocal microscopy

Executive summary, peptide clinic and refreshments

Writing room and APAF Conference room

No prac on 2 or 3 Oct

Practical 3. Analysis of N-linked glycans on the native lactoferrin glycoprotein

isolated from human and bovine milk

Tue	9.10.	Sample preparation of native and recombinant lactoferrin
Wed	10.10.	Release of oligosaccharides by enzyme treatment
		Wrapping up Practical 2
Tue	16.10.	Purification and analysis of oligosaccharides by liquid
Wed	17.10.	chromatography-mass spectrometry and interpretation of data
		Wrapping up Practical 3
Tue	23.10.	**The Great Debate I** TBA
Wed	24.10.	
Tue	30.10.	**The Great Debate II** TBA
Wed	31.10.	
For CBMS731 only:		**Seminar presentations**
Tue	6.11. **or**	TBA
Wed	7.11.	

Note that a block practical is organised during the mid-semester break (week 39). We are looking for 32 volunteers to attend this mode of practicals. Please list your name on iLearn for expression of interest.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and

Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/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/study/getting-started/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 outcomes

- 3. Collect and synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.

Assessment tasks

- Practical reports 1-3
- The Great Debate
- Continuing assessment

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

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
- 4. Work in a group as well as well as an individual.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 7. Critically evaluate work by others and learn from it.

Assessment tasks

- Practical reports 1-3
- Primer crafting task
- The Great Debate
- Continuing assessment
- Final examination

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 outcomes

- 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.

- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 7. Critically evaluate work by others and learn from it.

Assessment tasks

- Practical reports 1-3
- Primer crafting task
- The Great Debate
- Continuing assessment
- Final examination

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

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 6. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical reports 1-3
- The Great Debate
- Continuing assessment

- Final examination

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

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
- 7. Critically evaluate work by others and learn from it.

Assessment tasks

- Practical reports 1-3
- Primer crafting task
- The Great Debate
- Continuing assessment
- Final examination

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 outcomes

- 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 synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.

Assessment tasks

- Practical reports 1-3
- Continuing assessment
- Final examination

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

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the modern society.
- 3. Collect and synthesise experimental data in the form of a scientific report, which conforms to a standard biotechnology journal, including the use of appropriate scientific referencing.
- 4. Work in a group as well as well as an individual.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 7. Critically evaluate work by others and learn from it.

Assessment tasks

- Practical reports 1-3
- Primer crafting task
- The Great Debate
- Continuing assessment
- Final examination

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 outcomes

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the modern society.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 6. Discuss the ethical aspects related to recombinant DNA technology.
- 7. Critically evaluate work by others and learn from it.

Assessment tasks

- Practical reports 1-3
- Primer crafting task
- The Great Debate
- Continuing assessment
- Final examination

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 outcomes

- 1. Explain the broad and interdisciplinary nature of biotechnology and how selected areas, discussed in the lectures contribute to the modern society.
- 5. Extract relevant information from scientific literature, and argue a point of view in a group debate setting.
- 6. Discuss the ethical aspects related to recombinant DNA technology.

Assessment tasks

- Practical reports 1-3
- The Great Debate
- Continuing assessment

- Final examination

Changes from Previous Offering

The Namesake peptide task has been changed to Primer crafting task and peer-assessment.

In 2018, a block practical option is offered for up to 30 students over the mid-semester break (Week 39). The labs will be run on 24-28 September from 10 am to 3 pm (Mon-Fri). Some days may go a bit over. Students wishing to attend the block practicals are requested to contact the unit convener in the first week of teaching.