# CBMS336

## Molecular Biology and Genomics

S1 Day 2015

*Dept of Chemistry & Biomolecular Sciences*

## Contents

# General Information

Unit convenor and teaching staff
Convenor
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Lecturer
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Lab Technician
Ray Duell

Credit points
3

Prerequisites
39cp including CBMS224

Corequisites

Co-badged status

Unit description
Molecular biology is a central science in twenty-first century biology and biotechnology. Understanding the fundamentals of molecular biology is essential for many other fields in the life sciences, including microbiology, cell biology, immunology, and development. Molecular biology makes a significant and increasing contribution to major sectors of our society including agriculture and medicine, and is also important in environmental science and forensics. In this unit we explore topics that allow students to obtain an advanced understanding of the mechanisms of molecular biology, including those of DNA replication and recombination, prokaryotic gene expression, eukaryotic gene expression, mobile elements, the functions of the nucleus, and epigenetics. We also address topics on the rapidly changing technologies in molecular biology, including those used in genome sequencing, metagenomics, and microarray analysis. Practical sessions complement the lectures and provide students with hands-on experience with a range of critical laboratory skills including those required for DNA and RNA isolation, PCR and RT-PCR, cloning, and bioinformatics. Students gain experience in working with both bacterial and eukaryotic systems in the laboratory classes so that their skills and experience are valuable for a variety of positions in both industry and research.

## 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:

Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.
Students will have an understanding of the revolutionary impact of genomics across all biological sciences.
Students will also display evidence of good report-writing skills including appropriate scientific referencing.

# General Assessment Information

**Assignments**

- **All assignments must be submitted to the appropriate assignment box for your unit.** Assignment boxes are located in the reception area of the Science Centre (Room 101), ground floor at the western end of building E7A.

The Centre is open 8.30am - 5.30pm Monday to Friday.

- **All assignments are to be submitted by midday on the date specified and must include a completed and signed coversheet stapled to the front cover.**

**Problem Set**

**Problems 1 - 12** should be done in time for marking and discussion during the practical session of the **Week 12**.

**Requirements**

- **Students are required to satisfactorily complete all components of the unit to**

**pass.**

Satisfactory completion of all components includes the practical assignments and the problem sets which are both integral components of the unit. Apart from the marks formally allocated to these components, a comprehensive understanding of them will greatly assist you in the final exam. You should remember that the final exam covers **ALL** components of the unit.

- **Attendance at the practical sessions is compulsory.**

# Assessment Tasks

| Name | Weighting | Due |
|---|---|---|
| Laboratory Reports | 25% | Apr 8, Apr 15, May 27 |
| Bioinformatic Report | 10% | June 3 |
| Mid-Semester Test | 10% | Week 7 |
| Problem Set | 5% | Week 12 |
| Final Examination | 50% | University Examination Period |

## Laboratory Reports

Due: **Apr 8, Apr 15, May 27**
Weighting: **25%**

3 lab reports, 1500 words each

On successful completion you will be able to:

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
- Students will also display evidence of good report-writing skills including appropriate scientific referencing.

## Bioinformatic Report

Due: **June 3**
Weighting: **10%**

Report on Bioinformatic Analysis

On successful completion you will be able to:

- Students will have an understanding of the revolutionary impact of genomics across all biological sciences.
- Students will also display evidence of good report-writing skills including appropriate scientific referencing.

## Mid-Semester Test

Due: **Week 7**
Weighting: **10%**

Multiple Choice Test carried out during regularly scheduled laboratory time.

On successful completion you will be able to:

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
- Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.

## Problem Set

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

12 Question Problem Set in Prac Manual.

On successful completion you will be able to:

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.

## Final Examination

Due: **University Examination Period**
Weighting: **50%**

2 essays, 20 short answer questions

On successful completion you will be able to:

- Students will be proficient in the theory and practice of a range of molecular biology

experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.

- Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.
- Students will have an understanding of the revolutionary impact of genomics across all biological sciences.

# Delivery and Resources

**Classes** There are two weekly lectures of 1 hour (C5C Collaborative Forum, 2pm Tuesday, 1pm Thursday) and a weekly practical session of 3 hours (F7B102-105, 1 – 4pm Wednesday or 9am-12pm Thursday). In weeks 10 and 11, the practical class is replaced with a bioinformatic workshop in the same location. Attendance at practical sessions (and bioinformatic workshop) is a compulsory component of this unit. Lecture recordings and graphics slides are available online through iLearn (https://ilearn.mq.edu.au/login/MQ/), although lecture attendance in person is highly recommended. The practical manual is also available online through iLearn.

**Required and Recommended Texts** The course syllabus is defined by all of the subject material presented in lectures and practicals, much of which is beyond standard textbooks. The prescribed text for this unit is Molecular Biology Fifth edition by Robert F Weaver. Available from the Co-op bookshop. The following texts may also be useful and are available in the library:

GenesIX by Benjamin Lewin

Mobile Genetic Elements by Sherratt

Molecular Cloning: A Laboratory Manual by Maniatis, Fritsch and Sambrook

An Introduction to Genetic Engineering by Des Nicholl.

**Technology Requirements** Within this Unit, you will be introduced to Web-based search engines that are commonly used in molecular biology. Our expectation is that you will be able to readily access the internet and have a computer available to you for web browsing and preparation of your laboratory reports. Handwritten reports will not be accepted. Your laboratory reports will be submitted and circulated via the online Turnitin program, for which access instructions will be given at submission time. Your practical reports will require you to carry out minor computational tasks, for which a calculator and access to basic statistical tools will be required. We place a large emphasis on correct referencing style in all your reports, and use of the program EndNote is encouraged, but not essential.

# Unit Schedule

| Week | Date | Lecture | Title | Lecturer |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Feb 24 | 1 | Introduction/What is Molecular Biology/Genome Structure | Haynes |
| | Feb 26 | 2 | Gene Organization/function | Haynes |
| 2 | Mar 3 | 3 | Molecular Biology Techniques | Haynes |
| | Mar 5 | 4 | Molecular Biology Techniques | Haynes |
| 3 | Mar 10 | 5 | Molecular Cloning | Haynes |
| | Mar 12 | 6 | Tools for studying Gene Activity | Haynes |
| 4 | Mar 17 | 7 | Transcription in Prokaryotes | Paulsen |
| | Mar 19 | 8 | Structure of Prokaryotic Operons | Paulsen |
| 5 | Mar 24 | 9 | Bacterial Gene Regulation | Paulsen |
| | Mar 26 | 10 | Transcription in Eukaryotes | Paulsen |
| 6 | Mar 31 | 11 | Eukaryotic Gene Regulation | Paulsen |
| | Apr 2 | 12 | Nucleosomes/Histones/Chromatin | Paulsen |
| | | | Semester break | |
| 7 | Apr 21 | 13 | Messenger RNA splicing | Paulsen |
| | Apr 23 | 14 | Mechanism of Translation | Paulsen |
| 8 | Apr 28 | 15 | Ribosomes and transfer RNA | Paulsen |
| | Apr 30 | 16 | DNA replication | Paulsen |
| 9 | May 5 | 17 | DNA recombination | Paulsen |
| | May 7 | 18 | DNA repair | Paulsen |
| 10 | May 12 | 19 | Mobile DNA elements | Paulsen |
| | May 14 | 20 | Mobile DNA elements | Paulsen |
| 11 | May 19 | 21 | Genome Sequencing | Paulsen |

| | | | | |
|---|---|---|---|---|
| | **May 21** | **22** | **Genomes, Pan-Genomes and Metagenomics** | Paulsen |
| **12** | **May 26** | **23** | **Bioinformatics and Genome Annotation** | Paulsen |
| | **May 28** | **24** | **Functional Genomics and Systems Biology** | Paulsen |
| **13** | **Jun 2** | **25** | **Revision** | Paulsen |
| | **Jun 4** | **26** | **Revision** | Paulsen |

# 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/

## 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://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

## 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

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
- Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.
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### Assessment tasks

- Laboratory Reports

- Bioinformatic Report
- Mid-Semester Test
- Problem Set
- Final Examination

## 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

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
- Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.
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## Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

### Learning outcome

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.

### Assessment tasks

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## 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

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
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## 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

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
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## 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

- Students will be proficient in the theory and practice of a range of molecular biology experimental techniques, including PCR, restriction enzyme digestion, gel electrophoresis, cloning, site-directed mutagenesis, DNA sequencing and DNA hybridization.
- Students will have a thorough understanding of essential molecular processes in the cell, especially as related to DNA and RNA. These molecular processes include transcription, translation, DNA replication, recombination, DNA repair, and transposition.
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# 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 outcome

- Students will also display evidence of good report-writing skills including appropriate scientific referencing.

## Assessment tasks

- Laboratory Reports
- Bioinformatic Report