



# CBMS224

## Molecular Biology

S2 Day 2017

*Dept of Chemistry & Biomolecular Sciences*

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#### **Disclaimer**

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## General Information

Unit convenor and teaching staff

Lecturer

Hasinika Gamage

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Credit points

3

Prerequisites

CBMS103 or CBMS107) and BIOL115

Corequisites

Co-badged status

CBMS624

Unit description

The combination of CBMS223 with this unit provides an essential core of biochemistry and molecular biology. This unit aims to provide students with further insights into the molecular processes of the living cell, and at the same time help students to understand the complex language of molecular biology. Topics covered include: molecular biological techniques, prokaryotic and eukaryotic gene regulation and genome organisation, transcription of RNA, translation of RNA to proteins, replication of DNA, bacterial and animal viruses, photosynthesis, and proteomics. The practical program is designed to give students a broad introduction to modern molecular biology techniques including extraction of DNA and RNA from cells, reverse transcriptase PCR, agarose- and SDS-polyacrylamide-gel electrophoresis, cloning of cDNA, DNA sequencing, and heterologous protein expression in *E. coli* and analysis of the expressed protein products. As such it is highly recommended for all biomolecular sciences students.

## 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:

Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and

chemical conditions.

Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.

Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.

Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.

Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.

Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.

Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

## General Assessment Information

All practical assessment items must be submitted BOTH as a hard copy and online via turnitin.

Assessments conform to the current assessment policy: [http://www.mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://www.mq.edu.au/policy/docs/assessment/policy_2016.html)

10% penalty per day for late assessments. Assessment items submitted more than 1 week late will not be marked, except for serious and unavoidable disruptions (See [http://mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://mq.edu.au/policy/docs/disruption_studies/policy.html) )

## Assessment Tasks

Name	Weighting	Hurdle	Due
<a href="#"><u>Practical report outline</u></a>	5%	No	24th August
<a href="#"><u>Mid-semester test</u></a>	10%	No	Week 6
<a href="#"><u>Student seminar</u></a>	10%	No	Week 11
<a href="#"><u>Practical examination</u></a>	10%	No	Week 12
<a href="#"><u>Practical Report</u></a>	10%	No	Week 12
<a href="#"><u>Final Exam</u></a>	55%	No	TBA

## Practical report outline

Due: **24th August**

Weighting: **5%**

The title, abstract and introduction will need to be submitted on Thursday of week 4 together with a flow diagram of the practical. It is expected that you will know the name of your *Chlamydomonas* gene and have done some literature searching together with searching <http://www.ncbi.nlm.nih.gov/> pub med and protein databanks to work out what is known about your gene and gene product from *Chlamydomonas*. You will also have read ALL of the practical notes and worked out a flow diagram of the practical components placed in a logical order for cloning, expressing and analysing your gene and gene product.

This is worth 5%. It is expected that you will revise and update the abstract and introduction to include in the final report.

On successful completion you will be able to:

- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

## Mid-semester test

Due: **Week 6**

Weighting: **10%**

The Mid-semester Test will cover lecture material and give you an idea of the types of questions that will be asked in the final examination. Held during lecture time.

On successful completion you will be able to:

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Compare and contrast the processes of transcription, translation and replication in

eukaryotes and prokaryotes.

- Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.

## Student seminar

Due: **Week 11**

Weighting: **10%**

The seminar will provide you with the opportunity to research the current literature and to begin to understand the formal writing style of scientific papers. You will present the overview of a specific topic in the biomolecular science area to the class, thus gaining experience in presentation techniques and public speaking.

The review topic will be assigned to you through iLearn during the mid semester break. To help you start a review article on that topic will be supplied but you may use additional published reviews. Note that the topics are broad and you should check the detailed information on the iLearn web site as to what is expected for this seminar.

You must also submit a single sheet of 5 key points on your topic area.

On successful completion you will be able to:

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.
- Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

## Practical examination

Due: **Week 12**

Weighting: **10%**

The practical exam is designed to test your practical skills. It will consist of two parts.

A practical theory component where you will be given data to analyze and interpret. This data is

of a similar type that you have generated in the laboratory sessions during semester.

A hands on practical component. This is designed to test your laboratory skills such as pipetting accuracy and ability to interpret and follow a written method. The test is open book and you WILL require your laboratory manual to find and use the appropriate method.

On successful completion you will be able to:

- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.

## Practical Report

Due: **Week 12**

Weighting: **10%**

The Practical Report will provide you with the opportunity to write a scientific paper using ALL of the experimental results obtained over the course of the semester. You will be primarily assessed on your data analysis and interpretation. Detailed marking criteria and an example report are available on the iLearn web site. This is to be handed in at the completion of the practical exam and can be used during the exam.

On successful completion you will be able to:

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

## Final Exam

Due: **TBA**

Weighting: **55%**

The final exam has three sections:

Multiple choice section (50 questions), 50% of the exam.

A short answer section similar to the midsemester exam, 30 % of exam.

One essay/long or extended answer question, 20% of exam. You will get a choice of three or four question for this section and are expected to write 1-3 pages.

On successful completion you will be able to:

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.
- Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.

## **Delivery and Resources**

### **Technology used and required**

It is important that you have a scientific calculator as hand-held calculators will be used in tutorials, practicals, for assignments, tests and in the final examination. Note that text retrieval calculators are not allowed in the in-semester tests or final examination.

Use will be made of Excel and other data processing and display software. Computers carrying this software are available in the teaching laboratories. Items of interest, links to other on-line material and iLectures will be placed on the unit iLearn website.

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

### **Lecture and Tutorial times**

The timetable for classes can be found on the University web site at: <http://www.timetables.mq.edu.au/>

- 2 x 1 hr lectures per week
- 3 hr Practical classes are interspersed with 2 hr tutorials/discussions of the practicals.

## Teaching and Learning Strategy

- CBMS224 will comprise 2 lectures (or equivalent) per week, with practical (usually 3 hours) sessions interspersed with tutorials (1 to 2 hours). Live lecture recordings, ECHO will be available through a link to iLectures.
- Students are expected to attend all practical and tutorial classes. You will be required to submit a formal lab report and keep an up to date laboratory book. In addition you will be required to give a seminar on a seminar topic related to the lecture topics.
- Satisfactory performance in BOTH the final exam and in the practical component is required to pass.

The assessment tasks are designed to give you feedback as well as to assess your progress within the unit. More specifically:

- o The Mid-semester Test will cover lecture material and give you an idea of the types of questions that will be asked in the final examination.
- o The seminar will provide you with the opportunity to research the current literature and to begin to understand the formal writing style of scientific manuscripts. You will present the results of a published paper to the class, thus gaining experience in presentation techniques and public speaking.
- o The Practical Test is designed to test your practical skills.
- o The Practical Report will provide you with the opportunity write a scientific paper using all of the experimental results obtained over the course of the semester
- Marked work and midsemester and practical exam results should be returned within 2 weeks of being submitted.
- Students are to hand in their assignments after the practical test in week 12. The practical test is open book and students may need their practical report results to complete the practical exam.
- The seminar presentation will be discussed with students during semester.

Late assignments will receive a 10% per day penalty. Assignments handed in more than 1 week late will not be marked. Extensions will only be given in extenuating circumstances and must be discussed with the unit convenor BEFORE the due date.

## Information about iLearn or other resources for this unit.

- There is no web page for this unit.
- The unit will utilise iLearn (<https://ilearn.mq.edu.au>). Select the CBMS224 link and log on with your student id and password.

## Changes since the last offering of this unit.

None



## Other material

- Prescribed or recommended text(s):

Garrett and Grisham BIOCHEMISTRY (Third edition, Saunders). Another suitable contemporary biochemistry text is BIOCHEMISTRY (Berg, Tymoczko, Stryer, 5th edition, 2002, Freeman Press).

Genuine molecular biology texts are a bit harder to find, but there is a new edition of the MOLECULAR BIOLOGY OF THE GENE (5th edition) by Watson and others (Benjamin-Cummings Publishers). Useful molecular biology can be found also in Lewin GENES VIII (Pearson Education) 2003) and in MOLECULAR BIOLOGY OF THE CELL (Alberts et al., Garland Science, 2002). Other information may be obtained from Prescott, Harley, Klein: MICROBIOLOGY (McGraw-Hill 1999) or other microbiology texts. Several of these books are also recommended for other Units so this will influence decisions as to whether to invest in them.

- Prescribed unit materials:

Practical notes are available from the bookshop

## Unit Schedule

Tutorial (T) /Practical (P)	Wed or Thurs	Experiment no. and topic
P1/T1	Week 1	<b>P1- Lab induction. Compulsory.</b> T1 Introductory Tutorial/Workshop on: Gene control, <i>lac</i> operon, transcription, DNA replication
P1	Week 2	<b>A1</b> Preparation of <i>E. coli</i> competent cells <b>A2</b> 'Miniprep' extraction of plasmid DNA from <i>E. coli</i> <b>A3</b> Transformation of <i>E. coli</i> competent cells with plasmid DNA
P2/T2	Week 3	<b>B1</b> Growth of transformant <i>E. coli</i> cells and inducible expression of proteins <b>T2</b> Recombinant DNA, Introduction to physical mapping
P3	Week 4	<b>C1</b> Extraction of RNA from <i>Chlamydomonas</i> <b>C2</b> RT-PCR of RNA with a primer set to amplify a <i>Chlamydomonas</i> cDNA <b>Practical Outline: Due Thursday at science centre. Turnitin submission required.</b>
P4 (2hr) T3 (1hr)	Week 5	<b>D1</b> Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis <b>D2</b> Set up of DNA sequencing reaction <b>T3: Translation and protein synthesis</b>

No lab or tut	Week 6	<b>Midsemester test</b>
P5(2hr) T4(1hr)	Week 7	<b>E1</b> SDS-PAGE of total protein from induced and uninduced transformant cells <b>E2</b> Bioinformatics: Analysis of sequencing results <b>Tutorial:</b> More genetic engineering, cloning strategies
		<b>Mid-semester break</b>
P6(2hr) T5(1hr)	Week 8	<b>F1</b> Preparation of induced SDS-PAGE gel band for MS analysis <b>Tutorial:</b> Review mid-semester test; Eukaryotic genomes
P7(3hr)	Week 9	<b>G1</b> Extraction and MS analysis of induced protein from gel plug
P8(2hr)	Week 10	<b>H1</b> Bioinformatics: Analysis of MS results
T6	Week 11	<b>Student seminars:</b> Wonders of the biomolecular world
Prac Test	Week 12	<ul style="list-style-type: none"> <li>· <b>Practical Test</b></li> <li>· <b>Hand in hard copy of Practical Report: Turnitin submission also required.</b></li> </ul>
T7	Week 13	Revision tutorial; trial exam questions

## Learning and Teaching Activities

### Lectures

Lecture topics (note some topics run for more than a single lecture): 1. Introduction: DNA and RNA: Structure and function. 2. DNA replication 3. DNA replication II: DNA polymerases, sequencing and PCR 4. Transcription; RNA from DNA (example of the lac operon) 5. The genetic code: Translating mRNA into protein 6. Translation: ribosome structure, mechanism and function 7. Recombinant DNA techniques and systems 8. Recombinant DNA Expression systems 9. Proteomics 10. Molecular biology of bacterial viruses (phage T4, phiX, lambda phage) 11. Mutation and DNA repair 12. Organization and function of eukaryotic genomes 13. Mitochondrial and chloroplast genomes 14. Lipoproteins and steroid hormones 15. Second messengers and hormone action 16. Photosynthesis

### Practicals

A1 Preparation of E. coli competent cells A2 'Miniprep' extraction of plasmid DNA from E. coli A3 Transformation of E. coli competent cells with plasmid DNA B1 Growth of transformant E. coli

cells and inducible expression of proteins C1 Extraction of RNA from Chlamydomonas C2 RT-PCR of RNA with a primer set to amplify a Chlamydomonas cDNA D1 Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis D2 Set up of DNA sequencing reaction E1 SDS-PAGE of total protein from induced and uninduced transformant cells E2 Bioinformatics: Analysis of sequencing results F1 Preparation of induced SDS-PAGE gel band for MS analysis G1 Extraction and MS analysis of induced protein from gel plug H1 Bioinformatics: Analysis of MS results

## Tutorials/Workshops

T1 Introductory Tutorial/Workshop on: Gene control, lac operon, transcription, DNA replication  
T2 Recombinant DNA, Introduction to physical mapping T3: Translation and protein synthesis  
T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes

## 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](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

Assessment Policy [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](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](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](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/](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](http://ask.mq.edu.au).

## Student Support

Macquarie University provides a range of support services for students. For details, visit <http://stu>

[dents.mq.edu.au/support/](https://dents.mq.edu.au/support/)

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](https://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](https://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/](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

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.

## Assessment task

- Student seminar

## Learning and teaching activity

- T1 Introductory Tutorial/Workshop on: Gene control, lac operon, transcription, DNA replication T2 Recombinant DNA, Introduction to physical mapping T3: Translation and protein synthesis T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes

## 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 and teaching activities

- A1 Preparation of E. coli competent cells A2 'Miniprep' extraction of plasmid DNA from E. coli A3 Transformation of E. coli competent cells with plasmid DNA B1 Growth of transformant E. coli cells and inducible expression of proteins C1 Extraction of RNA from Chlamydomonas C2 RT-PCR of RNA with a primer set to amplify a Chlamydomonas cDNA D1 Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis D2 Set up of DNA sequencing reaction E1 SDS-PAGE of total protein from induced and uninduced transformant cells E2 Bioinformatics: Analysis of sequencing results F1 Preparation of induced SDS-PAGE gel band for MS analysis G1 Extraction and MS analysis of induced protein from gel plug H1 Bioinformatics: Analysis of MS results

## 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 and teaching activities

- Lecture topics (note some topics run for more than a single lecture): 1. Introduction: DNA and RNA: Structure and function. 2. DNA replication 3. DNA replication II: DNA

polymerases, sequencing and PCR 4. Transcription; RNA from DNA (example of the lac operon) 5. The genetic code: Translating mRNA into protein 6. Translation: ribosome structure, mechanism and function 7. Recombinant DNA techniques and systems 8. Recombinant DNA Expression systems 9. Proteomics 10. Molecular biology of bacterial viruses (phage T4, phiX, lambda phage) 11. Mutation and DNA repair 12. Organization and function of eukaryotic genomes 13. Mitochondrial and chloroplast genomes 14. Lipoproteins and steroid hormones 15. Second messengers and hormone action 16. Photosynthesis

## 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

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.
- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

## Assessment tasks

- Practical report outline
- Mid-semester test
- Student seminar
- Practical examination
- Practical Report
- Final Exam

## Learning and teaching activities

- Lecture topics (note some topics run for more than a single lecture): 1. Introduction: DNA and RNA: Structure and function. 2. DNA replication 3. DNA replication II: DNA polymerases, sequencing and PCR 4. Transcription; RNA from DNA (example of the lac operon) 5. The genetic code: Translating mRNA into protein 6. Translation: ribosome structure, mechanism and function 7. Recombinant DNA techniques and systems 8. Recombinant DNA Expression systems 9. Proteomics 10. Molecular biology of bacterial viruses (phage T4, phiX, lambda phage) 11. Mutation and DNA repair 12. Organization and function of eukaryotic genomes 13. Mitochondrial and chloroplast genomes 14. Lipoproteins and steroid hormones 15. Second messengers and hormone action 16. Photosynthesis
- A1 Preparation of E. coli competent cells A2 'Miniprep' extraction of plasmid DNA from E. coli A3 Transformation of E. coli competent cells with plasmid DNA B1 Growth of transformant E. coli cells and inducible expression of proteins C1 Extraction of RNA from Chlamydomonas C2 RT-PCR of RNA with a primer set to amplify a Chlamydomonas cDNA D1 Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis D2 Set up of DNA sequencing reaction E1 SDS-PAGE of total protein from induced and uninduced transformant cells E2 Bioinformatics: Analysis of sequencing results F1 Preparation of induced SDS-PAGE gel band for MS analysis G1 Extraction and MS analysis of induced protein from gel plug H1 Bioinformatics: Analysis of MS results
- T1 Introductory Tutorial/Workshop on: Gene control, lac operon, transcription, DNA replication T2 Recombinant DNA, Introduction to physical mapping T3: Translation and protein synthesis T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes

## 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**

- Use the appropriate abbreviations and scientific conventions for describing DNA, RNA and protein sequences and utilise their knowledge of the chemical and physical properties of DNA to deduce what happens to DNA under different physical and chemical conditions.
- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.

## **Assessment tasks**

- Practical report outline
- Mid-semester test
- Practical examination
- Final Exam

## **Learning and teaching activities**

- A1 Preparation of E. coli competent cells A2 'Miniprep' extraction of plasmid DNA from E. coli A3 Transformation of E. coli competent cells with plasmid DNA B1 Growth of transformant E. coli cells and inducible expression of proteins C1 Extraction of RNA from Chlamydomonas C2 RT-PCR of RNA with a primer set to amplify a Chlamydomonas cDNA D1 Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis D2 Set up of DNA sequencing reaction E1 SDS-PAGE of total protein from induced and uninduced transformant cells E2 Bioinformatics: Analysis of sequencing results F1 Preparation of induced SDS-PAGE gel band for MS analysis G1 Extraction and MS analysis of induced protein from gel plug H1 Bioinformatics: Analysis of MS results
- T1 Introductory Tutorial/Workshop on: Gene control, lac operon, transcription, DNA replication T2 Recombinant DNA, Introduction to physical mapping T3: Translation and protein synthesis T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes



## 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

- Utilise appropriate enzymes for handling, extracting and modifying DNA in vitro and be able to relate the different methods for introducing DNA into cells.
- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.
- Analyse and interpret gel electrophoresis data, DNA sequencing data and basic proteomic data.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

### Assessment task

- Practical report outline

### Learning and teaching activity

- A1 Preparation of E. coli competent cells A2 'Miniprep' extraction of plasmid DNA from E. coli A3 Transformation of E. coli competent cells with plasmid DNA B1 Growth of transformant E. coli cells and inducible expression of proteins C1 Extraction of RNA from Chlamydomonas C2 RT-PCR of RNA with a primer set to amplify a Chlamydomonas cDNA D1 Analysis of RNA, plasmid and PCR product by agarose gel electrophoresis D2 Set up of DNA sequencing reaction E1 SDS-PAGE of total protein from induced and uninduced transformant cells E2 Bioinformatics: Analysis of sequencing results F1 Preparation of induced SDS-PAGE gel band for MS analysis G1 Extraction and MS analysis of induced protein from gel plug H1 Bioinformatics: Analysis of MS results
- T1 Introductory Tutorial/Workshop on: Gene control, lac operon, transcription, DNA replication T2 Recombinant DNA, Introduction to physical mapping T3: Translation and protein synthesis T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes

## 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

- Compare and contrast the processes of transcription, translation and replication in eukaryotes and prokaryotes.
- Describe the “light” reactions and carbon fixation reactions of photosynthesis and the products of these reactions.
- Summarise and present in oral form key points from the molecular biological literature, using scientific papers as starting points to obtain further information on topics in the molecular biology field.

### Assessment tasks

- Practical report outline
- Mid-semester test
- Student seminar
- Practical examination
- Practical Report
- Final Exam

### Learning and teaching activities

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protein synthesis T4: More genetic engineering, cloning strategies T5: Review mid-semester test; Eukaryotic genomes

## Socially and Environmentally Active and Responsible

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

This graduate capability is supported by:

### Learning outcome

- Build on generic practical skills learnt in prerequisite units to conduct experiments involving purification, manipulation and analysis of nucleic acids and proteins from different types of cells.

### Learning and teaching activities

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## Changes from Previous Offering

Rephrasing and clarification of the learning outcomes