



# CBMS732

## Protein Discovery and Analysis

S1 Day 2014

*Chemistry and Biomolecular Sciences*

### Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	2
<u>Assessment Tasks</u>	3
<u>Delivery and Resources</u>	6
<u>Unit Schedule</u>	9
<u>Policies and Procedures</u>	10

#### Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

## General Information

Unit convenor and teaching staff

Unit Convenor

Bridget Mabbutt

[bridget.mabbutt@mq.edu.au](mailto:bridget.mabbutt@mq.edu.au)

Contact via [bridget.mabbutt@mq.edu.au](mailto:bridget.mabbutt@mq.edu.au)

Credit points

4

Prerequisites

Admission to MRes

Corequisites

Co-badged status

This Unit is co-taught with CBMS732 and CBMS832

Unit description

This unit outlines molecular principles underlying today's developments in protein science. As well as detailing modern separation technologies, the course addresses structural biology, protein analysis and sequence informatics. Practices common in the biotechnology and pharmaceutical industries to purify macromolecules (including recombinant proteins) are emphasized. Analysis methods are introduced in relation to proteomics, genomics and biomedical research. Molecular properties leading to the 3D shape of proteins are detailed, and contemporary structure methods outlined. Practical and project segments of the unit involve hands-on protein skills, molecular graphics and use of key protein web resources, and introduce opportunities for critical writing and interpretation.

## 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:

Understand methods used today to isolate and handle proteins

Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro

Develop a sound knowledge of protein structure and how it is encoded in a protein (or

gene) sequence

Gain hands-on practical experience in protein characterisation, and competency with contemporary web tools

Exhibit a creative approach to articulating biomolecular forms and architectures

Extract, interpret and analyse information from a variety of scientific sources concerning proteins

Develop presentation skills (written, oral) relevant in biomedical science

Gain confidence in evaluating the scientific responses of peers

## Assessment Tasks

Name	Weighting	Due
<u>Final examination</u>	40%	University examination period
<u>Laboratory reports</u>	30%	28April, 5May, 26May
<u>Pet Protein (Purification)</u>	10%	7April
<u>Pet Protein (Structure)</u>	10%	3June or 10June
<u>Pet Protein Model</u>	10%	3June or 10June

### Final examination

Due: **University examination period**

Weighting: **40%**

This written exam will incorporate problem-solving exercises and 2 short essays.

On successful completion you will be able to:

- Understand methods used today to isolate and handle proteins
- Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro
- Extract, interpret and analyse information from a variety of scientific sources concerning proteins

### Laboratory reports

Due: **28April, 5May, 26May**

Weighting: **30%**

Laboratory reports must be submitted as a full report of your experimental data and **discussion and analysis** of your findings. Separate sections for Aims/Methods/Results & Discussion/

References must all be included.

Bibliography listings must conform to an acceptable style (for guidance, see [www.mq.edu.au/on\\_campus/library/research/referencing/](http://www.mq.edu.au/on_campus/library/research/referencing/)), or the report will be returned unmarked for correction and re-submission.

In the case of the "Molecular Graphics" practical, your submitted report must fully conform to the style of the "*Journal of Molecular Biology*".

Laboratory reports must also be submitted in electronic form to the Turnitin program (see iLearn site for login details). Marks will be deducted for reports handed in after the due date (5% / day).

All written work (assignments and lab reports) are to be submitted via the assignment box located in the Science Centre (Room 101, Building E7A). Submissions must include a completed and signed cover sheet stapled to the front cover. Handwritten work will not be accepted.

All marked work will be returned in class, generally within 3 weeks.

On successful completion you will be able to:

- Understand methods used today to isolate and handle proteins
- Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro
- Develop a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence
- Gain hands-on practical experience in protein characterisation, and competency with contemporary web tools
- Develop presentation skills (written, oral) relevant in biomedical science

## Pet Protein (Purification)

Due: **7April**

Weighting: **10%**

This is a literature assignment and will require locating prime sources in books and journals.

As your own case study, you will be allocated a protein of industrial/medical importance in class. You will undertake literature searches, conduct your own analysis utilising theory from lectures and construct interpretive flowcharts.

On successful completion you will be able to:

- Understand methods used today to isolate and handle proteins

- Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro
- Gain hands-on practical experience in protein characterisation, and competency with contemporary web tools
- Extract, interpret and analyse information from a variety of scientific sources concerning proteins
- Develop presentation skills (written, oral) relevant in biomedical science

## Pet Protein (Structure)

Due: **3June or 10June**

Weighting: **10%**

Research the literature concerning the structure and structure determination methods relevant to your Pet Protein.

Transmit your understanding of the individual protein to your fellow students in seminar form.

You are required to :

- Describe the structural method(s) used to elucidate its structure.
- Outline the features and spatial organization of the molecule.
- Describe structural features that relate to the function of your protein.

On successful completion you will be able to:

- Develop a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence
- Exhibit a creative approach to articulating biomolecular forms and architectures
- Extract, interpret and analyse information from a variety of scientific sources concerning proteins
- Develop presentation skills (written, oral) relevant in biomedical science

## Pet Protein Model

Due: **3June or 10June**

Weighting: **10%**

Construct a model (hint: wire, tape, kitchen utensils...) that shows the three-dimensional shape of your Pet Protein. You will be assessed on the extent to which your model successfully shows the shape and form of the protein in three-dimensions.

If your protein is particularly large, only one domain need be demonstrated.

On successful completion you will be able to:

- Develop a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence
- Exhibit a creative approach to articulating biomolecular forms and architectures
- Extract, interpret and analyse information from a variety of scientific sources concerning proteins
- Gain confidence in evaluating the scientific responses of peers

## Delivery and Resources

### Your classes

Lectures will be twice weekly: **Tuesday (9 am)** and **Wednesday (10 am)**.

Weekly tutorials (Friday 11 am or 12pm) will be used for additional material and problem solving-workshops. In the last weeks of semester, additional lectures may be delivered in this tutorial hour.

It is essential that you be available to attend all lectures. **ilectures are NOT made available during session**, as the classroom experience is integral to the subject material of this Unit.

The course syllabus is defined by all of the subject material presented in lectures (including guest lectures) and practicals, much of which is beyond standard textbooks.

Should you miss a specific class (illness or misadventure), please contact the Unit Convenor (in iLearn) to organise access to the relevant iLecture file.

### Laboratory Sessions:

A **3-day block practical** on Protein chromatography is scheduled in the mid-semester break (first week).

During session, additional practical tasks are scheduled on **Tuesday afternoons (2-6 pm)**. You will attend ~5 afternoons according to your allocated laboratory group.

Attendance is compulsory on all allocated days of class. If you are sick, please consult the Unit Convenor(iLearn) to ensure all laboratory and project work is completed. Outstanding practical work will result in failure of this Unit.

Please carefully check the location of each laboratory activity, as classes start promptly. **Latecomers may be excluded from class.**

Weeks 1&2		-		
Week 3	18Mar	<b>WORKSHOP: Searching the primary literature</b>		2-5pm, 832 and 732 students (E4B 118)
Week 4&5		-		
Week 6	7Apr		<i>Pet Protein (Purification) due</i>	832 and 732 students

	8Apr	<b>PRACTICAL: Mass spectrometry informatics</b>		2-6pm, all students (E4B 118)
mid- sem break	14-17Apr	<b>THREE-DAY PRACTICAL: Protein chromatography</b>		full days (E7B 349/350): 14,15,16Apr GRP <b>A</b> 15,16,17Apr Grp <b>B</b>
Week 7	28Apr	-	<i>MassSpec report due</i>	all students
Week 8	5May	-	<i>Chromatography report due</i>	all students
Week 9	13May	<b>PRACTICAL: Molecular Graphics</b>		2-6pm, all students (E4B 118)
Week 10	20May	-		
Week 11	26May		<i>MolG report due</i>	all students
	27May	<b>FILM: DNA-Life story</b>		all students
Week 12	3Jun	<b>SEMINARS: Pet Protein (Structure)</b>		2-6pm, GRP <b>A</b> (venue tba)
Week 13	10Jun	<b>SEMINARS: Pet Protein (Structure)</b>		2-6pm, GRP <b>B</b> (venue tba)

#### Required and recommended texts

The textbook of which you are required to obtain a personal copy is: **“Physical Biochemistry: Principles and Applications”, David Sheehan, John Wiley (2<sup>nd</sup> ed, 2002).**

Because of the multidisciplinary nature of this course, you will be expected to read more widely than this, however.

Strongly recommended **reference texts** available in the library (short-term loan only):

“Proteins: Structure and Function”, D. Whitford, John Wiley, 2005

“Protein Structure and Function”, Petsko & Ringe, New Science Press, 2004

“Introduction to Protein Structure”, Branden & Tooze, Garland, 1999

“Purifying proteins for proteomics : a laboratory manual” ed. R.J. Simpson. Cold Spring Harbor Laboratory Press, 2004

Other **general references** that you may find useful are:

R. Scopes, "Protein purification: principles and practice", New York, Springer-Verlag, 1994

Garrett & Grisham, “Biochemistry” (esp. Chs 4 – 6), Harcourt Brace, 1999

T. Creighton, “Proteins: Structures and Molecular Properties”, Freeman, 1993

#### Web resources

The Unit will run as an online unit within iLearn (<http://learn.mq.edu.au>). Within this Unit, you will be introduced to Web-based tools, search engines and graphics software that are commonly used today in protein science. There are

many excellent websites, apps and YouTube presentations to show how protein are made and constantly move around.

It is an expectation that you will become familiar with the following sites during the course:

- [www.uniprot.org/](http://www.uniprot.org/)

This is a centralised resource for “vital statistics” of known proteins. Try out your Pet Protein here!

- <http://au.expasy.org>

“Proteomics” website hosted by the Swiss Institute for Bioinformatics. Provides many of the tools for doing your own protein analysis & bioinformatics. Good links, so start here.

- [www.ncbi.nlm.nih.gov/pubmed](http://www.ncbi.nlm.nih.gov/pubmed) (or just type Pubmed)

Essential for your literature searches-free and easy searching of all journals- anywhere, anytime.

- [www.rcsb.org/pdb](http://www.rcsb.org/pdb) (or just type PDB)

the world’s central protein structure database. Use this to locate structures and view them in 3D.

- [www.sunsetlakesoftware.com](http://www.sunsetlakesoftware.com) (or AppleStore)

free downloadable “Molecules” application:

*“an application for the iPhone and iPod touch that allows you to view three-dimensional renderings of molecules and manipulate them using your fingers. You can rotate the molecules by moving your finger across the display, zoom in or out by using two-finger pinch gestures, or pan the molecule by moving two fingers across the screen at once.”*

### Technology Requirements

Within this Unit, you will be introduced to Web-based tools, search engines and graphics software that are commonly used today in biomedical science. You will require internet access and a computer for web browsing, preparation of your reports and case study analysis. Your project and laboratory reports will be submitted and circulated via the online Turnitin program.

Your practical reports will require you to carry out minor computational tasks, for which a calculator and access to basic statistical software 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.

The capacity to download and install a simple molecular graphics program will assist you greatly in the Unit. Your model-building assessment task can be carried out with very simple materials; it is not an expectation that expensive art supplies need be purchased.

### New for 2014

Peer assessment task have been excluded this year to have a more balanced workload.



## Unit Schedule

Lectures	
1 - 3	FUNCTIONAL GROUPS IN PROTEINS
4	ISOLATING BIOMOLECULES recombinant sources; quantitation & detection
5 & 6	SEPARATION OF PROTEIN MIXTURES separation by precipitation; gel filtration for separation
7 - 10	CHROMATOGRAPHY FOR PURIFICATION ion exchange; hydrophobic/reversed-phase; affinity chromatography
11 -13	PROTEIN ANALYSIS METHODS 2D gel electrophoresis (MM); mass spectrometry (PH); sugar/glycoprotein analysis (NP)
14 - 16	PROTEIN FOLDS AND DOMAINS all alpha-structures (globin fold, helix bundles); all beta structures (antiparallel barrels, the beta helix); mixed alpha/beta folds
17- 19	TERTIARY STRUCTURE DETERMINATION x-ray crystallography; NMR spectroscopy
20 & 21	HOW PROTEINS FOLD IN SOLUTION thermodynamics of protein folds; circular dichroism
22 & 23	BIOINFORMATICS structure prediction methods; the CASP project
24	MEMBRANE PROTEINS (KH)
25	FLUORESCENCE TECHNOLOGIES (LB)

## 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.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](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](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/](https://students.mq.edu.au/support/student_conduct/)

## Student Support

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

## Learning Skills

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