CBMS832

Protein Discovery and Analysis

S1 Day 2014

Chemistry and Biomolecular Sciences

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General Information

Unit convenor and teaching staff
Unit Convenor
Bridget Mabbutt
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Credit points
4

Prerequisites
Admission to MBiotech or MBiotechMCom or MLabQAMgt or PGDipLabQAMgt or PGCertLabQAMgt or MRadiopharmSc or MSc

Corequisites

Co-badged status
This Unit is co-taught with CBMS332 and CBMS732

Unit description
This unit outlines molecular principles underlying today's developments in protein science. As well as detailing modern separation technologies, the unit addresses structural biology, protein analysis and sequence informatics. Practices common in the biotechnology and pharmaceutical industries to purify macromolecules (including recombinant proteins) are emphasised. 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 develop critical interpretation and involve hands-on protein skills, molecular graphics and use of key web-based resources.

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 bimolecular 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 and working in team settings

Assessment Tasks

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

Final examination

Due: **University examination period**
Weighting: **40%**

This written paper will incoporate problem-solving excercises and 2 short essays

On successful completion you will be able to:

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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. Handwritten work will not be accepted. 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/), 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"*. For CBMS832 students, this submission will be jointly managed as a team exercise.

Marks will be deducted for reports handed in after the due date (5% / day).

Laboratory reports must also be submitted in electronic form to the Turnitin program (see iLearn site for login details).

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.

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

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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:

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- 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 method relevant to your Pet Protein.

Transmit your understanding of the individual protein strcutre to your fellow students in a presenation. You are required to:

- outline the method used to derive the structure
- outline the features and spatial organisation of the molecule
- describe the structural features that relate to the functionof this 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 bimolecular 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:

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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 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	**WORKSHOP: Searching the primary literature**		2-5pm, 832 and 732 students
Week 4&5		-		
Week 6	7Apr		*Pet Protein (purification) due*	832 and 732 students
	8Apr	**PRACTICAL: Mass spectrometry informatics**		2-6pm, all students (E4B 118)
mid-sem break	14-17Apr	**THREE-DAY PRACTICAL: Protein chromatography**		full days (E7B 349/350): 14,15,16Apr GRP **A** 15,16,17Apr Grp **B**
Week 7	28Apr	-	*MassSpec report due*	all students
Week 8	5May		*Chromatography report due*	all students
Week 9	13May	**PRACTICAL: Molecular Graphics**		2-6pm, all students (E4B 118)
Week 10	19May	-		
Week 11	26May		*MolG report due*	all students
	27May	**FILM: DNA-Life story**		all students
Week 12	3Jun	**SEMINARS: Pet Protein (Structure)**		2-6pm, GRP **A** (venue tba)
Week 13	10Jun	**SEMINARS: Pet Protein (Structure)**		2-6pm, GRP **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 (2nd 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/**

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 Intitute 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 (or just type Pubmed)

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

- 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** (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 review assessment task is 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

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/

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

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- 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

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- 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

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

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- Understand methods used today to isolate and handle proteins
- Gain hands-on practical experience in protein characterisation, and competency with contemporary web tools
- Exhibit a creative approach to articulating bimolecular forms and architectures
- Extract, interpret and analyse information from a variety of scientific sources concerning proteins

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- Exhibit a creative approach to articulating bimolecular forms and architectures
- Develop presentation skills (written, oral) relevant in biomedical science
- Gain confidence in evaluating the scientific responses of peers and working in team settings

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

Learning outcomes

- Develop presentation skills (written, oral) relevant in biomedical science
- Gain confidence in evaluating the scientific responses of peers and working in team settings

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- Exhibit a creative approach to articulating bimolecular 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 and working in team settings