CBMS332

Protein Discovery and Analysis

S1 Day 2014

Chemistry and Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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Credit points
3

Prerequisites
6cp from CBMS200-CBMS233

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 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 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

Be able to describe biomolecular forms and architectures

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

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

Assessment Tasks

Name	Weighting	Due
Final examination	40%	University examination period
Laboratory reports	30%	28April, 5May, 26May
Mid-year exam	10%	14April
Pet Protein Structure	20%	3June or 10June

Final examination

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

This written exam is based on problem-solving exercises.

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 and interpret 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. Handwritten work will not be accepted.

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.

Laboratory reports must 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.

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

Mid-year exam

Due: **14April**
Weighting: **10%**

A protein purification scenario and questions will be uploaded in Week 6 for a three-day period. This task will test material covered within lectures 1-10.

Hand-written responses will be required from each student. It must be submitted via the assignment box located in the Science Centre (Room 101, Building E7A. Submission must include a completed and signed cover sheet stapled to the front cover.

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

Pet Protein Structure

Due: **3June or 10June**
Weighting: **20%**

This is assessment of your research and analytical skills, and continues throughout the semester to enhance each topic area.

You will be assigned an individual “Pet Protein” as a basis for structural analysis during Week 7. Details are given in the follow pages outlining this case study project.

As well as presenting analysis of your own case study in written form, you will be required to transmit your understanding of the individual protein to your fellow students via seminars and presentation of your own constructed three-dimensional protein model:

Pet Protein (Structure), seminar & questions	10%
Pet Protein model: **due at seminar**	10%

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
- Be able to describe biomolecular forms and architectures
- Develop presentation skills (written, oral) relevant in biomedical science

Delivery and Resources

Your classes

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

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.

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

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.

Weekly tutorials for problem-solving exercises aimed at the post-graduate group of students (Friday 11 am or 12pm), will be optionally open to the CBMS332 group. In the last weeks of semester, additional lectures may be delivered in this Tutorial hour.

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 in 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. L**atecomers may be excluded from class.**

Weeks 1-5		-		
Week 6	8Apr	**PRACTICAL: Mass spectrometry informatics**		2-6 pm all students (E4B 118)
	11Apr		mid-semester test (online)	332 students
mid-sem break	14 Apr	-	*mid-semester hand-in*	332 students
	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	20May	**WORKSHOP: Searching the primary literature**		2-5pm, 332 students (E4B 118)
Week 11	26May	-	*MolG report due*	all students
	27May	**FILM: DNA-Life story**		all students (venue tba)
Week 12	27May	**SEMINARS: Pet Protein (Tertiary structure)**		2-6pm, GRP **A** (venue tba)
	28May	**SEMINARS: Pet Protein (Tertiary 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

Methods of protein isolation and characterisation will be tested by a mid-semester test rather than a research report. This exam will test material covered within lectures 1-10.

Molecular graphics practical will report as a reflective essay, not a formal practical report.

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

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 outcome

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

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

- 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

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

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

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

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

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

- Be able to describe biomolecular forms and architectures
- Develop presentation skills (written, oral) relevant in biomedical science

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

- Be able to describe biomolecular forms and architectures
- Develop presentation skills (written, oral) relevant in biomedical science