CBMS832

Protein Discovery and Analysis

S1 Day 2017

Dept of Chemistry & Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
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Credit points
4

Prerequisites
Admission to MBiotech or MBiotechMCom or MLabQAMgt or MRadiopharmSc or MSc or MBioBus

Corequisites

Co-badged status

Unit description
This unit outlines molecular principles underlying today's developments in protein science and biomedical research. As well as detailing modern separation technologies, the course addresses structural biology, protein analysis and bioinformatics. Practices common in the biotechnology and pharmaceutical industries to isolate recombinant proteins are emphasized. Analysis methods are introduced in relation to proteomics, genomics and biochemical research. Molecular properties leading to the 3D shape of proteins are detailed, and contemporary structure methods outlined.

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:

Assimilate and interpret methods used today to isolate and handle proteins

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

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

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 a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence

General Assessment Information

Three modes of assessment are used to determine your progress in CBMS832.

Assessment Tasks

Name	Weighting	Hurdle	Due
Final examination	40%	No	University Examination period
Protein workshop report	15%	No	May 1
Molecular graphics practical	10%	No	May 26
“Pet Protein” case project	35%	No	June 7

Final examination

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

- This written exam will incorporate problem-solving exercises and short essays.
- The paper will be scheduled within the University Examination period for First Half Year 2017. All students must ensure that they are available until the final day of this official examination period.

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Protein workshop report

Due: **May 1**
Weighting: **15%**

- A full report must be made of your experimental data and **discussion and analysis** of your findings. Separate sections for Aims; Methods; Results & Discussion; References must all be included.
- Submit the report via the assignment box located in the FSE student centre (Level 2, MUSE building C7A) including a completed and signed cover sheet stapled to the front cover.
- Electronic submission to the Turnitin program (see iLearn site) is also required for this task by the due date.
- Bibliography listings must conform to an acceptable style (for guidance, see http://libguides.mq.edu.au/Referencing Mq library link), or the reports will be returned unmarked for correction and re-submission.

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Molecular graphics practical

Due: **May 26**
Weighting: **10%**

- In addition to filling in the worksheets on the day of the practical, a specific reflective tasks will be assigned and must be submitted via the assignment box located in the FSE student centre (Level 2, MUSE building C7A) including a completed and signed cover sheet stapled to the front cover.
- Electronic submission of the reflective essay on the Turnitin program (see iLearn site) is also required for this task by the due date.
- Marks will be deducted for reports handed in after the due date (10% of the total mark/ day).

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“Pet Protein” case project

Due: **June 7**
Weighting: **35%**

- This is assessment of your research and analytical skills, and continues throughout the semester to enhance each topic area.
- Your individual topic for the term “Pet Protein” project will be distributed in the practical session of Week 3. 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 A: Purification, written report: **due Apr 10 -** 15%
    - Pet Protein B: Structure, model, seminar & questions: **due June 7,** model - 10% and presentation - 10%
- Overall, project work will be assessed according to:
    - the quality and extent of your research
    - the depth and **molecular detail** of your analysis
    - appropriate use of internet tools
    - the clarity of your communication (verbal and written) and molecular analysis
    - the extent to which your model successfully shows the shape and form of your protein **in three-dimensions**
    - correct bibliography layout (i.e. alphabetical or numbered listing), with reference to all primary source material (i.e. journal articles, not web-based information).

On successful completion you will be able to:

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vitro

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Delivery and Resources

Classes:

- Lectures will be twice weekly: **Tuesday (9 am)** in **W5C 320** and **Wednesday (9 am)** in **W5C 220.**
- The course syllabus is defined by the subject material presented in all lectures (including guest lectures) and practicals, much of which is beyond standard textbooks.
- From week 2, tutorials run for all students thrice a week: **Tuesday (10 am)** in **W6B 382, Tuesday (12pm)** in **E7B 200** and **Wednesday (5 pm)** in **E5A 120.** These are structured as problem-solving workshops. You are required to attend for *either* of the three sessions.

Laboratory Sessions:

A block chromatography workshop (workshop_1 to workshop_5) is scheduled in the first week of mid-semester break, i.e. from April 18 – 21 and April 24.

*CBMS 832 students are required to attend ONLY Workshop 3 and 4 scheduled for **Apr 20-21**, (Thur-Fri).*

- During session, **practicals** (named Practical_1 in the University timetable) are scheduled on several **Wednesday afternoons (11am-3pm).** You will attend for 4 afternoons, according to your allocated laboratory group (detailed in the table below).
- You will be allocated a lab group (Group 3 or Group 4) by the Unit convenor and communicated via the iLearn interface.
- Participation is compulsory on the allocated days of class. If you are sick, please consult with the Unit Convenor to ensure all laboratory and project work is completed. Outstanding reports 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.**

- You are not permitted to change groups during semester.

Required and Recommended texts

- **The textbook of which you are expected to purchase a personal copy is: "Physical Biochemistry: Principles and Applications", David Sheehan, John Wiley (2nd ed, 2002).** Online access of the text is available on the MQ Library website.
- Because of the multidisciplinary nature of this course, you will be expected to read more widely than this, however. The library has an excellent collection of up-to-date reference material to cover the course and laboratory subjects - explore it!!
- 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, 2009
    - "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, 2013
    - 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/
- www.expasy.org/proteomics
- www.ncbi.nlm.nih.gov/pubmed
- www.rcsb.org/pdb

Technology Requirements

- You will require access to the internet and have a computer available for accessing the iLearn site, web browsing, preparation of your reports and presentations (Word and

PowerPoint software), molecular viewing and case study analysis. Printer access is required to generate hard copy of reports.

- Your project and laboratory reports will be electronically submitted via the online Turnitin program within the CBMS332/732/832 iLearn portal.
- 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 strong emphasis on correct referencing style in all your reports. Use of the program EndNote (http://libguides.mq.edu.au/EndNoteMac, http://libguides.mq.edu.au/EndNotePC) 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.

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; mass spectrometry; sugar/glycoprotein analysis
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

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_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

Disruption to Studies Policy (in effect until Dec 4th, 2017): 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/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

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

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise

- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://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

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:

Assessment task

- Final examination

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

- Assimilate and interpret methods used today to isolate and handle proteins
- Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro
- Develop presentation skills (written, oral) relevant in biomedical science
- Gain hands-on practical experience in protein characterisation, and competency with

contemporary web tools
- Develop a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics practical
- “Pet Protein” case project

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

- Assimilate and interpret methods used today to isolate and handle proteins
- Comprehend the molecular behaviour of proteins (gene products), both in vivo and in vitro
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- Gain hands-on practical experience in protein characterisation, and competency with contemporary web tools
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Assessment tasks

- Final examination
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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

- 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

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics practical
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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 outcome

- Be able to describe biomolecular forms and architectures

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics practical
- “Pet Protein” case project

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

- Be able to describe biomolecular forms and architectures
- Develop a sound knowledge of protein structure and how it is encoded in a protein (or gene) sequence