CBMS332

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
3

Prerequisites
6cp from CBMS200-CBMS233

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 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 analyze and 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

General Assessment Information

- Four modes of assessment are used to determine your progress in CBMS332.

Assessment Tasks

Name	Weighting	Hurdle	Due
Final examination	40%	No	University Examination period
Protein workshop report	15%	No	May 1
Molecular graphics report	10%	No	May 15
Take-home mid-year exam	15%	No	April 10
“Pet Protein” Structure	20%	No	May 31

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:

- Assimilate and interpret methods used today to isolate and handle proteins
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- 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 analyze and describe biomolecular forms and architectures

Protein workshop report

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

- A full report must be made of 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.
- Marks will be deducted for reports handed in after the due date (10% of the total mark/ day).

On successful completion you will be able to:

- Assimilate and interpret methods used today to isolate and handle proteins
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Molecular graphics report

Due: **May 15**
Weighting: **10%**

- Submit the work-sheets filled on the day of practical.
- Marks will be deducted for reports handed in after the due date (10% of the total mark/ day).
- All marked work will be returned via FSE student centre, generally within 3 weeks.

On successful completion you will be able to:

- Assimilate and interpret methods used today to isolate and handle proteins
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- Extract and interpret information from a variety of scientific sources concerning proteins
- Develop presentation skills (written, oral) relevant in biomedical science

Take-home mid-year exam

Due: **April 10**
Weighting: **15%**

- A protein purification scenario and questions will be uploaded for a three-day period (**April 7-9**). This task will test material covered within lectures 1-12.
- Hand-written responses will be required from each student and must be submitted via the assignment box located in the FSE student centre (Level 2, MUSE building C7A). Submissions must include a completed and signed cover sheet stapled to the front cover.
- Turnitin submission is not required for this task.
- Marks will be deducted for reports handed in after the due date (10% of the total mark/ day).

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

“Pet Protein” Structure

Due: **May 31**
Weighting: **20%**

- This is assessment of research and analytical skills, and continues throughout the semester to enhance each topic area.
- Students will be assigned an individual “Pet Protein” as a basis for structural analysis during Week 6.
- You are 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:
- 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**

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 analyze and 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

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 332 students are required to attend ONLY Workshop 1 and 2 scheduled for **Apr 18-19**, (Tue-Wed).*

- 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.
- You will be allocated a lab group (Group 1 or Group 2) 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

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

Assessment tasks

- Protein workshop report
- Molecular graphics report
- “Pet Protein” Structure

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

- 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 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

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics report
- Take-home mid-year exam

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

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics report
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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

- Assimilate and interpret 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

Assessment tasks

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

Assessment tasks

- Final examination
- Protein workshop report
- Molecular graphics report
- Take-home mid-year exam
- “Pet Protein” Structure