CBMS332

Protein Discovery and Analysis

S1 Day 2016

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:

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

General Assessment Information

Five modes of assessment are used to determine your progress in CBMS332. **Satisfactory (i.e pass level) performance must separately be achieved in all four of the assessment areas to pass this Unit.**

Assessment Tasks

Name	Weighting	Due
Final examination	40%	University Examination period
Laboratory reports	25%	May 6, May 26
Take-home mid-year exam	10%	Apr 11
"Pet Protein" Structure	15%	June 2 or June 9
Class quizzes	10%	periodic

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
- 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

Laboratory reports

Due: **May 6, May 26**

Weighting: **25%**

- For the Protein Chromatography practical (**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.
- For the Molecular graphics practical (**10%**), specific reflective tasks will be assigned.
- Bibliography listings must conform to an acceptable style (for guidance, see www.mq.edu.au/on_campus/library/research/referencing), or the reports will be returned unmarked for correction and re-submission.
- All written work (assignments and lab reports) are to 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.
- All work must also be submitted in electronic form to the Turnitin program (see iLearn site) by the due date.
- Marks will be deducted for reports handed in after the due date (10% of the total mark/ day).
- 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
- 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
- Develop presentation skills (written, oral) relevant in biomedical science

Take-home mid-year exam

Due: **Apr 11**
Weighting: **10%**

- A protein purification scenario and questions will be uploaded in second week of mid-semester break (April 7) for a three-day period**.**
- This task will test material covered within lectures 1-12. Hand-written responses will be required from each student.

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

“Pet Protein” Structure

Due: **June 2 or June 9**
Weighting: **15%**

- 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 6. Details are given in the following pages outlining this case study project.
- 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 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

Class quizzes

Due: **periodic**
Weighting: **10%**

- Short quizzes will be used to assess your understanding of the course content. These must be completed in the class. They contribute to your final course grading.

On successful completion you will be able to:

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

vitro

- Be able to describe biomolecular forms and architectures

Delivery and Resources

Your Classes

- Lectures will be twice weekly: **Thursday (9 am)** in **E6A 102 theatrette** and **Thursday (1 pm)** in **W5C 320.**
- **It is essential that you be available to attend all the classes in person. 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 lecture through illness or misadventure, please contact Dr Shah in iLearn to organise access to the relevant lecture file.
- iLectures will be released for revision purposes from teaching week 12.
- 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 twice a week**.** These are structured as problem-solving workshops. You are required to attend for *either* of the two days. An additional lecture may be delivered in these tutorial hours.

Laboratory Sessions

- **A block practical** is scheduled in the first week of mid-semester break, i.e. from **April 11 – 15.** You will be allocated a lab group by the Unit convenor and be required to attend for *either* Mon-Wed (Apr 11-13) or Wed-Fri (Apr 13-15) of the practical week.
- During session, **workshops** (named Practical_1 in the University timetable) are scheduled on several **Thursday afternoons (2-6 pm).** You will attend for 3 afternoons, according to your allocated laboratory group.
- Attendance 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.**

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).

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/**

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.

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.

Unit Schedule

Lectures

1 - 3	FUNCTIONAL GROUPS IN PROTEINS
4	ISOLATING BIOMOLECULES
5 & 6	SEPARATION OF PROTEINS
7 & 8	PROTEIN ANALYSIS
9	FLUORESCENCE TECHNOLOGIES (LB)
10 - 13	CHROMATOGRAPHY FOR PURIFICATION
14	PROTEIN ANALYSIS (cont.)
15 - 17	PROTEIN FOLDS AND DOMAINS
18 - 20	TERTIARY STRUCTURE DETERMINATION
21 & 22	HOW PROTEINS FOLD IN SOLUTION
23 & 24	BIOINFORMATICS
25	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

New Assessment Policy in effect from Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy_2016.html. For more information visit http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/

Assessment Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy prior to Session 2 2016 http://mq.edu.au/policy/docs/grading/policy.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 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/

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

Assessment tasks

- Laboratory reports
- “Pet Protein” Structure

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Assessment task

- Final examination

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

Assessment tasks

- Final examination
- Laboratory reports
- Take-home mid-year exam
- Class quizzes

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
- Laboratory reports
- Take-home mid-year exam

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

Assessment tasks

- Final examination
- Laboratory reports
- “Pet Protein” Structure

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

Assessment tasks

- Final examination
- Laboratory reports
- Take-home mid-year exam
- “Pet Protein” Structure