CBMS793

Research Topic: Advanced Biomolecular Analysis

S2 Day 2014

Chemistry and Biomolecular Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
Mark Molloy
mark.molloy@mq.edu.au
Contact via mark.molloy@mq.edu.au

Instructor
Nicki Packer
nicki.packer@mq.edu.au
Contact via nicki.packer@mq.edu.au

Instructor
Ian Paulsen
ian.paulsen@mq.edu.au
Contact via ian.paulsen@mq.edu.au

Instructor
Bhumika Shah
bhumika.shah@mq.edu.au

Credit points
4

Prerequisites
Admission to MRes

Corequisites

Co-badged status

Unit description
This unit addresses some advanced methods of analysis utilised in the biomolecular sciences. Biomolecular sciences spans the study of individual molecular structures and biochemical reactions to also encompass the 'omics' sciences of genomics, proteomics, metabolomics and glycomics. These sciences all generate large and complex datasets that require specialized programs and methods to assemble and analyse. The analyses are challenging, as they not only require a good knowledge of biochemistry, molecular biology, and cell and developmental biology, but also an understanding of limitations of both the programs and the data quality. This unit will provided a background to the data acquisition methods, quality control of the datasets, and analysis methods within a number of these areas. Most importantly it will provide hands-on experience in the analysis of real large-scale datasets and the correct use of the appropriate analysis tools available.

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:

Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods

Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis

Process the datasets to give a broad overview of data in terms of size, quality and utility for further analysis

Learn how to analyze the dataset and compare it with established information about the system under investigation

Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

General Assessment Information

- All written work must be submitted via the assignments box located in the Science Centre (E7A 101). Submission must include a completed and signed cover sheet stapled to the front cover.
- Late submissions **will** be penalised with 10% loss of the maximum mark for each day past the deadline. More than 5 days late will result in 0 marks awarded unless **Disruption to Studies application** has been requested.
- If there is any medical reason why you cannot submit work on time you should lodge a

Disruption of Studies application, otherwise your mark will be penalized for lateness.

Assessment Tasks

Name	Weighting	Due
Quantitative MS techniques	10%	21st August
Molecular Graphics Structures	10%	18th Sept 2014
Proteomics Data Report	20%	26th Sept 2014
Genomics Data Presentation	20%	24th Oct
Glycomics Data Report	10%	20th Nov 2014
Final Examination	30%	TBD

Quantitative MS techniques

Due: **21st August**
Weighting: **10%**

From the primary literature discuss in an oral presentation (15min) an example of a quantitative MS technique, focused on the technical aspects and data generated.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Molecular Graphics Structures

Due: **18th Sept 2014**
Weighting: **10%**

Students will produce a protein structure and animation using PyMOL software.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Learn how to analyze the dataset and compare it with established information about the

system under investigation
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Proteomics Data Report

Due: **26th Sept 2014**
Weighting: **20%**

1. (7.5%) Students will be given a proteomic dataset from an iTRAQ expt. Use software tools to identify differentially expressed proteins. Carryout data mining and pathway analysis to demonstrate basic impact on cell biology.
2. (12.5%) Students will be given a proteomic dataset from an MRM expt. Peak areas will be exported for use in Excel. Determine mean, S.D. and CV for each assay. Identify differentially expressed proteins amongst 2 groups.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Process the datasets to give a broad overview of data in terms of size, quality and utility for further analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Genomics Data Presentation

Due: **24th Oct**
Weighting: **20%**

Students to be given two genome datasets. These are to be analysed following guidelines presented in the tutorials. The outcomes of these results are to be given as an Oral Presentation of 12min plus 3min question time.

On successful completion you will be able to:

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and

the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Process the datasets to give a broad overview of data in terms of size, quality and utility for further analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Glycomics Data Report

Due: **20th Nov 2014**
Weighting: **10%**

Students will be given a related glycomics and glycoproteomics dataset from LC-MS/MS analyses of purified human immunoglobulin (IgG). Use software tools to determine the monosaccharide composition of the carbohydrates (N-glycans) linked to IgG, their relative abundances and where they are linked to the IgG polypeptide backbone.

On successful completion you will be able to:
- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Final Examination

Due: **TBD**
Weighting: **30%**

Problem solving, essays and short answers

On successful completion you will be able to:
- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods

- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Delivery and Resources

This unit uses team-based teaching in the form of 'lectorials' that encompass both lectures and hands-on experiences in data analysis. The tutors are actively involved in research activities to bring knowledge from real-world experiences in their respective fields. All tutorials take place on Thursday 2-6pm in F7B433 unless otherwise instructed. Tutorials will NOT be recorded. You must attend these tutorials to gain practical experience with data analysis. As some of the assessment is based on your practical use of specific software it is essential that you attend these classes.

It is expected that each student will bring to class a laptop PC computer to install data analysis software, or prior arrangements will be made with the convenor.

Students are encouraged to post and answer questions using the iLearn site.

Unit Schedule

Week	Date	Title	Lecturer
Proteomics			
1	Thurs 7th Aug	Unit overview	MM
		Introduction to quantitative protein mass spectrometry techniques	MMcKay
2	Thurs 14th Aug	Principles of quantitative experiment design and statistical analysis	MM
		Advanced MS workflows	MM, MMcKay
3	Thurs 21st Aug	Pathway mapping and data mining	DP, AG

4	Thurs 28th Aug	Targeted mass spectrometry (assay development, quantitation principles, SID, absolute quant)	MMcKay
5	Thurs 4th Sept	Review targeted MS	MMcKay
Molecular Graphics for protein structure			
6	Thurs 11th Sept	Introduction to PyMOL molecular graphics	BM, BS
7	Thurs 18th Sept	Molecular graphics II	BM, BS
Mid-Semester Break 22 Sept-3rd Oct			
Genomics			
8	Thurs 9th Oct	Genomics Introduction Community Phylogenetics (16S amplicon)	IP, SM
9	Thurs 16th Oct	Review analysis of 16S amplicon data Metagenomic sequencing	IP, SM
10	Thurs 23rd Oct	Review metagenomic analysis	IP, SM
11	Thurs 30th Oct	Oral Presentations	IP, SM
Glycans and Glycoproteins			
12	Thurs 6th Nov	Introductory Glycan and Glycoprotein analysis	NP, MA
13	Thurs 13th Nov	Glycan Databases and Analysis	NP, MC

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.ht

ml

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

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Process the datasets to give a broad overview of data in terms of size, quality and utility for further analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation

Assessment tasks

- Quantitative MS techniques
- Molecular Graphics Structures
- Proteomics Data Report
- Genomics Data Presentation
- Glycomics Data Report
- Final Examination

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

- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis

- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Assessment tasks

- Quantitative MS techniques
- Molecular Graphics Structures
- Proteomics Data Report
- Genomics Data Presentation
- Glycomics Data Report
- Final Examination

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

- Process the datasets to give a broad overview of data in terms of size, quality and utility for further analysis
- Learn how to analyze the dataset and compare it with established information about the system under investigation

Assessment tasks

- Molecular Graphics Structures
- Proteomics Data Report
- Genomics Data Presentation
- Glycomics Data Report
- Final Examination

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

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Assessment tasks

- Quantitative MS techniques
- Proteomics Data Report
- Genomics Data Presentation
- Final Examination

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

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Assessment tasks

- Quantitative MS techniques
- Molecular Graphics Structures
- Proteomics Data Report
- Genomics Data Presentation
- Final Examination

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

- Knowledge of appropriate techniques used in acquiring large biomolecular datasets and the limitations of the use of these methods
- Familiarisation with experiment design and critically assess the quality of large biomolecular datasets prior to in-depth analysis
- Demonstrate an ability to effectively report and draw new conclusions about a biomolecular system from analytical data

Assessment tasks

- Quantitative MS techniques
- Molecular Graphics Structures
- Proteomics Data Report
- Genomics Data Presentation
- Glycomics Data Report
- Final Examination