

# Collecting, Analysing and Interpreting Big Data in Biology

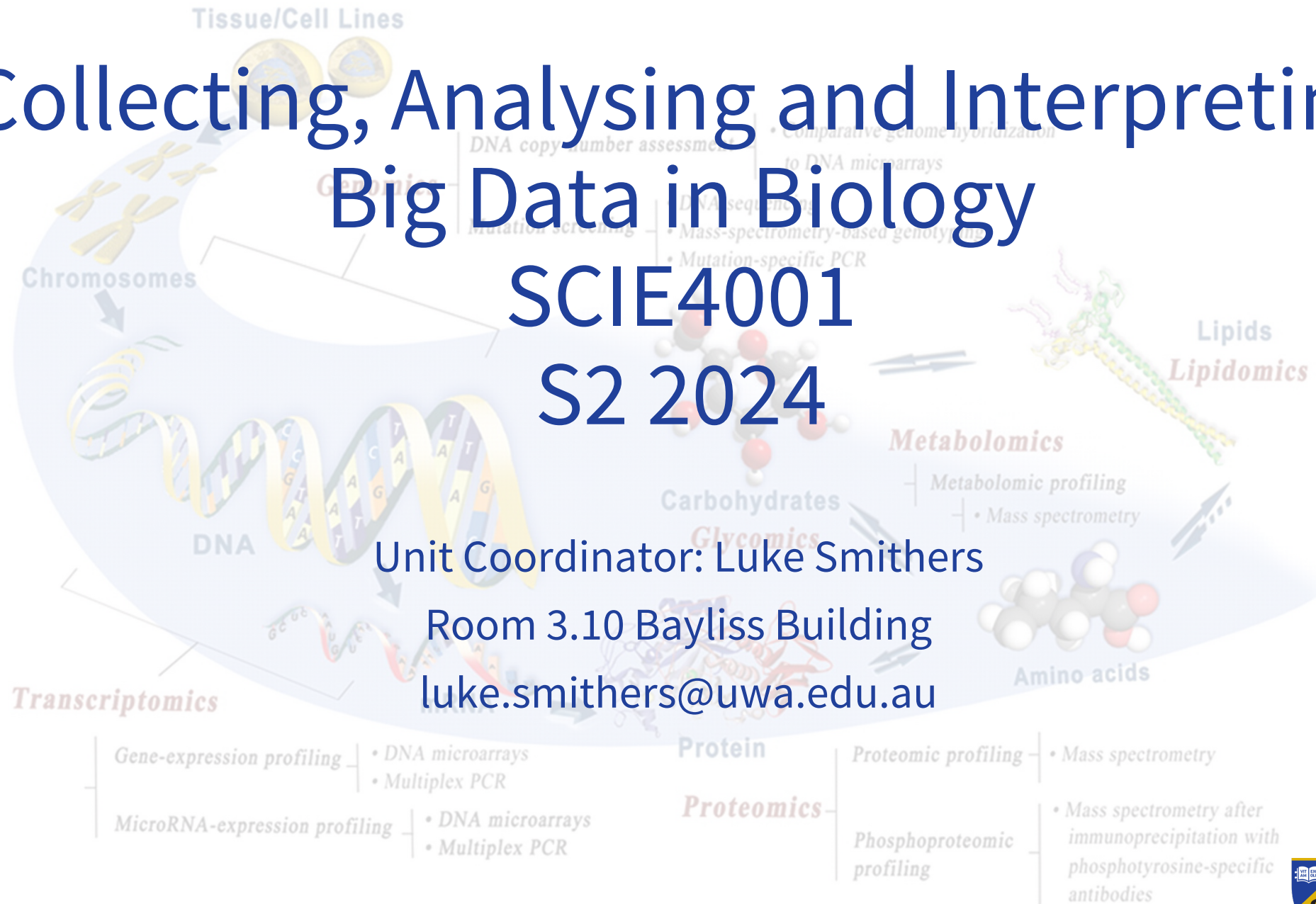
SCIE4001

S2 2024

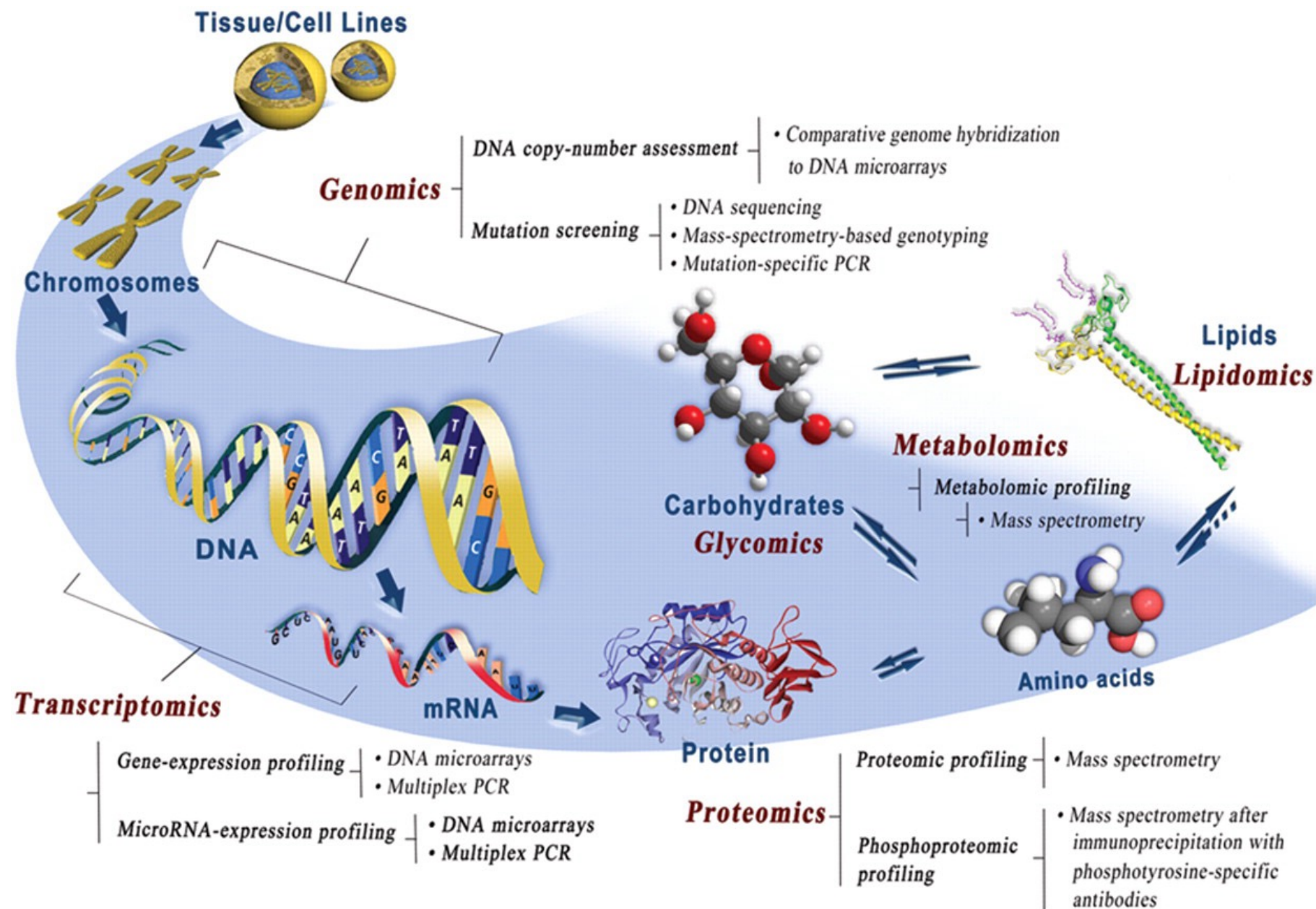
Unit Coordinator: Luke Smithers

Room 3.10 Bayliss Building

[luke.smithers@uwa.edu.au](mailto:luke.smithers@uwa.edu.au)



THE UNIVERSITY OF  
**WESTERN**  
AUSTRALIA



# Collecting, Analysing and Interpreting **Big Data** in Biology

**Big Data** = large, massively parallel datasets that require specialised tools and software to analyse.

Often:

- Undirected “discovery” science (“what happens if...”)
- Quantity and broad-scope noisy data, rather than precision experiments
- ... but can inform precision experiments!
- Data can be mined or re-processed for all sorts of hypothesis testing beyond original goal

Recommended reading: <https://doi.org/10.7554/eLife.47381>





# Collecting, Analysing and Interpreting Big Data in Biology

This unit contains modules on the objectives and applications of cutting-edge genomic approaches including geno/phenotyping, genomics, epigenomics, transcriptomics, proteomics and metabolomics.

You will gain an understanding of how cutting-edge genomics experiments are planned and carried out, what information they reveal and how they impact the biology of the system being studied.

The background features a complex diagram illustrating the flow of biological data. At the top, 'Tissue/Cell Lines' are shown as yellow spheres. Arrows lead to 'Chromosomes' (represented by yellow and blue helices) and 'DNA' (a blue double helix). From 'DNA', arrows point to 'Genomics' (with sub-points: DNA copy-number assessment, Comparative genome hybridization to DNA microarrays, DNA sequencing, Mutation screening, Mass-spectrometry-based genotyping, and Mutation-specific PCR). Other arrows lead to 'Lipids' (green spheres), 'Carbohydrates' (red and white spheres), and 'Amino acids' (blue and white spheres). These lead to 'Lipidomics', 'Glycomics', and 'Proteomics' respectively. 'Proteomics' includes sub-points: Multiplex PCR, DNA microarrays, and Mass spectrometry after immunoprecipitation with phosphotyrosine-specific antibodies. 'Metabolomics' is also shown with sub-points: Metabolomic profiling and Mass spectrometry. The entire diagram is set against a light blue circular backdrop.

# Collecting, Analysing and Interpreting Big Data in Biology

You will learn:

- How omics experiments are planned and executed (**collecting**)
- What kinds of data are generated by these experiments and how that data is interpreted (**analysing and interpreting**)
- Discuss what impacts omics data has on biology (**what do we learn?**).

# Lecture Schedule

**Tuesday 23 July 2024** (*Semester Week 1, Calendar week 30*)

**Module 1**

Genotype to Phenotype	1.5 hours	9-10.30 am	(MM)	BAYL 2.15 (Seminar Room)
Genotype to Phenotype Application	1.5 hours	10.30-12 pm	(MM)	BAYL 2.15 (Seminar Room)

**Tuesday 23 July 2024** (*Semester Week 1, Calendar week 30*)

**Module 2**

Transcriptomics	1.5 hours	1-2.30 pm	(RL)	BAYL 2.15 (Seminar Room)
Transcriptomics Application	1.5 hours	2.30-4 pm	(MW)	BAYL 2.15 (Seminar Room)

**Tuesday 30 July 2024** (*Semester Week 2, Calendar week 31*)

**Module 3**

Genomics	1.5 hours	9-10.30 am	(DE)	BAYL 2.15 (Seminar Room)
Genomics Application	1.5 hours	10.30-12 pm	(DE)	BAYL 2.15 (Seminar Room)

**Tuesday 30 July 2024** (*Semester Week 2, Calendar week 31*)

**Module 4**

Metabolomics	1.5 hours	1-2.30 pm	(NT)	BAYL 2.15 (Seminar Room)
Metabolomics Application	1.5 hours	2.30-4 pm	(NT)	BAYL 2.15 (Seminar Room)

**Tuesday 6 August 2024** (*Semester Week 3, Calendar week 32*)

**Module 5**

Epigenomics	1.5 hours	9-10.30 am	(RL)	BAYL 2.15 (Seminar Room)
Epigenomics Application	1.5 hours	10.30-12 pm	(RL)	BAYL 2.15 (Seminar Room)

**Tuesday 6 August 2024** (*Semester Week 3, Calendar week 32*)

**Module 6**

Proteomics	1.5 hours	1-2.30 pm	(NT)	BAYL 2.15 (Seminar Room)
Proteomics Application	1.5 hours	2.30-4 pm	(NT)	BAYL 2.15 (Seminar Room)

**Wednesday 7 August 2024** (*Semester Week 3, Calendar week 32*)

Research Skills & UWA Library	1 hour	2-3 pm	(RA)	BAYL 2.15 (Seminar Room)
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**Teaching staff**

MM – Monika Murcha

DE – Dave Edwards

NT – Nic Taylor

RL – Ryan Lister

MW – Mark Waters

RA – Rosemary Archondakis

# Assessments

Item	Weight	Description	Release Date	Due Date
Assignment 1 on Module 1 2 Questions (of 3 Options)	Formative Assessment	Receive a Mark and Plagiarism Assessment.  Provides opportunity to discuss answers with Lecturer	Tuesday 30th July 2024 09:00	Tuesday 13th August 2024 23:59 [2 weeks]
Assignment 2 on Modules 2 and 3. 2 Questions (of 4 Options)	25%	Students Answer 2 Questions (of 4 options) associated with both Modules	Tuesday 6th August 2024 09:00	Tuesday 10th September 2024 23:59 [5 weeks]
Assignment 3 on Modules 4, 5 and 6. 3 Questions (of 6 Options)	45%	Students Answer 3 Questions (of 6 options) associated with all three Modules	Tuesday 27th August 2024 09:00	Tuesday 8th October 2024 23:59 [6 weeks]
Oral presentation	30%	10 minute group video presentation on a publication relevant to one of the Modules.		Monday 16th September 2024 23:59

# Student Group Presentations

A research journal article related to each module will be made available on LMS for you to review and choose which paper you would like to present as part of a group presentation. Students will be evenly divided between topics based on a first-come, first-assigned basis following an email indicating the module preference to the Unit Coordinator (Luke Smithers, [luke.smithers@uwa.edu.au](mailto:luke.smithers@uwa.edu.au)). Students will then be assigned to groups of 3 to 4 with similar topic preferences. The groups will then meet with the module lead on **Monday 12 August 2023** (please see Presentation Preparation Program) to discuss the paper and for the module lead to provide guidance on what should be presented and what background research should be presented. You will then work as a group to prepare a 10 minute video presentation on your assigned paper.

## SCIE4001 Tutorial/Presentation Program

3-4 persons per group, one topic per group.

Each group will deliver a 10-minute pre-recorded presentation.

### Monday 12 August 2024 (Week 33) Presentation Preparation

Module	Time	Where	Module Lead
1. Genotype to Phenotype	09:00 – 10:00	Bayliss 2.15 ± MS Teams	MM
2. Genomics	10:00 – 11:00	Bayliss 2.15 ± MS Teams	DE
3. Metabolomics	11:00 – 12:00	Bayliss 2.15 ± MS Teams	NT
4. Proteomics	13:00 – 14:00	Bayliss 2.15 ± MS Teams	NT
5. Transcriptomics	14:00 – 15:00	Bayliss 2.15 ± MS Teams	MW
6. Epigenomics*	TBC	TBC	RL

\*Prof Ryan Lister is unavailable on this date and the preparation session will be arranged closer to the time.

-- 5 Week Gap --

### Monday 16 September 2024 (Week 38)

Assignment due – Submit your group presentation by email to your module lead by 11:59 pm:

MM – Monika Murcha – [monika.murcha@uwa.edu.au](mailto:monika.murcha@uwa.edu.au)

DE – Dave Edwards – [dave.edwards@uwa.edu.au](mailto:dave.edwards@uwa.edu.au)

RL – Ryan Lister – [ryan.lister@uwa.edu.au](mailto:ryan.lister@uwa.edu.au)

MW – Mark Waters – [mark.waters@uwa.edu.au](mailto:mark.waters@uwa.edu.au)

NT – Nic Taylor – [nicolas.taylor@uwa.edu.au](mailto:nicolas.taylor@uwa.edu.au)



# Student Group Presentation Papers on LMS

## Presentation Papers



### Module 1 Genotype to Phenotype

Attached Files: [presentation paper.pdf](#) (2.014 MB)   
[presentation paper supp files .pdf](#) (1.567 MB)



### Module 2 Genomics

Attached Files: [Bayer\\_The Plant Genome\\_2021 \(Genomics\).pdf](#) (1.396 MB)



### Module 3 Metabolomics

Attached Files: [GC-Orbi-MS protocol.pdf](#) (4.895 MB)



### Module 4 Proteomics

Attached Files: [PIIS096800042100027X.pdf](#) (1.683 MB)



### Module 5 Transcriptomics

Attached Files: [Real-A single-cell atlas of Plasmodium falciparum transmission through the mosquito.pdf](#) (1.396 MB)



### Module 6 Epigenomics

Attached Files: [Shawn Liu et al. - Rescue of Fragile X Syndrome Neurons by DNA Methylation Editing.pdf](#) (1.396 MB)



### Presentation Marking Rubric

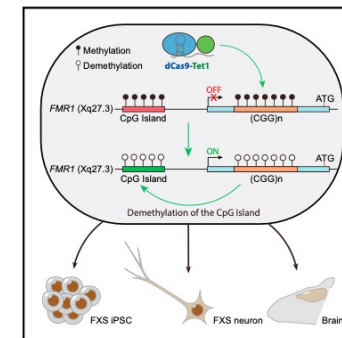
Attached Files: [Oral Presentation Rubric SCIE4001.pdf](#) (38.852 KB)

Cell

Article

## Rescue of Fragile X Syndrome Neurons by DNA Methylation Editing of the *FMR1* Gene

### Graphical Abstract



### Authors

X. Shawn Liu, Hao Wu, Marine Krzisch, ..., Angela Cacace, Richard A. Young, Rudolf Jaenisch

### Correspondence

jaenisch@wi.mit.edu

### In Brief

Rescue of fragile X syndrome neurons by CRISPR-mediated DNA methylation editing of the *FMR1* gene.

### Highlights

- Targeted demethylation of CGG repeats by dCas9-Tet1 reactivates *FMR1* in FXS cells
- Demethylation of CGG repeats induces an active chromatin status for *FMR1* promoter
- Methylation-edited FXS neurons behave similarly as wild-type neurons
- FMR1* reactivation by dCas9-Tet1 is sustainable in a human/mouse chimeric model

Liu et al., 2018, Cell 173, 1–14  
March 22, 2018 © 2018 Elsevier Inc.  
<https://doi.org/10.1016/j.cell.2018.01.012>

CellPress

SCIE4001 Collecting, Analysing and Interpreting Big Data in Biology SEM-2 2023

Unit Dashboard

Unit Readings

Unit Evaluation

## UNIT INFORMATION

Announcements

Unit Outline

Lecture Slides

Unit Information

Teaching Staff

## LEARNING CONTENT

Lecture Recordings

Presentation Papers

Digital Classroom Team

## ASSESSMENTS

Assignments

# Student Group Presentations



Contact Luke Smithers (luke.smithers@uwa.edu.au) with your **Topic preference** and **any clashes with the time slots** by **Thursday 8 August**. If no preference received, you will be assigned to a topic and group at random.



Schedule will be made available 1 week prior to presentation preparation sessions.



Attendance is encouraged at all presentations as these will help with you later assignments.

# Unit Reading material

- There is no one textbook that covers all the aspects of this course.
- The Lecturers may provide additional reading material; however, it is expected that **YOU** will research further learning in your own time.

**Lecture Timetable**  
Attached Files: [SCIE4001 Lectures 2023 v1.2.pdf](#)  (131.935 KB)

**Presentation Information**  
Attached Files: [SCIE4001 Presentations 2023 v1.0.pdf](#)  (116.68 KB)

**Library Information Literacy Skills Toolkit**   
Please find a link to the Library Information Literacy Skills Toolkit where you can find information about referencing and plagiarism

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# Maintaining Academic Integrity

**Academic misconduct** devalues the degree you are paying for, and leads to mistrust in the HE system. It also leads to a poor educational outcome. Would you like your doctor to have gained his/her degree by cheating?

Examples of serious academic misconduct include:

- **Submitting someone else's work as your own.** Includes online assignment services (contract cheating), previous students, friends...
- **Uploading/downloading assessments** and learning materials to file sharing websites
- **Copying and pasting from internet sources** *with or without proper citation.*
- **Collusion:** working together on an assessment item meant for individuals i.e. sharing answers or working together. *Discussion to aid understanding* is OK and encouraged, but submission of a jointly-authored piece of work is misconduct.
- **Use of generative AI (ChatGPT)** unless explicitly authorised in the assessment, and proper attribution given.



# Maintaining Academic Integrity

Breaches of academic integrity can come with severe penalties, including failing the unit. This is expensive both in time and money.

Remember: **it is better to be late than to cheat.**

For expectations for student conduct and ethical scholarship:

<https://www.uwa.edu.au/students/Getting-started/Student-conduct>

For advice on what constitutes academic misconduct, on how to avoid it, and for general advice on learning effectively, see the *StudySmarter* resources available at:

<https://www.uwa.edu.au/students/Support-services/Academic-support>