Macromolecular Evolution and Engineering – BIOL457/BCHM457 (2024)

AIM

In this course, we will examine how (and why) nature has evolved its repertoire of biological macromolecules (DNA, RNA, and proteins) to perform the functions of life. The last 50 years has seen an explosion in our knowledge of how these macromolecules function. Importantly, we are now able to design and build our own macromolecules for bespoke purposes—for example, enzymes to access to new synthetic methods, proteins as biosensors, and the design and engineering of new biosynthetic pathways in cells to produce biofuels. Thus, in parallel to learning how nature has evolved its macromolecule repertoire, we will also explore how we design new macromolecules; that is, synthetic biology. Within this context, we will consider a broader understanding of the social and cultural sensitivities to genetic engineering and use of native New Zealand genetic diversity.

During the course our aim is to encourage and provide advice and feedback to enable you to develop skills in written and oral communication, and in the efficient acquisition of scientific information. The course will involve group discussion, presentation of scientific papers, and preparation and critique of a review article.

PREPARATORY COURSE

BIOL331/BCHM301 (Biochemistry 3, or BCHM305, or BCHM306) and/or Protein Science (BCHM403), which is designed to be a compatible course run in S1. In addition, one from the following is highly recommended: BIOL313 (Microbiology), BIOL333 (Molecular Genetics) (or equivalent, as determined by the coordinator).

COORDINATOR

Ren Dobson, email renwick.dobson@canterbury.ac.nz

LECTURERS

Ren Dobson, contact details as above

Grant Pearce, email grant.pearce@canterbury.ac.nz

Jodie Johnston, email jodie.johnston@canterbury.ac.nz

Vanessa Morris, email vanessa.morris@canterbury.ac.nz

Tim Allison, email timothy.allison@canterbury.ac.nz

Christoph Goebl, email christoph.goebl@canterbury.ac.nz

SCHEDULE OF SEMINARS

The class will meet on Friday's from 1:00 p.m. – 3:00 p.m. in Psychology - Sociology 251 (**note** that timetabling may change this, so check). The schedule of seminars are as follows:

	Topic	Teacher	Date/Time
Seminar 1	Protein Engineering 1: engineering thermal stability	Grant Pearce	19th July
Seminar 2	Protein Engineering 2: engineering membrane proteins	Tim Allison	26th July
Seminar 3	Protein Engineering 3: designing enzymes	Jodie Johnston	2nd August
Seminar 4	Molecular Adaptation (assessed)	Ren Dobson	9th August
Seminar 5	Protein Engineering 4: Antibody therapy	Vanessa Morris	16th August
Seminar 6	Biomedical research	Christoph Goebl	23rd August

READING

Collecting readings for this course is your responsibility. For set seminars, readings will be provided in electronic form (available on Learn or emailed) or in a form that may be photocopied. All course announcements will be distributed by email and/or announced on Learn or in session.

ASSESSMENT

Assignment (due in Term 4)	45%
Research Talk (**seminar 4**)	10%
Exam	45%

Goals

The primary goal of this course is to assist student development as scholars and advance their research skills in fields of science that use molecular evolution and molecular design (*i.e.*, synthetic biology) to address a wide diversity of biological questions and problems. The course focuses on the critical evaluation of scientific methodology and how such methodology can be applied to engineer new biomolecules.

Learning Outcomes

As a student in this course, I will develop:

- A detailed understanding of how evolution selects for particular functions in a biomolecule (RNA/DNA/Proteins) (*assessment task: preparation of method summaries*)
- The ability to analyse and critically interpret experimental data and published research (*assessment task: data analysis exercises, oral presentations, exam*).
- Skills in the verbal and written presentation of scientific ideas (*assessment task: oral presentation, practical write-up, review and proposal*).
- An understanding of the scientific practice and principles of evolution and macromolecular science, and an appreciation of why the evolution of macromolecules is important in the new field of synthetic biology (*assessment task: oral presentations, review, proposal and exam*).
- A bicultural understanding relating to the area of genetic modification (gene engineering) and gene piracy in the context of New Zealand (the discovery and use of New Zealand specific fauna and flora in accessing new and novel genetic diversity) including recognizing the knowledge that comes from Maori about these species and sharing any knew knowledge we gain (*assessment task: scenario and consultation*).
- Synthesise and critically evaluate primary scientific literature to generate a clear and concise argument in support of a perspective (*assessment task: evaluation of a research paper*).

Transferable Skills Register

As a student in this course, I will develop the following skills:

- Experience in analysing protein science and evolutionary data generated using a variety of methods. There will also be the opportunity to gain experience in carrying out some of these experiments and using the equipment. *We will have tutorials looking at the analysis of protein science data, and you will be given the opportunity to analyse novel data.*
- Critical synthesis of information. In everyday life and in many job situations you will be required to read information from different sources, construct your own understanding and shape your own viewpoint. *In tutorials we will discuss recent macromolecular engineering and evolution research papers in a group environment and this will develop your abilities to assess the quality of the information, how methods are applied to research, and develop skills in working in a collaborative environment (providing a sense of Whanaungatanga).*
- Verbal presentation. In most careers in science the ability to present findings clearly in verbal form is likely to be critical. *In tutorial sessions we will provide clear guidance on what makes a good presentation and you will test these skills in small group sessions.*

	Critically competent	Employable, innovative and enterprising	Biculturally competent and confident	Engaged with the community	Globally aware
Macromolecular Evolution & Engineering	X	X	X		X

In planning activities and assessments for this course we will be guided by the descriptors for Level 8 of the NZQF:

Level Knowledge	Skills	Application
Advanced technical and/or theoretical knowledge in a discipline or practice, involving a critical understanding of the underpinning key principles	Analyse, generate solutions to complex and sometimes unpredictable problems Evaluate and apply a range of processes relevant to the field of work or study	Developing identification with a profession and/or discipline through application of advanced generic skills and/or specialist knowledge and skills Some responsibility for integrity of profession or discipline

RULES, REGULATIONS, AND WHAT TO DO WHEN THINGS GO WRONG

[updated March 2023]

If in doubt: ASK! The course coordinator is happy to answer questions. All staff involved in the course are available for advice on specific issues.

What do I do if I have to miss a test/exam or if my performance was impaired?
In Biological Sciences, we require a satisfactory level of achievement in both the theoretical aspects of the discipline and in practical activities. **This means you must attend all class activities (labs, tutorials, fieldtrips)** and submit all items of assessment unless you have a very good reason not to (e.g. medical reasons) and if this has been approved by your course coordinator.

If you feel that **illness, injury, bereavement or other extenuating circumstances beyond your control** prevented you from completing a **test/exam** worth 10% or more of the total course assessment, or if these circumstances affected your performance in such assessments, you should apply for Special Consideration. Applications for Special Consideration should be submitted via the Special Consideration website http://www.canterbury.ac.nz/study/special-consideration/ *within five working days* of the assessment or its due date. You should also notify the course coordinator. If you apply for Special Consideration because of medical reasons, you should visit a doctor within a reasonable timeframe (application form available on the website above or from the Student Health Centre).

The Special Consideration provisions are intended to assist students who have covered the work of a course but have been prevented by illness or other critical circumstances from demonstrating their mastery of the material or skills at the time of a text/exam – **they do not excuse you from doing the test/exam** within a reasonable time agreed with the course coordinator.

What do I do if I have to miss a quiz or assignment or if I need an extension?
You cannot apply for Special Consideration if you miss an assessment that is not a test/exam, such as a quiz, lab report, essay, literature review or other assignment, or if the test/exam is worth less than 10% or more of the total course assessment. If this happens or if you need an extension because of **illness, injury, bereavement or other extenuating circumstances beyond your control**, please contact the course coordinator and arrange an alternate activity and/or submission date. You should also do this if you have to miss a laboratory, tutorial or field trip.

What are other valid reasons to miss an assessment or mandatory course activity?
The Special Considerations policy (https://www.canterbury.ac.nz/about/governance/ucpolicy/student/special-consideration-procedures-and-guidelines/) outlines only a few kinds of activities that UC considers valid reasons for missing an assessment or mandatory course activity other than those outlined above. These include **involvement in international or national representative sport or cultural groups.** Holiday trips, birthday parties, weddings, work-related commitments etc. are not given special status in this University policy. Please contact your course coordinator to ask for an alternate activity and/or submission date if you are eligible.

Special Consideration for late discontinuation of a course
Students prevented by **extenuating circumstances** from completing the course after the final date for withdrawing, may apply for Special Consideration for late discontinuation of the course. Applications must be submitted via http://www.canterbury.ac.nz/study/special-consideration/ no later than five working days after the examination period has finished.

Academic Integrity
It is the responsibility of each student to be familiar with the definitions, policies and procedures concerning academic misconduct/dishonest behaviour. Instances of academic misconduct will be dealt with in a serious and appropriate manner. Students should refer to: https://www.canterbury.ac.nz/about/ako/academic-quality/academic-integrity/

Plagiarism
It is essential that you are aware that plagiarism is considered a very serious offence by the academic community, the University and the School of Biological Sciences. Plagiarism is defined as taking content from another work or author and presenting it, without attribution, as if it is your own work. Content here includes text (sentences or major parts of sentences), display items (graphs and tables), and overall structure (the detailed sequence of ideas). Plagiarism includes:

- re-use of previous assignments (even if each individual sentence has been rephrased to say the same thing in different words, if the overall structure is re-used).
- copying of another student's work (with or without their consent).
- the unreferenced use of published material or material from the internet, e.g. cutting and pasting of paragraphs or pages into an essay.
- the generation of text using artificial intelligence technology without disclosure and when it is not intended to be part of an assignment.

For most pieces of in-term assessment you will be given information concerning the use of direct and indirect quotes from previously published work. If you have any doubt about the appropriate use of published material, please speak with an academic staff member. If you are unsure what plagiarism is, seek advice.

It is a School policy that courses will likely that you submit work electronically for subsequent analysis of originality using *Turnitin*. Students agree that by taking courses in BIOL, assessments may be submitted to Turnitin.com for textual similarity review. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the

purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Terms and Conditions of Use as posted on the Turnitin.com site.

Where do I hand in assignments and then collect them once marked?
All assignments should be submitted as directed by the course coordinator. Typically, this will be electronically via Learn for on-line grading and for analysis in *Turnitin*. If a hard copy is requested, assignments should be placed in the designated collection boxes in the foyer of the 2nd floor of the School of Biological Sciences (Julius von Haast building, at the top of the stairs). All assignments must be accompanied by a cover sheet signed by you stating that the submitted work is not plagiarised. Cover sheets are available on top of the collection boxes, or you can download one from the Biology website (http://www.canterbury.ac.nz/media/documents/science-documents/assignment-coversheet.pdf).

Marked assignments will be returned through Learn or, if in hard copy, can be collected from the School of Biological Sciences reception, unless directed otherwise by the course coordinator. Teaching staff will endeavour to return work as soon as possible, and should contact you if there are likely to be any delays that will prevent return within the maximum 4-week timeframe.

What if I can't get it finished in time?
Reports and assignments should be handed in on time. Extensions may be granted if you have a valid reason (see above). **If you require an extension, you should request one from the course coordinator** (or the lecturer responsible for marking the work), with as much notice as possible. Please do this BEFORE the deadline for the assignment. **If you have been given an extension and you have been asked to submit a hard-copy of your work, you should hand the work DIRECTLY to the course coordinator** (do not put it in the drop box as it may not be cleared after the due date).
If an extension has not been granted:

- work handed in within 1 hour of the deadline: penalty of up to 5 percentage points of the mark for the assignment (e.g., a mark of 75% might be reduced to 70%).
- work handed in 1 – 24 hours after the deadline: penalty of 10 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 65%).
- work handed in 1 – 7 days after the deadline: penalty of 15 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 60%).
- work handed in more than 7 days after the deadline will not be marked or earn credit.

What if I have written more than the word or page limit?
If there is a word limit on an assignment, it is usually there to stop you doing too much work and to encourage you to write succinctly. You can be up to 10% over without too much worry, but if the length increases beyond that your mark may suffer due to failure to follow the requirements. If you find yourself way over the word limit talk to the lecturer concerned about how to get your assignment to an acceptable length. Unless specifically advised that there is flexibility, you must adhere to the word limit indicated.

What if I fail part of the course?
In Biological Sciences, we require a satisfactory level of achievement in both the theoretical aspects of the discipline and in practical activities. This means you must attend all class activities and submit all items of assessment unless you have a very good reason not to (e.g. medical reasons). **A student must attain an average score of at least 40% for in-course assessments (e.g. assignments, reports, quizzes) and an average score of at least 40% in the exam and/or tests, AND score at least 50% overall for the course, to be awarded a passing grade. See the course outlines for clarification of the assessment items included in each category and ask the coordinator if you are still unsure.**

What's the best way to give feedback?
We welcome constructive feedback at all times – help us to make this a valuable course for you. We endeavour to remain approachable at all times. If you would rather give feedback anonymously, please use the online course survey or talk to lab demonstrators, or your class rep (who will all report back to the staff-student liaison committee that includes a representative from each of the undergraduate classes). Class representatives will be selected from each class at the start of course.

What's the best way to complain?
If you feel you have not been fairly treated during this course, please raise the issue with the lecturer or course coordinator in the first instance. Other avenues include your class rep., who can raise issues anonymously, or the UCSA education coordinator.

Grading

A+	90% or above
A	85 – 90
A-	80 – 84
B+	75 – 79
B	70 – 74
B-	65 – 69
C+	60 – 64
C	55 – 59
C-	50 – 54

A restricted pass (R) **may** be awarded to those who are close to a pass (i.e. an overall score of 48-49.9%) AND who have achieved at least a 40% overall score in both in-course assessment and tests/exams. If an R grade is awarded you

gain credit for the course but **cannot continue into papers that require this course as a pre-requisite**. NB. The R grade is only available at 100 and 200 level - it cannot be awarded for third year papers.

Failing grades: D 40-49 E 0–39