School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information

CHEM433
Toxicology and Methods in Drug Discovery

0.125 EFTS 15 Points
Second Semester 2026

Description

If you are interested in human and animal health, how biological systems work at the molecular level and are passionate about how you can apply your science skills and knowledge in health-related areas, then this is the course for you. In this course we cover several core topics in drug development. Starting with an overview of drug development the course then focuses on key early aspects in the drug development process; target and hit identification and lead development. We introduce important *in-vitro* drug-testing techniques and methods to visualize drug-drug target interactions. We then address the role metals play in medicinal chemistry, including their interaction with nucleic acid targets and toxicological considerations. Self-directed learning topics will reinforce the concepts presented and allow you to extend your understanding.

This course is presented in the second semester only. It counts 15 points towards a Bachelor of Science with Honours / Masters of Science / Postgraduate Diploma of Science degree and should be taken in conjunction with other 400-level courses as advised by the postgraduate coordinator.

Timetable

Lectures: Two hours of lectures per week. Details to be confirmed on 'My Timetable' and the Web.
Tutorials*:* There will be no formal tutorial slot for this course.

Students should note that in the Science Faculty that the average student is responsible for approximately 4.5 hours of additional study for each hour of lecture at 400-level.

NOTE: If you do not submit an assignment for assessment, you will be allotted zero marks, which will affect your final result. You should ensure that you pick up marked assignments and keep them until the end of the course as evidence that the work was completed and marked in the case that either is disputed. To guard against accidental loss, it would be prudent to keep photocopies or electronic copies of anything submitted. If you submit work electronically, please cc a copy to yourself in lieu of keeping a physical copy.

Course Co-ordinator

Dr. Jodie Johnston, School of Physical and Chemical Sciences
Room BT325, phone 369 3044, email: *Jodie.johnston@canterbury.ac.nz*
*Email, phone or come and see me **at any time** if you have questions about the course.*

Assessment

Assignment(s)/In-class test (Allison/Johnston): 55%
Exam (Hartshorn): 45%

Examination and Formal Tests

Tests: Time and date to be advised; 2 hrs in length.
Exam: Time and date to be advised; 2 hrs in length.

Textbook

Due to the broad nature of this course a range of texts, including textbooks and primary literature materials may be referred to for use to supplement the lecture material prepared by each lecturer.
Copies of key recommended texts will be made available on short term loan from the Engineering and Physical Sciences Library.

Additionally, each lecturer will provide library references and information handouts where appropriate.

Prerequisites

There are no set prerequisites for the course but students are expected to have completed chemistry to the level

found in either CHEM337 or CHEM322 or BCHM338.

Web-based resources

Various learning resources (lecture material, reference links, quizzes, discussion forums etc.) for this course are available via the University of Canterbury's *Learn* web site – http://learn.canterbury.ac.nz/. This site will also be used regularly as a means of communication and information distribution for all of your Canterbury courses. **You should familiarise yourself with *Learn* as soon as possible**.

Goals of the Course

The goal of this course is to take students in a discovery journey in which they will be able to piece together, understand and appreciate the pathway taking them from studying the molecular basis of disease to designing, making and testing potential drug treatments. It will include toxicological considerations critical in drug development. The course will cover aspects of both small molecule drugs and larger biopharmaceutical biologics. Students will learn core chemical and biological concepts and principles in an applied manner.

Summary of the Course Content

THE DRUG DEVELOPMENT PIPELINE: A ROLE FOR STRUCTURAL BIOLOGY, BIOCHEMISTRY AND BIOPHYSICAL METHODS (7 x 2hr sessions)

This topic will commence with an overview of the drug discovery pipeline with a focus on the early stages (hit generation and lead generation/optimization). After this introduction the focus will be on ways in which drug candidate molecules and macromolecules can be tested for effectiveness against the desired drug target system. It will give an in-depth look at some of the important structural biological, biophysical and biochemical techniques used by the pharma industry to explore drug candidate-drug target interaction and how these fit into the drug development process. The later sessions will be run in an interactive manner with a focus on student-driven learning and a number of in-class activities (for which in-person attendance is required).

This part of the course will be assessed via in-class activities/assignments and an in-class test.

Lecturers:

Dr Timothy Allison (weeks 3-7), Room JvH522, ext 93034, timothy.allison@canterbury.ac.nz

Dr Jodie Johnston (weeks 1-7), Room JvH519, ext 93044, jodie.johnston@canterbury.ac.nz

METAL IONS AND NUCLEIC ACIDS IN MEDICINAL CHEMISTRY AND TOXICOLOGY (5 x 2hr sessions)

This block of lectures will examine the different ways that metal ions and their complexes are connected to and involved in the chemistry of nucleic acids, with a focus on medicinal chemistry and particular aspects of toxicology. Metal ions are critical to the synthesis of deoxyribonucleotides, the polymerisation reactions that form DNA and RNA, and in initiating further chemistry through binding to DNA/RNA polymers in different ways. We will examine ribonucleotide reductases, polymerase reactions, zinc finger proteins, and the ways that molecular inorganic species such as cisplatin and heavy metals such as lead and mercury can interact either directly with DNA or with molecules involved in DNA processing, to exert therapeutic or toxicological effects. Throughout the lectures we will focus on the experimental evidence that underpins our chemical knowledge in this field.

This material will be assessed in the end of semester exam.

Lecturer:

Professor Richard Hartshorn, JvH 630

Specific Learning Outcomes

Biophysical Techniques and Structural Biology in Drug Development.

At the end of this lecture block you should be able to:

- Best able to describe the stages in drug development generally with a focus on hit generation, lead generation and lead optimization
- Describe the different techniques used for testing and measuring drug target-drug candidate interactions in the context of small molecule drugs and discuss at which stage of drug development these might be most commonly used and why
- Give examples of different approaches taken to screen for bioactive drug candidates.
- Discuss the advantages/disadvantages and limitations of each biophysical method.
- Describe the role of structural biology in the drug development pipeline.

Inorganic Chemistry & Drug toxicity in Drug Discovery

At the end of this lecture block you should be able to:

- Compare and contrast the different structures of DNA and RNA
- Show the different ways that metal ions and their complexes can bind to those structures
- Explain how metal ions are involved in the synthesis and reactions of DNA and RNA
- Show a detailed understanding of the modes of action of platinum drugs in cancer treatment
- Discuss the origins of heavy metal toxicity and explain how they are tied into nucleic acid chemistry
- Provide examples of the different methods that have been used to elucidate this chemistry
- Predict, with reasoning, the ways that metal complexes you have not previously seen may interact with DNA or RNA
- Suggest, with reasoning, appropriate experiments to test your predictions

GENERAL INFORMATION | TE KIMI MŌHIOHIO 2026

Policy on 'Dishonest Practice'| Ngā Takahitanga me ngā Tinihanga

The University has strict guidelines regarding 'dishonest practice' and 'breach of instructions' in relation to the completion and submission of examinable material. In cases where dishonest practice is involved in tests or other work submitted for credit, a department may choose to not mark such work – see the online guidelines in relation to 'Academic Integrity'.

The School of Physical and Chemical Sciences upholds this policy. It considers plagiarism, collusion, copying and ghost writing – all detailed below – to be unacceptable and dishonest practices:

- ***Plagiarism | Tārua Whānako*** is the presentation of any material (text, data or figures, on any medium including computer files) from any other source without clear and adequate acknowledgement of the source.
- ***Collusion*** is the presentation of work performed in whole, or in part, in conjunction with another person or persons, but submitted as if it has been completed by the named author alone. This interpretation is not intended to discourage students from having discussions about how to approach an assigned task and incorporating general ideas that come from those discussions into their own individual submissions, but acknowledgement is necessary.
- ***Copying*** is the use of material (in any medium, including computer files) produced by another person or persons with or without their knowledge and approval. **This includes copying of the lab reports (raw data may be shared within the group if permitted or required by the experiment) – data analysis and interpretation of obtained results MUST be performed individually.**
- ***Ghost writing*** is the use of other person(s) (whether with or without payment) to prepare all or part of an item of work submitted for assessment.
- ***Generative AI Tools: The following shall apply to all assessments in this course, except where a lecturer has specifically stated otherwise in written instructions for an assessment.***
  In all assessments, you are strictly prohibited from using generative artificial intelligence (AI) to generate any materials or content related to the assessment. This is because students are expected to solve problems and demonstrate knowledge and understanding without the assistance of AI. The use of AI-generated content is not permitted and may be considered a breach of academic integrity. Please ensure that all work submitted is the result of your own human knowledge, skills, and efforts.

Special consideration of assessment | Ngā Pairuri Motuhake

'Special Consideration' (previously termed 'Aegrotat Application') for an item of assessment is for students who have covered the work involved but have been prevented from demonstrating their knowledge or skills at the time of the assessment due to unforeseen circumstances, whether illness, injury, bereavement, car crash or any other extenuating circumstance *beyond one's control*. Special Consideration for a test/exam may be because a student has not sat it or has done so with impaired performance. Applications can be submitted via the above link and must be made **no later than five working days after the assessment due date**. Note that special consideration is **not available for items worth less than 10% of the overall course mark**. In the case of illness or injury, medical consultation should normally have taken place either shortly before or within 24 hours after the due date for the required work or test/examination.

Note that you may be required to sit a special exam or your grade may not be changed if there is insufficient evidence of your performance from other invigilated assessment items in the course. ***You have the right to appeal any decision.***

It is important to understand that Special Consideration is only available *where course work has been covered*, and the inability to demonstrate this fully is both *no longer possible* AND is due to *unexpected circumstances beyond one's control*. Thus Special Consideration **is NOT available for:**

- essays, assignments or quizzes where an extension of time is available to complete the assessment item (see below for the process to involved);

- missed lectures during the semester;
- experiencing examination anxiety;
- having several examinations or assessments close together;
- known impairment, such as chronic illness (medical or psychological), injury or disability unless medical evidence confirms that the circumstances were exacerbated, despite appropriate management, at the time of assessment;
- mistaking the date or time of an examination (this is a circumstance one can control!);
- failing to turn up to an examination or test because of sleeping in (a circumstance as above!);
- where applications are repeatedly made for the same or similar reason, then the application may be declined on the grounds that the reason is not unexpected;
- where the application is made at the time of the assessment but the supporting documentation is received significantly after this date or after the date results are released; or
- the application is made following the release of results (unless under exceptional circumstances).

Extensions of deadlines | Tononga Wā Āpiti
Where an extension may be granted for an assessment item, this will be decided by application to the course co-ordinator and/or the lecturer concerned.

Late withdrawal from a course
If you are prevented by extenuating circumstances from completing the course after the final date for withdrawing from the course, you may apply for special consideration for late discontinuation. For details on special consideration, or to make an application, refer to the Examinations Office website http://www.canterbury.ac.nz/exams/. Applications must be submitted ***within five days*** of the end of the main examination period for the semester.

Missing of tests | Te Matangaro i ngā Whakamātautau
In rare cases a student will not be able to sit a test. In such cases, the student should consult with the course co-ordinator to arrange alternative procedures. **This must be done well in advance of the set date for the test.**

Past exams
Past exams can be found on the Library website.

Submission of reports and assignments
Reports (including lab reports) and assignments should be handed in on time. Extensions will be granted only in exceptional circumstances (such as illness or bereavement). If an extension is required, as early as possible you should request it from the lecturer concerned.
Note: If you do not submit an assignment for assessment, you will be allotted zero marks, which will affect your final result. You should ensure that you pick up marked assignments and keep them until the end of the course as evidence that the work was completed and marked in the case that either is disputed. To guard against accidental loss, it would be prudent to keep photocopies or electronic copies of anything submitted.

Late Work
Acceptance of late work for assessment will be at the discretion of the course coordinator and/or the lecturer concerned. If your assessment is likely to be late, please contact the relevant of these people ***before the assessment is due***. Never assume that an extension will be automatically granted – some courses have the policy of no late work being accepted. A commonly exercised policy is to deduct 10% of the total marks for each day that the work is late, where weekends and public holidays also count as such days.

Marks and Grades | Taumata Ako
The following numbers should be considered as a guide to the expected grades under normal circumstances.

Grade:	**A+**	**A**	**A−**	**B+**	**B**	**B−**	**C+**	**C**	**C-**	**D**	**E**
Minimum mark %:	**90**	**85**	**80**	**75**	**70**	**65**	**60**	**55**	**50**	**40**	**0**

The School reserves the right to adjust this mark/grade conversion, up or down, to achieve consistency of assessments standards.

Reconsideration of Grades: Students should, in the first instance, speak to the course co-ordinator about their marks. If they cannot reach an agreeable solution, or have questions about their grade in a course, students should then speak to the Coordinator of 400-level studies, Professor Sarah Masters (phone 369 4229). Students can appeal any decision made on their final grade. You can apply at the Registry for reconsideration of the final grade within four weeks of the date of publication of final results. Be aware that there are time limits for each step of the appeals process.

Student Accessibility Services | Te Whaikaha
Students can speak with someone at Student Accessibility Service, phone: 369 3334 (or ext. 93334), email: sas@canterbury.ac.nz).

***Academic Advice*:** Professor Sarah Masters is the coordinator of 400-level chemistry courses. Her interest is in the academic performance and well-being of all such students. Anyone experiencing problems with their chemistry courses or requiring guidance about their 400-level courses should get in contact with Sarah.

Sarah Masters
Coordinator of 400-level Chemistry Courses
School of Physical and Chemical Sciences
2026