School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information

CHEM433
Drug Development and Toxicology

0.125 EFTS 15 Points
Second Semester 2022

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 introduce you to the basic concepts of drug development. Starting with an overview of drug development from disease to practical real-world treatments, the course then focuses on key early aspects in the drug development process; molecular basis for disease, target identification and lead development. We introduce the modern shift to biopharmaceuticals, and important *in-vitro* drug-testing techniques and methods to visualize drug-drug target interactions. We then address toxicological considerations, which are critical in drug development. Self-directed learning topics will reinforce the concepts presented and allow you to extend your understanding into the later stages of the drug development (i.e. regulatory, toxicology, environmental and clinical testing considerations).

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.

Assignments*: This course will involve self-directed learning assignments.* The timing and nature of these will be at the discretion of the teaching team. The assessable output will either take the form of analysis of data, a written report and/or an oral presentation with written summary handout.

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

Students should note that, in the Faculty of Science, students are responsible for about three hours of additional study or work on assignments for each hour of lectures or tutorials at the 400-level.

Course Coordinator

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

Assessment

Test (Marquez):	25 %
Assignment(s) (Allison/Johnston):	35 % total
Exam (Shaw):	40 %

Examination and Formal Tests
Test: Time and date to be advised; 1.5 hrs in length.
Exam: Time and date to be advised; 1.5 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

OVERVIEW AND INTRODUCTION TO THE MEDICINIAL CHEMISTRY PIPELINE (6 lectures)

This is the **capstone section** of this course and will cover:
An overview of medicinal chemistry and "What is a drug target?"
What is meant by lead development and how this fits into the overall medicinal chemistry pipeline?
A detailed look at inhibitor synthesis and discussion of concepts and approaches involved in inhibitor optimization and the importance of chemical shape.

This material will be assessed in a test.
Lecturer:
***Professor Rudi Marquez,* rudi.marquez@canterbury.ac.nz**

BIOPHYSICAL TECHNIQUES AND STRUCTURAL BIOLOGY IN DRUG DEVELOPMENT (8 lectures)

This topic will cover 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 biophysical techniques used by the pharma industry to explore drug candidate-drug target interaction including the key roles structural biology has played in the drug development process.

This part of the course includes problem solving and interactive sessions and will be internally assessed via assignment(s) totaling 35 % of the final marks for this course.
Lecturers:
Dr Timothy Allison, timothy.allison@canterbury.ac.nz
Dr Jodie Johnston, jodie.johnston@canterbury.ac.nz

DRUG TOXICITY, METABOLISM AND PHARMACOKINETICS (10 lectures)

Medicinal chemists are a key facet of the drug discovery team. The products of their work and ideas move along the drug discovery and regulation chain hopefully to become new drugs to give medics the wherewithal to better treat disease and to make money for the pharmaceutical company. Of the many thousands up on thousands of candidate drugs created by medicinal chemists very few ever make it to market. The main reasons for a candidate drug's failure is poor efficacy or unacceptable toxicity.

Toxicology screening is usually carried out early in the discovery process so that money is not wasted working on a drug that will never become a medicine. If the initial screen does not suggest untoward toxicity, the developmental process goes ahead and full blown toxicity tests and clinical trials are carried out to assess risk and balance this against the drug's benefit – to achieve regulatory approval the drug's benefits must outweigh its risks.

The results of the toxicity studies are combined with results of efficacy studies to form the registration application dossier which is presented to the appropriate government regulatory committee for assessment and hopefully approval.

In his lectures Ian will outline the medicines regulatory process, discuss the battery of toxicity tests used to assess safety, outline the clinical trials process, and set the results in the context of an application for government approval to market a new medicine.

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

Lecturer:
Prof. Ian Shaw, ian.shaw@canterbury.ac.nz

Specific Learning Outcomes

Overview and Introduction to Medicinal Chemistry.
At the end of this lecture block you should be able to:

- Define medicinal chemistry, and its relationship to human health.
- Define what a drug target is.
- Explain what makes a good drug target.
- Give examples of different drug targets being currently followed by industry.
- Define what a lead compound is.
- Explain the difference between an inhibitor, a lead compound and a drug candidate.
- Discuss the roles that synthetic chemistry has in the generation of lead compounds.

Biophysical Techniques and Structural Biology in Drug Development.
At the end of this lecture block you should be able to:

- Define what is *in-vitro* and *in-vivo* testing.
- Describe the different techniques used for testing and measuring drug target-drug candidate interactions in the context of both small molecule drugs and biopharmaceuticals.
- 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.

Drug toxicity, metabolism and pharmacokinetics
At the end of this lecture block you should be able to:

- Give an overview of the medicines regulatory process
- Describe the range of toxicity tests used to assess safety
- Define what a clinical trial is and outline the process that is involved in running one

GENERAL INFORMATION 2022

Policy on 'Dishonest Practice'
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 ('Academic Integrity and Breach of Instruction Regulations').

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

- ***Plagiarism*** 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) (with, or without payment) to prepare all or part of an item of work submitted for assessment.

Additional Information
Special consideration of assessment*:** If you feel that illness, injury, bereavement or any other critical extenuating circumstance beyond your control has prevented you from completing an item of assessment or affected your performance in that assessment, you may apply for special consideration. Special consideration is not available for items worth less than 10% of the course. Applications for special consideration should be made **within five days** of the due date for the work or examination. In the case of illness or injury, medical consultation should normally have taken place shortly before, or within 24 hours after, the due date for the required work or the date of the test or examination. For details on special consideration, or to make an application, refer to the Examinations Office website http://www.canterbury.ac.nz/exams/. ***You have the right to appeal any decision.

Extensions of deadlines: Where an extension may be granted for an assessment item, this will be decided by application to the course co-ordinator.

Late withdrawal from the 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*:** 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.**

***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 will be at the discretion of the course coordinator. Please contact the coordinator if your assessment is likely to be late.

Marks and Grades: The following numbers should be considered as a guide to the expected grades under normal circumstances. The School reserves the right to adjust mark/grade conversions, if necessary.

Please note that for all invigilated assessments (tests and exams) worth 33% and above, failure to obtain a mark of at least 40% will result in a final grade no higher than an R at 100 and 200 level, and a C- at 300 level.

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**

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, Dr Sarah Masters (Room 422, Beatrice Tinsley Building, 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.

Students with Disabilities: Students with disabilities should speak with someone at Equity and Disability Service, phone: 369 3334 (or ext. 93334), email: eds@canterbury.ac.nz).

***Academic Advice*:** Dr Dan Foley is the coordinator of postgraduate chemistry courses. His 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 postgraduate studies should get in contact with Dan.

Dan Foley
Coordinator of Postgraduate Studies
School of Physical and Chemical Sciences
2022