School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information | Ngā Whakamārama

CHEM 346
Contemporary Medicinal Chemistry

0.125 EFTS 15 Points
First Semester 2024

Description | Whakamahuki
This course covers several topics in modern medicinal chemistry, focusing on a range of important disease states that have been the focus of attention of medicinal chemists and the pharmaceutical industry. These include:

- anti-microbial compounds
- anti-cancer compounds
- drugs acting on the nervous system
- drugs acting on the cardiovascular system
- bioactive natural products from NZ and the Pacific regions; their uses in Rongoā, investigation of molecular modes of action, and their potential development into medicines

In each case the molecular structure of bioactive compounds will be correlated with is mode of action against the particular disease state. The medicinal chemistry process for drug development will be discussed as appropriate. Highly important contemporary issues, such as the development of drug resistance, will be discussed, and strategies that may be used to overcome them outlined.

Timetable | Wātaka
Lectures and tutorials: Three contact hours per week. Details to be confirmed on 'My Timetable' and the Web.

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 the 300-level.

Course Coordinator | Kairuruku Akoranga
Dr Daniel Foley, Room JvH630a, ext 90479, ***daniel.foley@canterbury.ac.nz***

Assessment | Aromatawai

Group presentation and personal report:	30%
Test:	30% (details to be advised)
End of course exam:	40%

Examination and Formal Tests | Ngā Whakamātautau Ōkawa
End of year Exam: Three hours, with questions from Jodie Johnston

***Mid*-Semester** Test: 1.5 hours, with questions from Rudi Marquez

Textbooks | Tuhinga
An Introduction to Medicinal Chemistry, Graham L. Patrick, Oxford University Press, Sixth Edition, 2017
Copies are available on reserve in the Engineering and Physical Sciences Library

Prerequisites
P: CHEM246
R: CHEM212, CHEM242

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 (Ako)* 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 (Ako)* as soon as possible.

Goal of the Course

This course aims to build upon the introductory course in Medicinal Chemistry (CHEM246). Principles introduced in that course will be exemplified and extended by considering a series of disease states / infective agents, and examining how drugs have been developed to combat them. In each case, the molecular basis of the therapy will be discussed, along with the drug development process that was gone through in order to discover currently used therapies. Students will also be introduced to NZ and Pacific natural products. The uses of NZ flora in traditional Rongoā will be discussed, including several cases studies in which bioactive compounds have now been identified and their mode of action elucidated. The development of some natural products originally isolated from NZ and Pacific regions into clinically used therapies will also be discussed.

Learning Outcomes

As a student in this course I will develop the ability to:

- evaluate the mode of action of a variety of modern chemotherapeutic agents used for the treatment of several types of cancers, and to be able to correlate structure with mode of action
- demonstrate how these anti-cancer compounds are made
- demonstrate the molecular mode of action of a variety of drugs acting on the cholinergic nervous system
- demonstrate the molecular mode of action of a variety of drugs acting on the adrenergic nervous system
- demonstrate the molecular mode of action of a variety of drugs acting on opioid receptors
- demonstrate the molecular mode of action of a variety of drugs acting on the cardiovascular system
- demonstrate how compounds that act on the Central Nervous and Cardiovascular systems are made
- evaluate the molecular mode of action of a variety of antibiotic compounds, and be able to correlate structure with mode of action
- demonstrate how these antibiotics molecules have been developed
- conjecture how antibiotic drug resistance develops, and methods for combatting this
- explain the viral infection processes
- evaluate how several different anti-viral compounds work, and how they have been developed
- conjecture how vaccines work, and how they are made
- appraise the molecular diversity of naturally occurring molecules found in NZ, Polynesia, and Pacific regions
- appreciate the uses of some of these natural products in Rongoā and other indigenous medicinal practices
- analyse several case studies undertaken to identify the bioactivate components of NZ and Polynesian flora and elucidate their molecular mode of action
- evaluate how a selection of some currently used therapeutic agents have been arrived at based on original isolation of natural products from the NZ and Pacific regions

Transferable Skill Register

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

- analytical, critical thinking and problem solving
- pattern spotting and logical analysis
- written communication
- working effectively and professionally with diverse communities
- bi-cultural competence

Summary of the Course Content

The topics coved by this course are:

ANTICANCER COMPOUNDS **(9 contact hours)**

Cancer is not one disease but many. This part of the course will consider several different types of cancer, how therapeutic agents have been developed to combat these disease states, and discuss future directions for improved treatments. After examining the causative reasons for cancer development, chemotherapeutic agents which act by a variety of mechanisms will be considered. Firstly, agents that interfere with DNA will be investigated, including DNA intercalating agents, alkylating agents, and inhibitors of DNA synthesis. Hormone based therapies used to treat several types of cancer will be discussed. Other chemotherapeutic agents which either act on structural proteins important in cancer (e.g. by inhibition of tubulin de/polymerisation), or interfere with signalling pathways (e.g. kinase inhibitors), or act by other mechanisms (e.g. as matrix metalloproteinase inhibitors), will also be examined. The development and application of monoclonal antibodies as anti-cancer agents will be discussed. Future directions including the development of anti-cancer vaccines and the use of immune checkpoint inhibitors will also be discussed.

Lecturer: Dr Daniel Foley, Room JvH630a, ext 90479, *daniel.foley@canterbury.ac.nz*

DRUGS ACTING ON THE NERVOUS AND CARDIOVASCULAR SYSTEMS **(9 contact hours)**

The first part of this section of the course will consider a wide selection important drugs that act on the nervous system. The modes of action of a variety drugs which act as agonists/antagonists of cholinergic and adrenergic receptors will be discussed, including drugs which act on acetylcholine esterases. Drugs which act against opioid receptors, and their modes of action, will also be detailed.

Cardiovascular diseases (CVD) are the leading cause of death in all countries globally, except for in Africa. Correspondingly this is an enormously important therapeutic area. The second part of this section of the course will consider the cardiovascular system, and how a selection of drugs act as; for example as has anti-hypertensives, vasoconstrictors, vasodilators, and as ion channel blockers. The modes of action of number of other drugs which act against CVD will also be considered; for example lipid regulators and anti-coagulants.

Lecturer: Professor Rudi Marquez-Mazlin, Room JvH 730, ext 90162, *rudi.marquez-mazlin@canterbury.ac.nz*

ANTIMICROBIALS **(12 contact hours; 11 in 2024 due to ANZAC)**

Bacterial and viral infections are the most common causes of human illness. This part of the course will consider the development of a range of antibiotics and anti-viral compounds including their isolation, synthesis, mechanisms of action, development of resistance and drug optimisation. After an general introduction to the area of infectious disease and antimicrobial drug development the first part of the block will consider the different modes of action of a series of antibiotics. Inhibitors of bacterial cell wall biosynthesis will be discussed in detail, including beta lactams (e.g. penicillin's). Other antibacterial agents which act by either impairing protein synthesis (e.g. aminoglycosides, tetracyclines), or by inhibition of transcription (e.g. rifamycins) will also be reviewed. The development of antibiotic resistance will be discussed along with strategies that are being used to combat this. The second part of the block will focus on anti-viral agents; the life cycle of viruses will be discussed and the different modes of action of a series of anti-viral compounds investigated. These will include compounds that are active against DNA viruses (e.g. inhibitors of viral DNA polymerases), and a number of RNA viruses. HIV will be a specific focus with the development of inhibitors of HIV reverse transcriptase and HIV proteases being detailed. The development of drugs active against influenza virus (e.g. neuraminidase inhibitors) will also be explored in depth. The course will also briefly consider the principles of protective vaccination against viral infection.

Lecturer: Dr Jodie Johnston, Room JvH522, *jodie.johnston@canterbury.ac.nz*

NZ AND PACIFIC NATURAL PRODUCTS AND INDIGENOUS MEDICINE **(6 contact hours)**

This part of the course will focus on bioactive natural products. Starting with a general overview of the area and core concepts, it will then focus on natural products isolated from the NZ and Pacific regions; their uses in indigenous medicines, elucidation of their molecular structures and modes of action, and, in some cases, their development into clinically applied therapeutic agents. The uses of several NZ plants in traditional Māori medicine | Rongoā will be discussed, alongside case studies of the isolation of bioactive components and elucidation of their molecular mode of action (where known). Consideration will be then move to bioactive natural products from the wider Pacific regions. Again a number of examples of structural elucidation and investigation of molecular mode of action will be detailed (where possible). Finally a small number of case studies where the isolation of such natural products has led to the development of clinically used therapeutic agents will be discussed.

Lecturer: Dr Jodie Johnston, Room JvH522, *jodie.johnston@canterbury.ac.nz*

GENERAL INFORMATION | TE KIMI MŌHIOHIO 2024

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. Note that the use of **AI generative tools such as ChatGPT** for assessment work is *strictly forbidden*, except where the lecturer concerned has specifically granted approval.

- ***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.

Special consideration of assessment | Ngā Pairuri Motuhake

'Special Consideration' 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 tests and exams

Past tests can be found on our Chemistry Undergraduate website. 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.

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; in general this requirement will not be applied at 300 level, but if it is then the course coordinator will inform the class and it will result in a final grade no higher than a C–.

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 Director of Undergraduate Studies, Assoc Prof Greg Russell. 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

Assoc Prof Greg Russell is the coordinator of undergraduate 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 B.Sc. in Chemistry should get in contact with Greg.

Staff-Class Rep Liaison

Assoc Prof Greg Russell is in charge of liaison with students in chemistry courses. Your class will appoint a student representative to the liaison committee at the start of the semester. Please feel free to talk to the Academic Liaison or the student rep about any problems or concerns that you might have.

Greg Russell (greg.russell@canterbury.ac.nz, tel. 369 5129)
Director of Undergraduate Studies
School of Physical and Chemical Sciences

2024