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 2022

Description | Whakamahuki
This course covers several topics in modern medicinal chemistry, focussing 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
Associate Professor Chris Fitchett, Room BT 424/West 818, ext 95344**, *chris.fitchett@canterbury.ac.nz***

Assessment | Aromatawai

Assignment:	30%
Test:	30% (precise details to be advised)
End of course exam:	40%

Examination and Formal Tests | Ngā Whakamātautau Ōkawa
End of year Exam: Three hours

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 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 are made
- 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 made
- conjecture how vaccines work, and how they are made
- 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
- 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:

ANTIMICROBIALS **(10 contact hours)**

Bacterial and viral infections are the most common causes of human illness. This part of the course will consider how antibiotics and anti-viral compounds have been isolated and synthesised. The different modes of action of a series of antibiotics will be considered. Inhibitors of bacterial cell wall biosynthesis will be discussed in detail, including beta lactams (e.g. penicillins and cephalosporins). Other antibacterial agents which act by either impairing protein synthesis (e.g. aminoglycosides, tetracyclines, macrolides), or by inhibition of transcription / replication (e.g. quinolones) will also be reviewed. The development of antibiotic resistance will be discussed along with strategies that are being used to combat this. 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 specifically discussed alongside the development of inhibitors of HIV reverse transcriptase and HIV proteases. The development of drugs active against both the influenza virus (e.g. neuraminidase inhibitors) and hepatitis C will also be discussed. The course will also briefly consider the principles of protective vaccination against viral infection.

Lecturer: Dr Jodie Johnston, BT325/ER402, ext 93044, *jodie.johnston@canterbury.ac.nz*

ANTICANCER COMPOUNDS **(10 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: Professor Rudi Marquez, Room West 530, ext 90162, *rudi.marquez@canterbury.ac.nz*

DRUGS ACTING ON THE NERVOUS AND CARDIOVASCULAR SYSTEMS **(10 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: Dr Daniel Foley, Room 323, Beatrice Tinsley, ext 90479, *daniel.foley@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 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: Associate Professor Chris Fitchett, BT 424/West 818, ext 95344, *chris.fitchett@canterbury.ac.nz*

GENERAL INFORMATION 2022

Chemistry Department 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 Department of Chemistry 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.**

Past tests and exams: these can be found on our website using the link below:

www.chem.canterbury.ac.nz/for/undergraduate.shtml

***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; 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**

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 (phone 3694228). 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*:** 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
2022