UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information

BCHM 306
Biochemical Pathology

0.125 EFTS 15 Points
Semester 2 2024

Biochemical pathology is the study of the biochemistry underlying disease. It is important in medicine because it allows us to understand the underlying causes of diseases which helps us to design drugs to treat diseases. In addition, understanding the biochemical changes that occur in diseased states allows us to measure biochemical changes in blood, urine and tissues to help with disease diagnosis. For example, in liver cancer sometimes the bile duct is occluded which means that bilirubin (a haemoglobin breakdown product) cannot be excreted in bile, this leads to high blood bilirubin levels. A high bilirubin level found during a routine blood test points the pathologist to something amiss in the liver, this in turn might lead to a cancer diagnosis if that is the underlying reason for raised blood bilirubin. Biochemical indicators, such as blood bilirubin, are very important as part of the battery of information that a doctor puts together as part of the diagnostic process.

Not only diseases lead to biochemical changes that point to underlying biochemical causation (mechanisms), but also poisoning causes cell and tissue damage that leads to biochemical changes that are important in toxicological diagnosis. For example, continuing the blood bilirubin theme, paracetamol overdose causes liver damage because of a highly liver toxic paracetamol metabolite, this leads to high blood bilirubin which would point a toxicologist in the direction of liver toxicity. Similarly, at autopsy, the liver of a person who died as a result of paracetamol poisoning will be mottled and yellowish in colour (bilirubin is yellow), and histological studies will show cellular changes consistent with liver toxicity. These are key facets of the diagnostic process.

In this course we will explore the underlying biochemistry of diseases and toxicity, and show why the changes occur and how they are used as part of the diagnostic process. We will focus on cholesterol-related disorders and Alzheimer's disease to illustrate key biochemical principles underlying disease pathology. We will extend this thinking to how toxicologists assess the safety of chemicals being developed as medicines, pesticides, etc., and how the risk of these compounds are set against their benefits in a regulatory context. We will study disease and poisoning examples to illustrate our lectures.

The course is divided into 3 sections: biochemistry of cardiovascular disease and oxidative stress (Associate Professor Steven Gieseg), biochemistry of Alzheimer's disease (Dr Vanessa Morris) and toxicology (Professor Ian Shaw).

AIM

This course is designed to help you to understand the biochemistry underpinning disease (e.g. cancer), how diseases are diagnosed using biochemical markers (e.g. heart disease, Alzheimer's disease), mechanisms of cell and organ toxicity, and how toxic molecules can be used to our benefit (e.g. in cancer chemotherapy).

The course aims to introduce you to modern biochemical ideas and research, and will include a substantial amount of reading from the biochemical literature, as well as from your recommended textbook. The course is intended to complement courses such as BCHM305, BCHM338, BCHM339, BCHM381, BIOL330, BIOL313.

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 and critical acquisition of scientific information.

PREREQUISITES

BCHM253/BIOL253 and BCHM222, and 15 points from BCHM206, BCHM212/CHEM212. Recommended BCHM202/BIOL231.

COURSE COORDINATOR

Professor Ian Shaw, School of Physical & Chemical Sciences, von Haast 736, phone 369 4302 (ext. 94302), email ian.shaw@anterbury.ac.nz

Email me if you have any queries about the course.

LECTURERS

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Assoc. Prof. Steven Gieseg, School of Biological Sciences,
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Dr Vanessa Morris, School of Biological Sciences
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TIMETABLE

Lectures: Two hours of lectures per week. Details to be confirmed on 'My Timetable' and the web.
Tutorials: One hour of tutorials per fortnight. Details to be confirmed on 'My Timetable' and the web.

Students should note that in the Science Faculty the average student is responsible for approximately 4.5 hours of additional study for each hour of lecture at the 300-level.

TEXTBOOKS

Recommended text for the biochemistry underpinning this course – Lehninger Biochemistry by D L Nelson & M M Cox

For further reading on risk and food-born toxins - Food Safety; the Science of Keeping Food Safe by I C Shaw

For further, detailed reading on toxicology - Casarett and Doull's Toxicology: The Basic Science of Poisons by C D Klaassen

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.

ASSESSMENT

Tutorial assignments:	Two assignments: Ian Shaw 20%; Steven Gieseg/Vanessa Morris 20%
Exam:	60%

LEARNING OUTCOMES

This is a specialised third year course to build on prior study in biochemistry, chemistry and biology. At the end of the course, you will have developed critical analysis skills in biochemical pathology, developed advanced problem-solving skills, and be able to:

- explain the biochemical basis of toxicology,
- provide examples of the use of biochemical markers in diagnosis,
- delineate the link between cholesterol and lipoprotein metabolism and the process of cardiovascular disease,
- explain the general principals of free radical biochemistry,
- explain how toxic molecules can be used to treat diseases,
- present complex biochemical ideas for both experts and non-specialists (science communication),
- communicate effectively in written English,
- effectively access and use information relevant to the subject,
- demonstrate advanced knowledge of a subject of science and an ability to apply scientific principles and concepts,
- research, analyse, evaluate, and argue from evidence,
- work independently.

Transferable Skills

- critical analysis of the scientific literature (including understanding the limitations of scientific data). *(this skill maps to the UC attribute: Critically competent)*
- constructing your own understanding and shaping your own viewpoint based on reading scientific literature. *(this skill maps to the UC attributes: Critically competent and Globally aware)*
- Communicating science both spoken and written to both specialists and non-specialists. *(this skill maps to the UC attributes: Employable, innovative and enterprising, and Globally aware)*

Transferable skills are important because you might pursue a career that is not directly related to the knowledge gained in your course of study; in this case skills that transfer form one field to another are very important. As a student in this course, you will develop the following transferable skills:

UC Graduate Attributes:

	Critically competent	Employable, innovative and enterprising	Biculturally competent and confident	Engaged with the community	Globally aware
Biochemical Pathology	X	X			X

SUMMARY OF COURSE CONTENT

The topics covered by this course are:

OVERVIEW OF BIOCHEMICAL PATHOLOGY **(2 lectures term 3)**

Lecturer: Professor Ian Shaw

Biochemical pathology is the understanding of the biochemistry underpinning disease, and the use of biochemistry to diagnose and treat diseases. This is a huge field that we cannot hope to comprehensively cover in one semester. For this reason, the course will focus on several facets of the subject: biochemical toxicology, free radicals-mediated pathology, cholesterol and cardiac disease, and the aetiology of cancer and its treatment. To set this in perspective the first two lectures of the course will explore biochemical pathology as a whole to set the scene.

BIOCHEMICAL TOXICOLOGY **(8 lectures term 3)**

Lecturer: Professor Ian Shaw

Before we can discuss the effects of toxic chemicals on cells we need to understand normal cell function so our first lecture will review the cell and how it functions, then we can look at how cells and whole organisms (including humans) respond to toxic chemicals (acute and chronic toxicity), explore how toxicologists study these responses, and look at how we can assess the risk of exposure to toxic chemicals (e.g. from food and the environment). Chronic toxicity (e.g., carcinogenesis) will be explored as a means of understanding cancer and its causes. Finally, the use of toxins to treat diseases (e.g., cancer chemotherapy) will be used to show that not all toxins are bad.

The 8 lectures will cover the following:

- What is pathology? The fundamentals of diagnosis
- Xenobiochemistry
- Cell protection mechanisms
- Food toxicology
- Estrogen mimics
- Risk assessment
- Covid-19
- The toxicology of vaping

ALZHEIMER'S DISEASE **(4 lectures terms 3 & 4)**

Lecturer: Dr Vanessa Morris

Neurodegenerative diseases, such as Azheimer's disease, involve progressive dysfunction and death of neurons in the central nervous system. Nerve cell death is preceeded by myriad biochemical changes throughout the nervous system, including protein misfolding and aggregation and chronic inflammation. Which changes are causative and which are consequences is highly debated. We will discuss the underlying pathological changes in Alzheimer's disease, as well as current and future diagnostic and therapeutic strategies.

CHOLESTEROL: LIPOPROTEINS TO FREE RADICALS **(10 lectures terms 4)**

Lecturer: Associate Professor Steven Gieseg

Lipoprotein Metabolism, Heart Disease, and Free Radicals. We will begin by examining the pathway of cholesterol synthesis and rapidly move into an exploration the mechanisms of atherosclerosis (heart disease). This will involve a detailed look at the control of cholesterol synthesis and transport around the body. The oxidative mechanism of heart disease will be examined with emphasis on the possible role of antioxidants in inhibiting this process. In addition to providing a basic understanding of free radical biochemistry and the mechanisms of heart disease, this lecture series will demonstrate how an understanding of both biology and chemistry are important in understanding a disease process.

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

If in doubt: ASK! The course co-ordinator is happy to field questions at any time. All staff involved in the course are generally available for advice on specific issues.

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 – 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

'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

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

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.**

Where do I hand in assignments and then collect them once marked?

All assignments should be placed in the designated collection box in the foyer of the 2nd floor of the School of Biological Sciences (near the main office), unless directed otherwise by the course co-ordinator. 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 (under Undergraduate). In addition, you may also be asked to submit your work electronically (via Learn) for analysis in *Turnitin*. You will be given instructions on how to do this in the assignment handout. Marked assignments can be collected from the Secretaries' Office, unless directed otherwise by the course co-ordinator. 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. **If you require an extension, you should request one from the course co-ordinator** (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 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 must be handed in by the due date to gain full credit
- work handed in up to 7 days after the deadline will be marked, but the marks will be discounted 25% before they are recorded to the student's credit
- any work handed in more than 7 days after the deadline date 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. It also makes things easier to assess. 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.

What if I fail part of the course?

In BIOL, 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) and an average score of at least 40% in the exam and/or test, AND score at least 50% overall for the course, to be awarded a passing grade. See course outline 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 on-line 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 co-ordinator 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