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 2022

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, Beatrice Tinsley Building 327, 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.

Delivery of the course in 2022

We plan to deliver the course in person this year. However, in order to protect us all during the current period of increased COVID-19 incidence, **ALL** students attending lectures or tutorials **MUST WEAR A FACE MASK**.

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:	three assignments; one at 15% and the other two at 7.5% each (total 30%)
Exam:	70%

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 & 1 tutorial, term 3)**

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.

Lecturer: Professor Ian Shaw

BIOCHEMICAL TOXICOLOGY **(8 lectures & 4 tutorials, term 3)**

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 happens when cells are challenged with toxic chemicals?
- Mechanisms of toxicity – acute and chronic
- Carcinogenesis and cancer chemotherapy
- Cellular protection mechanisms
- Food toxicology
- Risk vs benefit
- Toxicity testing

Lecturer: Professor Ian Shaw

ALZHEIMER'S DISEASE **(4 lectures & 2 tutorials, terms 3 & 4)**

Lecturer: Dr Vanessa Morris

CHOLESTEROL: LIPOPROTEINS TO FREE RADICALS **(10 lectures & 5 tutorials, term 4)**

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.

Lecturer: Associate Professor Steven Gieseg

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.

What do I do if I have to miss something or if my performance was impaired?

If you feel that **illness, injury, bereavement or other extenuating circumstances beyond your control** have prevented you from completing an item of assessment worth 10% or more of total course assessment or if these circumstances affected your performance in such assessments, you should apply for Special Consideration. Applications for Special Consideration should be submitted via the Examinations Office website http://www.canterbury.ac.nz/regulations/general/general_regs_aegrotat.shtml and notify the course co-ordinator *within five days* of the assessment or its due date. If this is for medical reasons you should visit a doctor within 24 hours of the assessment (application form available on-line or from the Student Health Centre). The Special Consideration provisions are intended to assist students who have covered the work of a course but have been prevented by illness or other critical circumstances from demonstrating their mastery of the material or skills at the time of assessment – they do not excuse you from doing the assessment within a reasonable time agreed with the course co-ordinator. You should expect to be required to submit additional work if you miss a major assignment (e.g. a field trip for which a major write-up is required).

In rare cases you may not be able to complete an assessment or attend a field trip, because of **involvement in international or national representative sport or cultural groups**. In such cases you should also apply for Special Consideration. Please review the Special Considerations policy because very few kinds of activities will be eligible for consideration (e.g. holiday trips, birthday parties etc. are not given special status in the University policy).

Students prevented by extenuating circumstances from completing the course after the final date for withdrawing, may apply for Special Consideration for late discontinuation of the course. Applications *must* be submitted to the Examinations Office within five days of the end of the main examination period for the semester.

For further details on Special Consideration applications, please refer to the Examinations Office website http://www.canterbury.ac.nz/regulations/general/general_regs_aegrotat.shtml.

Plagiarism

It is essential that you are aware that plagiarism is considered a very serious offence by the Academic community, the University and the School of Biological Sciences. Plagiarism is defined as taking content from another work or author and presenting it, without attribution, as if it is your own work. Content here includes text (sentences or major parts of sentences), display items (graphs and tables), and overall structure (the detailed sequence of ideas). Plagiarism includes:

- re-use of previous assignments (even if each individual sentence has been rephrased to say the same thing in different words, if the overall structure is re-used)
- copying of another student's work (with or without their consent)
- the unreferenced use of published material or material from the internet e.g. cutting and pasting of paragraphs or pages into an essay.

For most pieces of in-term assessment you will be given information concerning the use of direct and indirect quotes from previously published work. If you are in any doubt about appropriate use of published material, please speak with a member of academic staff. If you are still unsure what plagiarism is, then seek advice.

It is a School policy that courses may request you submit work electronically for subsequent analysis of originality using *Turnitin*. Students agree that by taking courses in BIOL, assessments may be submitted to Turnitin.com for textual similarity review. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Terms and Conditions of Use posted on the Turnitin.com site.

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