



## MEDICAL AND HEALTH SCIENCES

# MEDSCI 142 Course Outline

## Biology for Biomedical Science: Human Organ Systems

**Disclaimer: This is a living document. Information provided is based on best available data at the time of preparation. Subsequent updates may not be reflected, thus this document should only be considered as general reference.**

### Course Co-ordinators

Please direct all enquiries to the Course Coordinators in the first instance:



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### Official Calendar Description

Introduction to human biology with particular emphasis on integrated organ function. The course will deal with: structures and processes associated with the function of the nervous, locomotor, cardiovascular, respiratory, digestive, renal, endocrine, musculoskeletal and reproductive systems.

### Overview

This is the primary first-year human biology course at the University of Auckland which prepares students for more advanced study in a wide range of professional programs (including biomedical engineering, biomedical science, food science and nutrition, health sciences, medicinal chemistry, medicine, nursing, optometry, pharmacy, sports science, *etc.*). It has an enrolment of about 1,300 students (2020).

MEDSCI 142 is taught by staff in the Department of Anatomy and Medical Imaging, Department of Physiology, Discipline of Nutrition and Department of Obstetrics and Gynaecology in the Faculty of Medical and Health Sciences.

### Pre-requisites

BIOSCI 107 is not a pre-requisite for MEDSCI 142. MEDSCI 142 and BIOSCI 107 are designed to complement each other, and most students do both courses. If your academic record at school (or university) is reasonably strong, and you have disciplined study habits, then you can take MEDSCI 142 with a reasonable chance of success.

Taking biology at school might be helpful, however we understand that human anatomy and physiology is not a key part of the NCEA curriculum. This means most students taking MEDSCI 142 will be learning new content, so you won't really be at a disadvantage. Once the course starts, however, we do move at quite a fast pace. This is necessarily a content-heavy course to prepare students for the rigour of subsequent studies, but if you revise daily and keep up, you will succeed in this course.

Former students have said they find YouTube very useful for general background/overarching 'big picture'. Channels include "[Crash Course](#)", "[Handwritten Tutorials](#)" and of course "[Khan Academy](#)". The topics that are covered in MEDSCI 142 are outlined later in this document.

## Course outline from previous years

Course outlines from previous years are unavailable. The course has evolved (and will continue to evolve) slightly over the years, however the breadth and depth of the topics covered has remained (and will remain) relatively consistent. The learning outcomes and competencies are considered comparable from year to year.

## HUMANBIO 142 / MEDSCI 142

In 2006 the University of Auckland officially renamed the course from **HUMANBIO 142** to **MEDSCI 142**. This is why in the [University of Auckland Calendar](#), HUMANBIO 142 is listed as a restriction (i.e. students who have taken HUMANBIO 142 are not normally permitted to take MEDSCI 142).

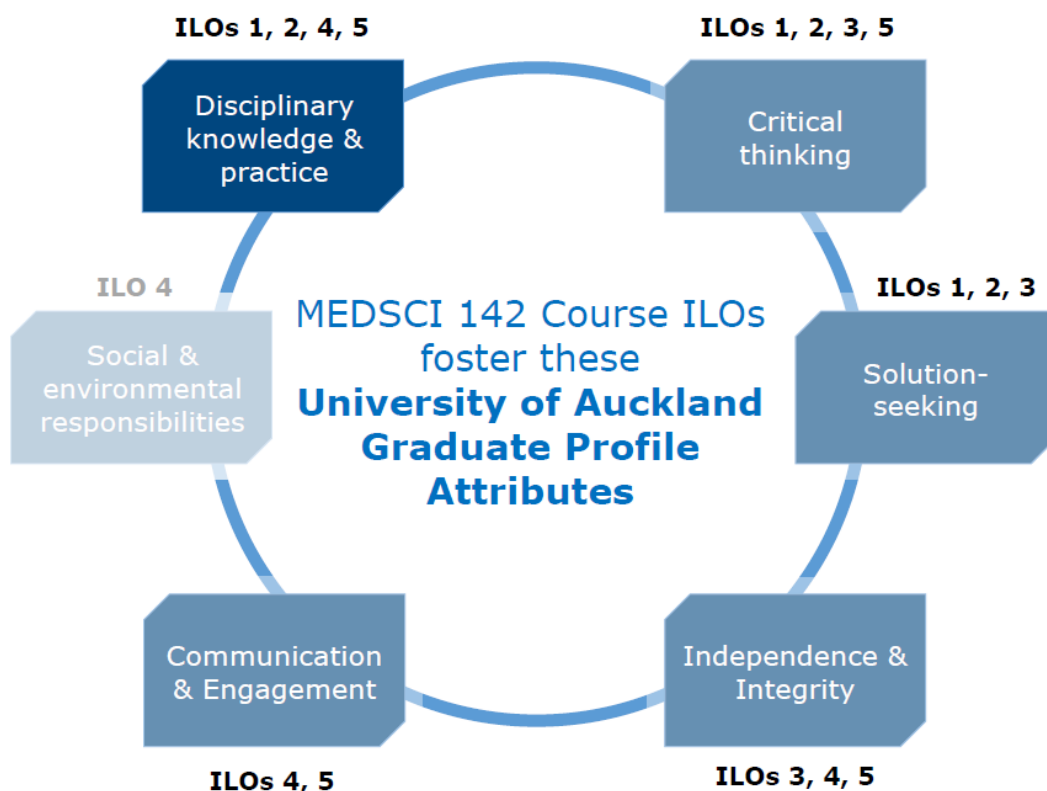
## Intended Learning Outcomes (ILOs) of the course

1. Explain in depth the importance of particular organ systems
2. Explain how any imbalance can affect health and lead to disease
3. Use and develop your intellectual, cognitive and practical skills to complete the learning and assessment activities
4. Communicate your knowledge and understanding as a future healthcare and/or scientific professional with fellow students, the academic faculty and the community
5. Plan and evaluate your own progress towards achieving personal and professional goals

Upon successful completion of the course, students should be able to:

1. Show competency in declaring and applying specialist knowledge and practical skills;
2. Communicate as a future healthcare or scientific professional with fellow students and the academic faculty;
3. Plan and evaluate their own progress towards achieving personal and professional goals, through the use and development of generic intellectual, cognitive and practical skills.

## Alignment of course ILOs with the University of Auckland Graduate Profile



## Course content and format of delivery

The course content includes the structure and function of selected human organ systems:

- Nervous (4 lectures)
- Cardiovascular (7 lectures)
- Autonomic and Endocrine (2 lectures)
- Reproductive (4 lectures)
- Musculoskeletal (5 lectures)
- Respiratory (6 lectures)
- Renal (4 lectures, 1 online)
- Alimentary (3 lectures)

### Lectures

From 2019, there are 35 lectures in the course, with each organ system occupying 2-7 lectures. Lectures explore the integrated anatomy and physiology of each system. Clinical examples and recent research advances are incorporated where appropriate.

### Laboratory (practical) classes

A programme of six, 2.5-hour laboratory sessions accompanies the lectures. There are:

- Three animal dissection laboratories, covering **alimentary**, **cardiovascular**, and **musculoskeletal** systems;
- One based on plastinated tissue of the human brain (**nervous**);
- One involving physiological measurements (ventilation/**respiratory**);
- One is a mixture of modalities, covering the **reproductive** systems.

The laboratories are experiential learning opportunities designed to complement the theoretical concepts introduced in lectures, and to facilitate the achievement of the learning outcomes.

The lab sessions are assessed using a short test at the end of each session. Marks are awarded for assessments in each of the 6 labs, but only the 5 best lab marks for the semester are included in the 10% of the overall course mark derived from laboratories (see below). Achievement of laboratory intended learning outcomes is also assessed in the mid- and end-of-semester tests.

### Assessment

**Practical/laboratories (10%):** *Students must achieve >5% to pass the course as a whole.*  
10% from short end-of-lab quizzes (single-best option, multiple-choice questions (MCQs))

**Theory (90%):** *Students must achieve >45% to pass the course as a whole.*

20% from structured online learning and revision activities

40% from in-course tests:

- a 1.5-hour mid-semester test (single-best option MCQs)
- a 1.5-hour end-of-semester test (single-best option MCQs)

30% from the 3-hour final exam (short-answer questions / diagrams; no MCQs)

### Course grades

Final course grades are allocated using the University of Auckland grade boundaries with 0.5 rounding. For clarity, the **minimum thresholds** of which are listed in the table below. These mark thresholds must be cleared in order for a particular grade to be awarded.

Passing grades											
	Grade boundary	Minimum threshold		Grade boundary	Minimum threshold		Grade boundary	Minimum threshold		Grade boundary	Minimum threshold
A+	90.00	89.50	B+	75.00	74.50	C+	60.00	59.50	D+	45.00	44.50
A	85.00	84.50	B	70.00	69.50	C	55.00	54.50	D	40.00	39.50
A-	80.00	79.50	B-	65.00	64.50	C-	50.00	49.50	D-	0.00	0.00

The percentage of enrolled students who passed the course in 2019 was approximately 78%. The average pass rate across the last five years is closer to 76%.

## Textbook

### Tortora & Derrickson "Principles of Anatomy and Physiology" 2<sup>nd</sup> Asia-Pacific edition

- Textbook with Interactive E-Text Code: ISBN 9780730363538
  - Available for \$176.63 NZD from [ubiq](#)
- Interactive E-Text: ISBN 9780730354987
  - Available for \$75 AUD via [Wiley Direct](#)

Lecturers assume that every student has access to a copy of the text, but you don't have to buy your own copy. We recommend that you borrow a copy from the University's many libraries and see first-hand if you find it useful before making your decision.

- [City Campus General Library](#)
- [Grafton Campus Philson Library](#)

This is an excellent textbook. It will be valuable in later years if you intend to continue with biomedical courses. Older editions may be bought second-hand and will be quite satisfactory, but page references given during lectures will refer to the current edition.

For lecture topics which are well-covered in the text, only brief notes and diagrams will be provided in this Course Guide. The lecturer will probably use images of textbook diagrams, and will refer to specific passages in the book which all are examinable. Information in the text and course guide will not be duplicated on Canvas (the University's Learning Management System).

## Intended learning outcomes for each body system

**NB: the order presented here does not necessarily reflect the order in which the topics are taught**

### ***Nervous system***

- Identify the major subdivisions of the human brain
- Draw an outline of the lateral view of the cerebral cortex and identify the major gyri / sulci, lobes, and the sensory / motor and language areas
- Explain the functional effects of lesions (e.g. strokes) of the cerebral cortex
- Describe the general structures of the spinal cord
- Explain how touch and pressure / pain and temperature information is conveyed from the skin to the spinal cord
- Explain how lower motor neurons control muscle activity
- Understand the effect of injuries to the spinal cord
- Describe the general organisation of the two major somatosensory pathways from the skin to the cerebral cortex
- Describe key differences between the discriminative and non-discriminative pathways
- How are the various parts of the body represented in the primary somatosensory cortex? Which body parts have the largest representation and why?
- Describe the body representation in the primary motor cortex (which parts of the body have the largest representation)
- Describe the overall structure and function of the pyramidal tract and how it contributes to muscle control
- Explain how the basal ganglia and cerebellum contribute to movement control
- Describe the major symptomatic differences between diseases of the pyramidal, basal ganglia, and cerebella systems
- Describe the basic neuropathology and chemistry of Parkinson's Disease
- Outline how a better research knowledge of the pathology / chemistry of Parkinson's disease has led to the development of new treatment strategies

**Cardiovascular**

- Compare the systemic and pulmonary blood circuits, and briefly describe unusual features of venous drainage from the gut
- Describe or label the chambers and great vessels of the heart
- Explain and / or draw the ventricular inlet and outlet valves in their open and closed states
- Relate the shape and wall thickness of the four chambers to the maximum blood pressure within them
- Explain the orientation of the heart and describe its borders
- Explain in principle the relationship of the pericardium to the heart
- Describe the mechanism and electrical functions of the fibrous skeleton
- Draw, or write brief notes about, the conduction system
- Describe in a logical sequence the events of the cardiac cycle, including impulse propagation by the conduction system, pressures in the chambers and great vessels, valve openings and closures, and heart sounds.
- Briefly describe the structure and function of the major classes of blood vessels, and be able to compare the features of two or more classes
- Provide a simple explanation or drawing of the two coronary arteries
- Explain the concept of demand and supply as it applies to the cardiovascular system
- Draw and explain a pressure/volume loop
- Describe the Frank-Starling law of the heart
- Describe the features of the heart's conduction system
- Explain the cardiac action potential and how it differs from action potential found in nerves
- Explain the phases of the ECG complex and relate to their underlying physiology
- Explain the control of heart rate by the autonomic nervous system
- Explain in detail the concepts relating to the equation  $BP = CO \times TPR$
- Describe the regulation of blood pressure by baroreflexes
- Explain the physical relationships between pressure, flow and resistance
- Define factors that affect the vasculature
- Describe the transfer of substances across the capillary wall

**Autonomic and Endocrine systems**

- Describe the structure of the nervous system and features of transmission of impulses from one nerve to another
- Describe the difference between myelinated and unmyelinated nerves
- Name the neurotransmitters associated with sympathetic and parasympathetic divisions
- Explain the features of the alarm and relaxation responses
- Compare the autonomic and somatic nervous systems
- Describe the locations of the endocrine organs of the human body
- Name two broad classes of hormones and explain how they interact with target cells
- Draw diagrams to show the two general mechanisms of hormone action based on their chemical solubility
- Explain and/or draw the relationship between the hypothalamus and pituitary glands
- Explain or complete a flow diagram describing events in the alarm and / or resistance reactions
- List the physiological responses which result from the alarm response and resistance reactions
- List the physiological mechanisms that connect the nervous and endocrine systems to the immune system
- Explain why stress affects immune function

**Reproductive system**

- Describe the endocrine glands controlling reproductive processes
- Identify the hormones that regulate the activity of the ovaries and testes
- Understand the function of the hormones produced by the ovaries and testes
- Describe the female reproductive organs

- Describe the histology of the ovary
- Describe the events of follicular development
- Describe the key events during the female reproductive cycle
- Describe the key events during sex determination and differentiation
- Describe the key events during puberty
- Describe the key events during menopause
- List the events of spermatogenesis and identify where these events occur within the testes
- Draw a diagram describe the endocrine (hormonal) control of sperm production
- Label a diagram of spermatozoa
- Describe the technique of intracytoplasmic sperm injection
- Label a diagram of the male reproductive tract
- Describe the course of sperm as it traverses the male reproductive tract
- Describe the basic mechanism by which erection occurs
- Describe the incidence of benign prostatic hyperplasia and prostate cancer and the consequences of these conditions

### ***Musculoskeletal system***

- List the functions of the adult skeleton and the two main skeletal regions
- Describe the general regional organisation and anatomy of a long bone
- Explain the appearance, location and function of the different cell types found in bone tissue
- Describe the features that make bone a specialised connective tissue
- List the differences between the two main types of adult bone
- Describe two ways in which osteons are formed
- Broadly classify joints by function
- Explain or draw a typical synovial joint and its important features
- Describe the components of articular cartilage and how they are arranged
- Describe the structure of a typical proteoglycan complex
- Explain the mechanisms and processes that occur during the loading and unloading of articular cartilage
- Draw and describe the function and organisation of the layers and cells found in the articular capsule
- List the important components and functions of synovial fluid
- List the functions of muscle tissue
- Describe the basic arrangement of a muscle
- Describe the organisation of skeletal muscle, including its surrounding connective tissue, from a sarcomere through to the surrounding fascia
- Describe skeletal muscle compartmentalisation
- Define and discuss skeletal muscle hypertrophy and atrophy
- Describe the structural features that enable force generated by sarcomere contraction to be transmitted to the movement of bone

### ***Renal system***

- Describe the overall organisation of the human (multilobar) kidney
- Outline the blood supply of the kidneys
- Outline the organisation of the nephron and collecting ducts and describe how they are arranged in the kidney
- Describe the tissue and cellular organisation of the renal corpuscle, in particular the elements which form the glomerular filter
- Describe the tissue and cellular organisation of the tubular components of the nephron, including a broad understanding of the regional differences
- List the main functions of the kidney
- Describe the distribution of fluid in the body and the process of osmosis
- Use appropriate terms to describe a solution's osmolarity and tonicity

- Describe the relative concentrations of  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cl}^-$  in intracellular and extracellular fluid
- Describe how filtration, reabsorption and secretion contributes to urine production.
- Describe the major determinants of glomerular filtration
- Describe, at a basic level, how glomerular filtration can be regulated
- Describe the process involved in producing a dilute urine by outlining the movement of  $\text{Na}^+$ , water and glucose in each region of the nephron
- Describe how anti-diuretic hormone influences urine production
- Describe the role of the renin-angiotensin-aldosterone system in blood pressure regulation
- Describe the responses to ingestion of  $\text{NaCl}$  or water

### ***Respiratory system***

- Distinguish between external, internal and cellular respiration
- Describe or label a diagram of the nasal cavities, and comment on their function
- Distinguish three regions of the pharynx and explain how food is kept out of the airway during swallowing
- List, in descending order of size, the passages which make up the conducting and respiratory airways
- Describe the main features of the trachea
- Label a diagram of the bronchial or bronchiolar wall
- Describe, label or draw the cells which occur in the alveolar wall.
- Identify what constitutes the diffusion barrier
- List or label the lobes of the lungs
- Define what is meant by a lung segment, and explain its clinical significance
- Name the pleurae and describe their relations to the lung, body wall and diaphragm
- Briefly explain how movements of the rib cage and diaphragm cause ventilation of the lungs, and name the muscles chiefly responsible
- Define respiration
- List the main muscles associated with breathing and their innervation
- Describe the respiratory cycle with reference to changes in intra-pulmonary and intrapleural pressure
- Explain how different lung volumes are measured
- List the name of some clinical tests aimed at assessing respiratory function
- Define compliance of the lung and importance of surfactant to reduce surface tension
- Explain the consequences of chronic obstructive pulmonary disease (COPD) & fibrosis to ventilation on lung compliance
- Describe the respiratory airway tree, the 'funnel effect', dead space and its impact on ventilation
- Describe a reflex involved in controlling airflow
- Give examples of diseases affecting airway resistance
- Explain why the pulmonary circulation is a low pressure system
- Explain the significance of the terms: sheet flow, vessel distension/recruitment
- Explain the reasons for regional differences in blood flow in the upright lung
- Explain why the ideal ventilation-perfusion ratio ( $V:Q$ ) value is one but in reality it is  $< 1$
- Describe the implications of pulmonary hypertension and consequences for ventilation
- Explain the factors controlling diffusion of gas from the alveoli into the blood stream
- Explain what is meant by gas diffusion vs. blood perfusion limitation of gas uptake from the lungs
- Explain how oxygen and carbon dioxide are transported in blood
- Explain the physiological significance of the oxygen dissociation curve for haemoglobin
- Describe the difference between saturation and content of oxygen in blood
- Explain why foetal haemoglobin and myoglobin have left shifted oxygen dissociation curves
- Describe the Bohr shift, chloride shift and the Haldane effect
- Explain how blood gas levels themselves control the rate and depth of breathing

***Alimentary system***

- Describe or label the main parts of a tooth
- Describe or draw the papillae and intrinsic muscles of the tongue
- List the three major salivary glands, describe the function of their secretions
- Explain at least four methods by which surface area of the epithelium lining the gut tube may be increased
- List four main functions of the digestive system and explain how they vary along the length of the gut tube
- List or label the four layers which generally make up the wall of the gut tube. Describe the tissue components of each layer, and comment on their functions
- Describe the ways in which the standard gut tube is modified in the oesophagus, and relate this to function
- Describe or label gross anatomical features of the stomach, including its four regions
- Describe or label gastric pits and glands of the mucosa, and comment on the cell types which occur there. Explain how they contribute to the functions of the stomach
- Briefly list the major functions of the liver
- Explain using notes or a diagram how hepatocytes are placed in relation to the blood and bile spaces around them
- Explain or label the structure of one liver lobule and the vessels which convey blood or bile to or from it
- Write brief notes about the exocrine function of the pancreas
- Explain or label the exocrine acini and their branching system of ducts
- List the three regions of the small intestine, and describe their functions
- Explain the ways in which the standard gut tube is modified in the intestine, and identify the adaptations which increase surface area
- Describe or label intestinal villi and glands, and comment on the cell types found there
- List the seven regions and describe the main functions of the large intestine
- Explain the ways in which the standard gut tube is modified in the colon, especially the external muscle coat
- Describe or label mucosal glands of the colon, and comment on the cell types found there



## Teaching and learning innovations / version history (living document)

Year	Innovation / course evaluation / focus group feedback sessions	Course ILO alignment
2004	Obtained focus group feedback (facilitated semi-structured interviews with students) and used this to inform curriculum design.	
2008	Obtained focus group feedback and used this to inform curriculum design.	
2010	Conducted an official UoA course evaluation.	CS10 = 94.8%
2011	Implemented the practice of providing personalised feedback of MCQ test performance for students ( <b>ProResults</b> ).	1, 2, 5
	Implemented <b>PeerWise</b> ( <a href="https://peerwise.cs.auckland.ac.nz/">https://peerwise.cs.auckland.ac.nz/</a> ) as a supplementary learning tool (optional, non-grade bearing). Facilitated focus group feedback discussion with students and Paul Denny, inventor of PeerWise).	1, 2, 3, 4, 5
2012	Underwent an official UoA course review.	
	Shift of assessment weighting from 12% in-lab quizzes 28% mid-semester test 60% final exam	to 12% in-lab quizzes 50% two in-course tests 38% final exam
	Continued the practice of providing personalised feedback of MCQ test performance for students, using a more user-friendly tool ( <b>MCQ Results</b> ) <a href="https://medprog.fmhs.auckland.ac.nz/mcqresults/">https://medprog.fmhs.auckland.ac.nz/mcqresults/</a>	1, 2, 5
	Implemented <b>Piazza</b> and Piazza Tutors as a supplementary learning tool (optional, non-grade bearing). Used as a peer- and near-peer learning / online tutorial / 'virtual office hours' tool, while fostering an online learning community. <a href="http://www.piazza.com">www.piazza.com</a>	1, 2, 4, 5
	Obtained focus group feedback and used this to inform curriculum design.	
2013	Continued to foster an online learning community through Piazza and Piazza Tutors.	1, 2, 4, 5
	Continued to provide personalised feedback on performance in MCQ assessments.	1, 2, 5
	Developed resources aimed to help students to develop their metacognition and to become independent learners: <a href="http://www.tinyurl.com/142study">http://www.tinyurl.com/142study</a>	3, 5
	Implemented pre- and post-class 'on-task' activities, designed to guide students to engage in cognitively active learning behaviour during study time, and study consistently throughout the course (distributed learning). Students are shown how the activities offer opportunities to practise meeting the intended learning outcomes for the first 13 lectures, after which students are encouraged to create their own 'on-task' activities (and share these on Piazza).	1, 2, 3, 4, 5
	Piloted an ipsative 'mock test' initiative, providing formative feedback to students two weeks prior to the first major in-course test. This is designed to reduce any self-over- or under-estimation of ability or diligence ahead of the actual test, and to allow students adequate time to take action to rectify the situation.	1, 2, 3, 5
	Obtained ethics approval to evaluate the effectiveness and impact of these interventions on student learning outcomes. This study was approved by the University of Auckland Human Ethics Committee on 07 May, 2013, for a period of three years – reference number UAHEC 9295.	

	Conducted an official UoA course evaluation.	CS10 = 91.6%
	Obtained focus group feedback and used this to inform curriculum and course design.	
2014	Continued to foster an online learning community through Piazza and Piazza Tutors.	1, 2, 4, 5
	Continued to provide personalised feedback on performance in MCQ assessments.	1, 2, 5
	Continued to develop and promote student metacognition and independent learning.	3, 5
	Continued to develop and update pre- and post-class 'on-task' activities.	1, 2, 3, 4, 5
	Continued to support the ipsative 'mock test' initiative.	1, 2, 3, 5
	Preliminary results of the impact of the Piazza online learning community and the mock test were presented at the 2014 Tertiary Education Research in New Zealand conference [ <a href="#">Abstract</a> ]	
2015	Shift of assessment weighting from 12% in-lab quizzes 50% in-course tests 38% final exam	to 10% in-lab quizzes (best 5 out of 6 labs) 50% two in-course tests 40% final exam
	Continued to foster an online learning community through Piazza and Piazza Tutors.	1, 2, 4, 5
	Continued to provide personalised feedback on performance in MCQ assessments.	1, 2, 5
	Continued to develop and promote student metacognition and independent learning.	3, 5
	Continued to develop and update pre- and post-class 'on-task' activities.	1, 2, 3, 4, 5
	Continued to support the ipsative 'mock test' initiative.	1, 2, 3, 5
	Redesigned post-topic revision resources to create opportunities for students to practise overcoming test stresses/anxieties.	1, 2, 3, 5
	Promoting the use of MCQs to practise higher level thinking skills.	1, 2, 3, 5
	Piloted the "Personalised academic intervention": a 30-minute face-to-face consult to show students how to leverage embedded/existing teaching and learning activities to overcome learning barriers/change learning behaviour. Presented at the 2015 Tertiary Education Research in New Zealand conference [ <a href="#">Abstract</a> ]	1, 2, 3, 5
	A manuscript summarising the impact of the learning interventions in this large undergraduate human biology course is currently under preparation.	
2016	Maintained the interventions mentioned above. Conducted an official UoA SET course evaluation.	CS10 = 96.2%
2017	Shifted to lecture video recording in response to the student SET feedback comments and guided by the findings of the EW Sharman staff award for curriculum development study " <b>Examining the effects lecture recordings have on student engagement</b> " (PI Alistair Woodward; Co-investigator Angela Tsai).	
2018	Maintained the interventions mentioned above. Piloted the OnTask student engagement tool. Conducted an official UoA SET course evaluation.	CS10 = 93.2%

2019	Shift of assessment weighting from 10% in-lab quizzes (best 5 out of 6 labs) 50% two in-course tests 40% final exam	to 10% in-lab quizzes (best 5 out of 6 labs) 10% online learning and revision activities 40% two in-course tests 40% final exam
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Maintained the interventions mentioned above.  
Conducted an official UoA SET course evaluation.

CS10 = 92.9%

2020	Shift of assessment weighting from 10% in-lab quizzes (best 5 out of 6 labs) 10% online learning and revision activities 40% two in-course tests 40% final exam	to 10% in-lab quizzes (best 5 out of 6 labs) 20% online learning and revision activities 40% two in-course tests 30% final exam
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Maintained the interventions mentioned above.  
Conducted an official UoA SET course evaluation.

CS10 = 92.9%

- 2021 Tsai, A., Burrell, M. H., Sturm, S., & Garbett, D. (2021). Rethinking the Carrot and the Stick: A Case Study of Non-Grade-Bearing Learning Activities to Enhance Students' Engagement and Achievement. *New Zealand Journal of Educational Studies*. <https://doi.org/10.1007/s40841-021-00197-1> or <https://rdcu.be/ciQCM>

From 2021: *Students must achieve >45% in the theory component (90%) to pass the course as a whole.*