FACULTY OF SCIENCE

SCHOOL OF BIOTECHNOLOGY AND BIOMOLECULAR SCIENCES

BIOC3261

HUMAN BIOCHEMISTRY

SESSION 2, 2018

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Faculty of Science – BIOC3261 Human Biochemistry Course Outline

1. Information about the Course

NB: Some of this information is available on the UNSW Handbook[1]

Year of Delivery	2018
Course Code	BIOC3261
Course Name	Human Biochemistry
Academic Unit	BABS, School of Biotechnology and Biomolecular Sciences
Level of Course	3rd UG
Units of Credit	6UOC
Session(s) Offered	S2
Assumed Knowledge, Prerequisites or Co-requisites	BIOC2101, BIOC2201
Hours per Week	2-5
Number of Weeks	12 weeks
Commencement Date	Tuesday 31st of July (Week 2 of Session), 2018

Summary of Course Structure (for details see 'Course Schedule')

Component	HPW	Time	Day	Location
Lectures	**2**			
Lecture 1		1 - 2 pm	Tuesday	CLB 3
Lecture 2		10 - 11 am	Wednesday	CLB 1
Laboratory/ Other activity	**3**			
Lab – Option 1		2 - 5 pm	Monday	Weeks 4 & 8: Wallace Wurth Lab 123 Weeks 5-7: Mathews Room 309
Lab – Option 2		10 - 1 pm	Tuesday	Weeks 4 & 8: Wallace Wurth Lab 123 Weeks 5-7: Mathews Room 309
TOTAL	**5**			
Special Requests	Any students with special learning and/or assessment requirements should consult the course convener by **Week 2 of Session 2** so that appropriate adjustments can be made.			

2. Staff Involved in the Course

Staff	Role	Name	Contact Details
Course Convenor		Dr. Anne M. Galea	a.galea@unsw.edu.au
Additional Teaching Staff	Lecturers	Prof. Andrew J. Brown Dr. Jerry Greenfield Dr. Kyle Hoehn Dr. Michal Janitz Dr. Ross Laybutt Dr. Kate Quinlan Dr. Vladimir Sytnyk Dr. Irina Voineagu Prof. H. Rob Yang	aj.brown@unsw.edu.au j.greenfield@garvan.org.au k.hoehn@unsw.edu.au m.janitz@unsw.edu.au r.laybutt@garvan.org.au kate.quinlan@unsw.edu.au v.sytnyk@unsw.edu.au i.voineagu@unsw.edu.au H.Rob.Yang@unsw.edu.au

[1] UNSW Online Handbook: http://www.handbook.unsw.edu.au

3. Course Details

Course Description[2]	This course showcases some more advanced aspects of biochemistry that are particularly relevant to humans. Specialist lectures are given by experts in the area. These include lectures on diabetes by a leading team from the Garvan Research Institute, and lectures on neurobiology, lipid metabolism, and the biochemistry of athletic performance by experts with diverse international research experience in their respective fields.
Course Aims	The aim of this course is to provide students with a fundamental understanding of 'normal' human metabolism as it contrasts with various pathological states, such as heart disease, diabetes, cancer and neurological conditions. The course will also hone the theoretical and analytical skills required to critically evaluate the claims that underpin trending health treatments and procedures, such as dietary supplementation and weight regulation strategies.
Student Learning Outcomes	At the end of this course, students will be able to: 1. Describe the key features that define 'normal' biochemical profiles in human metabolism (with a focus on lipid and carbohydrate metabolism). 2. List and explain the factors contributing to various conditions and disease states (such as fasting, exercise, heart disease, diabetes, cancer and neurological disorders) in which certain biochemical pathways are altered. 3. Identify, analyse and critically evaluate scientific literature and evidence relating to popular weight loss treatments, dietary supplementation, and/or medical breakthroughs in the field of human biochemistry. 4. Carry out clinical biochemical procedures for the measurement and analysis of blood cholesterol and urine glucose levels in human specimens, classify these as 'normal' or 'abnormal' profiles, and explain any clinical implications relating to these outcomes.

Graduate Attributes Developed in this Course

Science Graduate Attributes	**Select the level of FOCUS** *0 = NO FOCUS* *1 = MINIMAL* *2 = MINOR* *3 = MAJOR*	**Activities / Assessment**
Research, inquiry and analytical thinking abilities	3	Lectures: Evaluating scientific evidence. Nutrition Symposia: Evaluating health claims. Projects: Research and inquiry into various Human Biochemistry topics.
Capability and motivation for intellectual development	2	Lectures and self-directed learning tasks are all designed to motivate intellectual development. In particular, the Nutrition Symposia and Projects all are geared to foster creativity and innovation.
Ethical, social and professional understanding	1	Nutrition Symposia: Evaluating health claims.
Communication	3	Nutrition Symposia: Opportunity to present a lecture. Projects: Opportunity to present a lecture, make a video or write an essay.

[2] UNSW Handbook: http://www.handbook.unsw.edu.au

Teamwork, collaborative and management skills	3	Both the Project and the laboratory activities offer the opportunity for teamwork.
Information literacy	3	This is required for all of the self-directed learning tasks (e.g. Nutrition Symposia, Projects, laboratory activities).
Major Topics (Syllabus Outline)	**CHOLESTEROL** **Prof. Andrew J. Brown (BABS)** (3 lectures) The overall objective of these lectures is to describe the several roles that cholesterol has in health and disease. Topics will include: 1. General membrane functions of cholesterol; the evolutionary perfection of cholesterol; the role of cholesterol in the hedgehog signalling pathway in embryonic development. 2. Absorption of dietary cholesterol and transport in the circulation by lipoproteins; cellular cholesterol homeostasis and how the statin class of blood cholesterol lowering drugs work. 3. The SREBP pathway as master transcriptional regulators of cholesterol homeostasis. 4. Cholesterol and heart disease; HDL and Reverse Cholesterol Transport; cholesterol accumulation in macrophage-foam cells in atherosclerosis; the role of ABCA1 and nuclear receptors (LXR/RXR) in unloading cholesterol from macrophage-foam cells. 5. The final lecture will cover new research from Prof. Brown's lab which delves deeper into cellular cholesterol homeostasis and brings concepts from the previous lectures together. **LIPID METABOLISM IN HEALTHY BRAIN AND NEUROLOGICAL DISEASES** **Dr. Irina Voineagu (BABS)** (1 lecture) This lecture will cover lipid metabolism as it relates to normal brain physiology and brain pathology. The importance of lipids in human biochemistry is nowhere more apparent than in the brain, which is a lipid rich organ, and a large number of neurological conditions are attributed to altered lipid metabolism - often genetically encoded. In the lecture I will: (i) Discuss the basic biochemistry of brain lipids including lipid mediators of neuroinflammation. (ii) Discuss the biochemistry and properties of myelin . (iii) Give an overview of brain disorders resulting from altered lipid metabolism. **ADHESION & CELL COMMUNICATION IN NEUROLOGICAL CONDITIONS** **Dr. Vladimir Sytnyk (BABS)** (1 lecture) Adhesion and cell communication in neurological conditions The lecture would include: - A very brief introduction to the basics of brain organization (major cell types, structures). - Types of the cellular interactions in the brain. - Protein organization of synapses as a basic subcellular compartment involved in the information processing and storage in the brain, with some emphasis on the role of adhesion molecules. - Link between abnormalities in the cell adhesion molecule expression and synapse function in neurological conditions (Down syndrome, Alzheimer's disease and schizophrenia). - Mouse models to study neurological conditions.	

TRANSCRIPTOME REGULATION IN NEURODEGENERATIVE DISEASES
Dr. Michal Janitz (BABS) (1 lecture)
The term transcriptome refers to the total number of mRNA molecules expressed in a particular cell type, tissue or an organism. The concept of transcriptome emerged as a result of studies of gene expression on the genome-wide level using modern techniques of molecular biology such as DNA microarrays, high-throughput RNA interference and, very recently, next-generation DNA sequencing. In higher vertebrates, including human, there are several common functional and structural features of the transcriptome which allow the genes to be expressed in tightly coordinated manner during development and adult life. Furthermore, changes in transcriptome profile may also indicate the onset of the disease and might be observed long before any clinical symptoms emerge. In particular, molecular pathology of neurodegenerative diseases, such as Alzheimer's disease, is currently considered to be a result of aberrations in transcription regulation rather than mutations in genomic sequence. The lecture will address regulation of gene expression, the role of transcriptional factors, structure of promoter regions and coordination of transcription on the level of the whole genome in the context of molecular pathophysiology of the human brain.

OBESITY & LIPOTOXICITY
Prof. H. Rob Yang (BABS) (2 lectures)
Lipotoxicity refers to fatty acids-induced cell toxicity. In the obesity epidemic, lipotoxicity is one of the major factors that underlie devastating human diseases such as diabetes. In this lecture, I will first discuss that synthesis of storage neutral lipids (fat). I will then discuss the genetics of obesity, and how obesity may lead to lipotoxicity which causes impaired insulin signalling, beta cell death and type II diabetes.

A FRESH LOOK AT WEIGHT LOSS
Ruben Meerman (1 lecture)
Obesity is preventable and can be treated without drugs or side effects but a growing trans-disciplinary movement called 'Health At Every Size' is challenging these well-established facts. Adherents claim that diets don't work and are calling for a 'paradigm shift' to abandon weight loss objectives altogether and to concentrate on "weight neutral" health outcomes instead. This lecture puts weight gain and weight loss under the molecular microscope and provides a fresh biochemical perspective on the global overweight/obesity epidemic, its causes and potential cures.

DIABETES AND INSULIN/CARBOHYDRATE BIOCHEMISTRY
Dr. Kyle Hoehn (BABS), Dr. Jerry Greenfield (Garvan) and Dr. Ross Laybutt (Garvan) (5 lectures)
Diabetes is really a multitude of diseases. In broad terms it can be broken down into Type 1 and Type 2 diabetes. Type 1 or Juvenile onset diabetes results from the autoimmune destruction of the pancreatic beta cells and is characterised by a lack of circulating insulin.
Children with this disease are treated with insulin injections. Type 2 diabetes is characterized both by insulin resistance as well as pancreatic insufficiency. Type 2 diabetes is often associated with obesity and this is thought to be one of the major reasons that the incidence of Type 2 diabetes is increasing dramatically. Type 2 diabetes is most often treated with diet and exercise.
The lectures will cover:
1. The major pathophysiological features of Type 1 and Type 2 diabetes.
2. The clinical management of these diseases.
3. The cellular contribution to whole body glucose metabolism.
4. The molecular control of insulin action in peripheral tissues (muscle, liver

	and fat). 5. Insulin signal transduction pathways. 6. Major metabolic pathways regulated by insulin. 7. Molecular control of insulin secretion. 8. The cell biology of insulin biosynthesis and its regulated secretion. **THE BIOCHEMISTRY OF ATHLETIC PERFORMANCE** **Dr. Kate Quinlan (BABS)** (3 lectures) The objective of this lecture series is to discuss how biochemistry and metabolism change during and in response to exercise in humans. Topics will include: 1. an introduction into the biology of skeletal muscle. 2. the differences in contractile properties and metabolism of the different types of human skeletal muscle fibres. 3. how the body mobilises fuel stores and how skeletal muscle metabolises these fuels to generate energy for muscle contraction during exercise. 4. how the human body adapts to exercise training with a focus on muscle Adaptations. 5. how a polymorphism in the ACTN3 gene contributes to human athletic performance through altering muscle biology and muscle metabolism.
Relationship to Other Courses within the Program	This course builds on and greatly extends 2nd year biochemistry, giving insights into other levels of regulation of metabolism and other biochemical processes, often from a transcriptional and cell biological viewpoint. It therefore impinges upon a number of courses (e.g. biochemistry, molecular biology, proteins and cell biology).

4. Rationale and Strategies Underpinning the Course

Teaching Strategies	The lectures feature recent developments in aspects of human health and disease, particularly in areas of major metabolic disease. They also have a major lifestyle component which students should relate to in different ways. The Nutrition Symposia further help students to develop their understanding of metabolic states, diseases and regulation, as do the laboratory activities, which give the students the opportunity to measure their own glucose and cholesterol levels. The self-directed learning tasks (e.g. the project) are designed to encourage students to discover their own interesting examples of recent research relating to human biochemistry.
Rationale for learning and teaching in this course	A 3rd year subject should be an opportunity for students to hopefully rediscover (if it was ever lost) their own **enthusiasm and passion for science**, and so this course offers a number of self-directed learning tasks that students can choose for themselves. It is crucial that by the end of 3rd year, students are thinking like scientists – notably, that they can **critically evaluate the evidence**. For instance, in this course, we hold a Nutrition Symposium where students present critiques of methods for weight loss that are advertised and promoted via websites, but which do not work as claim. These are lively sessions where the students challenge each other's assumptions and learn what constitutes good evidence (e.g. peer-reviewed articles in good scientific journals) and what constitutes bad evidence (e.g. websites with something to sell). It is also important for the students to realise that our understanding of biological processes is constantly evolving, by presenting them with samples of the latest research.