FACULTY OF SCIENCE

SCHOOL OF BIOTECHNOLOGY AND BIOMOLECULAR SCIENCES

BIOC2101

PRINCIPLES OF BIOCHEMISTRY (ADVANCED)

TERM 2, 2019

BIOC2101 Principles of Biochemistry (Advanced)

Course Outline

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BIOC2101 – Principles of Biochemistry (Advanced) Course Outline

1. Course Information

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

Year of Delivery	2019
Course Code	BIOC2101
Course Name	Principles of Biochemistry (Advanced)
Academic Unit	School of Biotechnology and Biomolecular Sciences
Level of Course	2nd year undergraduate
Units of Credit	6
Term(s) Offered	T2
Assumed Knowledge, Prerequisites or Co-requisites	Prerequisites: BABS1201 and CHEM1011 or CHEM1031 or CHEM1051 and CHEM1021 or CHEM1041 or CHEM1061
Hours per Week	6
Number of Weeks	10 weeks
Commencement Date	Monday 3rd June 2019 (Week 1)

Summary of Course Structure

Component	Hours/week	Time	Day	Location
Lectures, tutorials, and exams	3			
Weekday lecture 1		3 – 4 pm	Monday	Central Lecture Block 7
Weekday lecture 2		5 – 6 pm	Wednesday	Science Theatre
Weekday lecture 3		2 – 3 pm	Friday	Mathews Theatre A
Laboratory	3			
Laboratory – Option 1		10 am – 1 pm	Tuesday	Wallace Wurth 122/123
Laboratory – Option 2		2 – 5 pm	Tuesday	Wallace Wurth 122/123
Laboratory – Option 3		10 am – 1 pm	Wednesday	Wallace Wurth 122/123

2. Staff Involved in the Course

Staff	Name	Contact Details
Course Convenor	Dr Anne Galea	a.galea@unsw.edu.au
Teaching Staff	Prof Andrew Brown A/Prof Kyle Hoehn Dr Rebecca LeBard Dr Vladimir Sytnyk Dr Nirmani Wijenayake Prof Marc Wilkins	aj.brown@unsw.edu.au k.hoehn@unsw.edu.au r.lebard@unsw.edu.au v.sytnyk@unsw.edu.au b.wijenayakeg@unsw.edu.au m.wilkins@unsw.edu.au

3. Course Details

Course Description[2]	BIOC2101 introduces modern biochemistry, covers fundamental aspects of the structure-function relationships of proteins, and an overall coverage of intermediary metabolism. Major topics covered include: the nature and function of proteins and enzymes; the metabolic working of cells, tissues and organs; the interrelationships between the pathways of carbohydrate, lipid and amino acid metabolism; the vital role of hormones in metabolic regulation; the energy-trapping mechanisms of animals; and interesting variations in the central metabolic pathways under various physiological conditions. Practical work complements the lectures and introduces the principles of biochemical analysis.

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

Course Aims[3]	• This course aims to introduce students to modern biochemistry with a particular emphasis on how we, as humans, convert foods to useful energy. • This course also aims to provide a solid context for new learning material by providing clinical, medical and everyday applications that correspond to the central themes and topics. • Practical classes are designed to reinforce the core biochemical concepts covered in lectures and introduce students to current laboratory techniques and biochemical assays.
Student Learning Outcomes[4]	By the completion of this course students should be able to: 1. Describe and contrast the functions and key features of the major metabolic pathways in humans. 2. Explain the various mechanisms that control and regulate the simultaneous functioning of anabolic and catabolic processes in the cells of living tissues. 3. Describe the integration of major metabolic pathways in the context of common human conditions, such as fasting, starvation, obesity and exercise. 4. Work safely and effectively in a modern biochemical laboratory to perform a range of biochemical assays, analytical techniques and related calculations. 5. Communicate experimental methods, outcomes and their interpretations in the format of a professional scientific report.

Graduate Attributes Developed in this Course[5]

Science Graduate Attributes[5]	**Level of FOCUS** *1 = MINIMAL* *2 = MINOR* *3 = MAJOR*	**Activities / Assessment**
Research, inquiry and analytical thinking abilities	3	Lectures, tutorials, laboratory experiments, online discussions, computer exercises / instruction and formative self-assessment, pre-lab quizzes, multiple choice questions, exam short answers / essay answers, solving complex problems, practical quiz and laboratory report.
Capability and motivation for intellectual development	3	Lectures, tutorials, laboratory experiments, online discussions, computer exercises / instruction and formative self-assessment, pre-lab quizzes, multiple choice questions, exam short answers / essay answers, solving complex problems, practical quiz and laboratory report.
Ethical, social and professional understanding	1	Laboratory experiments, lectures and tutorials, pre-lab quizzes, laboratory report and online laboratory safety quiz.
Communication	2	Laboratory experiments and online discussions, exam short answers / essay answers, laboratory report.
Teamwork, collaborative and management skills	2	Laboratory experiments and online discussions, laboratory report.
Information literacy	2	Lectures, tutorials, online resources, laboratory report.

Major Topics Covered

Introduction to Metabolism

Living organisms create and maintain their essential orderliness at the expense of their environment, which they cause to become more disordered in consequence. They are essentially an 'open' chemical system existing in a steady-state condition and must therefore extract energy, generally as chemical fuel, from their surroundings. Viewed as a machine, they must obey the same thermodynamic laws applicable to purely physical phenomena. The study of bioenergetics considers these energy relationships, without which the system of complex chemical reactions unique to life processes cannot be appreciated. All life processes on this planet have utilized a single specific molecule, adenosine triphosphate (ATP), as a concentrated form of chemical energy to which outside energy sources (as food) are converted and which is then used for biosynthetic purposes to maintain low entropy, *i.e.* highly ordered system. ATP will be used as a typical example to illustrate energy relationships applicable to biochemical reactions in general.

The term 'metabolism' encompasses all the chemical processes which occur within living organisms. 'Anabolism' is the sum of those processes by which structural and functional components of a cell are synthesized from simpler units. 'Catabolism' covers the processes whereby complex compounds are degraded to release energy and to provide the smaller units for the cell's synthetic processes. All living organisms break down food materials and synthesize cell components by ordered sequences of chemical reactions called metabolic pathways. These

[3] Learning and Teaching Unit: Course Outlines
[4] Learning and Teaching Unit: Learning Outcomes
[5] Contextualised Science Graduate Attributes

pathways are frequently common to all cells, thus both man and bacteria break down glucose to CO_2 and H_2O by essentially the same pathway. Each chemical reaction in the cell is catalysed by an enzyme. The operation of a metabolic pathway therefore depends on the properties of the individual enzymes catalysing the sequence of chemical reactions.

PROTEINS AND ENZYMES

Protein Structure – Topics:
- Proteins and the central dogma of molecular biology
- There are 20 amino acids encoded in DNA and used in protein synthesis
- Amino acids are joined to form peptides and proteins
- Proteins can form secondary structures
- Protein amino acid sequence determines its 3-D structure

Enzymes and Catalysis – Topics:
- What is an enzyme?
- What is a substrate?
- What is catalysis?
- Free energy and activation energy
- Transition states in catalysis
- Induced fit model of catalysis

Enzyme Kinetics – Topics:
- What is kinetics? Why study kinetics?
- Enzyme reaction velocity
- Test case: human foldase enzyme
- The Michaelis-Menten value, KM
- Implications of KM
- The Michaelis-Menten equation
- Lineweaver-Burk plots
- The kinetically perfect enzyme
- Enzyme engineering

Enzyme Inhibition and Regulation – Topics:
- Competitive and non-competitive inhibition
- Kinetics of (non)competitive inhibition
- Allosteric inhibition
- Zymogens
- Enzyme phosphorylation

CARBOHYDRATE CATABOLISM AND STORAGE

Carbohydrate catabolism I – Learning Outcomes:
- Explain what carbohydrates are
- Explain how monosaccharides are classed (number of carbons, aldose/ketose etc).
- Explain the terms stereoisomer / epimer / diastereomer
- Give an example of a disaccharide and explain the role of the glycosidic bond
- Explain what polysaccharides are and give some examples

Carbohydrate catabolism II – Overview:
- Carbohydrate digestion and transport
- Glycolysis: an energy conversion pathway for glucose
- Regulation of glycolysis
- The fate of the products of glycolysis

Glycogen – Learning Outcomes:
- Describe the general structure and function of glycogen.
- List the three key enzymes involved in glycogen breakdown and provide a brief description of their functions.
- Understand that glycogen is synthesised and degraded by different pathways.
- List the three key enzymes involved in glycogen synthesis and provide a brief description of their functions.
- Understand that the regulation of glycogen metabolism involves both allosteric control and hormonal control by covalent modification of regulatory enzymes.
- Describe the way in which glycogen breakdown and synthesis are reciprocally regulated.

Gluconeogenesis – Learning Outcomes:
- Provide a broad definition of the process of gluconeogenesis.
- Appreciate that glucose can be synthesised from lactate, pyruvate, glycerol and amino acids.
- Explain the Cori Cycle.
- Describe the three enzymatic steps of glycolysis that are bypassed in gluconeogenesis.
- Name the enzymes that are NOT common to glycolysis and gluconeogenesis.
- Explain the energy requirements of gluconeogenesis.
- Explain how glycolysis and gluconeogenesis are reciprocally regulated.

BIOENERGETICS

TCA Cycle – Learning Outcomes:
- State the primary function of the TCA cycle
- Provide the net reaction of the TCA cycle
- Explain the role of NADH and $FADH_2$
- Explain why the cycle functions only in aerobic conditions
- Describe how the TCA cycle is regulated at three levels
- Discuss how cytoplasmic NADH are transported across the mitochondrial membrane and any impact this has on ATP yields

Respiratory chain – Learning Outcomes:
- Outline to function of the respiratory chain
- Describe the importance of the mitochondrial structure in reference to the respiratory chain
- Explain the pathway of electrons through the respiratory chain, from their entry points to the reduction of oxygen to water
- Describe the movements of protons across the membrane in the context of the respiratory chain and the creation of a proton gradient

Redox biochemistry – Learning Outcomes:
- Understand where reactive species are produced
- What are the major types of reactive species in the cell
- Describe the major antioxidant defence systems in place

Oxidative Phosphorylation – Learning Outcomes:
- Outline the chemiosmotic theory
- Describe the structure and function of ATP synthase
- Explain what the P/O ratio is
- Explain what an uncoupler does and provide an example
- Describe the ways in which an agent may inhibit oxidative phosphorylation
- Discuss the role reactive oxygen species play in oxidative phosphorylation
- Describe the process of oxidative phosphorylation giving reference to the mitochondrial membrane
- Calculate the number of ATP equivalents generated from a glucose molecule

PROTEIN CATABOLISM

Amino Acid Catabolism – Learning Outcomes:
- Explain the process whereby an amino group is removed form an amino acid.
- Discuss the degradation of AA in muscle during prolonged exercise and fasting.
- Describe how amino acid degradation is linked to the TCA cycle.
- Discuss the Urea cycle e.g. ATP used, where performed, where the two N in urea are from.
- Explain what is meant by the terms keto- and glucogenic amino acids and provide examples.
- Give examples of conditions where there are errors in the degradation of amino acids.

Protein digestion and turnover – Learning Outcomes:
- List the sources of amino acids for building proteins.
- Describe what is meant by the term essential amino acids.
- Describe the breakdown of dietary proteins
- Discuss the process of protein turnover
- Explain the function of ubiquitin and the proteasome

SIGNAL TRANSDUCTION IN METABOLISM

Signal Transduction – Learning Outcomes:
- Briefly describe the function of cell / organelle membranes and how proteins may be associated with them.
- Briefly explain the structures of integral membrane proteins.
- Describe the role of a receptor in signal transduction

- Describe the structure of 7TM receptors and provide an example.
- Outline the process of signal transduction.
- Describe the features and action of 7TM and protein kinase receptors, giving examples.
- Discuss the role of secondary messengers and give examples.
- Explain what can occur if there is a defect in a signal transduction pathway.

FAT METABOLISM AND STORAGE

Fat metabolism I, II, III and IV – Learning Outcomes:
- List roles of fats in the diet.
- List roles of fats in the body.
- Briefly describe the structure and function of some of the major fats in the body.
- Provide examples of fats that contain one or more fatty acids.
- Describe the general structure of a fatty acid.
- Explain the difference between saturated and unsaturated fatty acids.
- List examples of lipid-soluble vitamins and their roles/functions.
- Describe the steps involved in the digestion and absorption of fats.
- Outline the major steps that take place during the digestion of dietary lipids.
- Describe the process of lipid absorption and chylomicron formation in intestinal cells.
- Describe the general structure of a lipoprotein.
- Describe the main features of each of the different classes of lipoproteins.
- Explain the difference between exogenous and endogenous transport of lipoproteins.
- Briefly explain the difference between 'good' versus 'bad' types of cholesterol.
- Briefly explain the role of the liver in lipoprotein metabolism.
- Briefly describe the three main stages of fatty acid breakdown.
- Outline the overall stoichiometry & energy yield of fatty acid breakdown.
- Explain where, when and how ketone bodies are produced.
- Briefly describe the three main stages of fatty acid synthesis.
- Describe the first committed step in fatty acid synthesis.
- Describe the structure and function of the fatty acid synthase complex.
- Outline the overall stoichiometry of palmitate synthesis.
- Briefly explain why and how fatty acids can be modified.
- Compare and contrast the main features of β-oxidation and fatty acid synthesis.
- Briefly describe the main mechanisms of control of fatty acid metabolism.

INTEGRATION OF METABOLISM

Hormonal control of Fuel Metabolism – Learning Outcomes:
- Discuss the role of glucose transporters and comment on the differences between the various isoforms.
- Describe the structure of receptor tyrosine kinases, using the insulin receptor as an example.
- Outline the role of insulin on the liver, skeletal muscle and adipose tissues in the fed state.
- Outline the role of glucagon on the liver in the fasted state.
- Outline the role of adrenaline on the liver, skeletal muscle and adipose tissues.

Metabolic Specialisation of Tissues – Learning Outcomes:
- Describe how different glucose transporters confer tissue-specificity
- Explain how different hormones (e.g. insulin, glucagon) act on different tissues

Fuel Supply in Fasting – Learning Outcomes:
- Explain the three steps of the starved-fed cycle.
- Describe the effects of glucagon, cyclic-AMP and F-2,6-bisP during fasting.
- Explain the strategies employed for maintaining blood glucose levels during fasting/starvation.
- Explain what happens after liver glycogen is depleted.
- Describe the various effects of prolonged starvation.
- Describe the overall changes in fuel metabolism during starvation - particularly with respect to requirements of the brain.

Fuel Supply in Exercise – Learning Outcomes:
- Outline the structure of muscle fibres and their requirement for energy.
- Explain the difference between Type I and II muscle fibres in appearance, functional properties and metabolic profiles.
- Explain the role of adenylate kinase and link this to the role of ATP/AMP as regulators of glycolysis and glycogen metabolism.
- Explain the role of creatine phosphate, creatine kinase, and the fate of creatine.
- Discuss how the energy sources for a sprinter, middle distance runner and marathon runner differ.

Relationship to Other Courses within the Program	BIOC2101 is a requirement for Medical Science programs. The course builds on many concepts introduced in first level courses, particularly BABS1201 Molecules, Cells and Genes. It provides the knowledge and skills required for the third level courses including BIOC3261 Human Biochemistry and BIOC3111 Molecular Biology of Proteins.

4. Rationale and Strategies Underpinning the Course

Teaching Strategies	Course content is initially presented in lectures. Key concepts from the lectures are incorporated into practical sessions, where students also learn laboratory techniques and safe workplace skills. Students are provided with avenues for revision, practice and discussion of the course content through large group or online independent tutorials on each major content area.
Rationale for learning and teaching in this course[6],	Lectures are used in the course to introduce and introduce new concepts and elaborate on intermediary metabolism and its regulation. Laboratory sessions are designed to complement the lecture material in addition to teaching professional technical skills and safe and efficient work practices. Tutorials (large group and online independent) are used to reinforce concepts presented in the lectures through problem solving, and to encourage further enquiry. Both laboratories and tutorials aim to promote effective communication, discussion and teamwork. The integration of these main teaching areas of the course are in accordance with the UNSW Guidelines on Learning that inform Teaching[7]. Specifically: • Effective learning is supported when students are actively engaged in the learning process. • Effective learning is supported by a climate of inquiry where students feel appropriately challenged and activities are linked to research and scholarship. • Activities that are interesting and challenging, but which also create opportunities for students to have fun, can enhance the learning experience. • Learning is more effective when students' prior experience and knowledge are recognised and built on. • Students become more engaged in the learning process if they can see the relevance of their studies to professional, disciplinary and/or personal contexts. • If dialogue is encouraged between students and teachers and among students (in and out of class), thus creating a community of learners, student motivation and engagement can be increased. • Students learn in different ways and their learning can be better supported by the use of multiple teaching methods and modes of instruction (visual, auditory, kinaesthetic, and read/write). • Clearly articulated expectations, goals, learning outcomes, and course requirements increase student motivation and improve learning. • When students are encouraged to take responsibility for their own learning, they are more likely to develop higher-order thinking skills such as analysis, synthesis, and evaluation. • Graduate attributes – the qualities and skills the university hopes its students will develop as a result of their university studies – are most effectively acquired in a disciplinary context. • Learning cooperatively with peers - rather than in an individualistic or competitive way - may help students to develop interpersonal, professional, and cognitive skills to a higher level. • Effective learning is facilitated by assessment practices and other student learning activities that are designed to support the achievement of desired learning outcomes. • Meaningful and timely feedback to students improves learning.

5. Course Schedule

Some of this information is available on the Online Handbook[8] and the UNSW Timetable[9].

Week	Begins	**Monday 3PM Lecture** **Central Lecture Block 7**	**Practical** **Wallace Wurth 122/123** **Tue 10-1pm, Tue 2-5pm or Wed 10-1pm**	**Wednesday 5 PM Lecture** **Science Theatre**	**Friday 2 PM Lecture** **Mathews Theatre A**
Week 1	03 June	Lecture 1: Introduction to Biochemistry - AMG	No Lab (but must complete Safety Quiz BEFORE Week 2)	Lecture 2: Proteins - MW	Lecture 3: Enzymes - MW
Week 2	10 June	No lecture - Public Holiday	Biochemistry skills & calculations	Lecture 4: Enzyme Kinetics - MW	Lecture 5: Enzyme Regulation - MW
Week 3	17 June	Lecture 6: Carbohydrates - VS	Spectrophotometry	Lecture 7: Glycolysis - VS	Lecture 8: Regulation of glycolysis - VS
Week 4	24 June	Lecture 9: TCA Cycle - RLB	Enzymes	Lecture 10: Oxidative phosphorylation 1 - RLB	**TERM QUIZ**
Week 5	01 July	Lecture 11: Oxidative phosphorylation 2 - AMG	Enzyme Inhibition	Lecture 12: Oxidative phosphorylation 3 - AMG	Lecture 13: Oxidative phosphorylation 4 - AMG
Week 6	08 July	Lecture 14: Gluconeogenesis - NW	Glycolysis	Lecture 15: Glycogen - NW	Lecture 16: Fats 1 - AB
Week 7	15 July	Lecture 17: Fats 2 - AB	Separation Techniques	Lecture 18: Fats 3 - AB	Lecture 19: Fats 4 - AB
Week 8	22 July	Lecture 20: Protein Catabolism - RLB	Glucose Tolerance Test	Lecture 21 Practical Revision - AMG	Lecture 22: Urea cycle - RLB
Week 9	29 July	Lecture 23: Hormones - AMG	**PRACTICAL QUIZ**	Lecture 24: Metabolic Specialisation of Tissues - KH	Lecture 25: Exercise - RLB
Week 10	05 August	Lecture 26: Fasting - KH	Optional Revision Session (No Lab)	Lecture 27: Integration of Metabolism - KH	Lecture 28: Concluding Lecture - AMG

[8] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au
[9] UNSW Timetable: http://www.timetable.unsw.edu.au/

6. Assessment Tasks and Feedback

Task	Knowledge & abilities assessed	Assessment format and/or criteria	%	Date	Feedback		
					WHO	WHEN	HOW
BABS Health and Safety Quiz	**COMPULSORY:** Assesses knowledge of safe working practices and procedures in BABS teaching laboratories.	Online formats (e.g. multiple choice, true or false, drag-and-drop, correct order). Accessed via Moodle. Students only need to complete this quiz once for all BABS courses.	-	Must be completed with 100% correct answers BEFORE Week 2 laboratory class	Convenor	Immediately	Online (Moodle)
Pre-lab Quizzes	Cover practical theory, calculations and safety matters relevant to each practical class. Help students prepare for laboratory classes and study for practical quiz.	Online formats (e.g. multiple choice, true or false, drag-and-drop, correct order). Accessed via Moodle.	-	Pre-lab quizzes should be completed BEFORE each weekly laboratory class	Convenor	Immediately	Online (Moodle)
Formative Quiz	**OPTIONAL:** Covers all content from lectures 1-8 (inclusive). Aims to help students understand the type and depth of content that is covered and assessed in the course.	Online formats (e.g. multiple choice, true or false, drag-and-drop, correct order). Accessed via Moodle. Can be conducted anywhere and anytime after quiz opens.	-	Opens 5pm Friday 21st June (**Week 3**)	Convenor	Immediately	Online (Moodle)
Term Quiz	Covers all content from lectures 1-8 (Weeks 1-3), inclusive.	Multiple choice and short answer formats. Conducted during class in lecture theatre.	**15**	Friday 28th June (**Week 4**)	Convenor	Friday 5th July (**Week 5**)	Online (Moodle)
Laboratory Report Assignment	Students prepare a written laboratory report based on experimental results provided. This assignment is worth 15% and consists of 3 parts: 1) Draft report submission (5%) 2) Peer Review component (4%) 3) Final report submission (6%)	Full details on report format and criteria are provided in relevant section of this manual and online in Moodle. All 3 parts are conducted online in Moodle.	**5**	**Draft Report DUE**: 5pm Fri 5th July (**W5**)	Peers/ Convenor	Monday 22nd July (**W8**)	Online (Moodle)
			4	**Peer Review DUE**: 5pm Fri 19th July (**W7**)	Convenor	Monday 22nd July (**W8**)	
			6	**Final Report DUE**: 5pm Fri 2nd Aug (**W9**)	Demonstrator	Friday 9th Aug (**W10**)	
Practical Quiz	Covers all practical theory, calculations and safety from Weeks 2 to 8 (inclusive).	Multiple choice and short answer formats. Conducted during laboratory classes.	**20**	During practical times in **Week 9**	Convenor	Friday 16th Aug (**W11**)	Online (Moodle)
Final Theory Exam	Covers all lecture content from Lectures 9 - 28 (Weeks 4 to 10), inclusive.	Multiple choice questions, essay, and short response questions.	**50**	See final examination timetable			

TOTAL: 100

7. Additional Resources and Support

Text Book	**Biochemistry 9th edition**, WH Freeman and Company, 2019. JM Berg, JL Tymoczko, GJ Gatto, and L Stryer Availability: UNSW bookshop, UNSW library: Open Reserve/High use collection
Course Manual	Course manual containing course outline, assessment schedule and practical information is available for downloading via Moodle.
Recommended Internet Sites	All students enrolled in BIOC2101 automatically have access to the course Moodle site https://moodle.telt.unsw.edu.au/. This site will be used to distribute course notes and information and should be checked at regular intervals. Specifically, the Moodle site will be used to provide: • Important course announcements • Assessment marks • Practical notes • Lecture handouts and recordings • Information about examination arrangements • Further assessment information resulting from special consideration • Self-directed learning resources There are also many computer exercises and teaching aids available to students enrolled in BIOC2101 Principles of Biochemistry (Advanced). Links to the textbook companion websites (if available) and additional online animations and revision tutorial can be found on the course Moodle site.
Study Spaces	There are student common areas for study or relaxation on the ground floor of the Biological Sciences Building E26 and in the UNSW Library.

8. Required Equipment, Training and Enabling Skills

Equipment Required	To all lab classes bring: • Personal protection equipment (PPE): safety glasses, lab coat & closed shoes • Calculator • Timer (e.g. watch)
Enabling Skills Training Required to Complete this Course	Students need to complete the BABS Health and Safety Quiz (online) prior to the start of practical classes in Week 2; students are also required to complete individual pre-laboratory quizzes prior to each practical class.

9. Course Evaluation and Development

MyExperience	Students can provide feedback on the course via online myExperience surveys, as instructed, in the final week of term. The latest information on how student feedback has been used to update and improve the course can be found on the Moodle site for the course.

10. Administration Matters

Expectations of Students	**ATTENDANCE:** Students are expected to be regular and punctual in attendance at all classes (lectures, practicals and large-group lecture tutorials). Although attendance at lectures is not compulsory, it is highly recommended. Students who do not attend lectures (or access the lecture recording within 24 hours) often fall behind and/or perform poorly due to the complex material in the course. Attendance at practical classes is compulsory. **If students miss more than 1 practical class, they may be refused final assessment or may receive a UF grade.** **PRE-LAB QUIZZES:** Students are required to complete a pre-lab quiz prior to each weekly laboratory class. Pre-lab quizzes can be accessed via Moodle and information about the availability of quizzes will be communicated via Moodle announcements (if required). Although the completion of pre-lab quizzes is not compulsory, it is highly recommended. I**f you do not complete the pre-lab quiz and achieve a grade of 100% prior to each laboratory class, you will not be adequately prepared for the class and this may present significant barriers to you, your laboratory partner, and your laboratory demonstrator.** Pre-lab quizzes will also help you to prepare for the Practical Quiz in Week 9. **PRACTICAL SKILLS AND DATA RECORDING:** In some practical classes, the demonstration of specific laboratory skills and/or the collection of raw data results will need to be checked and confirmed by your Demonstrator or Course Convenor. These requirements will be made clear at specific stages in your Course Practical Guide/Manual. Failure to obtain such confirmation may result in an absence being recorded in your attendance record for that class. All students are expected to bring BIOC2101 laboratory guide instructions and paper for recording data/notes to each laboratory class. **ILLNESS AND MISADVENTURE:** The following procedures are designed to ensure that you are not penalised for absences for which there was an appropriate reason. If you are not fit to attend a **BIOC2101 practical class throughout Weeks 2 to 8 of Term**, please apply for Special Consideration following the guidelines provided on the following page or in Moodle within 24 hours of the class. If you are not fit to sit the **BIOC2101 Term Quiz in Week 4 or the Final Exam**, you must apply for Special Consideration following the guidelines provided on the following page or in Moodle prior to the start of the quiz/exam or within 24 hours of the quiz/exam. If you are unable to submit any component of the **BIOC2101 Laboratory Report** by the scheduled deadlines, you must email the Course Convenor AND apply for Special Consideration following the guidelines provided on the following page or in Moodle. **PLEASE NOTE that due to the automated online nature of the peer review component of the report assignment, failure to submit a component on time may result in the need for you to complete an alternative assignment.** **SATISFACTORY LABORATORY PERFORMANCE:** A pass in BIOC2101 is conditional upon a satisfactory performance in the practical program. This consists of: (i) attendance at all the practical classes (unless illness/misadventure is documented); (ii) satisfactory performance in the laboratory report assignment, and; (iii) maintenance of accurate and up-to-date laboratory notes, including the recording of all data and completion of calculations and questions.
Assignment Submissions	All components of the BIOC2101 Laboratory Report assignment will be submitted online via Moodle.

Occupational Health and Safety[10]	Prior to commencing the practical component of the course, you will need to complete and pass a BABS Health and Safety Quiz. Part of your laboratory practical manual comprises an Undergraduate Risk Assessment Guide for the School of Biotechnology and Biological Sciences. This addresses the hazards and risks you may encounter. To work with these correctly and safely, you will need to follow the safe work practices provided in the manual or by academic or technical staff involved in the course. Additional information on Health and Safety at UNSW can be found at: http://www.HS.unsw.edu.au/
Assessment Procedures **UNSW Assessment Policy**[11]	**SPECIAL CONSIDERATION AND FURTHER ASSESSMENT TERM 2 2019** Students who believe that their performance, either during the term or in the end of term exams, may have been affected by illness or other circumstances may apply for special consideration. Applications can be made for compulsory class absences such as (laboratories and tutorials), in-term assessments tasks, and final examinations. You must submit the application prior to the start of the relevant exam, or before a piece of assessment is due, except where illness or misadventure prevent you from doing so. If you become unwell on the day of the exam or fall sick during an exam, you must provide evidence dated within 24 hours of the exam, with your application. You must obtain and attach Third Party documentation before submitting the application. Failure to do so may result in the application being rejected. UNSW has a fit to sit/submit rule which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so. Further information on special consideration can be found at https://student.unsw.edu.au/specialconsideration. **HOW TO APPLY FOR SPECIAL CONSIDERATION** **The application must be made through Online Services in myUNSW (My Student Profile tab > My Student Services > Online Services > Special Consideration).** **Students will be contacted via *their official university email* as to the outcome of their application. It is the responsibility of all students to regularly consult their official student email accounts and myUNSW in order to ascertain whether or not they have been granted further assessment.** **SUPPLEMENTARY EXAMINATIONS:** Supplementary examinations may be given to those students who were absent from mid-term or final exams due to illness or misadventure. Only students who submit a compliant Special Consideration application (as per the above instructions) may be eligible for a supplementary examination. Students will be notified via the online special consideration system and their official UNSW email account as to the outcome of their application. Supplementary **mid-term examinations** will be managed internally by your course convenor and held during term. Supplementary **final examinations** will be managed externally by UNSW Exams Branch and held during the official BABS Supplementary Final Examination period. The BABS Supplementary Final Exam period for Term 2, 2019 is: **Monday 9th September – Friday 13th September 2019** **Supplementary Final Exams will be offered during this period ONLY. Failure to sit for the appropriate exam that you have been offered may result in an overall failure for the course. Further assessment will NOT be offered on any alternative dates.**

[10] UNSW HS Home page
[11] UNSW Assessment Policy

<table>
<tr><td>Equity and Diversity</td><td colspan="3">Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course Convenor prior to (or at the commencement of) their course. Such students may also contact Disability Services https://student.unsw.edu.au/disability for more information on the types of support they can provide (Disability Services Ph: 9385 4734, Email: disabilities@unsw.edu.au).

Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made on time and in full.</td></tr>
<tr><td rowspan="2">Student Complaint Procedure[12]</td><td>School Contact</td><td>Faculty Contact</td><td>University Contact</td></tr>
<tr><td>Mr John Wilson
Student Office,
Room G06, Ground Floor,
Biological Sciences
Building D26
j.e.wilson@unsw.edu.au
Ph: 9385 1748</td><td>Dr Gavin Edwards
Associate Dean
(Undergraduate Programs)
g.edwards@unsw.edu.au
Ph: 9385 4652</td><td>Student Conduct and Appeals
Officer Telephone: 02 9385 8515,
email:
studentcomplaints@unsw.edu.au

University Counselling and
Psychological Services[13]
Ph: 9385 5418</td></tr>
</table>

[12] UNSW Student Complaint Procedure
[13] University Counselling and Psychological Services

11. UNSW Academic Honesty and Plagiarism

Academic misconduct may apply to any work or document related to assessment that is submitted to the School of Biotechnology and Biomolecular Sciences; this includes quizzes, the marked practical, laboratory workbooks, and examinations. All work must represent a student's own individual efforts. Copying or paraphrasing another person's work and using another student's experimental results are all examples of academic misconduct.

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.
*Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle
† Adapted with kind permission from the University of Melbourne

12. Practical Information

Students are required to assemble in Laboratory WW122 or WW123, 1st Floor, Wallace Wurth Building, at the **beginning** of their enrolled class each week, starting from Week 2.

GENERAL INFORMATION

(i) **BEFORE** you can start your practical classes, you **MUST** complete an online **BABS Health and Safety Quiz** that is accessed through the BIOC2101 Moodle site. This quiz is compulsory for ALL BABS courses, but you only need to complete it once. Your final quiz mark will be checked prior to your lab in Week 2. (NOTE: If you completed the quiz through the BIOC2101 Moodle site, your mark can be checked online by your demonstrator; if you completed the quiz for a different BABS course, you must show a screen-shot of the completion page with your final mark to your demonstrator). If you have not scored 100% in the quiz, you will **NOT** be permitted to attend that lab class or any subsequent lab class until you have satisfied this requirement.

(ii) You should also complete a **Pre-lab quiz** for each of the wet labs **PRIOR** to each lab class. You should achieve a mark of 100% for each quiz to be fully prepared for the corresponding lab class. Students who have not completed the quiz prior to lab class are more likely to make mistakes in class, take longer to complete experimental activities, and experience difficulties understanding and applying the conceptual frameworks underpinning each task. Pre-lab quiz completion is also essential preparation for the Practical Quiz in Week 9.

(iii) *At ALL laboratory classes, students must wear a laboratory coat and fully-closed shoes made from non-absorbent materials to serve as proper foot protection*. **Students without footwear or wearing thongs, sandals or other open shoes will not be permitted in the laboratory.** Students are also required to wear eye protection during ALL experimental procedures and so are asked to provide their own safety glasses.

(iv) **Attendance at ALL BIOC2101 laboratory classes is COMPULSORY and an 80% attendance rule is enforced throughout the session** (i.e. students are required to attend at least 80% of laboratory classes to satisfy the requirements for passing the course). Students who miss a laboratory class due to illness or misadventure must submit a compliant application for Special Consideration online (see above).

PREPARATION

To derive the full benefit from the practical work, it is necessary to study the notes and relevant material **before** the class and not just blindly follow a "recipe". Students who adopt a "recipe approach" generally fail to understand the practical and obtain inferior results. This, in turn, usually means that they are unable to provide satisfactory answers for the related practical questions and thus obtain a low mark for their laboratory assessment.

We have found that a good way to prepare for the next laboratory exercise is to make a short summary of the actual techniques and manipulations that you will be using in the laboratory. This summary can take the form of some brief, written comments, or it can take the form of a flow diagram that maps out the steps that you will have to take to complete the experiment. Within this manual, a page has been provided at the beginning of each practical for writing up a summary and notes of the experiment(s) to be performed.

CONTINUOUS ASSESSMENT OF LABORATORY COMPONENT

Within the laboratory section of this manual, each experiment is followed by one or two question pages in which data, associated calculations and answers to specific questions are to be written. Each student must complete these sheets in full, preferably before the next practical class. It is strongly recommended that you ask your Demonstrator to check and assess your work as being either 'Satisfactory' or 'Unsatisfactory' before you leave each laboratory class. If your work is deemed as being 'Unsatisfactory', it is your responsibility to find out why and make the necessary corrections by speaking to your demonstrator, peers, or course convenor. By the end of your last practical in Week 8, you should ensure that you have completed ALL question pages in the manual and had them checked as being 'Satisfactory' by your Demonstrator. Failure to do so could leave you under-prepared for the Week 9 Practical Quiz.

REMEMBER: A pass in BIOC2101 is conditional upon a satisfactory performance in the practical program.

DOCUMENTING YOUR LABORATORY WORK AND ANSWERING RELATED QUESTIONS

The observations from your laboratory work must be recorded neatly at the time the observations are made. For most experiments, there is ample space provided for this recording of data in the practical notes themselves. ALL data, graphs and diagrams must be included in your manual where indicated. These recorded data therefore form the bulk of the information you will need to complete the questions at the end of each practical. These questions are designed to make you think about your experimental results, make observations and hopefully allow you to draw some conclusions from them. They will also help you relate your practical work to the theory presented in BIOC2101 lectures. Since you are being assessed by your Demonstrator on your ability to record and discuss your experimental results in a proper scientific manner, a few things to consider when documenting your lab work include:

- Write your results, observations and answers neatly and legibly in pen (pencil can be used for rough data and graphs).
- Graphs should be drawn properly on graph paper, titled and labelled correctly on both axes (**with appropriate units**) with the axes ruled in clearly.
- The spaces on the question sheets usually indicate the length of answers required.
- Where calculations are required, include the steps in your calculations so that your demonstrator can follow the method by which you attempted them. If the data are provided and your calculations are clearly set out and legible, your demonstrator may be able to trace any mistakes you might make and explain them to you. This may be important in your attempts to rectify the mistakes and thus allow your practical work to be assessed as 'Satisfactory'.

LABORATORY EQUIPMENT

All the necessary laboratory equipment required for each practical exercise will be provided for you on the day of your class.

Instructions concerning the collection, correct use and storage of equipment will be delivered during the introductory talk at the beginning of each lab class. Therefore, it is ESSENTIAL that you arrive at your laboratory class on time in order to hear the full equipment and safety discussion.

During each lab class, various items of equipment and apparatus will only be available from the technical staff. Other pieces of equipment will be given to you by your Demonstrator or available at the front of the laboratory. Failure to carry out all laboratory instructions and maintain a tidy and safe work space may result in your removal from the laboratory and disqualification from the prac (in extreme cases, but that will never happen right?).

NOTE: You are liable for any negligent or intentional damage to any equipment whilst it is in your care. Ensure that you follow all instructions closely and carefully so that any such damage is easily avoided. It is also your responsibility to ensure that all equipment is returned or disposed of correctly, as instructed by demonstrators and technical staff.

ACADEMIC MISCONDUCT

Information concerning the University Regulations concerning Academic Misconduct can be found on the UNSW website: https://my.unsw.edu.au/student/academiclife/assessment/AcademicMisconduct.html .
It is essential that all students read this information.

Academic Misconduct may apply to any work or document related to assessment that is submitted to the School; this includes the laboratory work you document/discuss within this manual, the three mid-session tests and the final examinations in June.

All work submitted for assessment must represent a student's own individual efforts. Copying or paraphrasing another person's work and using another student's experimental results are all examples of academic misconduct (see Academic Honesty and Plagiarism).

ATTENDANCE

Students are expected to be regular and punctual. Professional documentation (e.g. medical certificates) explaining **absences from formal assessments and laboratory practicals** should be included with an online application for Special Consideration according to the guidelines provided in this manual (and online via Moodle). All such documentation should be submitted within **24 hours** of the absence in question. This procedure will ensure that you are not penalised for absences for which there were appropriate medical or compassionate reasons.

IMPORTANT NOTE: IF STUDENTS ATTEND LESS THAN EIGHTY PERCENT OF THEIR POSSIBLE PRACTICALS, THEY MAY BE REFUSED FINAL ASSESSMENT.

GENERAL LABORATORY SAFETY

Biochemical laboratories contain chemicals and equipment that are potentially dangerous when misused or handled carelessly. Consequently, safe experimental procedures and responsible conduct in the laboratory are essential at all times. The regulations governing conduct in the laboratory have been set down by the NSW Environmentally Hazardous Chemical Regulation 2008, NSW WHS Regulation 2011, NSW Work-cover Publications, Work-safe National Codes of Practice and Guidance Notes and Australian Standards AS:2243 series Safety in Laboratories. These policies and standards apply to all university staff and students.

Section 4.11 Students are responsible for:

Complying with the requirements of this policy, legislation and Australian Standards

Following directions given to them by the person supervising their work

Co-operating in the performance of risk assessments

Participating in induction and training programs

Reading MSDS's for substances to be handled prior to doing experiments

Failure to comply will result in expulsion from the laboratory class.

PPE[1] REQUIREMENTS IN THE LABORATORY

- **Students must purchase a laboratory coat and wear it when in the laboratory.** It should be removed when leaving the lab *e.g.* on visits to the computer lab or toilets. Lab coats should not be left on benches or stools but hung on the coat hooks that are provided at the back of the laboratory.

- **Safety glasses** MUST be worn during ALL practical procedures.

- **Disposable plastic gloves will be provided for certain manipulations. These should be discarded after use or if torn.** All gloves should be removed from your hands by first holding the gloves at the wrist and pulling to turn them inside out before they are discarded into one of the 'solids waste' containers on top of bench.

- **Never** throw gloves or any other laboratory material into the domestic bins.

- **Never** use gloved hands to open doors etc. Either ask someone to open the door for you or remove one glove temporarily. **Always** remove gloves before leaving the lab.

- **Suitable foot protection (fully closed shoes made from non-absorbent materials) must be worn.** Students with bare feet, thongs, exposed shoes or strappy sandals will not be allowed into the working area.

[1] PPE – Personal Protection Equipment

SAFETY RULES IN THE LABORATORY

- **Eating, drinking and smoking are forbidden in the laboratory.**

- **Students with long hair must tie it back.**

- **Laboratory coats, safety glasses and appropriate footwear (NO thongs or open-toed shoes) must be worn at ALL times.**

- **All work with toxic, corrosive or flammable (etc.) chemicals must be conducted in a fume cupboard where possible.**

ALL INJURIES OR ACCIDENTS WITH CHEMICALS MUST BE REPORTED IMMEDIATELY…Either to your demonstrator or to a member of the technical staff.

RISK ASSESSMENTS

For your own protection and that of those with whom you will be working, you should read, before each week's experiment is started, the notes and instructions on the Risk Assessment Sheet preceding each experiment and take note of any hazards in the procedures to be used for that laboratory session.

Risk Assessments have been carried out on all practicals to highlight the potential for possible risks to the users. These cover chemical, biological and physical hazards. This is to ensure that the proper precautions are taken during all laboratory procedures.

The chemical risks have been assessed using **MSDSs (Material Data Safety Sheets).** These are available on file at the front of the lab. A copy of the Hazardous Substances Policy is also on file in the Prep Room.

As strong acids, alkalis and other toxic substances are used in some procedures, the relevant safety instructions will be included at the appropriate places in the manual. **Such dangerous materials must never be pipetted by mouth**, they should be manipulated with great care and if any come into contact with skin or clothing, wash the affected areas with water **immediately**, seek assistance and any antidote that may be applied.

Poisonous solutions will be provided in automatic dispensers; these should be operated gently and carefully because careless use can cause breakage or a spray of the reagent. Automatic pipettes will be provided where possible.

EMERGENCY PROCEDURES

- In the event of a fire or other serious emergency, the building may be evacuated. When the alarm has been activated, a "get ready to evacuate" siren will sound. You should immediately cease work and secure your workplace (*e.g.* cap solutions, turn off Bunsen burners). The second stage is the "evacuate the building" call. You should immediately make your way to the nearest exit unless another exit is designated by staff. **Follow directions from the staff and evacuation wardens and gather at Gate 9 in front of the Chancellery Building** (Gate 9 is on High Street near the John Clancy Auditorium). You should wait there until you have been checked off by your demonstrator.

- Emergency eye wash stations and Safety showers are installed at the back of the lab. Seek staff help immediately. If you get something in your eye, you must wash your eyes for at least 20 minutes.

- For procedures to clean up spills, seek staff help immediately.

- Special antidotes (if using cyanide) are located near the Prep Room windows. Seek staff help immediately.

- **If you are in doubt about any safety matter, please consult a member of staff.**

Internet sites/references:

National Occupational Health & Safety Commission:

http://www.nohsc.gov.au./hazsubs/index.htm

NSW Work-cover site:

http://www.workcover.nsw.gov.au/links.html

SAFETY IN HANDLING LABORATORY CHEMICALS

PIPETTING

Essentially all hazardous solutions (acids, alkalis, toxic solutions etc.) that are needed in the practical class will be provided in dispensers which will be set to deliver the correct volume. See Appendix for proper handling.

For all other pipetting, pipetting aids such as Gilson Pipetmans or Eppendorfs will be provided for use during classes. See Appendix for proper handling instructions. These should be returned to the prep. room at the end of the class.

BROKEN GLASSWARE AND OTHER SHARP OBJECTS

Should any breakage of glassware occur, the fragments must be swept up immediately and placed in the special bins provided for glass. These bins are located at the front of each laboratory and are clearly marked **"BROKEN GLASS ONLY".** Other sharp objects e.g. needles or razor blades should be placed in the **yellow "Sharps" Bins** located on each bench-top. **Broken glass or other sharp objects MUST NOT be placed in the waste paper bins or in any other bins, UNDER ANY CIRCUMSTANCES.**

DISPOSAL OF "CLINICAL" WASTE

Special labeled enamel or plastic containers are available on each laboratory bench for the disposal of gloves, gels, tips, microcentrifuge tubes, and any other used disposable plastic ware or Glad-wrap. **Never, ever put this material in the normal domestic waste bins**.

DISPOSAL OF CHEMICAL (LIQUID) WASTE

According to the Environmental Policy of the University no chemical waste may be disposed of down the laboratory sinks.

All chemical residues must be placed in the appropriate waste containers which will be provided in the laboratory. Solvent, aqueous, biological wastes and some chemicals may have separate waste containers which are usually located in the fume cupboards. For disposal details, always check your practical manual, the instructions written on the waste disposal containers in the lab or ask your demonstrator.