Biochemistry & Pharmacology Honours

The Honours degree in Biochemistry and Pharmacology is a one-year, full-time course consisting of coursework (25%) and research (75%) components. The research component is completed through a placement in a laboratory within the Department of Biochemistry and Pharmacology (DBP) at the University of Melbourne, or an affiliated external institute. Completion of Honours allows students to continue onto higher degree study (e.g., PhD) and provides intensive practical training in current experimental techniques, the opportunity to develop oral and written communication skills and the experience of working in an active, multidisciplinary research environment. These specific and generic skills are also beneficial for gaining future employment as a research assistant or in many other areas. Students commonly start their studies at the beginning of Semester One (February), but mid-year entry (July) at the start of Semester Two is also a possibility. Entry is by merit and open to Bachelor of Science or Bachelor of Biomedicine graduates or equivalent. A major in Biochemistry and Molecular Biology or Pharmacology is recommended, but not a prerequisite. Students are expected to have obtained a weighted average mark (WAM) of at least H3 (65%).

On completion of Honours, students should be able to:

- Demonstrate advanced knowledge about major advances in biomedical research in the disciplines of Biochemistry and/or Pharmacology.
- Articulate the methods, findings and context of research and data using a scientific style of writing.
- Articulate the methods, findings and context of research and data in oral presentations.
- Critically evaluate the findings and context in scientific articles.
- Apply experimental design and statistics in a research project.
- Work effectively, both independently and collaboratively, to generate research data.
- Identify and follow the principles of ethical scientific practice.

Students undertaking Biochemistry & Pharmacology Honours complete the following subjects:

- BCMB40002 Biochemistry & Pharmacology Coursework, 12.5 points.
- BIOM40001 Introduction to Biomedical Research, 12.5 points.
- BCMB40009/10 Biochemistry & Pharmacology Research 1 & 2. 75 points. (start-year)
  or
- BCMB40011/12 Biochemistry & Pharmacology Research 1 & 2. 75 points. (mid-year)

Important information!

Due to the merger of the Department of Biochemistry & Molecular Biology with the Department of Pharmacology and Therapeutics in 2021 the Honours course has been redesigned. This includes restructure of both the coursework (25%) and research (75%) components. Handbook entries for the redesigned subjects noted above will be available in late 2021, subject to academic board approval. The information outlined in this document is provided as a guide so that students undertaking mid-year entry in 2021 (commencing Monday 26th July 2021) are aware of the intended changes. While the content in respect to the research projects (BCMB40011/12) is correct as of the start Semester 2, 2021 the content concerning BCMB40002 and BIOM40001 is still being finalised and thus the information below is provided as a guide only. Assessment for these coursework subjects will be undertaken in Semester 1 2022, with finalised details provided prior to subject commencement. All effort will be made to minimise the differences between this document and the final subject guidelines. By undertaking 2021 mid-year Honours in the DBP you are confirming that you are aware of this.

For clarification, please contact the Honours coordinator:

Dr David Stroud (david.stroud@unimelb.edu.au)
Research Project (75 points total)

BCMB40009/10/11/12 Biochemistry & Pharmacology Research (50 and 25 points)

Overview

Students will undergo extensive research training with their own research project in the field of biochemistry or pharmacology under the supervision of a member of the Department of Biochemistry & Pharmacology (DBP) or an affiliated institution, acquiring skills in experimental design, technical expertise, critical thinking, data analysis, interpretation, and communication. Research projects are offered in a wide variety of research areas allowing students to choose a topic that interests them. Students will learn how to communicate their scientific research in oral presentations and thesis writing.

Specific Learning Outcomes

On completion of this subject, students should be able to:

- Select, summarise and critically appraise published research in biochemistry and/or pharmacology.
- Formulate a research hypothesis based upon a synthesis of the published research evidence.
- Design and undertake appropriate research experiments to answer a research hypothesis in biochemistry or pharmacology.
- Conduct supervised research in a specific area of biochemistry or pharmacology research.
- Communicate the methods and findings of a research project in oral and written form.
- Interpret and critically evaluate novel research findings.

Oral presentation of research project plan (5%)

Students will present a 10 minute oral presentation summarising the plan for their research project. Presentations include a background to the project, experimental approaches, preliminary results and ideas for future work. Students will have 3 minutes to answer questions from the audience. The invitation to these talks is open to all departmental staff and students.

Literature review (5%)

Students will write a 2,000 word literature review that will form the basis of the introduction to their thesis. Students will receive guidelines on the expectations for literature review. The literature review is assessed by a panel of examiners that will also read and evaluate the final Honours thesis.

Oral presentation of research project findings (15%)

After submission of their thesis, students will present a 15 minute oral presentation summarising their research project. Presentations are expected to include a background to the project, together with the major research findings, conclusions and significance. Talks will be presented to an audience consisting of staff and students from the DBP. Students will have 5 minutes to answer questions from the audience.

Honours Thesis and Oral Exam (65%)

The 10,000 word thesis is the major piece of assessment for the Honours course. It is designed to be a scientific report on the original, supervised research project undertaken by the student during the Honours year. An oral defence exam (approximately 20 mins) provides further assessment of the student’s depth of knowledge of the thesis content. The exam will be conducted by a panel of examiners that have read and evaluated the thesis.

Supervisor mark (10%)

The supervisor/s of each student is/are asked to assess the student’s performance over the course of the year. Assessment criteria include the student’s interest in the project, their industry (making the best use of the time available), initiative, experimental and/or theoretical skills, laboratory manners, effective contribution to laboratory meetings and ability to assess relevant literature.
Coursework (25 points total)

BCMB40002 Biochemistry & Pharmacology Coursework (12.5 points)

Students undertaking this subject must complete three modules. The first module will cover frontier topics in biochemistry and pharmacology. There will be lectures from experts in the field and students will learn how to critically evaluate scientific manuscripts, design experiments and analyse data, and implement appropriate statistical approaches. A second professional skills module will teach students skills in scientific communication. Students will prepare an abstract and poster describing a methodology used in biochemistry and/or pharmacology research, discussing the contents of the poster with their peers. The third module will introduce a number of breakthrough publications in the biochemistry and pharmacology fields. Students will learn how to communicate the significance of these publications to a non-specialist but scientifically educated audience in the written form. This subject is taken in Semester 1 (the first semester for students starting in February, or the second semester for students starting in July) together with BIOM40001 Introduction to Biomedical Research.

Specific Learning Outcomes

On completion of this subject, students should be able to:

• Demonstrate an advanced understanding of experimental design, experimental implementation, data and statistical evaluation and communication as it relates to modern biomedical research.
• Communicate research data, and its critical interpretation and scientific context in written scientific communication.
• Communicate research data, and its critical interpretation and scientific context in oral communication.
• Critically evaluate scientific data and interpret and contextualise scientific information from the literature.

Module 1: Critical Thinking (40%)

Students attend a series of lectures/workshops about current frontier topics in biochemistry and pharmacology. Topics include drug design/discovery, open questions in cell biology, evaluating mechanisms of drug action at the molecular level, frontier animal and cell based models, and advances in gene editing. There will be interactive workshops to assist with reading and evaluating scientific manuscripts, experimental design and statistical approaches.

Assessment: Students will complete an exam selecting two questions from a pre-prepared list related to topics in the series. Answers are limited to 1,000 words per question.

Essay-based answers to questions: 40% of final mark for subject.

Why is this module useful to develop skills as a researcher? This module exposes students to cutting-edge and relevant topics in biochemistry and/or pharmacology, teaching skills in critical evaluation of concepts. Examples include preparation of a pitch to a company interested in commercializing a research outcome, consulting a drug company on application of an assay, and writing an expression of interest for a funding opportunity. This module ensures students can resynthesize complex ideas into a succinct and easily digestible format, a critical skill in both industry-based and academic research careers.

Module 2: Communicating Science: Poster (40%)

This module provides students with the skills to communicate the rationale and significance of complex experimental methodology. Students will write a 250-word abstract and prepare a poster describing a methodology used in biochemistry and/or pharmacology. Students will attend a tutorial to explain the module objectives and assessment task.

Assessment: Students will select a topic for their abstract and poster. Topics are related to methodologies used in biochemistry and/or pharmacology research. Examples include (but are not limited to) CRISPR/Cas9, cryoEM, drug screening, NMR, biosensors, flow cytometry and mass spectrometry. The abstract should contain a brief description of the methodology and its use in biomedical research. The body of the abstract is limited to 250 words.

Abstract: 10% of final mark for subject.

Students will prepare a poster describing the methodology, its use and importance to biomedical research. Each poster will contain a detailed description of the methodology and its use in biomedical research. In addition, the poster could include how the methodology is being used in the student’s research project (case study), examples of use in published studies, comparisons with other technologies, or the history of the methodology and perhaps how it has been modified. Students will present their poster in small groups consisting of staff and students and will have 10 minutes to answer questions from the audience.

Poster: 30% of final mark for subject.

Why is this module useful to develop skills as a researcher? This goal of this module is to expose students to different methodologies used in their research and that of their peers and teach students to communicate complex methodological concepts to other scientists. Preparation of an abstract is a typical requirement for attendance at a scientific research conference. These are assessed by conference organizers and used to determine if the attendee is given a speaking slot at the conference. For graduate and early career researchers, the abstract is also used to award travel scholarships. In lieu of being offered an oral presentation it is typical for conference attendees to present a poster describing their research outcomes.
These are presented in poster sessions that are well attended and considered to be one of the social highlights of the conference. This module ensures students will learn these vital research skills early in their careers.

Module 3: Communicating Science: News & Views (20%)

This module provides insights into the major advances in biochemical research and technologies. At the beginning of the semester, students will be given access to recorded lectures that span different themes in biochemistry and/or pharmacology. The lecturer will be associated with a primary research manuscript that complements each lecture's content. This video and manuscript will describe a major advance in this field. Students will attend a tutorial to explain the module objectives and assessment task.

Assessment: Students must select one lecture and manuscript. Using the recorded lecture and the manuscript provided students will write a 1,000 word News and Views essay that summarises the major recent advance in biochemical research. “News and Views” articles inform non-specialist readers about new scientific advances, as reported in recently published papers. The goal of this assignment is to understand and interpret a research manuscript outside of your field and convey this knowledge to a non-specialist audience.

News and Views article: 20% of final mark for subject.

Why is this module useful to develop skills as a researcher? This module has two key goals: (i) expose students to emerging research themes; and (ii) teach students to communicate scientific concepts to non-specialist readers. Exploring research disciplines outside of your own is fundamental to development as a scientist. Engaging with lecture material, reading research articles and watching others present their science allows researchers to engage with novel concepts and experimental approaches that can be applied to their own research. Being able to convey scientific concepts to a non-specialist audience is one of the hardest things to learn to do as a scientist, but also one of the most critical. For instance, grants and research papers or job applications are generally reviewed by people outside of the specific discipline, hence researchers must be able to pitch and convey ideas to a general audience. This module ensures students learn this vital skill early in their careers.

BIOM40001 Introduction to Biomedical Research (12.5 points)

This subject employs a modular approach to prepare students for the processes and strategies at the core of modern biomedical research. This is achieved via a two-pronged approach employing self-directed study, oral presentations and written communication. For the self-study segment, students will be guided through a series of competency based online modules to serve as preparation for their own research projects. Online modules on the ethics of biomedical research, data integrity and legislation will equip students to consider the ethics requirements and implications of their research. Competency in the LabArchives/appropriate reference manager online modules will provide instruction and advice for recording data and to document their daily research work. Core statistical techniques and experimental design approaches using real-world examples will be presented as a basis for students to plan and analyse their own data. For the communication segment, students will participate in a journal club and present findings from selected manuscripts to their peers, focusing on critical evaluation of data and statistics of the paper along with contemporary research techniques employed. A 3-minute thesis (3MT) talk on the student’s own research project will allow students to present to their peers and to receive and provide feedback as part of their initiation to the research sphere. This is complemented by a lay writing assignment for students to provide a synopsis of scientific research that translates ground-breaking science to members of public as a communique to philanthropic organizations.

Specific Learning Outcomes

On completion of this subject, students should be able to:

- Explain key aspects of effective experimental design and implementation, and data evaluation and communication in modern biomedical research, and discuss these aspects with consideration to research ethics.
- Demonstrate competency in statistical analysis, hypothesis testing and data presentation.
- Identify and apply the principles of ethical conduct of research involving animals and humans, including regulatory requirements.
- Defend the need for the active management of intellectual property issues, scientific integrity and conflict of interest in a contemporary biomedical research context.
- Compare the scientific and technical basis of selected advanced techniques in biomedical research.

Module 1: Journal Club (30%)

The module is focused on reading and critically evaluating primary research literature that is outside the student’s specific discipline area. The Journal Club sessions will form an interdisciplinary experience with students from across the entire cohort. Each week, a student from their Journal Club group will present a paper from a pre-selected library of primary research papers that represent the diverse spectrum of discipline areas of students enrolled in the subject.
Assessment: Students will present one allocated Journal club paper (20-minute presentation; 10 minutes of questions) to their journal club group and attend all ten Journal Club sessions over the course of the semester and contribute to the discussion of the paper presented.

Journal club presentation: 22.5% of final mark for subject.

Active participation in discussion throughout the semester: 7.5% of final mark for subject.

Why is this module useful in skill development? Each discipline has their unique way of capturing, analysing and presenting data. Understanding and experiencing how researchers in other fields evaluate and interpret data will provide a richer and more comprehensive understanding of the impact of the student’s own research in the context other work and build a network of collaboration.

Module 2: Three Minute Thesis (3MT) (20%)
The 3MT will allow students to hone their skills in presenting a summary of their research project to others. This exercise will allow students to have an opportunity to enhance their ability to effectively explain the breadth and significance of their research to a non-specialist audience.

Assessment: Students deliver a 3MT oral presentation on the background, experimental approaches and significance of their student project in 3 minutes. Presentations will be given to other Honours students and a panel of examiners as part of a Student Symposium.

Oral presentation: 20% of final mark for subject.

Why is this module useful in skill development? The presentation of information on the student’s own project provides a valuable opportunity for students to network and for them to introduce themselves and their research to other students across the Faculty and thus promote a culture of collaboration. Further, it exposes the students to researchers from across the faculty, expanding their network and collaboration.

Module 3: Lay Writing Assignment (25%)
The aim of the lay writing assignment is for students to write a synopsis on a current topic of ethical concern or consideration (e.g., accelerated COVID vaccination; the creation of model embryos; the use of certain cell lines in vaccine production) and to communicate it in a language that is accessible to the general public and/or a philanthropic organisation.

Assessment: Students will write a 500-word synopsis that summarises a current biomedical ethical concern that we are currently facing and target their writing for a lay audience.

Assignment: 25% of final mark for subject.

Why is this module useful in skill development? This module provides practice in writing for a lay audience and improves the student’s written skills. Being able to communicate effectively to the public is an essential skill as a researcher.

Module 4: Statistics and experimental design (25%)
Students will be provided with self-study statistics sub-modules using both R and Graphpad PRISM software. Topics covered include measures of central tendency, hypothesis testing, experimental design, data collection and sampling, confidence interval measures, parametric and non-parametric analyses, power analyses, and effect sizes. Data will be curated and contributed from existing projects for an authentic presentation. Each sub-module will be complemented with formative and summative quizzes to test understanding.

Assessment: 6-hours of asynchronous learning assessed by end-of-module quizzes.

Quizzes: 25% of final mark for subject.

Why is this module useful in skill development? Statistical knowledge is a core skill needed for researchers to initiate a research project, to collect and analyse data for their experiments and to communicate their findings. Having a good grasp of statistics is also important for scientists to evaluate the work of their peers.

Competency modules (hurdle requirement)
Research Integrity and ethics: This module is comprised of 8 training modules of 1 hour each on research integrity (RIOT), animal ethics and the use of cell lines. The modules will be available throughout the teaching period. Achievement of satisfactory competency is evidence by completion certification. Total time required is 8 hours.

Data management: Online training modules in LabArchives for record keeping and/or appropriate reference manager forms the data management module. Achievement of satisfactory competency is evidence by completion certification. Total time required is 3 hours.