064AA Bachelor of Biomedical Science

Year and Campus:	2010 - Parkville
Fees Information:	Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees
Level:	Undergraduate
Duration & Credit Points:	300 credit points taken over 36 months full time. This course is available as full or part time.
Coordinator:	Associate Professor Paul Whitington (Course coordinator - Academic)Dr Matt Perugini (Course coordinator - Students)
Contact:	Eastern Precinct Student Centre **epsc-contact@unimelb.edu.au (mailto:epsc-contact@unimelb.edu.au)** **http://www.studentcentre.unimelb.edu.au/eastern (http://www.studentcentre.unimelb.edu.au/eastern)**
Course Overview:	There is no new intake into this course after 2007. The Bachelor of Biomedical Science aims to produce flexible and well-informed graduates with specific training in a wide range of biomedical applications of the basic sciences. The course has been designed with a particular emphasis on the development of integrated knowledge of genome structure and its role in whole animal systems biology. The design takes into account the rapidly emerging importance of computational molecular biology (bioinformatics) and opportunities for exploiting knowledge of complete genome structures in biomedical contexts.
Objectives:	The specific course objectives are that graduates should: # have a broad knowledge of science across a range of disciplines, with a high level of understanding and appreciation in specialist areas of the biomedical sciences; # have an appreciation of integrated cellular tissue and whole body systems, particularly in the context of the new age of cell and molecular biology, genetic manipulation, rational drug design and therapeutics; # have an appreciation of comparative biology and the value of a range of single cell organisms (eg. yeasts) as model systems for investigating biomedically-relevant cellular processes; # have well developed skills in bioinformatics (computational molecular biology) and an awareness of state-of-the-art laboratory techniques of biomedical relevance and their application.
Course Structure & Available Subjects:	The Bachelor of Biomedical Science course is closely aligned with the Bachelor of Science course and makes provision for some common areas of study in a broad range of the biomedical sciences. However it is distinct in its provision for compulsory (core) subjects at each year level. These subjects have been designed to achieve the vertical integration of major themes of the new biologies, biomedical biotechnology and bioinformatics.
Subject Options:	Completion of 300 points is required, comprising: # 175 points of core subjects # 75 points of third year level subjects as specified in one of eight specialist streams in biomedical sciences; and # 50 points of science subjects in a biomedical science discipline. **First year level core subjects** 100 points of core subjects at first year level: # 650-131 Biomed: Molecules, Cells & Organisms # # 650-132 Biomed: Genetics & Biodiversity # # 610-051 Chemistry (Biomedical Science A) # # 610-052 Chemistry (Biomedical Science B) # # 620-151 Introduction to Biomedical Mathematics # # 620-152 Introduction to Biomedical Statistics # # 640-151 Physics for Biomedical Science A # # 640-152 Physics for Biomedical Science B

The subjects listed above were offered for the final time in 2007. Students who have not yet completed these first year level subjects (or approved alternative subjects) prior to 2010 should seek advice from the Science Student Centre about appropriate alternative subjects offered in 2010.

Second year level core subjects

50 points of core subjects at second year level:

- **521-213 Integrated Biomedical Science I (25 points)**
- **536-250 Integrated Biomedical Science II (25 points)**

The subjects listed above were offered for the final time in 2008.

From 2009, the following four subjects are the approved alternative subjects:

Subject	Study Period Commencement:	Credit Points:
CEDB20003 Fundamentals of Cell Biology	Semester 1	12.50
BCMB20002 Biochemistry and Molecular Biology	Semester 1	12.50
PHYS20008 Integrative Human Physiology	Semester 1, Semester 2	12.50
BCMB20005 Techniques in Molecular Science	Semester 1, Semester 2	12.50

Third year level core subjects

- **521-308 Genome Science**
- **536-350 Genes to Phenotype: Control & Integration**

The subjects listed above were offered for the last time in 2009

From 2010, the approved alternative to 521-308 Genome Science is

Subject	Study Period Commencement:	Credit Points:
BCMB30002 Functional Genomics and Bioinformatics	Semester 1	12.50

From 2010, the approved alternative to 536-350 Genes to Phenotype: Control and Integration will be any one of:

Subject	Study Period Commencement:	Credit Points:
CEDB30002 Concepts in Cell & Developmental Biology	Semester 1	12.50
CEDB30003 Developmental Biology	Semester 2	12.50
PHYS30001 Cardiovascular Health: Genes & Hormones	Semester 1	12.50
PHYS30008 Frontiers in Physiology	Semester 2	12.50
BCMB30004 Cell Signalling and Neurochemistry	Semester 2	12.50
BCMB30003 Molecular Aspects of Cell Biology	March	12.50
GENE30005 Human and Medical Genetics	Semester 2	12.50

Specialist streams in Biomedical Science at third year level.

In addition to the 25 points of third year level core subjects, students must complete a further 75 points of third year level biomedical science subjects for a course total of 100 points of subjects at third year level.

Stream 1: Functional, computational and applied genomics
Stream 2: Physiological genomics
Stream 3: Biotechnology and therapeutics
Stream 4: Molecular biology of the cell in health and disease
Stream 5: Reproductive and developmental biology
Stream 6: Neuroscience
Stream 7: Microorganisms, infection and immunity
Stream 8: Biomedical physics and chemistry

Structure of specialist streams

The majority of students who commenced this course in the 2007 (the final first year intake of the course) are expected to complete at the end of 2009. For the smaller number of students continuing in this course in 2010 advice on appropriate selection will depend on individual circumstances including the individual student's stage of progression in the course (e.g. the number of third year level subjects completed).

A number of third year level subjects available to BBiomedSc students across a number of departments were offered for the last time in 2009. Any new third year level subject replacing a subject previously available to BBiomedSc students will be available within the relevant specialist stream.

For advice on appropriate subjects contributing to each of the specialist streams, students may contact the Science Student Centre, the relevant stream coordinators, or the course coordinators. Any third year level subject that a student completed that was listed in any previous year's handbook as contributing to a specialist stream will count towards their course.

Stream 1: Functional, computational and applied genomics

Coordinators: Assoc Prof P Gooley and Prof J Camakaris
Students completing this stream will achieve an understanding of the organisation and expression of the human genome, and other eukaryotic and prokaryotic genomes, obtain insight into the human proteome project (HPP), and acquire valuable skills in several areas of molecular biology, functional genomics, proteomic techniques, genetic analysis, computational genomics (bioinformatics), and analysis of protein structure, function and post-translational modifications. Basic knowledge will be integrated with applications such as gene mapping and discovery, gene therapy, biotechnology, and understanding the molecular basis of genetic diseases and cancer. This stream provides an excellent grounding for careers in basic science, medical research, proteomics, bioinformatics and biotechnology. Employment and post-graduate study opportunities will exist in university departments, research institutes (eg. Bio21 Institute) and hospitals, and in the biotechnology, pharmaceutical and bioinformatics industries.

Stream 2: Physiological genomics

Coordinator: Professor D Williams

This stream is for students wishing to enter the rapidly expanding world of physiological genomics. This new post-genomic discipline defines the function of genes in living tissues. Physiological genomics is important in tracing the effects of newly discovered genes and mutations and provides insights into new means of preventing or treating genetic diseases. It combines molecular and physiological skills in the context of complex living systems. Students will develop an understanding of the interactions that characterise the integrated and coordinated way in which genetic codes are translated into the function of cells, tissues, organs and the organism. With the emerging application of genomic discoveries, graduates could consider careers in basic science as well as clinical research. Employment opportunities exist in university academic departments, research institutes, hospitals, the pharmaceutical industry and biotechnology companies.

Stream 3: Biotechnology and therapeutics

Coordinator (Biotechnology): Dr D Tribe
Coordinator (Therapeutics): Prof A Stewart
Coordinators (Drug Technology): Dr U Wille and Prof A Stewart
Within Stream 3 there are three themes of study which are designed to provide insight into the rapidly developing interdisciplinary approaches that are providing new molecular innovations to improve our quality of life. Biotechnology is concerned with the commercial development and production of new agents, whereas pharmacology is concerned with the discovery and mechanism of action of such agents. Graduates with research training in these areas could be destined for a career in the pharmaceutical industry or in regulatory affairs. Research

opportunities also exist in universities, research institutes, hospitals and an increasing number of start-up biotechnology companies.
The biotechnology theme will provide students with an understanding of the wide range of tools and techniques that are being used to manipulate genes, manage cell growth, and control enzyme catalysis for the creation of new products and manufacturing processes. It also provides familiarity with the ongoing conceptual advances and scientific innovations that are driving the continued expansion of biotechnology. Students may choose subjects that constitute a plant biotechnology substream.
The therapeutics theme will provide students with an understanding of the principles of pharmacology, which is the science of drug action at the molecular and physiological level. New developments in methods of drug discovery will be described and students will be given practical experience in the skills used by pharmacologists to unravel the mechanisms by which drugs produce their effects. Other topics include the study of the toxic actions of drugs and other environmental chemicals and the way that the body breaks down and eliminates such chemicals.
The drug technology theme will provide students with theory and practical experience in the drug development operations of the pharmaceutical industry. Rational design of pharmaceuticals at the molecular level is replacing previous 'hit and miss' random screening methods. Contemporary techniques in combinatorial chemistry, high-throughput analysis and computer-based rational drug design techniques (based on molecular structure) will be covered.

Stream 4: Molecular biology of the cell in health and disease

Coordinators: Dr R de Iongh and Prof P Gleeson
The subjects in this stream deal with the links between the genome and phenome at all levels of organisation - from cells to organisms. Understanding these links is pivotal to apply recent advances in our knowledge of the human genome to the solution of medical problems. Students will emerge from this stream with a sound understanding of the genetic and molecular basis for normal cell and tissue function. They will also have an appreciation of how cellular processes can be disrupted as a result of inherited or environmentally induced mutations, inappropriate diet or infection. This stream provides an ideal grounding for careers in biomedical research into human diseases such as cancer, diabetes, hypertension etc. as well as basic research in cell and developmental biology. It opens up employment opportunities in university departments, hospitals, research institutes and biotechnology companies developing diagnostic and therapeutic products.

Stream 5: Reproductive and developmental biology

Coordinator: Dr Mary Familari
Reproductive and developmental biology are two rapidly expanding fields offering many exciting opportunities for graduates at the forefront of biotechnology. These areas have numerous clinical applications such as in vitro fertilization (IVF), development of new contraceptives and the newest field, embryonic stem cell technology, which holds enormous therapeutic potential for the repair of diseased and damaged tissues. This stream is designed to give students a broad background in the genetics, molecular and cellular basis of diverse topics including reproduction, embryonic and fetal development in human, and other animal models. It covers the genetic and cellular events of: 1. development of egg to embryo; 2. pregnancy; 3. lactation; 4. birth and birth defects; 5. sexual differentiation; 6. fertility and control strategies for the prevention of HIV; and 7. cloning and stem cell research. This stream is taught by leading researchers in the fields of reproduction, sexual differentiation and embryonic development using state-of-the-art molecular and genetic technologies. This stream also provides a good background for those students interested in the application of assisted reproductive technology for the conservation of endangered species. The electives have been chosen to allow students to further focus on areas that particularly interest them and can lead to Honours and postgraduate research. This stream opens up employment opportunities in three broad areas: in biomedical research, biotechnology and agricultural industries. Graduates are well qualified for employment in fertility clinics; assisted reproductive technology and biotechnology companies such as IVF Australia; and veterinary and agricultural industries such as CSIRO, Environment Australia, Natural Resources and Environment, Parks Victoria and Victorian Institute of Animal Sciences. There are numerous large research centers in Victoria whose medical research focuses on aspects of reproduction and stem cell biology that offer many employment opportunities as well as opportunities for Honours and postgraduate study.

Stream 6: Neuroscience

Coordinator: Dr P Kitchener
Understanding the human brain is one of the pre-eminent scientific challenges of the 21st Century. Neuroscience is a broad discipline and in this stream is addressed over a wide range from the molecular and cellular mechanisms underlying neural function to complex behaviours such as thought and language. The range of subjects offered aims to provide

	students with insight into the molecular and cellular mechanisms fundamental to neural function; an understanding of how neurons form the building blocks of the nervous system, how they transmit information, communicate with each other, form elementary circuits, and store information; an appreciation of the fundamentals of systems underlying sensory perception; an understanding of how the nervous system initiates and controls movements of the body; an appreciation of the plasticity of the nervous system, how it adapts to changing environments, how it ages, how nerve injuries may be repaired or may lead to irreversible damage; insight into how drugs and diseases affect the nervous system. A neuroscience background leads to career opportunities in scientific and medical research in university departments, research institutes, hospitals; and to broader opportunities in drug companies, and in bioengineering companies (diagnostic and therapeutic equipment, robotics). **Stream 7: Microorganisms, infection and immunity** Coordinators: Prof R Robins-Browne and Ms S Uren Infectious diseases are the major world wide cause of morbidity and mortality. The Stream 7 core subjects provide a deep understanding of the diverse agents of infection (bacteria, viruses, fungi and parasites), and the many diseases they cause. The molecular basis of the ability of various microorganisms to cause disease (pathogenesis) will be discussed, together with strategies to interrupt this process, including the development of new antibiotics and other agents. The immunology component of the course allows students to become familiar with the way the immune system responds to defend the body against infections. Techniques to boost the immune response by the development of novel vaccines and other interventions are explored. As well, the immunology subjects provide an understanding of the mechanisms operating in response to tumours, transplants, and in allergies and autoimmune diseases. Stream 7 electives have been chosen to allow students to further focus on areas of particular interest to them. This stream opens up employment opportunities in the areas of medical microbiological and immunological diagnostics, food science, biotechnology (including medical and veterinary vaccine and therapeutics development and production), and basic research into a range of microorganisms (including those bacteria and viruses which cause diarrhoea, HIV, influenza and tuberculosis), microbial genetics and pathogenesis. The depth of the immunological content of the course allows students to continue to explore the immune system by research into such diverse areas as allergies, autoimmune diseases including diabetes and arthritis, transplantation and cancer immunology. **Stream 8: Biomedical physics and chemistry** Coordinator (Physics): Assoc Prof Ann Roberts Coordinator (Chemistry): Dr U Wille
Entry Requirements:	There is no new student intake into this course after 2007.
Core Participation Requirements:	It is University policy to take all reasonable steps to minimise the impact of disability upon academic study and reasonable steps will be made to enhance a student's participation in the University's programs. Students who feel their disability may impact upon their active and safe participation in a subject are encouraged to discuss this with the relevant subject coordinator and the Disability Liaison Unit.
Further Study:	Honours and Masters level studies are available as indicated at **http://www.science.unimelb.edu.au (http://www.science.unimelb.edu.au)**
Graduate Attributes:	In biomedical science at the University of Melbourne we expect to educate our students in the fundamental skill of transforming information into knowledge. This outcome is fully consistent with the University's general ambition for our graduates, and emphasises the transferability of the skills practised in science. Throughout their course, students will find that many of the abilities that they develop are shared, valued, and applicable to activities in all walks of life. In particular, these are the skills that are essential to providing leadership to the biomedical science industries of the Australian economy and culture. Bachelor of Biomedical Science graduates have concentrated knowledge across the range of biomedical discipline areas, as well as particular areas of specialisation. The integrated nature of the course means that they are able to apply this knowledge readily to different issues, problems or workplaces. They are also able to see beyond specific discipline boundaries and can evaluate and integrate new information and ideas readily into their existing knowledge base. Having undertaken laboratory and tutorial classes, biomedical science graduates are adept at activity planning as well as the application of theory to practice. They are well versed in a variety of state-of-the-art laboratory techniques of biomedical relevance as well as skills in bioinformatics. Many graduates will have been exposed to laboratory research in research institutes associated with the University. They are not only able to work independently on basic research projects, but are also familiar

	with professional work cultures and readily adapt to new organisations. In additional they are aware of the bioethical issues surrounding areas such as new genetics and animal cloning investigations. The scientific training of these graduates gives them strong cognitive skills and they are able to: observe, record and evaluate data or evidence appropriately; deal with complex data sets and apply their strong numerical competence to identify and analyse key factors and components; make effective use of information to identify and solve problems; and synthesize and integrate disparate elements into a meaningful whole. Graduates take these skills further in the creative realm, formulating hypotheses that can be tested for validity. They are used to extrapolating from the known to the unknown and are comfortable working with analogues rather than needing to deal with literal situations. They understand the need to question and clarify before developing a response to a particular issue or problem, enabling them to analyse critically. Science disciplines value clear reporting. Consequently, the biomedical science graduate has developed skills of efficient and effective communication of ideas and results, whether in the accepted modes of scientific report writing or through more informal oral presentations. Graduates recognise the need to present information and ideas in an effective written form that is appropriate to the purpose and the reader. The need to manage the multiplicity of tasks (lectures, laboratory and assignment work), means that biomedical science graduates are aware of the need to structure and manage time effectively and efficiently, to retain balance, and to prioritise their activities. They are able to juggle several tasks simultaneously, take responsibility for their own work, independently or within a group, and to plan their schedule appropriately.
Generic Skills:	Upon completion of this course students should have developed the following generic skills: # when solving scientific problems: - be capable of applying appropriate knowledge, - be able to access relevant information particularly through the use of information technology and traditional libraries, - understand the principles of project and experimental design, - have a capacity to apply practical skills, technology and computational systems; # be able to communicate the results of their studies in written and oral form and through computer-based presentations; # have experience in teamwork and leadership; # have an appreciation of the historical background and evolution of scientific concepts; and # have an awareness of bioethics, particularly in the context of areas such as the new genetics and animal cloning investigations.