Biomedical science

For information on the course structure of the Bachelor of Biomedical Science see *Bachelor of Biomedical Science (BBiomedSc) (p.16)*. Stream-specific core and elective subjects are listed and full descriptions can be found under the relevant department entries.

The following subjects are normally only available to students enrolled in the Bachelor of Biomedical Science course.

Subject descriptions

100-level subjects

650-131 Biomed: Molecules, Cells & Organisms

Note: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Engineering (Biomedical Engineering) students.

Experiments involving the use of animals are an essential part of this subject; exemption from these experiments is not possible.

Credit cannot be gained for this subject and 600-131 (before 2004), 600-141 (before 2004), 650-141 or 202-103.

This is a joint botany and zoology subject.

Credit points: 12.5

Coordinator: A/Prof D Gleeson

Corequisites: Students are expected to enrol in both 600-131 and 600-132.

Contact: 36 lectures (three per week), 36 hours of practicals and computer-based activities (three hours per week) and ten 1-hour tutorial/workshop sessions *(Semester 1)*.

Description: This subject aims to familiarise students with modern concepts of molecular, cell and organismal biology as a foundation for further studies in biomedical science. Two major topics are addressed. Cell and molecular biology includes the chemical building blocks of life, functioning cells, cell evolution and endosymbiosis; cell organelles, their structure and function; movement across membranes: structure, permeability and transport; the cell wall and extracellular matrix; cell metabolism: enzymes and cellular reactions; excitable cells; energy transformations; cell divisions: mitosis and meiosis; cells and tissues; cellular communication and signalling; tissue culture and cloning. Animal physiology includes a comparative approach to circulation, nutrition and digestion, excretion, respiration and gaseous exchange, thermoregulation, reproduction, development, the immune system, hormonal control and nervous systems.

Students will develop generic skills in:

- dissection techniques and the preparation of slides;
- the recording of observations and the analysis and interpretation of data;
- the preparation of biological drawings;
- manipulating laboratory equipment, in particular using microscopes; and
- accessing information sources and discerning use of the world wide web.

Assessment: A multiple choice test taking approximately 35 minutes held mid-semester (10%); work in practical classes during the semester, made up of written work not exceeding 1500 words, assessment of practical skills within the practical class, and no more than 4 short multiple choice tests (total 25%); a 3-hour written examination on theory and practical work in the examination period (65%). A pass in the practical work is necessary to pass the subject.

Prescribed texts: WK Purves, GH Orians, HC Heller and D Sadava, *Life*, 7th edn, Sinaver/Freeman, 2004.

650-132 Biomed: Genetics & Biodiversity

Note: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Engineering (Biomedical Engineering) students.

Experiments involving the use of animals are an essential part of this subject; exemption from these experiments is not possible.

Credit cannot be gained for this subject and 600-132 (before 2004), 600-142 (before 2004), or 650-142.

This is a joint botany, genetics and zoology subject.

Credit points: 12.5

Coordinator: A/Prof D Gleeson

Corequisites: Students are expected to enrol in both 600-131 and 600-132.

Contact: 36 lectures (three per week), 36 hours of practicals and computer-based activities (three hours per week) and ten 1-hour tutorial/workshop sessions *(Semester 2)*.

Description: Topics include the genetic consequences of meiosis; inheritance; chromosomes, genes/alleles, dominance relationships, autosomal/sex-linked inheritance; one locus, blood groups, pedigree analysis, examples of human genetic disease; more than one locus, gene interaction, linkage, multifactorial/quantitative inheritance, heritability; DNA structure and function, replication, protein synthesis, mutation; genes and development; tools used for molecular genetic analysis: restriction enzymes, PCR, gel electrophoresis, aims of the Human Genome Project; recombinant DNA technology; genes in populations; human diversity, polymorphisms, selection, the theory of evolution; generation of species; biodiversity and genetic resources; model systems for biomedical research; Monera: beneficial and harmful bacteria; viruses and infectious molecules; fungal pathogens and the role of fungi in medicine; Protista: including parasitology; plants: phytochemistry, natural products chemistry, allergens and toxic plants; animals: including invertebrate parasitology, and their role as vectors of disease; evolution of chordates and vertebrates; and evolution of primates and humans.

Students will develop generic skills in:

- the recording of observations and the analysis and interpretation of data;
- the statistical analysis of genetic data;
- manipulating laboratory equipment, in particular using microscopes and gel electrophoresis;
- basic microbial techniques; and
- accessing information sources and discerning use of the world wide web.

Assessment: A multiple choice test taking approximately 35 minutes held mid-semester (10%); work in practical classes during the semester, made up of written work not exceeding 1500 words, assessment of practical skills within the practical class, and no more than 4 short multiple choice tests (total 25%); a 3-hour written examination on theory and practical work in the examination period (65%). A pass in the practical work is necessary to pass the subject.

Prescribed texts: W K Purves, G H Orians, H C Heller and D Sadava, *Life*, 7th edn, Sinaver/Freeman, 2004.

610-051 Chemistry (Biomedical Science A)

Availability: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Engineering (Biomedical Engineering) students.

Credit points: 12.5

Coordinator: Dr U Wille

Prerequisites: VCE Chemistry or its equivalent.

Contact: 36 lectures (three per week), eight 3-hour sessions of practical work, 10 hours of tutorials and 9 hours of problem-solving/computer-aided learning *(Semester 1)*.

Description: Upon completion of 610-051, students should have an understanding of the place of chemistry in a biomedical context; the nature of hydrocarbons; the nature of gases; the nature of chemical equilibria and structure and bonding of inorganic molecules.

In the practical component, students should develop basic laboratory skills (observation, analytical technique, report writing); oral communication skills; independent learning skills; and an appreciation of the health and safety issues associated with the safe handling and disposal of laboratory chemicals.

The subject provides an introduction to bonding and structure in organic molecules, gases (solubility, diffusion), energy (sources, food), equilibria, acid-base chemistry, intermolecular forces and solids.

Assessment: A 30-minute written class test held mid-semester (5%); ongoing assessment of practical work during the semester (20%); a 3-hour written examination in the examination period (75%). Satisfactory completion of practical work is necessary to pass the subject.

Prescribed texts: S Zumdahl, *Chemical Principles*, 5th edn, Houghton Mifflin, 2005. • J McMurry, *Organic Chemistry*, 6th edn, Thomson Brooks/Cole, 2004.

610-052 Chemistry (Biomedical Science B)

Availability: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Engineering (Biomedical Engineering) students.

Credit points: 12.5

Coordinator: Dr U Wille

Prerequisites: Chemistry 610-051

Contact: 36 lectures (three per week), eight 3-hour sessions of practical work, 10 hours tutorials, 9 hours problem-solving/ computer-aided learning *(Semester 2)*.

Description: Upon completion of this subject, students should have an understanding of the reactivity of organic molecules; atomic structure; reaction kinetics; the structure and reactivity of biomolecules and metal chemistry in biology.

In the practical component, students should develop basic laboratory skills (observation, analytical technique, report writing); oral communication skills; independent learning skills; and an appreciation of the health and safety issues associated with the safe handling and disposal of laboratory chemicals.

The subject provides an introduction to the chemistry of functional groups important to biological processes; the structures of biological molecules;

reaction rates (catalysis), atomic spectra and structure, chemistry of the main group elements; redox reactions; and metal chemistry in biology.

Assessment: A 30-minute written class test held mid-semester (5%); ongoing assessment of practical work during the semester (20%); a 3-hour written examination in the examination period (75%). Satisfactory completion of practical work is necessary to pass the subject.

Prescribed texts: S Zumdahl, *Chemical Principles*, 5th edn, Houghton Mifflin, 2005. • J McMurry, *Organic Chemistry*, 6th edn, Thomson Brooks/Cole, 2004.

620-151 Introduction to Biomedical Mathematics

Note: This subject is only available to Bachelor of Biomedical Science students.

Students may only gain credit for one of 620-151, 620-161 and [02]620-163.

Credit points: 12.5

Coordinator: Dr D King

Prerequisites: VCE Mathematical Methods 3/4.

Contact: 36 lectures (three per week) and eleven 1-hour tutorials (one per week) *(Semester 1)*.

Description: This subject develops elementary rules for manipulating matrices; concepts of basic functions of one variable; and basic procedures for the solution of differential equations and linear programming problems. Students should develop manipulative skills in the use of matrices and standard functions; the skills to find derivatives and antiderivatives of functions of one variable; and an ability to apply these skills to word problems in bioscience. This subject demonstrates the sequential conceptual structure of the mathematics of functions and the value of differential equations in bioscience.

Matrices topics include row operations, systems of linear equations, graphical and matrix methods for linear programming; duality; and applications in bioscience. Calculus topics include functions of one real variable; differentiation and integration of standard functions; related rates of change; differential equations, including simple simultaneous equations and their applications to population dynamics and physiological systems; and numerical solution of differential equations.

Assessment: Up to 25 pages of written assignments due during the semester (10%); a 45-minute written test held mid-semester (either 0% or 15%); a 3-hour written examination in the examination period (75% or 90%). The relative weighting of the examination and the mid-semester test will be chosen so as to maximise the student's final mark.

620-152 Introduction to Biomedical Statistics

Note: This subject is only available to Bachelor of Biomedical Science students.

Students may only gain credit for one of 620-152 and 620-160.

Students who gain credit for 620-152 can progress to 620-270 Applied Statistics.

Students who have completed 620-131, 620-202, 620-270 or 620-272 may not enrol in this subject for credit.

Credit points: 12.5

Coordinator: Dr M Ng

Prerequisites: VCE Mathematical Methods 3/4.

Contact: 36 lectures (three per week), 11 one-hour computer laboratory classes (one per week) and 11 one-hour tutorials (one per week) *(Semester 2)*.

Description: This subject lays the foundations for an understanding of the fundamental concepts of probability and statistics, as they relate to the biomedical sciences. Students completing this subject will develop skills in data analysis, probability, basic statistical inference and some of the statistical techniques commonly used in the biomedical sciences. They will also learn about the importance of good study design in scientific and medical research.

Topics include scientific method and experimental design, including randomisation and blocking; rates and standardisation; life tables; probability in medicine and biology, especially genetics; Bayes' theorem; Poisson distribution; types of epidemiological study: randomised controlled trials, cohort studies, longitudinal studies, case-control studies; guidelines for supporting an argument for cause and effect based on observational data; data description and analysis; random sampling; population parameters and sample statistics; estimation, confidence intervals and hypothesis testing based on the binomial and normal distributions; and introduction to bivariate data, including correlation and linear regression.

Assessment: Up to 36 pages of written assignments due during the semester (15%); computer-based tests during computer laboratory classes (5%); a 3-hour written examination in the examination period (80%).

640-151 Physics for Biomedical Science A

Note: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Optometry students.

Students may only gain credit for one of 640-005, 640-121, 640-141, 640-151 and 640-161.

Credit points: 12.5

Coordinator: Dr M K Livett

Prerequisites: Some knowledge of physics, VCE Unit 3/4 Mathematical Methods or equivalent.

For BSc students, entry to this subject will be by invitation of the Head of the School of Physics, usually requiring a very high level of achievement in the final year of secondary school.

Contact: 36 lectures (three per week), 12 one-hour tutorials (one per week) and laboratory work and assignment(s) involving 30 hours of work during the semester *(Semester 1)*.

Description: This subject will develop students' appreciation of the importance of physical principles to biomedical science as well as their understanding of the principles underpinning human structure and function, medical diagnostics and therapeutics. Students completing this subject will be able to:

- explain the basic principles of sound, optics, atomic physics, lasers and biomechanics;
- apply these principles, together with mathematical reasoning, to situations in the biomedical sciences; and
- acquire and interpret experimental data.

In addition, students will be able to:

- participate as an effective member of tutorial, laboratory and study groups;
- communicate their understanding of physics orally and in written form in tutorials, lab classes, seminar program and study groups; and
- manage their time commitments to this subject in order to be prepared for regular lab and tutorial classes as well as tests and examination.

The subject provides an introduction to:

- acoustics: hearing, speech, ultrasound imaging, therapeutic applications of sound (properties of waves, the nature of sound, superposition of waves, Doppler effect, interaction of sound with matter);
- optics: optical imaging and sensing, human and animal vision (reflection, refraction and dispersion of light, mirrors, optical fibres, lenses, optical imaging and optical instruments);
- atomic physics and lasers: fluorescence imaging and spectroscopy, laser surgery (structure of the atom, photons, spectroscopy, interaction of light with matter); and
- mechanics: human and animal movement, sport, injuries (Newton's laws of motion, energy transfer and transformation, mechanical properties of materials, elasticity, compression and extension).

Assessment: A 3-hour end-of-semester written examination (65%); laboratory work together with a group project (25%); up to three tests totalling up to two hours and/or written assignments during the semester, up to an equivalent of 2000 words (10%). Students must complete both laboratory and project work satisfactorily to obtain a pass.

Prescribed texts: RA Serway and JW Jewett, *Principles of Physics*, 4th edn, Thomson, 2006. • J Faughn, *Life Science Applications for Physics*, Harcourt, 1998.

640-152 Physics for Biomedical Science B

Note: This subject is only available to Bachelor of Biomedical Science students and Bachelor of Optometry students.

Students may only gain credit for one of 640-006, 640-122, 640-142, 640-152 and 640-162.

Credit points: 12.5

Coordinator: Dr M K Livett

Prerequisites: Some knowledge of physics, VCE Unit 3/4 Mathematical Methods or equivalent. It will be assumed that students are familiar with the content of 640-151 Physics for Biomedical Science A *(p.2)*.

For BSc students, entry to this subject will be by invitation of the Head of the School of Physics, usually requiring a very high level of achievement in the final year of secondary school.

Contact: 36 lectures (three per week), 12 one-hour tutorials (one per week) and laboratory work and assignment(s) involving 30 hours of work during the semester *(Semester 2)*.

Description: This subject will develop students' appreciation of the importance of physical principles to biomedical science, as well as their understanding of the principles underpinning human structure and function, medical diagnostics and therapeutics.

Students completing this subject will be able to:

- explain the basic principles of fluids, thermal physics, electricity and magnetism, radiation and imaging;
- apply these principles, together with mathematical reasoning, to situations in the biomedical sciences; and

- acquire and interpret experimental data.

In addition, students will be able to:

- participate as an effective member of tutorial, laboratory and study groups;
- communicate their understanding of physics orally and in written form in tutorials, lab classes, seminar program and study groups; and
- manage their time commitments to this subject in order to be prepared for regular lab and tutorial classes as well as tests and examination.

The subject provides an introduction to:

- fluids: blood flow, respiration, membranes (pressure in fluids, fluid flow, viscosity, surface tension);
- thermal physics: energy balance of living organisms, ion movement across membranes (thermal energy, temperature, heating processes, first law of thermodynamics, diffusion);
- electricity and magnetism: bioelectricity, nerve conduction, electrical safety, therapeutic uses of electromagnetic waves (forces between electric charges, electric circuits, resistance, capacitance, magnetic forces, electromagnetic waves);
- radiation: radiation safety, therapeutic uses of radiation (the atomic nucleus, isotopes, nuclear decay and radiation, physical and biological half-life, ionising radiation); and
- imaging: modern biomedical imaging (X-rays, CT-scans and angiography, MRI, positron emission tomography).

Assessment: A 3-hour end-of-semester written examination (65%); laboratory work together with a group project (25%); up to three tests totalling up to two hours and/or written assignments during the semester, up to an equivalent of 2000 words (10%). Students must complete both laboratory and project work satisfactorily to obtain a pass.

Prescribed texts: RA Serway and JW Jewett, *Principles of Physics*, 4th edn, Thomson, 2006. • J Faughn, *Life Science Applications for Physics*, Harcourt, 1998.

200-level core subjects

521-213 Integrated Biomedical Science I

Note: This subject is only available to Bachelor of Biomedical Science students.

Credit points: 25

Coordinator: Dr T Mulhern; A/Prof T Lithgow

Prerequisites: 650-131 and 650-132; 610-051 and 610-052.

Contact: Six hours of lectures and three hours of practicals or self-directed computer-based learning exercises per week *(Semester 1)*.

Description: This multidisciplinary subject blends biochemistry, molecular and cell biology, tissue biology and physiology, to develop knowledge of the relationship between the structure and function of the major classes of biomolecules, higher ordered structures and cells, as well as the contribution these molecules make to cellular, tissue and whole systems biology.

The biochemistry component (36 lectures) covers structure and function of proteins, biological membranes and nucleic acids; and an introduction to recombinant DNA technology, including genome analysis, proteomics and bioinformatics. The cell biology stream (24 lectures) includes the histology and ultrastructure of cells and basic tissue types, epithelium, muscle, nerve, haemopoietic and connective tissues; and the organisation of the major organs and the structure and function of cellular organelles, cytoskeletal structures and the extracellular matrix. The introductory physiology stream (12 lectures) will concentrate on mammalian (especially human) physiology: homeostasis, the relationship between organs and organ systems, cell physiology, excitable cells and electrolyte transport.

Practical work will develop basic experimental, data analysis and interpretation skills in biochemistry, physiology and cell and tissue biology techniques.

In addition to the specific skills gained, students will think critically and organise knowledge from diverse resources, expand from theoretical principles to practical explanations and acquire abilities in collaborative work.

Assessment: Ongoing assessment of laboratory practical work during the semester (15%); a 1500-word written assignment due during the semester (10%); two 1-hour multiple choice tests during the semester (5% total); two 2-hour written examinations in the examination period on theory and practical work (70% total).

536-250 Integrated Biomedical Science II

Note: This subject is only available to Bachelor of Biomedical Science students.

Credit points: 25

Coordinator: A/Prof R Kemm

Prerequisites: 521-213 Integrated Biomedical Science I *(p.3)*.

Contact: 66 hours of lectures and 54 hours of practicals and computer-aided learning classes *(Semester 2)*.

Description: The overall aim will be to build on the knowledge developed in 521-213 Integrated Biomedical Science I and to extend coverage to include the intermediary metabolism, organ and whole systems physiology and tissue biology, genes and gene expression and the major regulatory systems. The biochemistry stream (22 lectures) will cover metabolism, bioenergetics, waste elimination, regulation of metabolism including the molecular basis of cell signaling, molecular mechanisms and regulation of gene replication, expression and protein synthesis. Biochemistry will also combine with physiology to cover integrated whole body responses to metabolic and physiological stress and nutrition. The physiology stream (44 lectures) will concentrate on the transduction of neurotransmitter, hormone and other messages; control systems common to many organs, the autonomic nervous system and the endocrine system. Coverage of specific organ systems will include renal, respiratory and cardiovascular systems, digestive and excretory, reproductive, locomotor, neurophysiology (taught with relevant histology and structure in conjunction with anatomy and cell biology). The practical work will be designed to develop and extend experimental, data analysis and interpretation skills in biochemistry and physiology techniques. Following completion of this subject, students should be able to develop communication skills (written and oral), critical thinking and analytical skills and participate effectively as a team member.

Assessment: Weekly assessment of written practical class reports of less than 1500 words (15%) and computer-aided learning classes (5%); online e-learning (5%) and one scientific report in a journal format of less than 2000 words due during semester (10%); one 1-hour written examination held mid-semester (15%); two 2-hour written examinations in the examination period on theory and practical work (25% each).

Prescribed texts: D U Silverthorn, *Human Physiology*, 4th ed, Pearson Education. **or** Rhoades and Pflanzer, *Human Physiology*, 4th ed, Thomas Learning. **or** Sherwood, *Human Physiology: From Cells to Systems*, 5th ed, Thomas Learning. • Stryer, *Biochemistry*, 4th ed, W H Freeman and Co. **or** Nelson and Cox, *Lehninger Principles of Biochemistry*, 3rd ed, Worth Publishers.

300-level core subjects

521-308 Genome Science

Note: This subject is only available to Bachelor of Biomedical Science students.

Credit points: 12.5

Coordinator: Dr M Perugini

Prerequisites: 521-213 Integrated Biomedical Science I *(p.3)* and 536-250 Integrated Biomedical Science II *(p.3)*.

Contact: Two hours of lectures per week (total 24 hours) and three hours of computer-assisted practicals or applied bioinformatics project exercises per week (total 36 hours) *(Semester 1)*.

Description: The subject aims to develop knowledge and skills in and an understanding of the rationale and experimental strategies and computational sequence analyses being used in the major international genome programs (particularly the Human Genome Project) and an appreciation of the potential for future applications of this knowledge and relevance to the transcriptome, proteome and metabolome.

The subject will be organised into three components: a lecture series, computer-based exercises, and an applied bioinformatics project.

The lecture series will cover the following areas: an overview of the history, goals and discoveries of the Human Genome Project; general experimental strategies for complete structural characterisation of genomes; comparative genomics focusing on gene organisation and diversification in evolution; haplotypes and single nucleotide polymorphisms; principles of computational molecular biology (bioinformatics) directed towards DNA and protein sequence alignments, pattern recognition, evolutionary comparisons and molecular modelling of protein structures; gene expression analysis using microarray technology with applications to human disease; the Human Proteome Project and the development of a proteome knowledge base and model systems; methods for the analysis and quantitation of the proteome and protein-protein interactions; and metabolomic profiling and applications to drug discovery. It will also cover ethical issues relating to biomedical research, publications and scientific conduct.

The computer-based exercises will aim to develop skills in sequence data retrieval, sequence alignments and pattern recognition.

The applied bioinformatics project is designed to provide students with skills in bioinformatics, library research, oral communication, report writing and team work in a relevant area of genome science.

Assessment: Practical and computer-based exercises during the semester (10%); a 1-hour written examination held mid-semester (10%); a 10-minute applied bioinformatics project oral presentation during the semester (15%); a 1500-word applied bioinformatics project report due during the semester

(15%); a 2-hour written examination in the examination period on the theoretical and practical components of the subject (50%).

536-350 Genes to Phenotype:Control & Integration

Note: This subject is only available to Bachelor of Biomedical Science students.

Credit points: 12.5

Coordinator: Prof S Harrap

Prerequisites: 521-213 Integrated Biomedical Science I *(p.3)* and 536-250 Integrated Biomedical Science II *(p.3)*

Contact: Two hours per week of lectures (total of 24 hours), up to four hours per week of workshops, practicals and computer-based self-directed learning exercises (total of 48 hours) *(Semester 2).*

Description: The subject will provide a broad picture of the role of genes in the function and integrated control of cells, tissues and whole organisms, particularly mammals. The aim will be to develop an understanding of the role of genes in the context of whole animals by investigating the embryological, physiological and biochemical consequences of natural genetic variations and experimental genetic manipulations, using contemporary molecular biology techniques. The subject will address issues such as integration and coordinated control of systems and adaptation to change. The juxtaposition of the subject with 521-308 Genome Science *(p.3)* complements the emphasis on the fundamental involvement of molecular systems in critical integrated processes. The theme *Genotypes to Phenotypes* will cover the major principles that underpin the genetic determination of the life processes. The topics to be covered will include genome to organism, fertility and infertility, gametes, fertilisation, differentiation, organogensis, sexual determination and differentiation, biological rhythms and ageing. The second theme *Genetic Diversity - Causes and Consequences* will build on the understanding of genes and healthy phenotypes to consider the ways in which genetic diversity is maintained in populations and from one generation to the next. It will consider the adaptations to environmental stress (insecticides, drug resistance, heavy metals) and internal alterations to genes (monogenic and polygenic traits). The final theme *Genotypes to Phenotypes in Disease* will explore examples of genes causing quantitative and qualitative variations that may be harmful to individuals. Some examples that will be discussed will include cardiovascular diseases, familial cardiomyopathy, muscular dystrophies and channelopathies (cystic fibrosis, long QT syndrome, epilepsy, and myotonias). The practicals and workshops will incorporate computer-based self-directed learning exercises and reflect the three themes of the subject. The practical component may include visits to relevant research and/or industrial laboratories and complementary library exercises with a view to developing a research proposal in a specific area relevant to material covered in lectures. The practical and workshop components of the subject will assist students in developing communication skills (written and oral), critical thinking and analytical skills and participating effectively as a team member.

Assessment: Three 45-minute written examinations during semester (each worth 25%); ongoing assessment of written reports on the practicals and computer-based self-directed learning exercises throughout the semester (25%).