

# Genetics

Genetics is fundamental to all biological sciences and therefore any student specialising in a biological science discipline should consider taking some genetics subjects.

Subjects in genetics aim to provide students with an understanding of the applications of a genetic approach to fundamental biological problems. The nature and analysis of genetic variation in organisms ranging from microbes to humans, and implications for modern evolutionary theories, are considered. Particular emphasis is placed on the combined use of classical and molecular genetic methodology to analyse biological phenomena at both the cellular and population levels. Subjects include studies relevant to biomedical applications of genetics and to biotechnology.

Students who wish to specialise in genetics are encouraged to do a genetics major as detailed on page 13. Completion of a genetics major will provide the student with an understanding of the fundamental aspects of genetics at 200-level, progressing at 300-level to advanced aspects of molecular genetics, ecological genetics, molecular evolution, genomics, practical genetic analysis, and a choice of additional studies in developmental, human and experimental genetics.

For BSc or BSc combined degree students, completion of a genetics major is a prerequisite for entry into honours in genetics. Students who completed their studies prior to 1999 and wish to be eligible for entry into honours in genetics are also required to complete a genetics major. Exceptions to this prerequisite may be allowed by the Head of Department on a case-by-case basis.

Students completing the Bachelor of Biomedical Science must complete 25 points of 300-level genetics subjects to be eligible for honours in genetics.

At 200-level it is recommended that all students take biochemistry and molecular biology 521-211 and 521-212.

Students taking a genetics major may consider a second major depending upon their interests. For those with an interest in molecular genetics the following are recommended: majors in biochemistry and molecular biology, biotechnology, cell biology, immunology, microbiology, neuroscience and plant sciences. For those with an interest in population and evolutionary genetics the following are recommended: majors in animal behaviour and evolution, conservation and Australian wildlife, ecology, plant science, marine biology, mathematics and statistics; of a co-major in environmental science.

Students not wishing to undertake a second major in addition to a genetics major should consider an appropriate selection of subjects from biochemistry and molecular biology (recommended), chemistry, botany, zoology, microbiology, psychology, mathematics and statistics, and physiology.

Students wishing to take some genetics subjects without completing a genetics major should take 652-214 and 652-215 and a selection from 652-301, 652-302, 652-303 and 652-305 depending upon their interests.

## Bachelor of Science (Honours)

For information about the faculty and departmental entry requirements for honours, please refer to *Bachelor of Science (Honours)* and *Bachelor of Information Systems (Honours) (p.1)*. These requirements should be considered when planning your course.

## Further information

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## Subject descriptions

### 200-level subjects

#### 652-214 Principles of Genetics

**Note:** This subject can be taken by itself but is designed to be part of a two semester sequence with 652-215.

Both 652-214 and 652-215 (or 652-214, 521-213 and 536-250) are prerequisites for 300-level genetics subjects.

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Dr P Batterham; Dr B Appleton (summer)

**Prerequisites:** Biology 650-142 or 650-132 (prior to 2004: 600-142 or 600-132). Biology 650-141 or 650-131 (prior to 2004: 600-141 or 600-131) is recommended.

**Contact:** 48 hours of lectures, problem classes and computer exercises (*Semester 1, repeat Summer*).

**Description:** This subject provides a coverage of genetics from the DNA molecule and inheritance to the factors which modulate allele frequencies in natural populations; the genetic and molecular basis of phenotypic variation; genetic analysis in eukaryotes, viruses and bacteria; the nature of the genetic material; gene structure and function; quantitative inheritance; and genes at the population level.

Completion of this subject is expected to enhance a student's ability to understand the fundamental principles of genetics and to describe the experiments used to establish them. Students will develop skills to apply these principles to solve genetic problems and demonstrate how genetic analysis can be used to investigate aspects of biology.

Completion of this subject is expected to enhance the generic skills of a student in the application of fundamental scientific principles to solve new problems; in the application of scientific method through the development of hypotheses based on observations; and in planning effective work schedules to meet deadlines for assessable work.

**Assessment:** Summer Semester: A 2-hour written examination at the end of semester (60%) and four tests during semester (40% in total). Semester 1: A 2-hour written examination at the end of semester (70%) and three tests during semester (30% in total).

**Prescribed texts:** P J Russell, *iGenetics*, Benjamin-Cummings.

### 652-215 Genes and Genomes

**Note:** Not available to students enrolled in the BBiomedSc.

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Assoc Prof M Davis

**Prerequisites:** Biology 650-141 and 650-142; or biology 650-131 and 650-132 (prior to 2004: 600-141 and 600-142; or biology 600-131 and 600-132).

**Contact:** 48 lectures and problem classes (four per week) (*Semester 2*).

**Description:** Upon completion of this subject students should have:

- an understanding of the molecular basis of gene structure, expression and regulation in prokaryotes and eukaryotes;
- an understanding of DNA replication, recombination and mutagenesis;
- an appreciation of the organisation of genomes in a variety of organisms and the nature of molecular evolution; and
- the skills to solve problems and analyse data using a genetic approach.

The subject provides an introduction to the molecular basis of gene structure and expression in prokaryotes and eukaryotes; the processes of DNA replication, mutation and recombination; the molecular tools of gene isolation and analysis; and molecular evolution.

**Assessment:** One 3-hour written examination at the end of the semester and up to four short-answer tests during semester.

**Prescribed texts:** P J Russell, *iGenetics*, Benjamin-Cummings.

### 652-216 Molecular & General Genetics Practical

**Note:** This subject may be done in either Semester 1 or Semester 2.

Special requirements: laboratory coat. Students doing the subject in Semester 1 must call into the Mendel Laboratory (Ground Floor, Genetics Department) during the February orientation period to be assigned to a laboratory group. Students doing the subject in Semester 2 should report to the Mendel Laboratory in the week before the beginning of Semester 2 to be assigned to a laboratory group.

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Mr S Hardy

**Prerequisites:** Biology 650-141 and 650-142; or biology 650-131 and 650-132 (prior to 2004: 600-141 and 600-142; or biology 600-131 and 600-132).

**Pre or Corequisites:** Genetics 654-214 or 654-215.

**Contact:** 12 lectures (one per week), 36 hours of practical work (three hours per week) and 12 hours of computer-assisted learning (average of one hour per week) (*Semester 1, repeat 2*).

**Description:** Upon completion of this subject students should have:

- competence in the experimental methods used in genetics;
- an understanding of the application of genetic principles to experimental strategies;
- the ability to analyse data generated from their own experiments;
- experience in writing scientific reports; and
- experience in using computers for genetic exercises.

The subject provides coverage of the techniques and experimental designs used in genetic, cytogenetic and molecular genetic analysis of microorganisms and higher organisms.

**Assessment:** One 2-hour written examination at the end of the semester; a mid-semester short answer test; experimental reports not exceeding 30 pages; a report, based on computer exercises, not exceeding five pages.

**Prescribed texts:** P J Russell, *iGenetics*, Benjamin-Cummings.

### 300-level subjects

#### 652-301 Genomes and Evolution

**Note:** This subject replaces 652-301 Ecological and Evolutionary Genetics (prior to 2001).

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Dr P Batterham

**Prerequisites:** Genetics 652-214 and 652-215.

BBiomedSc students: Genetics 652-214, 521-213 and 536-250.

**Contact:** 36 lectures (three hours per week) (*Semester 2*).

**Description:** Upon completion of this subject students should have:

- acquired an up-to-date understanding of whole-genome mapping and sequencing projects;
- developed a capacity to critically review the written literature and to access web-based databases of genomic information;
- understood how genes, gene pools, and genomes change through evolutionary time;
- developed a critical appreciation for the methods used to detect and quantify the major evolutionary forces;
- comprehended the logic used in inferring evolutionary processes from patterns of genetic variation in space and time; and
- appreciated the connections between molecular evolution and conservation biology and phylogenetics.

The emphasis of this subject is on the use of molecular markers in genome mapping, in understanding how evolutionary forces shape the gene pool, in dissecting polygenic traits by mapping quantitative trait loci, and in other applications such as phylogenetics and conservation biology.

The topics covered will be classical population genetics, the measurement of selection, processes of speciation, conservation genetics, molecular evolution of single-copy and multi-copy genes, phylogenetic reconstruction, development of saturated linkage maps, physical mapping of genomes, whole-genome sequencing projects, mapping quantitative trait loci, comparative genomics, functional genomics, and high-throughput methods for scoring genetic polymorphisms.

**Assessment:** A written test during semester; a 2-hour end-of-semester written examination; three tutorial assignments of not more than 500 words each.

#### 652-302 Molecular Genetics

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Dr R Todd

**Prerequisites:** Genetics 652-214 and 652-215.

BBiomedSc students: Genetics 652-214, 521-213 and 536-250.

**Contact:** 36 lectures (three per week) (*Semester 1*).

**Description:** Upon completion of the subject students should have:

- developed a general appreciation of the molecular basis of genetic processes in both prokaryotes and eukaryotes;
- understood all of the basic techniques of recombinant DNA analysis and genomics and be able to appreciate how these methods are applied to specific biological problems;
- obtained an understanding of how knowledge in molecular genetics is obtained and presented by the study of primary research papers and review articles; and
- acquired the basic concepts and knowledge to enable them to do more advanced courses in a wide range of areas of cellular and molecular biology.

The topics covered will be prokaryote gene structure, action and regulation; genomic and recombinant DNA methodology; eukaryotic gene structure, action and regulation; genetic manipulation of microorganisms, plants and animals and genetic engineering; genome structure, prokaryotic and eukaryotic mobile DNA elements; and the genetic control of the cell cycle.

**Assessment:** A 3-hour end-of-semester written examination; mid-semester tests or up to three problems/assignments of not more than 1000 words each.

#### 652-303 Developmental and Cellular Genetics

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Assoc Prof L Kelly

**Prerequisites:** Genetics 652-214 and 652-215.

BBiomedSc students: Genetics 652-214, 521-213 and 536-250.

Genetics 652-302 is recommended.

**Contact:** 36 lectures (three per week) (*Semester 2*).

**Description:** Upon completion of the subject students should have:

- become familiar with the techniques and concepts involved in the genetic investigation as applied to the developmental process and cell biology of various eukaryotic organisms;
- understood the usefulness of genetic analysis as a means to dissect biological systems; and
- gained a knowledge and understanding of some current biological problems, and of the application of genetic analysis to these problems.

The subject will cover developmental genetics in plants, animals and microorganisms; chromatin structure and its implication for gene regulation and development; neurogenetics; genome plasticity; oncogenetics; immunogenetics; and somatic cell genetics.

**Assessment:** A 3-hour end-of-semester written examination; up to three problems/assignments of no more than 1000 words each.

#### 652-304 Genetic Analysis

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Assoc Prof C Cobbett

**Prerequisites:** Genetics 652-214, 652-216 and 652-215.

BBiomedSc students: Genetics 652-214, 652-216 and 521-213 and 536-250.

**Corequisites:** Genetics 652-302.

BBiomedSc students: 521-308.

**Contact:** 12 lectures (one per week) and 36 hours of practical work (three hours per week) (*Semester 1*).

**Description:** Upon completion of the subject students should have:

- understood the application of genetic principles and different experimental designs in classical, molecular and population genetic analysis;
- appreciated the advantages and disadvantages of these different designs;
- developed a detailed understanding of the techniques employed in experimental designs;
- experienced the use of particular laboratory techniques and analytical approaches in each of these areas of genetics;
- become proficient in the analysis and interpretation of data derived from their own experimentation and that of others;
- gained experience in the written presentation of scientific data; and
- developed an ability to combine their understanding of genetic principles, experimental design and specific techniques to the investigation of new problems in biology.

The subject involves lectures and practical exercises which demonstrate the principles and techniques of genetic analysis from classical and population genetics to modern biochemical and molecular technology.

**Assessment:** A 2-hour written examination at the end of semester; problems and assignments and up to four written practical reports.

#### 652-305 Human Genetics

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Assoc Prof J Camakaris

**Prerequisites:** Genetics 652-214 and 652-215.

BBiomedSc students: Genetics 652-214, 521-213 and 536-250.

**Contact:** 36 lectures (three per week) (*Semester 1*).

**Description:** Upon completion of the subject students should have:

- appreciated the importance of genes in influencing human health, disease and evolution;
- recognised ways in which environmental factors may modify the effects of genes;
- appreciated the ethical issues raised by the 'New Genetics';
- understood the basic techniques and concepts of molecular genetics and human genomics which permit findings at the DNA level to be related to phenotype; and
- developed skills in use and application of methods of gene mapping and linkage in humans.

This subject focuses on several key areas in contemporary human genetics: mutation in humans and its molecular basis; polymorphisms; selection and its consequences; gene mapping; strategies for identifying genes which cause human disease; the molecular basis of genetic diseases; genetics of cancer and aging; the Human Genome Project and its applications; screening for genetic diseases; genetic counselling, human cytogenetics; and gene-environment interactions. Ethical issues will be discussed in context in various sections of the course.

**Assessment:** A 3-hour end-of-semester written examination (85%); up to three problem sets/assignments each less than 1000 words (5%); a test during semester (10%).

#### 652-306 Experimental Genetics

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Prof M Hynes

**Prerequisites:** Genetics 652-302 and 652-304.

**Contact:** 24 hours of lectures (an average of two per week) and 36 hours of laboratory practical/project work (an average of three per week) (*Semester 2*).

**Description:** Upon completion of the subject students should have:

- understood the way in which experiments in genetics are designed, communicated and interpreted;
- developed experience in the planning and execution of experiments;
- extended their abilities in oral and written scientific communication; and
- gained the ability to read and assimilate specific research papers and to see how the research reported relates to the broad field of genetics.

The subject involves lectures and lecture/discussions on research papers in genetics, practical exercises and a project in one area of genetics.

**Assessment:** Four written assignments relating to lecture/tutorial and practical exercises; an oral presentation and a project report.

