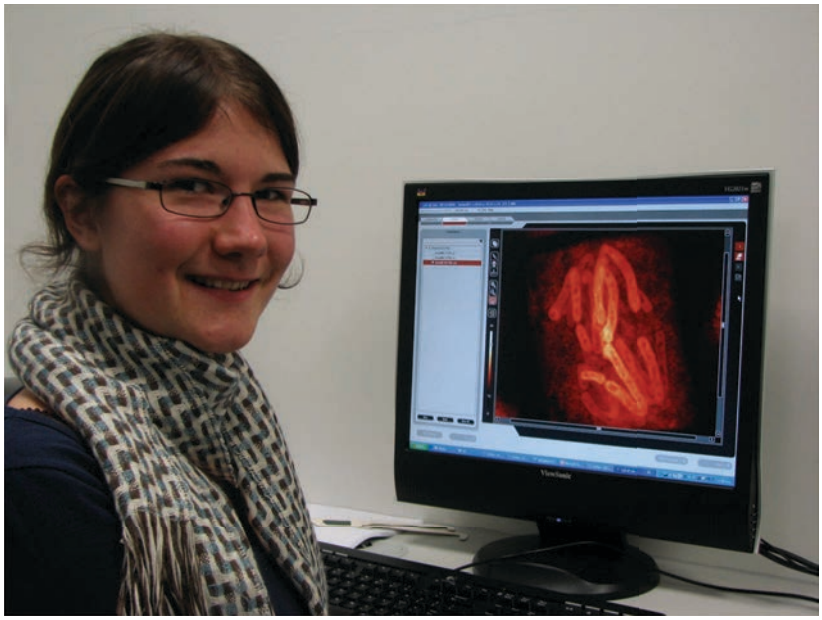
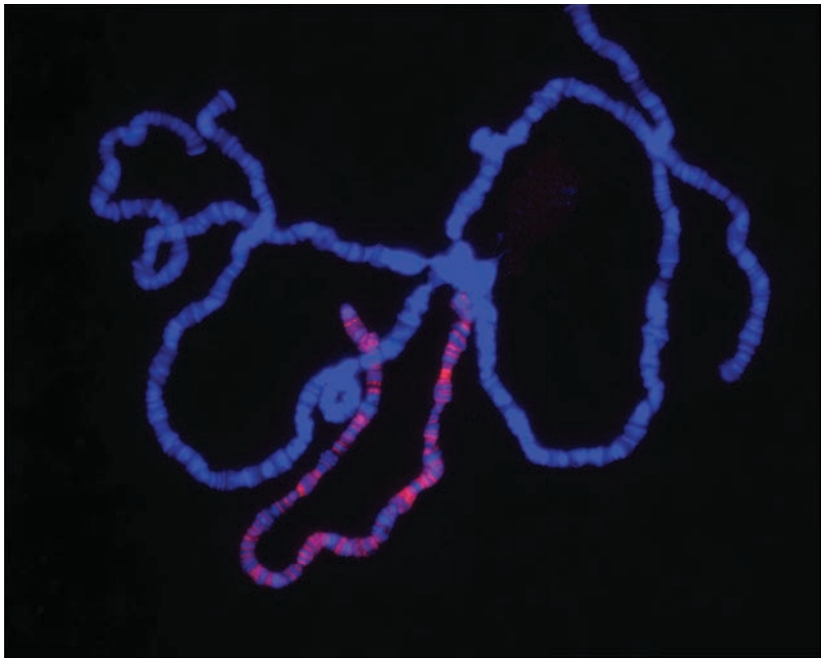
MASSEY UNIVERSITY

Bachelor of Science
Genetics

Undergraduate Handbook





Contents

WELCOME

COLLEGE OF SCIENCES
Genetics

To all prospective students,
If the 1930s was the great age of chemistry then without doubt this is the age of genetics. The development of DNA manipulation and high throughput DNA sequencing technologies have enabled researchers to determine the complete genome sequence for hundreds of organisms. We are only beginning to understand the complexity of genomes. However, geneticists now have at their disposal a powerful mix of research tools to study genes. There is much yet to be discovered!

Eric Lander, Professor of Biology at the Massachusetts Institute of Technology (MIT) said:
"That's what I love about genomics. We're learning that there are vast tracts of biology that we have missed. It's as if we suddenly could look at the whole earth and see that there are several continents we hadn't known about."

Genetics studies also include the rapidly emerging field of epigenetics, where an altered phenotype results not from a change in the DNA sequence of a gene but a change in gene expression. Modern epigenetic studies are focused on modifications to the DNA and histone proteins that have a profound impact on chromatin structure and hence gene expression. Epigenetic modifications play an important role in normal development, learning & memory and are important in some diseases such as cancer.

Massey University has a long tradition of genetics research and education. A wide range of undergraduate and postgraduate papers are available to you at Massey University. These include papers in classical transmission genetics and papers in modern molecular genetics such as DNA Technology and Gene Regulation.

The undergraduate papers offered in the Genetics major are detailed in this booklet. A B.Sc. degree majoring in Genetics will enable you to have a career in basic, biomedical and applied research, biotechnology, agriculture, horticulture, education, forensics or science administration. This degree will also enable you to embark on post-graduate studies in Genetics.

I welcome your interest in Genetics.

Associate Professor Rosie Bradshaw (PhD)
Subject Leader
Institute of Molecular BioSciences

Introduction

This handbook profiles papers that are of special interest to Genetics students, and are taught by the College of Sciences. We have made every attempt to ensure all details are correct. However, all students should note that the Massey University Calendar is the official source of information on courses and regulations.

The discipline of Genetics at Massey University consists of several academic staff members (p21). In addition, the group is well supported by several technical and administrative staff. Interests range from genomics, epigenetics, genetic control, plant protection and cell biology.

Staff in Genetics provide postgraduate opportunities with, for example, PGDipSc, Honours, Masters and PhD programmes available. Undergraduate students are eligible to apply for summer studentships that may be offered on an annual basis.

Teaching approach

Undergraduate papers are taught via lectures (usually 3 lectures per week at 100 & 200 level and 2 lectures per week at 300 level) and laboratory classes (usually one 3 hour class per week). Optional tutorials are offered at set times. Students are expected to spend some time in addition to the scheduled learning time, in reading and preparing for lectures and practical classes. Many papers are web supported. A comprehensive paper outline will be made available to enrolled students at the start of each paper.

The Bachelor of Science degree

Students have to pass 24 papers (each of 15 credits) in total to qualify for a BSc degree. Typically, eight papers have to be passed each year from papers listed in the BSc schedule in the Calendar. Students should ensure that the essential required papers for each major are included in their programme.

In planning your total degree, you can consult the 'Enrolment Science' Handbook, the Massey University Calendar, or contact Associate Professor Rosie Bradshaw (contact details p. 6).

Bachelor of Sciences – Major in Genetics

Programme Structure

Year 1	
123.101	Chemistry and Living Systems
162.101	Biology of Cells
119.155 †	Communication in Sciences
122.102	Biochemistry of Cells
161.130 †	Biometrics
PLUS three other approved papers	
* strongly recommended 123.102* 159.101 or 159.102	 Chemistry and the Material World Programming Fundamentals Computer Science Fundamentals

Year 2	
203.202	Genetic Analysis
203.203	Human Genetics
122.231	Genes and Gene Expression
162.211	Biology and Genetics of Microorganisms
PLUS four other approved papers.	
* strongly recommended 196.207* 122.232* 122.233*	 Biological Evolution Protein Biochemistry Metabolic Biochemistry
For a list of approved other papers, see p28	

Year 3	
203.300	DNA Technology
203.305	Advanced Practical Genetics
PLUS two of	
122.238	Genome Analysis
203.307	Advanced Cell Biology
203.303	Gene Regulation
PLUS four other approved papers.	
Papers with a significant genetic content include: 117.345 Genetics for Livestock Improvement 120.302 Plant Development 120.304 Plant Biotechnology 162.312 Molecular Microbiology	
For a list of approved other papers, see p28	

† or approved alternatives (See BSc regulations)

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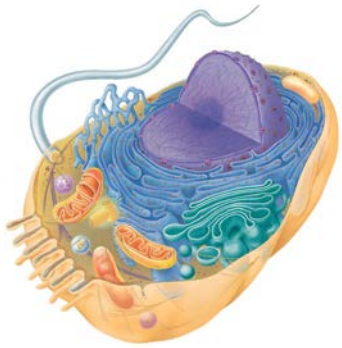
More Information

Students who intend to take papers offered in Genetics and who may wish for more information, should consult the major leader of Genetics, Associate Professor Rosie Bradshaw. Assoc Professor Kathy Kitson is the Programme Director for the College of Sciences at the Manawatu Campus and can also provide information of a more general nature.

YEAR ONE - Semester 1

162.101 Biology of Cells



Paper Co-ordinator: Assoc Professor Rosie Bradshaw

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Identify and describe cellular components and their functions.
2. Demonstrate understanding of how genetic information is inherited, used and controlled in cells.
3. Make connections between different concepts in cell biology.
4. Apply concepts of cell biology and genetics to analyse and draw conclusions from experimental data.
5. Demonstrate understand and correct use of appropriate vocabulary.
6. Design controlled experiments and interpret data.
7. Apply appropriate laboratory techniques to investigate cell biology with due regard to safety.
8. Recognise the importance of cell biology in society and the environment.

Outline: An introduction to eukaryotic and prokaryotic cell structure and function, and the chemistry of life. The flow of information within cells and transmission of genetic information to progeny in cell division. A description of cellular mechanisms for creating genetic diversity and the control of gene expression. An introduction to molecular genetics and genomics.

Pre- requisites: Students will be assumed to have studied at least 20 credits from NCEA Level 3 Biology and achieved at least 14, or passed Bursary Biology or 162.103 or an acceptable alternative.

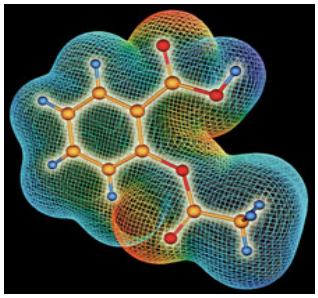
Extramural: Available extramurally in alternate years.

Assessment:

Online Assignments	10%
Laboratory Assessments	20%
Semester Test	15%
Final Examination	55%

Textbook: Campbell Biology (international version) Reece JB et al. 9thEdition Publisher: Pearson Benjamin Cummings (ISBN 9314994245622)

YEAR ONE -Semester 1



123.101 Chemistry and Living Systems

Paper Coordinator: Dr Gareth Rowlands

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Describe common organic compounds including biologically important molecules such as proteins, carbohydrates, fats and other natural products. Commercially important groups of materials such as polymers, detergents, fuels, dyes, and fragrances will also be considered.
2. Interpret the name or formula of an organic compound in terms of the functional groups present in the molecule, its stereochemistry including dynamic structure, and electronic properties. Explain and carry out the process of characterizing simple organic compounds using spectroscopic methods including NMR and IR spectroscopy.
3. Associate typical chemical reactivity with different functional groups and write equations for the reactions.
4. Be able to recognise and use some of the common mechanisms of organic reactions to explain and predict products. Write chemical equations for and analyse organic reactions in contents such as industrial processes and biological transformations.
5. Relate the concept of chemical equilibrium to reactions, including organic transformations, to analyse properties such as acidity and basicity; and apply the concept to industrial, biological and environmental processes.
6. Use the ideas of reaction kinetics to analyse reactions in terms of fundamental molecular processes and interpret the consequences for the preparation and reactions of organic materials.

Outline: This paper takes a wide range of examples from everyday life to illustrate concepts of organic and biological chemistry. The structure, properties and reactions of organic compounds, identification of organic compounds using spectroscopy, and the mechanisms of organic reactions are covered. It also introduces the concepts of chemical equilibrium, particularly as they are applied to acids and base, and chemical kinetics.

Pre-requisites: Students will be assumed to have studied at least 20 credits from NCEA Level 3 Chemistry and achieved at least 14, or passed Bursary Chemistry or 123.103 or an acceptable alternative.

Extramural: Available extramurally

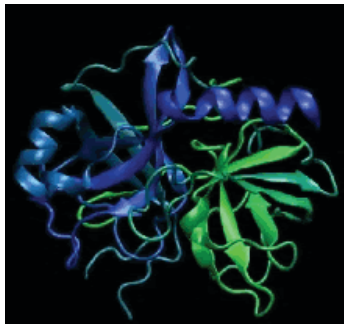
Assessment:

Laboratory Reports	20%
Mastery Tests	10%
Semester Test	20%
Final Examination	50%

Textbook: Chemistry Author: Blackman et al Publisher: Wiley, 2008

YEAR ONE - Semester 2

122.102 Biochemistry of Cells



Paper Co-ordinator: Assoc Professor Kathryn Stowell

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Understand and explain in writing the basic concepts of protein structure and how this relates to function, including the basic concepts of enzymology, such as mechanisms of catalysis and basic kinetic parameters.
2. Understand and explain in writing the basic concepts of carbohydrate structure and function, lipid structure and function, the structure and function of biological membranes and movement of molecules across membranes.
3. Demonstrate an understanding of how energy is obtained from food and utilized by living organisms, with reference to the pathways of glycolysis, the citric acid cycle, oxidative phosphorylation and gluconeogenesis, lipid and protein metabolism and basic concepts of metabolic regulation of these processes.
4. Demonstrate an understanding of the importance of ATP and proton gradients to living systems, including some aspects of muscle action and of photosynthesis.
5. Carry out some basic biochemical laboratory procedures and related biochemical calculations, including use of spectrophotometers, quantitative analysis of biological samples and measurement of enzyme activity.
6. Use a modern biochemistry textbook for reference or further learning.

Outline: A foundation course that introduces molecular aspects of the cellular processes occurring in humans, animals, microbes and plants. An exploration of the molecules of life, proteins and enzymes in action, energy for living and energy storage with applications to the environment, health and disease, biotechnology, nutrition, sport and exercise. Theoretical aspects are supported by a practical laboratory programme.

Pre-requisites: 123.101 and 162.101.

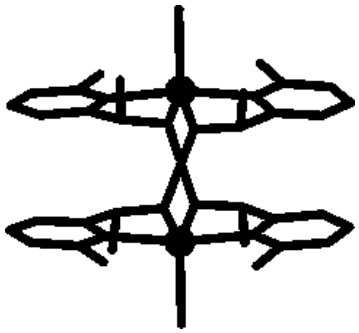
Extramural: Not available extramurally

Assessment:

Semester test	15%
Mastery Biology Assignment	5%
Lab Assignment	5%
Lab Reports	5%
Lab Theory Test	10%
Final examination	60%

Textbook: No set textbook

YEAR ONE - Semester 2



123.102 Chemistry and the Material World

Paper Co-ordinator: Dr Mark Waterland

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Discuss how chemistry and its applications impact society, and describe modern experimental techniques for chemical analysis and structure determination.
2. Explain the fundamental principles of atomic structure and their relationship to the periodic table, and the nature of covalent bonding.
3. Explain the colour, magnetism and chemical properties including catalysis, of compounds containing transition metals in terms of the structures of transition metal complexes.
4. Analyse chemical reactions by calculating the amount of energy released and the extent of energy dispersal and demonstrate that spontaneous chemical reactions always occur with an increase in the total extent of energy dispersal.
5. Use the concepts of non-covalent interactions to explain the properties of matter including gases and liquids and phenomena such as self-assembly.
6. Calculate the electrochemical potential of cells using the IUPAC convention and the Nernst equation, predict spontaneity of chemical processes and apply the concepts to electrolytic processes.
7. Demonstrate proficiency with basic practical techniques in the chemistry laboratory, and be familiar with the structures and names of the elements, and simple complexes, cations and anions.

Outline: This paper begins with a discussion of the impact of chemistry and its applications on modern society. Within this context, students will learn of the central role of energy dispersal in chemical and electrochemical transformations. Atomic structure will be related to the properties of elements and fundamental bonding theories will be used to rationalise molecular structures. Transition metal chemistry will be used to illustrate these concepts. Students will learn of the importance of intermolecular forces in determining the properties of matter.

Pre-requisites: NCEA Level 3 Chemistry, studied 20 credits achieved 14 credits minimum, or Bursary Chemistry, or 123.103.

Extramural: Available extramurally

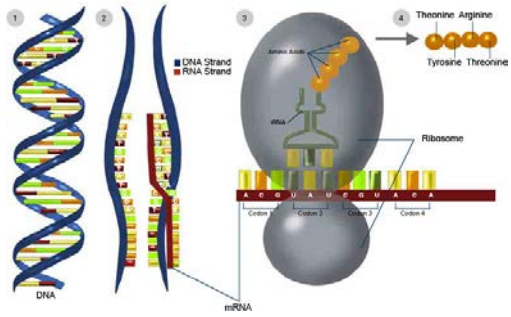
Assessment:

Mastery tests	10%
Semester test	20%
Laboratory test	10%
Laboratory work	10%
Final examination	50%

Textbook: Highly Recommended: Chemistry Author: Allan Blackman ISBN: 9 78047081 Edition: 1st Edition (2008) Publisher: John Wiley & Sons Australia

YEAR TWO - Semester 1

122.231 Genes and Gene Expression



Paper Co-ordinator: Assoc Prof Kathryn Stowell

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Demonstrate a detailed understanding of the main components of DNA structure at the molecular and macromolecular level.
2. Demonstrate a detailed understanding of the major molecular mechanisms involved in DNA replication, transcription and regulation of gene expression in E.coli.
3. Understand and explain the basic tools and techniques required to carry out in vitro manipulation of recombinant DNA and associated techniques, including the preparation and use of both genomic and cDNA libraries.
4. Design basic experimental strategies to construct recombinant plasmids.
5. Carry out basic experimental techniques central to the manipulation of recombinant DNA, eg: plasmid DNA preparation, restriction endonuclease digestion, agarose gel electrophoresis, bacterial transformation and the polymerase chain reaction.
6. Competently carry out numerical calculations required for general laboratory work required for biochemistry and molecular biology.

Outline: Structure of DNA. Replication, DNA repair and transcription. Regulation of prokaryote gene expression. Technologies used in the study of genes and gene expression: plasmids, sequencing, restriction enzymes, libraries, PCR, Southern, northern and western analysis, expression vectors and the production of recombinant proteins. A practical course that illustrates concepts presented in the lectures.

Pre-requisites: 162.101 Biology of Cells

Extramural: Not available extramurally.

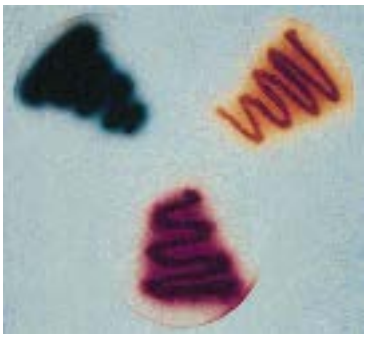
Assessment:

Laboratory exercises	2.5%
Laboratory Report	5%
Numeracy Test	2.5%
Lab Theory Test	20%
Semester test	10%
Final examination	60%

Textbook: Molecular Biology Author: Weaver Edition: 4th

YEAR TWO - Semester 1

162.211 Biology and Genetics of Microorganisms



Paper Co-ordinator: Dr Jan Schmid

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Be familiar with fundamental aspects of the biology of the major groups of microorganisms, including their structure, physiology, metabolism and genetics.
2. Recognise the importance of microbes in human affairs, that they are essential parts of all local and global ecosystems, and indispensable for sustaining life on earth.
3. Recognise the importance of microbes for all disciplines of biological research.
4. Be able to apply theoretical knowledge on how microbes function and technical skills taught to successfully carry out basic manipulations of microorganisms as required within biological sciences and related disciplines.
5. Describe key immunological techniques.
6. Describe career paths open to microbiology graduates.

Outline: Structure and metabolism of bacteria and their relationship to the environment. Bacterial genetics. Eukaryotic microbes – structure, physiology and genetics. Life cycle of viruses. The immune response. Practical training in the manipulation of microorganisms.

Pre-requisites: 162.101

Extramural: Not available extramurally.

Assessment:

Semester Test	19%
Lab Exercise Assessment	18%
Career Exercise	2%
Final Examination	61%

Textbook: Biology of Microorganisms - Author: Madigan, M.T., Martinko, J.M, Dunlap, P.V. & Clark, D.P Edition: 13th Publisher: Prentice-Hall (Notes: Earlier editions are adequate for most of the material covered)

YEAR TWO - Semester 1

203.203 Human Genetics

Paper Co-ordinator: Dr Neville Honey

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Understand genetic principles.
2. Understand the role of genetics in human biology.
3. Communicate his/her understanding of human genetics.

Outline: Aspects of genetics that are important in human biology. Topics include chromosome abnormalities, genes and genetic disease, immunogenetics, cancer, ageing, complex traits, family studies and populations.

Pre-requisites: 162.101

Extramural: Available extramurally, alternate years.

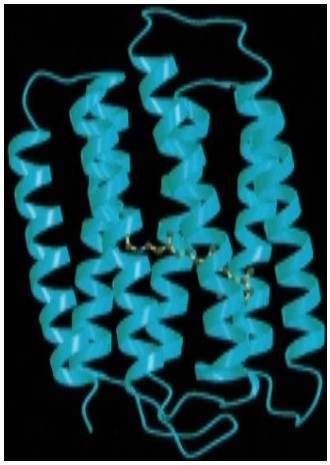
Assessment:

Semester test	15%
Online test	15%
Poster	15%
Final Examination	55%

Textbook: Human Genetics: Concepts and Applications Author: Lewis, R. Edition: 9th Publisher: McGraw Hill (Notes: 8th or 9th edition is acceptable)

YEAR TWO - Semester 2

122.232 Protein Biochemistry



Paper Co-ordinator: Dr Gill Norris

Learning Outcomes: Students who successfully complete this paper will be able to:

1. How proteins are synthesized in the cell then transported to their different destinations in the cell to carry out their various roles and the role of post-translational modifications in targeting and tuning function.
2. Basic enzyme kinetics.
3. The relationship of protein functions to both primary and tertiary structure.
4. The properties of and models for the organization of cell and organelle membranes and the proteins within those membranes. The effect of detergents on membrane components; the transport of molecules through membranes.
5. The structure and function of some membrane proteins, including ion channels and receptors.
6. The techniques required to carry out basic biochemical experiments. How to interpret experimental data and write up the results in report format.

Outline: How proteins are synthesised in the cell and directed to carry out their various roles. Topics will include protein biogenesis, targeting and post-translational modification, the relationship between protein structure and function, catalytic proteins, structural proteins, membranes and membrane proteins. Lectures will be complemented with a practical course focused on developing skills to investigate proteins.

Pre-requisites: 122.102 Biochemistry of Cells

Extramural: Not available extramurally.

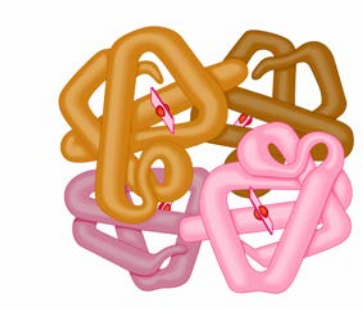
Assessment:

Practical work	5%
Reports	15%
Mid Semester Test	20%
Final Examination	60%

Textbook: Biochemistry Author: D. Voet and J.G. Voet ISBN: 0471250899 (v. 2) 0471250 Edition: 3rd Edition Publisher: New York ; Chichester : Wiley, 2003

YEAR TWO - Semester 2

122.233 Metabolic Biochemistry



Paper Co-ordinator: Dr Jeong Park

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Have a basic understanding of the dynamic aspects of cellular processes and of the integration of bio-chemical processes within cells (including an understanding of cellular communication and metabolism).
2. Be adequately prepared to undertake an advanced course in practical biochemistry.

Outline: Energy metabolism. Biosynthesis of carbohydrates and the metabolism of polysaccharides. Lipid metabolism. Nitrogen metabolism. Integration and regulation of carbohydrate, lipid and amino acid metabolism. Cellular communication systems.

Pre-requisites: 122.102 Biochemistry of Cells

Extramural: Not available extramurally.

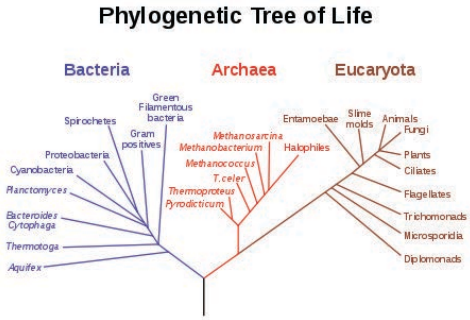
Assessment:

Laboratory reports/assignments	20%
Semester Test	20%
Final Examination	60%

Textbook: Textbook of Biochemistry with Clinical Correlations Author: Devlin ISBN: 9780470281734 Edition: 7th Publisher: John Wiley & Sons

YEAR TWO - Semester 2

196.207 Biological Evolution



Paper Co-ordinator: Assoc Professor Steven Trewick

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Explain the geological, biological, phylogenetic and rational evidence for evolution.
2. Express the concepts and implications of natural selection as a mechanism in evolution and describe examples.
3. Understand the basis of evolutionary genetics of populations and the genetic processes that underlie speciation.
4. Synthesise information learnt throughout the course and effectively integrate evolutionary theory across the life sciences.
5. Understand and interpret the patterns that underlie phylogenies (trees), and their use in testing evolutionary ideas.
6. Think in an innovative way, understand and apply the scientific method of hypothesis formulation and testing.

Outline: A general review of modern evolutionary biology and evolutionary theories, encompassing micro- and macro-evolution. The paper centres on genetic and environmental processes that operate in natural populations and among species. It explores the history and development of evolutionary thinking, the origins and age of life on earth, and prehistoric biodiversity. Other topics include evolutionary changes in DNA, human evolution, origin of life, the nature of species and how species arise. Laboratory classes include a range of theoretical, practical and computing exercises in population genetics, phylogenetics and data management.

Pre-requisites: A basic understanding of cell biology and genetics (162.101 Biology of Cells)

Extramural: Available extramurally.

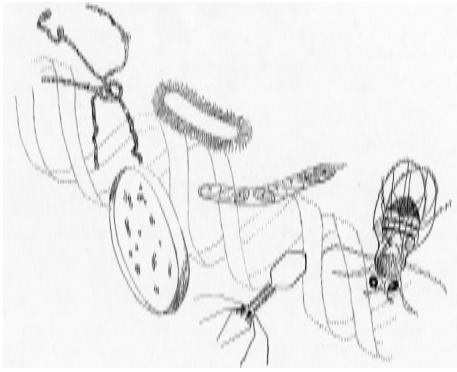
Assessment:

Written Report	20%
Laboratory Practicals	15%
Semester Test	20%
Final Examination	45%

Textbook: Biology Author: Campbell and Reece Edition: 9th or recent

YEAR TWO - Semester 2

203.202 Genetic Analysis



Paper Co-ordinator: Dr Neville Honey

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Understand the importance and role of genetics in living organisms.
2. Understand genetic principles.
3. Perform methods of genetic analysis.
4. Understand the role of genetics in populations and evolution.
5. Perform basic laboratory techniques and analyse the results.

Outline: A general course on methods and applications of genetic analysis. Topics include genetic variation, cytogenetics, gene inheritance, gene mapping, gene function, quantitative genetics, population genetics and evolution, cell and developmental biology.

Pre-requisites: 162.101 Biology of Cells

Extramural: Not available extramurally.

Assessment:

Practical Reports	8%
Prac Theory test	15%
Semester Test	15%
Online tests	5%
Final Examination	57%

Textbook: Concepts of Genetics Author: Klug et al (2012) Edition: 10th edition Publisher: Pearson International Edition.

YEAR THREE – Semester 1

120.304 Plant Biotechnology

Paper Co-ordinator: Dr Paul Dijkwel

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Describe some classical and modern methods for plant improvement through tissue culture and modern biotechnological methods.
2. Discuss ethical issues surrounding the use of genetically modified plants in New Zealand.
3. Show an understanding of practical steps to genetically modify one plant species and to assay the GFP reporter gene in transgenic plants using confocal microscopy.
4. Show an understanding of some practical steps to identify new traits for plant improvement.

Outline: An overview of modern methods by which plants can be modified to provide new genetic material for use in agriculture, horticulture, forestry and industry. This paper links basic and applied science and focuses on the dramatic progress being made in plant tissue culture, recombinant DNA technology, QTL analysis and marker-assisted selection. Emphasis is on both prospects and limitations, and includes discussion of environmental, ethical and regulatory issues

Pre-requisites: 120.101 Biology of Plants
122.231 Genes and Gene Expression

Extramural: Not available extramurally

Assessment:

Research paper analysis	10%
Laboratory record	20%
Mid Semester Test	10%
Final Examination	60%

Textbook: No set textbook

YEAR THREE – Semester 1

203.300 DNA Technology

Paper Co-ordinator: Dr Jasna Rakonjac

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Describe the biology that underlies DNA technology.
2. Describe the ways in which this underlying biology is manipulated in DNA technology.
3. Identify and describe the questions that can be addressed using DNA technology.
4. Demonstrate use of advanced skills in experimental molecular biology and DNA technology and explain the theoretical basis of these techniques.
5. Critically analyze, accurately observe and interpret experimental data from laboratory work and from the scientific literature.

Outline: DNA structure, topology and recombination. The contributions of bacteriophage to DNA technology. Advanced applications of gene cloning, PCR, microarrays and gene targeting. Practical experience will be gained with DNA quantification, molecular cloning, PCR, DNA sequencing, computer analysis and expression of heterologous genes.

Pre-requisites: 122.231 Genes and Gene expression

Extramural: Not available extramurally

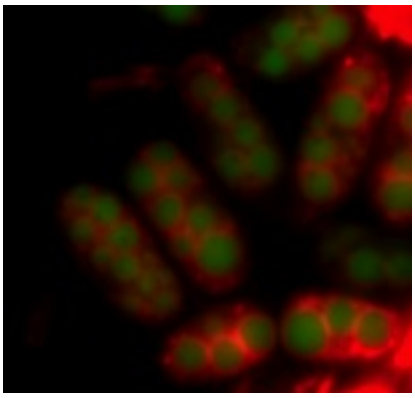
Assessment:

Laboratory notebook	5%
Assignment	10%
Laboratory test	15%
Semester Test	10%
Final Examination	60%

Textbook: Molecular Biology _ Author: Weaver, R.F. ISBN: 0071316868 5th edition Publisher: McGraw-Hill

YEAR THREE – Semester 1

203.307 Advanced Cell Biology



Paper Co-ordinator: Dr Tracy Hale

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Have acquired advanced skills in experimental cell biology and understand the theoretical basis of these techniques.
2. Describe the function and biogenesis of organelles.
3. Describe the organisation of the nucleus.
4. Describe how the cell cycle is controlled.
5. Describe the assembly, organisation and roles of the cytoskeleton.
6. Describe the roles of signal transduction pathways in relaying signals from the extracellular environment to the nucleus and their contribution to cancer.
7. Describe how cell lineages arise and are regulated.

Outline: A paper with a strong emphasis on the structure and function of cell components and the interactions between cells. Topics covered include chromosome structure and function, cell cycle, signal transduction, cytoskeleton and molecular motors, extracellular matrix, cell motility stem cells, cell death and cancer. The practical component has a strong emphasis on biochemical, genetic and microscopic methods that are used to study cells.

Pre-requisites: 162.101 Biology of Cells,
122.231 Genes and Gene Expression.

Extramural: Not available extramurally.

Assessment:

Chromosome lab test	10%
Reports (3)	15%
Semester Test	20%
Final Examination	55%

Textbook: Molecular Cell Biology Author: Lodish et al. Edition: 6th edition Publisher: WH Freeman and Co.
Molecular Biology of the Cell Author: Alberts et al. Edition: 5th, 2007 Publisher: Garland Publications

YEAR THREE – Semester 2

117.345 Genetics for Livestock Improvement

Paper Co-ordinator: Dr Rebecca Hickson

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Apply Mendel's principles of inheritance and discuss the importance of these and their exceptions in breeding programmes, particularly with respect to lethal and detrimental genes and changing gene frequencies.
2. Apply complex principles of inheritance to breeding schemes, including heritability, genetic variation, breeding values and selection indices as well as identify the impact of reproductive technologies on genetic gain.
3. Predict an animal's breeding values based on own, pedigree or progeny records.
4. Be familiar with the structure of the main livestock industries and identify the strengths and weaknesses of the structures with respect to genetic gain.
5. Calculate and interpret genetic relationships, inbreeding, crossbreeding, mating plans and maternal effects.

Outline: The relative influence of genetic and environmental factors on quantitative traits. Methods of calculating breeding values or indices to exploit genetic variation in quantitative traits. The use of computers to utilise pedigree and performance records. Selection for disease resistance, the use of new reproductive technologies to enhance genetic gain and the potential importance of molecular genetics in livestock improvement. Maternal influences and methods of selecting for maternal components. Crossbreeding and inbreeding as selection tools.

Pre-requisites: 117.254 Principles of Animal Production or 203.202 Genetic Analysis

Extramural: Available extramurally alternate years

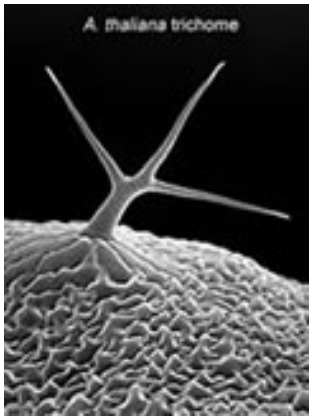
Assessment:

Assignment 1	10%
Assignment 2	20%
Assignment 3	20%
Final Examination	50%

Textbook: None

YEAR THREE – Semester 2

120.302 Plant Development



Paper Co-ordinator: Dr Vaughan Symonds

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Be familiar with various levels of plant organisation.
2. Understand basic patterns of morphogenesis and histogenesis in plants, including those associated with embryogenesis and organogenesis at the root and shoot apical meristems.
3. Understand how molecular, genetic and developmental methods of analysis can be applied to address specific problems in plant development.
4. Be able to critically assess the current literature in plant developmental biology.

Outline: Diverse patterns of plant development that were initially described from cytological and morphological perspectives are beginning to be understood at a mechanistic level through the use of molecular and genetic techniques. This paper provides an introduction to classic literature pertaining to different aspects of plant development and integrates it with more recent molecular genetic studies. The role of plant hormones and other signalling molecules in plant developed is also covered.

Pre-requisites: 120.101 Plant Biology, plus any two approved papers at 200 level 120.217 is recommended.

Extramural: Not available extramurally.

Assessment:

Writing assignment	10%
Laboratory notebook	5%
Laboratory interview	5%
Research Report	10%
Semester Test	20%
Final Examination	50%

Textbook: No set textbook

YEAR THREE – Semester 2

122.328 Genome Analysis

Paper Co-ordinator: Dr Claudia Voelckel

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Explain the strategies involved in whole genome sequencing, gene annotation and data analysis.
2. Use appropriate bioinformatic tools to search and interpret DNA and protein sequence databases to identify sequences relevant to biological functions.
3. Design strategies to investigate genotype and phenotype based on whole genome analyses.
4. Interrogate protein structure databases and interpret the data in terms of the relationships between primary sequence and tertiary structure and function.
5. Interpret nucleotide and protein sequence data to determine evolutionary relationships between organisms.
6. Explain the principles of transcriptomic, proteomic, metabolomic, epigenomic and metagenomic analyses and their relationship to systems biology.

Outline: An interactive and self-directed learning approach will be used to explore the analysis of genomes, transcriptomes, proteomes and metabolomes. The emphasis will be on understanding and applying a range of methodologies involved in extracting biologically significant information from both existing and novel data sets.

Pre-requisites: 203.300 DNA Technology

Extramural: Not available extramurally.

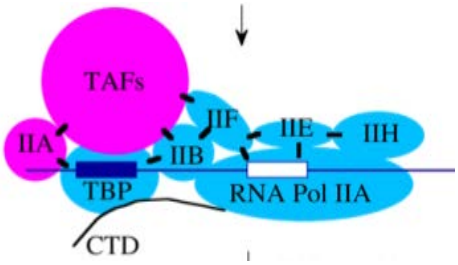
Assessment:

Weekly computer exercises	40%
Assignment (whole genome analysis)	20%
Assignment (functional genomics)	20%
Assignment (elective)	20%

Textbook: No set textbook

YEAR THREE – Semester 2

203.303 Gene Regulation



Paper Co-ordinator: Assoc Prof Kathryn Stowell

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Demonstrate an understanding of the experimental approaches used to identify the DNA sequences that control gene expression and the proteins that interact with these sequences.
2. Demonstrate an understanding of the transcription apparatus in eukaryotes and a global switch in gene expression in prokaryotes.
3. Describe and critically discuss the role of chromatin structure in gene regulation.
4. Explain the molecular mechanisms of RNA splicing and the regulation of splicing as a means of altering gene expression, with an emphasis on discussion of the experimental work used to develop the associated models.
5. Demonstrate an understanding, in the context of experimental evidence, of the regulation of globin gene/gene expression in mammals, sex determination in Drosophila and iron homeostasis in mammals.
6. Demonstrate an understanding of the biogenesis, in vivo and in vitro uses of siRNA and miRNA.

Outline: An advanced course on gene regulation. Topics include methods and experimental strategies for studying gene promoters and associated transcription factors, transcription initiation, transcription activation, role of chromatin structure in gene regulation, RNA processing and cytoplasmic control.

Pre-requisites: 203.300 DNA Technology

Extramural: Not available extramurally.

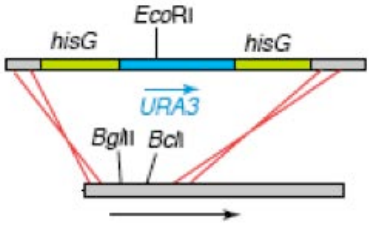
Assessment:

Problem sheets (2)	10% each
Oral presentation	10%
Semester Test	10%
Final Examination	60%

Textbook: Molecular Biology. Weaver. 4th edition, McGraw-Hill, New York

YEAR THREE – Semester 2

162.312 Molecular Microbiology



Paper Co-ordinator: Dr Jan Schmid

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Explain biochemically and genetically the targeting of proteins in bacterial cells.
2. Discuss screening methods for virulence factors.
3. Discuss the detailed molecular organization, function, and genetic basis, for surface proteins of eubacteria.
4. Illustrate how environmental changes affect expression of selected virulence determinants in pathogenic bacteria.
5. Explain the molecular basis of antigenic variation in bacteria.
6. Understand the life cycle of the HIV virus and its pathogenesis.
7. Demonstrate knowledge of molecular approaches to studying microbial ecology of the gastro-intestinal tract.
8. Understand the cross-talk between microbes and the immune system within the gastro-intestinal tract.
9. Demonstrate knowledge of modern research techniques for investigating the biology of pathogenic fungi.
10. Independently design approaches to a problem in microbiological research, to carry out the research, and to evaluate its results.

Outline: Major themes in modern microbiology. Molecular analysis of structure, function and export of bacterial surface proteins. Response to environmental change. Molecular typing and population dynamics in pathogens. Developmental signals and differentiation in micro-organisms. Students will have the opportunity to design, implement and evaluate molecular approaches to a problem in microbiology.

Pre-requisites: 162.211, 203.300

Extramural: Not available extramurally.

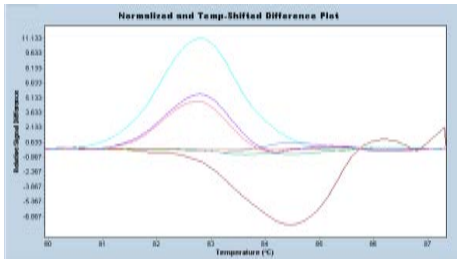
Assessment:

Semester Test	10%
In-lecture questions	8%
Laboratory Assessment	22%
Final Examination	60%

Textbook: No set textbook

YEAR THREE – Semester 2

203.305 Advanced Practical Genetics



Paper Co-ordinator: Prof Barry Scott

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Carry out experiments in advanced practical genetics, understand the theory behind those experiments and be familiar with their applications.
2. Analyse and evaluate experimental data from laboratory work and from the literature, and to communicate, by written reports and oral presentations, summaries of experimental findings.
3. Read, comprehend, describe and make oral presentations on Genetics topics described in textbooks, reviews and the primary literature.
4. Prepare and present a research proposal that is designed to test a specific hypothesis.
5. Explain their experimental data based on detailed records kept in their notebook.
6. To write paper critiques, laboratory reports and research proposals.

Outline: An advanced course in laboratory techniques used in Genetics. Emphasis is on understanding the theory behind the methods used, on data evaluation and on the application of genetic techniques to various questions in biology. Practicals include microarray analysis, transposon tagging, human microsatellite and SNP analysis and reporter gene expression.

Pre-requisites: 203.202 Genetic Analysis
203.300 DNA Technology

Extramural: Not available extramurally.

Assessment:

Questions sheets (4)	10%
Oral presentation	10%
Lab notebook write-up	10%
Lab interview	10%
Research proposal-oral	4%
Research proposal-written	16%
Final Examination	40%

Textbook: No specified texts for this paper

YEAR THREE – Semester 1, 2 and Summer School

247.300 Research in Biosciences

Paper Co-ordinator: Dr Vaughan Symonds

Learning Outcomes: Students who successfully complete this paper will be able to:

1. Gain practical research experience in biological sciences.
2. Understand how to plan and implement a research project.
3. Become familiar with data interpretation, analysis and presentation.
4. Become a self-sufficient laboratory worker.
5. Become familiar with a wide range of biological science techniques, projects, and literature.

Outline: The paper provides an opportunity for third year undergraduate students in the biological sciences to gain research experience in an academic laboratory. Under supervision of faculty students will develop a short research proposal, carry out the proposed research, write a research report, and present their findings.

Pre-requisites: Permission of Programme Director (A- average required for this paper)

Extramural: Not Available extramurally.

Assessment:

Mini-research proposal	20%
Research activities	20%
Oral report	10%
Research Report	50%

Textbook: No set textbook

BSc Genetics

YEAR ONE

S1: 123.101
Chemistry & Living Systems

S1: 162.101
Biology of Cells

S1: 119.155
Communications in Sciences

S2: 122.102
Biochemistry of Cells

S2: 161.130
Biometrics

Examples of elective papers in Sem 1 and 2:

S1: 159.101
Programming Fundamentals

S1: 199.101
Biology of Animals

S2: 120.101
Biology of Plants

S2: 123.102
Chemistry & the Material World

S2: 159.102
Computer Science Fundamentals

YEAR TWO

S1: 122.231
Genes and Gene Expression

S1: 162.211
Biology and Genetics of Microorganisms

S1: 203.203
Human Genetics

S2: 203.202
Genetic Analysis

Examples of elective papers in Sem 1 and 2:

S2: 122.232
Protein Biochemistry

S2: 122.233
Metabolic Biochemistry

S2: 196.207
Biological Evolution

YEAR THREE

S1: 203.300
DNA Technology

S2: 203.305
Advanced Practical Genetics

PLUS two of:

S1: 203.307
Advanced Cell Biology

S2: 203.303
Gene Regulation

S2: 122.328
Genome Analysis

Examples of elective papers in Sem 1 and 2:

S1: 120.304
Plant Biotechnology

S1: 162.303
Immunology

S2: 117.345
Genetics for Livestock Improvement

S2: 120.302
Plant Development

S2: 122.327
Advanced Biochemistry

S2: 162.312
Molecular Microbiology

For a complete list of approved papers for all years, see p33,

For a complete list of approved papers for all years, see p33,

Research

The Institute of Molecular BioSciences at Massey University (Manawatu) in Palmerston North has active research programmes carried out by staff and postgraduate students. Here we list only the main areas of interest of academic staff. Students should be aware that summer studentships are available and will be advertised in October/November each year. Check on the Massey website: http://imbs.massey.ac.nz/Teaching/Summer_Fellowships.htm

Research Interests of Academic Staff in Genetics

Barry Scott	Gene regulation and expression in plant-microbe interactions
Rosie Bradshaw	Fungal molecular genetics and genomics
Kathryn Stowell	Biochemistry, genetics and pathophysiology of human disorders
Peter Lockhart	Molecular Evolution in Plants
Vaughan Symonds	Plant Molecular Genetics
Jennifer Tate	Plant Systematics and Evolution
Neville Honey	Genetics Education
Tracy Hale	Cell Biology
Paul Dijkwel	Regulation of Leaf Senescence

General Information

Student Services

Student Services at Massey University Manawatu provide support to particularly first-year students to successfully integrate into university life and academic study. Check the website to find more out about their role: http://students.massey.ac.nz/

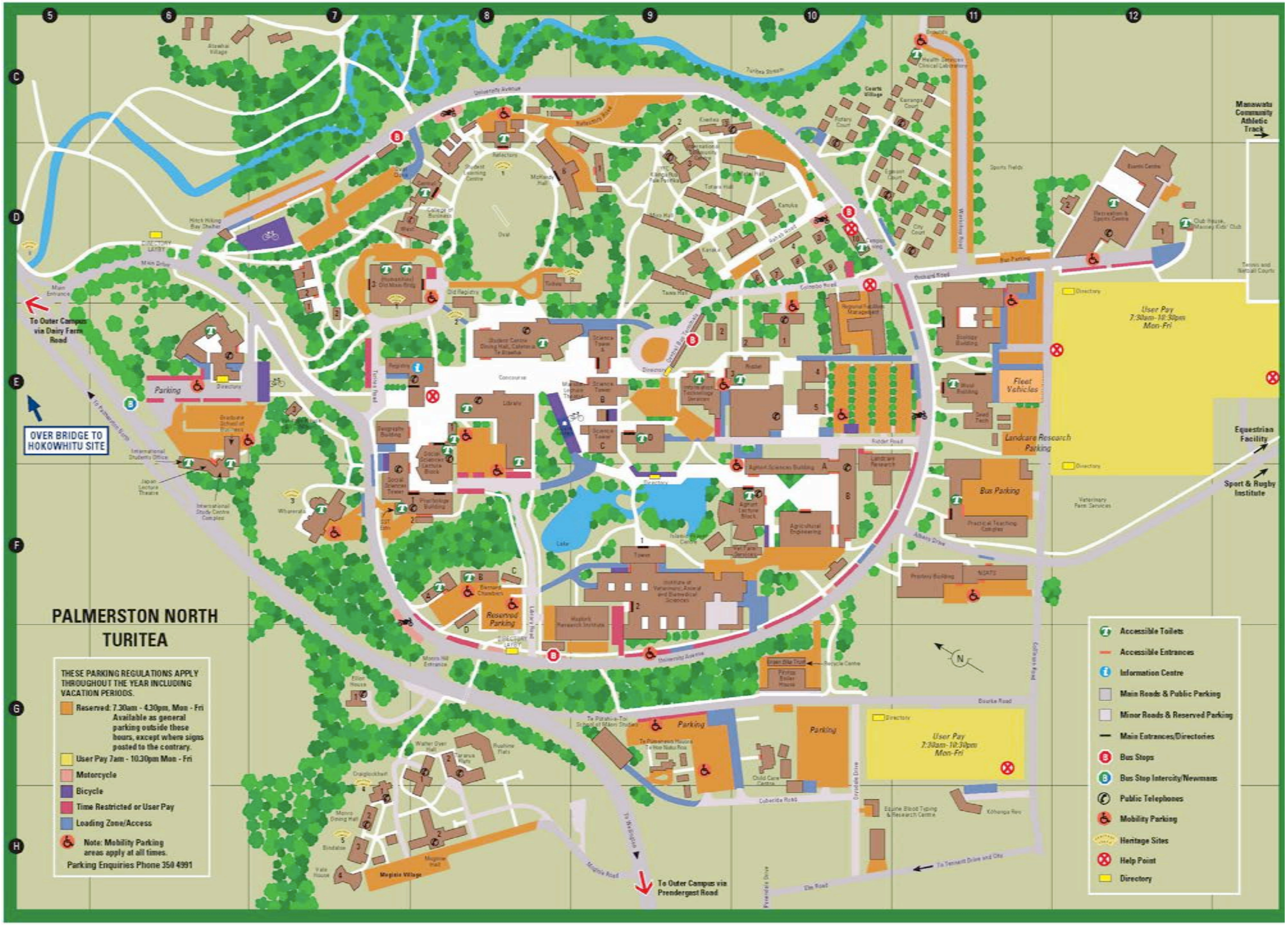
Student Learning Centre

The Student learning Centre offers a whole range of support classes for undergraduate, postgraduate, internal, extramural or international students. For details, please see: http://learning.massey.ac.nz/. Students with poor English language skills are advised to include 192.102 (Academic writing for speakers of other languages) in to their degree programme.

Extramural Study

At present it is not possible for students to complete an extramural BSc with a major in Biological Sciences. However, some papers of relevance to Biological Sciences students are offered from time to time. For details, check the 'Enrolment Science' Handbook.

Notes


PALMERSTON NORTH
TURITEA
THESE PARKING REGULATIONS APPLY THROUGHOUT THE YEAR INCLUDING VACATION PERIODS.
Reserved: 7.30am - 4.30pm, Mon - Fri Available as general parking outside these hours, except where signs posted to the contrary.
User Pay 7am - 10.30pm Mon - Fri
Motorcycle
Bicycle
Time Restricted or User Pay
Loading Zone/Access
Note: Mobility Parking areas apply at all times.
Parking Enquiries Phone 350 4991
Accessible Toilets
Accessible Entrances
Information Centre
Main Roads & Public Parking
Minor Roads & Reserved Parking
Main Entrances/Directories
Bus Stops
Bus Stop Intercity/Newmans
Public Telephones
Mobility Parking
Heritage Sites
Help Point
Directory
OVER BRIDGE TO HOKOWHITU SITE
To Outer Campus via Dairy Farm Road
To Outer Campus via Prendergast Road
User Pay 7:30am - 10:30pm Mon - Fri
Fleet Vehicles
Landcare Research Parking
Bus Parking
Reserved Parking
Parking
Equestrian Facility
Sport & Rugby Institute
Manawatu Community Athletic Track
Concourse
Library
Oval
Lake
Main Drive
University Avenue
Orchard Road
Bourke Road
Collinson Road

To find information about the BSc programme, majoring requirements for Genetics and papers offered, the following information is provided on the Massey University website:

Bachelor of Science (BSc)

Bachelor of Science (Genetics)

Entry Requirements

All students must have a university entrance qualification. Students beginning their study of Genetics should have a sound background in Chemistry and Biology at NCEA Level 3.

However, if you do not have a background of chemistry at the Year 13 level then you can take 123.103 Introductory Chemistry extramurally through Massey University over the summer before your first year of full-time study. This paper will introduce you to basic chemical vocabulary and provides training in the important chemical principles. You do need to already have a university entrance qualification or to expect to obtain one by sitting NCEA Level 3 at the end of this year. If you are interested in this suggestion get in touch with one of the College of Sciences contact people. Similarly, if you have not done NCEA Level 3 Biology you can take 162.103 Introductory Biology over the summer.

In their first year, students intending to major in Genetics should take 123.101 and 162.101 in Semester One and 122.102 in Semester Two. In addition they are strongly recommended to take Biometrics (161.130), and a second paper in Chemistry (123.102) in Semester Two.

For general entry requirements see Massey University entry requirements.

Bachelor of Science (Genetics) Structure

The Genetics programme at Massey University is the most comprehensive on offer at a New Zealand university, covering molecular, developmental, population, quantitative and evolutionary genetics. Graduates in Genetics will have a working knowledge of all these aspects of Genetics yet have the opportunity to specialise in an area of particular interest such as molecular genetics, cytogenetics or genomics. Massey University graduates will also be familiar with the bioethical issues that confront genetics and have a working knowledge of the regulations and codes of practice under which research in genetics is carried out. They are expected to have acquired good analytical skills and to be good communicators of their subject. In a rapidly moving field such as genetics the emphasis is on preparation for the future rather than skills for the present.

Majoring Requirements

123.101 Chemistry and Living Systems,
122.102 Biochemistry of Cells,
162.101 Biology of Cells,
122.231 Genes and Gene Expression,
162.211 Biology and Genetics of Micro-organisms
203.202 Genetic Analysis

203.203 Human Genetics
203.300 DNA Technology
203.305 Advanced Practical Genetics
Plus two of
122.328 Genome Analysis
203.303 Gene Regulation
203.307 Advanced Cell Biology

Papers

162.103 Introductory Biology
162.101 Biology of Cells
123.101 Chemistry and Living Systems
122.102 Biochemistry of Cells
162.211 Biology and Genetics of Microorganisms
203.202 Genetic Analysis
203.203 Human Genetics
122.231 Genes and Gene Expression
122.232 Protein Biochemistry
196.207 Biological Evolution
122.328 Genome Analysis
203.300 DNA Technology
203.303 Gene Regulation
203.305 Advanced Practical Genetics
203.307 Advanced Cell Biology
122.322 Protein Structure and Function
117.345 Genetics for Livestock Improvement
120.302 Plant Development
120.304 Plant Biotechnology
162.312 Molecular Microbiology
247.300 Research in Biosciences