MASSEY UNIVERSITY

Bachelor of Science
Microbiology

Undergraduate Handbook

Contents

WELCOME

COLLEGE OF SCIENCES
Microbiology

To all prospective students,

This is an exciting time to be a microbiology student. The world around us is rapidly changing. The new technologies for working with microorganisms have a major influence on how our society is changing and developing. It is important for you to learn about these technologies and the theories that underpin them so that you can play an important role in affecting a process of change in both scientific understanding and human perceptions and attitudes.

Microbiologists want to know how biological processes of microorganisms function and how they are controlled at the molecular and cellular level. This basic knowledge is critical for understanding life itself.

I am pleased to welcome you to Massey University. It is up to you to make the most of the many opportunities that we offer. A wide range of undergraduate and postgraduate papers are available to you at Massey University. The undergraduate papers offered in the Microbiology major are detailed in this booklet. They underpin a wide range of disciplines, from plant and animal physiology, biological chemistry, molecular biology, genetics, health science, human and animal nutrition, to pure microbiology itself.

A degree in Microbiology will enable you to have a career in research, teaching or the many biology-based industries as diverse as forensic science, molecular diagnostics, and biotechnology. This degree will also enable you to embark on post-graduate studies.

I welcome your interest in Microbiology and I hope that you will find your studies with the Massey University staff interesting, useful and enjoyable.

Professor Bernd Rehm
Subject Leader
Institute of Molecular BioSciences

Introduction

This handbook profiles papers that are of special interest to Microbiology 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 Microbiology at Massey University consists of academic and technical staff members across several Institutes in the College of Sciences. Interests range from basic, applied and medical microbiology, implementing studies on gene function, enzymology, molecular genetics, molecular biology, pathogenicity, biofilms, biotechnology and evolution.

Staff in Microbiology 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.

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Teaching approach

Undergraduate papers are taught via lectures (usually 3 lectures per week) 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 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.

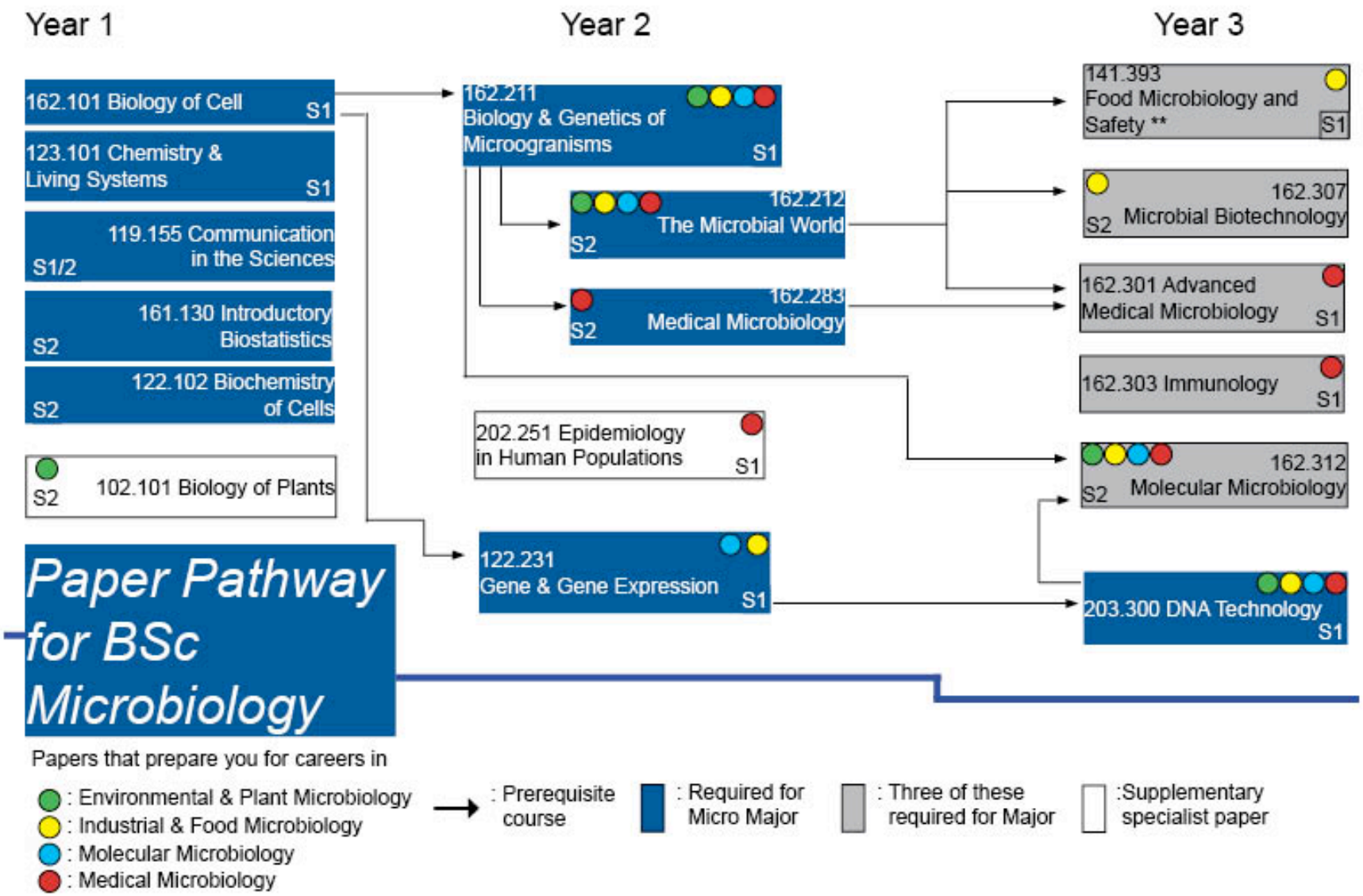
The Bachelor of Science degree

Students have to pass 24 (15 credit) papers 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.

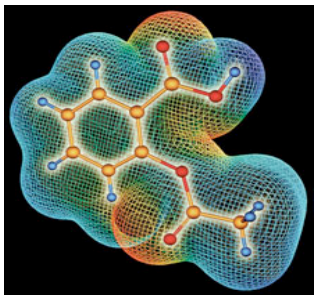
In planning your total degree, you can consult the 'Enrolment Science' Handbook, the Massey University Calendar, or contact Prof. Bernd Rehm (contact details p. 5).

More Information

Students who intend to take papers offered in Microbiology and who may wish for more information, should consult the major leader of Microbiology, Prof Bernd Rehm. Assoc Professor Kathy Kitson is the Programme Director for the College of Sciences at the Palmerston North Campus and will also provide information of a more general nature.


Year 1
Year 2
Year 3
162.101 Biology of Cell S1
123.101 Chemistry & Living Systems S1
119.155 Communication in the Sciences S1/2
161.130 Introductory Biostatistics S2
122.102 Biochemistry of Cells S2
S2 102.101 Biology of Plants
162.211 Biology & Genetics of Microogranisms S1
162.212 The Microbial World S2
162.283 Medical Microbiology S2
202.251 Epidemiology in Human Populations S1
122.231 Gene & Gene Expression S1
141.393 Food Microbiology and Safety ** S1
162.307 Microbial Biotechnology S2
162.301 Advanced Medical Microbiology S1
162.303 Immunology S1
162.312 Molecular Microbiology S2
203.300 DNA Technology S1
Paper Pathway for BSc Microbiology
Papers that prepare you for careers in
: Environmental & Plant Microbiology
: Industrial & Food Microbiology
: Molecular Microbiology
: Medical Microbiology
: Prerequisite course
: Required for Micro Major
: Three of these required for Major
:Supplementary specialist paper

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: In order to be successful in this paper, it is strongly recommended that students have studied at least 20 credits from NCEA Level 3 Chemistry and achieved at least 14, or achieved an equivalent level in an alternative assessment system to NCEA, or passed Bursary Chemistry or passed paper 123.103 or an acceptable alternative.

Extramural: Available extramurally.

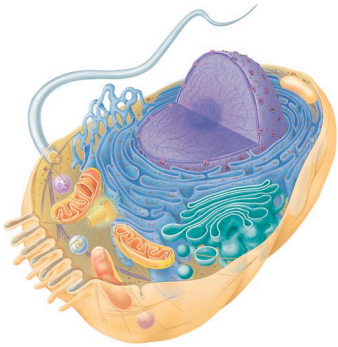
Assessment:

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

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

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: In order to be successful in this paper, it is strongly recommended that students have studied at least 20 credits from NCEA Level 3 Biology and achieved at least 14, or achieved an equivalent level in an alternative assessment system to NCEA, or passed Bursary Biology or passed paper 162.103 or an acceptable alternative.

Extramural: Available extramurally in alternative years.

Assessment:

Semester Test	15%
On-line assignments	10%
Laboratory Test	20%
Final Examination	55%

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

YEAR ONE - Semester 2

120.101 Biology of Plants

Paper Co-ordinator: Professor Michael McManus

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

1. Recognise and name structural parts, organs and repeating units of plants in both vegetative and reproductive states.
2. Recognise the major groups of living plants and principles relating to their classification.
3. Identify certain prescribed plants in the New Zealand flora (both indigenous and exotic).
4. Recognise and name anatomical features of plant tissues and how they underlie plant structure and form.
5. Have a knowledge of the plant cell and its functional components and of processes involved in cell division and differentiation.
6. Understand physiological principles of water relations at the cell and whole plant levels.
7. Understand the nature of photosynthesis and photoassimilate transport and partitioning.
8. Understand the developmental responses of plants to light, gravity and stress.
9. Have an understanding of the principles behind the manipulation of plant growth and development in contemporary plant biotechnology.

Outline: An integrated study of the structure, function and diversity of plants. Topics include: anatomy and morphology; maintenance of the organism (nutrition, photosynthesis, respiration and transport); growth and development; co-ordination and regulation of growth; effects of environment on growth and development; reproduction; floral biology; plant systematics and plant diversity; plant breeding, biotechnology and genetic engineering.

Pre-requisites: There are no pre- and co-requisites.

Extramural: Available extramurally alternate years.

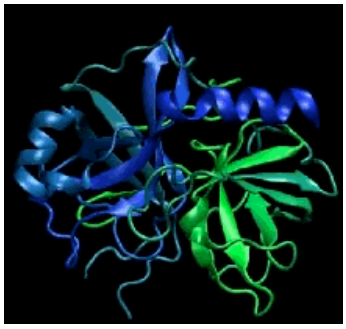
Assessment:

Semester test	10%
Laboratory tests	10%
Assignments (3)	20%
Final examination	60%

Textbook: Biology of Plants, Raven, Evert and Eichhorn (ISBN: 0716710072) 7th Edition. Publisher: W.H. Freeman and Company/Worth Publishers 2005

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: The study of cellular processes at a molecular level, applicable to plant, animal and microbial systems: proteins, including enzymes; major processes of carbohydrate metabolism; the importance of ATP and proton gradients in metabolism. Applications of Biochemistry in Medicine and Biotechnology are included.

Pre-requisites: 123.101 and 162.101.

Extramural: Not available extramurally

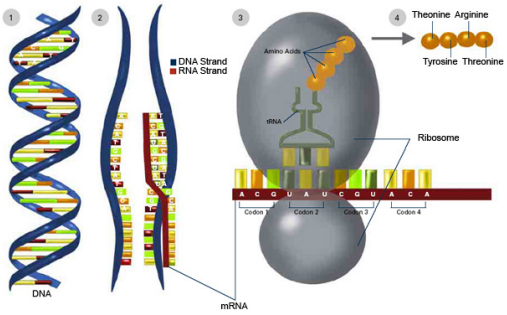
Assessment:

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

Textbook: Elliott, W.H. and Elliott, D.C. Biochemistry and Molecular Biology, 3rd edition (2005), , Oxford University Press, Oxford

YEAR TWO - Semester 1

122.231 Genes and Gene Expression



Paper Co-ordinator: Assoc Professor 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

YEAR TWO - Semester 1

285.201 Understanding Plant Protection

Paper Co-ordinator: Dr Terry Stewart

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

1. Discuss the significance of plant pests, diseases and weeds in relation to society at large, and yield and quality (including postharvest) of cultivated plants.
2. Describe the major biological features (including methods of spread) of the main groups of causal organisms (insects, mites, nematodes, fungi, bacteria, viruses, weeds).
3. Discuss the ways in which pest and disease organisms injure plants.
4. List and define common terms used to describe plant damage symptoms and signs of the causal agent.
5. Discuss the principles of plant pest, disease and weed control by cultural, biological and chemical means.
6. Identify common pests, diseases and weeds and be able to provide general control recommendations.

Outline: Importance of diseases, pests and weeds in horticultural, agricultural and forestry production. Introducing biology of organisms and understanding their management and control. Introduction to strategies available for chemical, non-chemical and integrated control methods.

Pre-requisites: 120.101 or 171.102 or 171.127 or 171.128 or 283.101 or 284.101;

Extramural: Available extramurally.

Assessment:

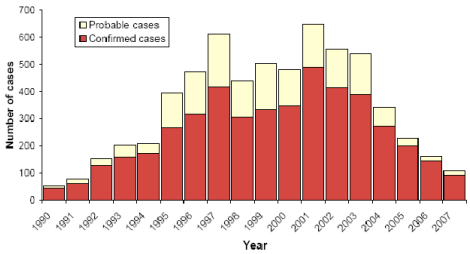
Collection Assessment	20%
Laboratory Work	10%
Final Examination	70%

Textbook: No set textbook

YEAR TWO - Semester 1

202.251 Principles of Epidemiology in Human Populations

Figure 22. Meningococcal disease notifications by year, 1990 - 2007



Paper Co-ordinator: Dr Jackie Benschop

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

1. Appreciate the importance of epidemiology in everyday life.
2. Calculate and interpret common measures of diseases frequency and association.
3. Describe the major features, strengths and weakness of common study designs and demonstrate an understanding of random and systematic error, selection and misclassification bias, confounding and interaction and the methods used to overcome these in study design and analysis.
4. Understand the principles of diagnostic testing, including screening tests, outbreak investigation, sampling and causation.
5. Critically appraise epidemiological literature.

Outline: History and scope of epidemiology; definitions of health and disease; causation; concepts of measurement of disease in populations; interpretation of diagnostic tests; observational studies and randomised clinical trials; epidemiology and public health; food-borne disease and zoonoses; epidemiology and health care planning.

Pre-requisites: Any 100-level paper from the BMLSc or BSc Schedule

Extramural: Not available extramurally.

Assessment:

Semester Test	15%
Assignment 1	10%
Assignment 2	15%
Final Examination	60%

Textbook: No set textbook

YEAR TWO - Semester 2

162.212 The Microbial World

Figure 2-10a Brock Biology of Microorganisms 11/e
© 2006 Pearson Prentice Hall, Inc.

Paper Co-ordinator: Dr Zoe Jordens

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

1. Explain the rationale of classification and phylogenetic organization of Bacteria and Archaea.
2. Discuss the diversity of cell structure with reference to detailed physiology, including Bacteria and Archaea.
3. Apply the general metabolic principles underlying glycolysis, TCA cycle and oxidative phosphorylation to a range of other metabolic types, with due reference to environmental factors favouring this kind of metabolism.
4. Explain the molecular basis of a range of bacterial environmental sensing mechanisms.
5. Discuss the major distinguishing features of selected microbial groups.
6. Apply appropriate microbiological techniques to investigate a range of bacteria and environments, in collaboration with other team members, with due regard for safety.
7. Locate relevant microbiological information using traditional and electronic search strategies.

Outline: Microbiology as an integrated study of the diversity of micro-organisms and microbial environments. The range of microbial cell structures and metabolism is described in relation to environmental niches, and the molecular mechanisms for responding to environmental change. Actions and interactions of micro-organisms in soil and water.

Pre-requisites: 162.101 Biology of Cells
162.211 Biology and Genetics of Microorganisms or
196.213 Microbial Ecology

Extramural: Not available extramurally.

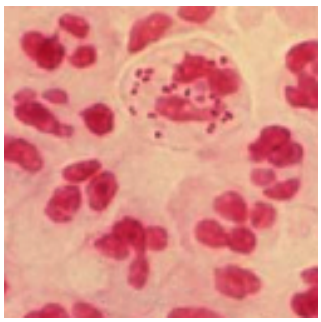
Assessment:

Semester Test	20%
Presentation	5%
Lab Book & Interview	25%
Final Examination	50%

Textbook: Biology of Microorganisms - Author: Madigan, M.T., Martinko, J.M, Dunlap, P.V. & Clark, D.P Edition: 13th Publisher: Prentice-Hall

YEAR TWO - Semester 2

162.283 Medical Microbiology



Paper Co-ordinator: Assoc Professor Mary Nulsen

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

1. Describe and classify the major groups of fungal pathogens of humans in New Zealand and the criteria for their differentiation.
2. Assess the clinical and public health significance of the dermatomycoses and other fungal pathogens, discuss the sources and transmission of the causal agents.
3. Describe and carry out specimen collection, processing, isolation and identification techniques for the selected fungi.
4. Outline the modes of action and discuss major advantages and disadvantages of the commonly used methods of sterilisation and disinfection and tests of their efficacy.
5. Describe the major properties of bacterial pathogens; describe and carry out tests used for the laboratory diagnosis of bacterial pathogens.
6. Discuss the host-parasite relationship and the steps typically involved in the development of infectious disease and describe the pathogenesis of human disease caused by selected bacteria.
7. Explain the modes of action of selected antimicrobial agents active against bacterial cell walls, ribosomes and nucleic acid synthesis.
8. Discuss the mechanisms of resistance to antimicrobial agents typically exhibited by bacteria with specific reference to selected examples.

Outline: An introduction to the general principles of host-pathogen interaction for some major groups of bacteria and fungi pathogenic for humans. Detection of pathogens in clinical specimens. Sterilisation, disinfection and control of microbial growth. Antimicrobial agents, resistance to antimicrobial agents and antimicrobial susceptibility testing.

Pre-requisites: 162.211 Biology and Genetics of Micro-organisms

Extramural: Not available extramurally.

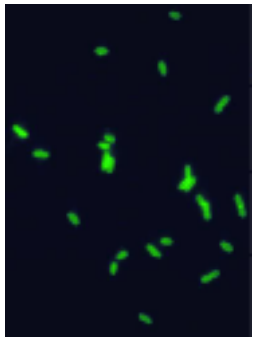
Assessment:

Essay	10%
Semester Test	10%
Written Practical	10%
Oral Practical	10%
Final Examination	60%

Textbook: Medical Microbiology - Author: Murray, Rosenthal and Pfaller Edition: 7th

YEAR THREE – Semester 1

162.301 Advanced Medical Microbiology



Paper Co-ordinator: Assoc Professor Mary Nulsen

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

1. Describe many of the major bacterial pathogens of humans including their Gram reaction, structure, virulence factors and toxins, and their mode of replication.
2. Discuss the epidemiology and pathogenesis of the human diseases caused by these bacterial pathogens.
3. Describe bacterial vaccines and discuss their strengths and weaknesses.
4. Outline the distribution of normal human flora and discuss the benefits and potential harm of these organisms.
5. Describe and carry out laboratory methods commonly used to isolate and/or identify bacterial pathogens and detect bacterial infections.
6. Describe and carry out basic laboratory methods used to isolate and/or identify viruses, propagate viruses and detect viral infections.
7. Describe the general structure of viruses and prions and their modes of replication.
8. Describe the major human pathogens within the selected virus groups in terms of their mode of replication, epidemiology, pathogenesis, the host immune response and laboratory diagnosis.
9. Outline the modes of action of the antiviral agents currently available and discuss the future prospects for antiviral chemotherapy.
10. Review and summarise material from the current literature relevant to Medical Bacteriology or Virology.

Outline: Some major bacterial pathogens of humans in terms of the organisms, their habitats, modes of transmission, disease patterns and laboratory diagnosis. The structure, classification, propagation, assay and transmission of some of the major viruses of humans. Immunity to viruses and the laboratory diagnosis of viral infections.

Pre-requisites: 162.211, 162.212 or 162.283, 122.102

Restrictions: 162.384, 162.381, 162.302

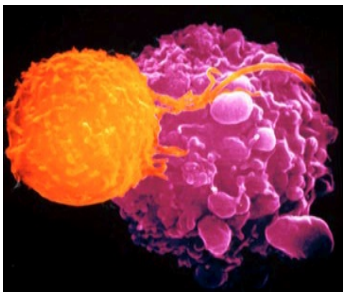
Extramural: Not available extramurally.

Assessment:

Semester Test	10%
Essay	10%
Written Practical Test	10%
Oral Practical Test	10%
Final Examination	60%

Textbook: Medical Microbiology - Author: Murray, Rosenthal and Pfaller Edition: 2009

YEAR THREE – Semester 1



162.303 Immunology

Paper Co-ordinator: Assoc Professor Alan Murray

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

1. Describe the cell types involved in the mammalian immune system and explain the differences between innate and acquired immunity.
2. Discuss the clonal selection theory and explain how antibodies are made and describe how cell mediated immune (CMI) responses are initiated.
3. Describe the principles of vaccination and the general features of the immune response to tumours and how protective immunity can be generated against viruses, bacteria and parasites.
4. Understand the basis of hypersensitivity reactions, immunodeficiency and autoimmunity.
5. Describe the principles and be able to perform: agglutination reactions, precipitation reactions, enzyme-linked immunosorbent assays, immunofluorescence, nephelometry, Complement Fixation Test and Western blotting. Describe the principle of monoclonal antibody production.

Outline: Principles of immunology including innate immunity, cell and antibody mediated immunity, major histocompatibility complex, hypersensitivities, immunodeficiency and autoimmunity. Introduction to vaccines, clinical immunology and immunological laboratory tests.

Pre-requisites: 162.101 plus any 200-level paper

Restrictions: 162.389

Extramural: Not available extramurally

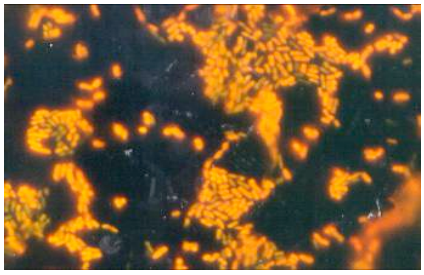
Assessment:

Practical Exam	20%
Mid-term Test	20%
Final Examination	60%

Textbook: Kuby Immunology - Author: Kindt et al. ISBN: 0716785900 6th edition Publisher: W.H. Freeman & Company

YEAR THREE – Semester 1

141.393 Food Microbiology and Safety



Paper Co-ordinator: Assoc Prof Steve Flint

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

1. Describe the means to prevent food poisoning and microbial spoilage of foods through preservation techniques such as heat treatment, chemical addition, manipulation of pH and water activity, irradiation, chilling and freezing, and by application of packaging techniques.
2. Apply hazard analysis techniques and formulation of food safety plans.
3. Apply shelf life prediction using microbial growth models.
4. Manipulate microbial cultures and contaminated materials, both in the laboratory and in the factory.

Outline: The interaction of microorganisms of spoilage and public health significance with food and with the processing environment. Industrial hygiene and food processing techniques for controlling microbial activity to produce safe, wholesome foods. Conventional and automated methods for detection, identification and enumeration of microbial populations in foods and premises. Predictive microbiology. Hazard analysis and formulation of a food safety programme for industrial production and handling of food; consideration of relevant food legislation.

Pre-requisites: Year 2 BTech or BE

Extramural: Not available extramurally.

Assessment:

Literature Review	15%
Laboratory report	10%
HACCP Group Project	15%
Lab Book	10%
Labortory Report 2	10%
Final Examination	40%

Textbook: No set textbook

YEAR THREE – Semester 1

280.346 Water and Wastes

Paper Co-ordinator: Professor Andy Shilton

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

1. Discuss key aspects of hydrology and describe the requirements and limitations of water supply systems; explain the general processes available for water treatment.
2. Define and discuss the importance of water quality parameters.
3. Discuss the general processes available for wastewater treatment and describe more in-depth a selected number of wastewater treatment processes.
4. Describe issues and processes relating to solid and hazardous waste management.
5. Have a broad overview of environmental management tools and New Zealand environmental legislation.

Outline: An introduction to hydrology, water quality characteristics, drinking water treatment and pump/pipeline systems. An overview of waste management strategies. An examination of wastewater treatment technologies including physical, biological and natural treatment systems. An introduction to solid waste and hazardous waste management.

Pre-requisites: Any 200 level paper

Extramural: Available extramurally.

Assessment:

Assignments (2)	40%
Final Examination	60%

Textbook: No set textbooks

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.

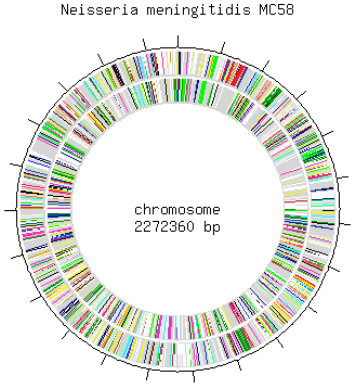
Assessment:

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

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

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

162.304 Environmental Microbiology
(Not currently being offered)

Paper Co-ordinator: TBA

Objective: Expansion of environmental microbiology encountered in 200 level. Microbiology in areas of soil, water, wastewater, wildlife management, rumen and aerobiology. Develop proficiency in analysing dynamic microbial and environmental processes.

Outline: Actions and interactions of microorganisms in water, soil, air and ruminant and consequences of colonisation processes

Pre-requisites: 162.211 or 141.222/162.213/196.213, 162.212

Extramural: Not available extramurally.

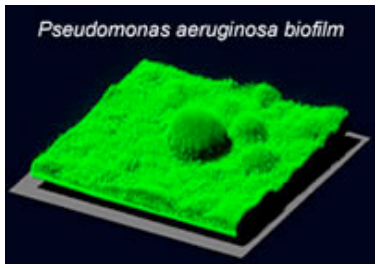
Assessment:

Laboratory Practical	Waste & Water	20%
	Air/Soil	5%
	Ruminants	5%
Final Examination		70%

Textbook: Maier, R.M., Pepper, I.L., and Gerba, C.P. 2000 Environmental Microbiology, Academic Press. 579.175 Mai

YEAR THREE – Semester 2

162.307 Microbial Biotechnology



Paper Co-ordinator: Professor Bernd Rehm

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

1. Describe pathways for biosynthesis of microbial products, including metabolic engineering.
2. Name commercial microbial products currently produced by biotechnological processes.
3. Set up a microbial production process including product analysis.
4. Design experimental strategies for microbial production processes.
5. Describe the diversity of microbial products.
6. Explain various screening techniques.

Outline: Selected topics in applied microbiology with a strong emphasis on established biotechnological production processes, such as e.g. various biopolymers.

Pre-requisites: 122.102, 162.211 (or 141.222), 162.212

Extramural: Not available extramurally.

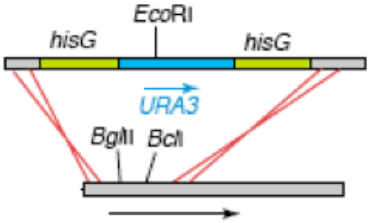
Assessment:

Semester Test	15%
Laboratory assessment	25%
Final Examination	60%

Textbook: No set textbook

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

285.301 Controlling Plant Pests and Diseases

Paper Co-ordinator: Dr Terry Stewart

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

1. Identify reliable sources of information.
2. Diagnose common pest and disease problems.
3. Take any pest or disease problem and formulate an integrated control program which will manage the problem.
4. Describe and discuss the environmental, social and political impact of various control techniques, both old and new.

Outline: Aspects of plant pest and pathogen biology will be studied to help understand how to obtain efficient and effective control. The full range of control techniques, both chemical and non-chemical, will be discussed. Students will learn about pests and diseases in their specific area of interest in agriculture, horticulture, forestry or conservation, be shown how to diagnose problems, and obtain experience in managing an integrated pest and disease control program in a simulated crop.

Pre-requisites: 171.284 or 171.202 or 283.201 or 285.201

Restrictions: 171.387

Extramural: Available extramurally.

Assessment:

Information Assignment	20%
Diagnostic Assignment	10%
Pest and disease Assignment	15%
Final Examination	55%

Textbook: No set textbook

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

Extramural: Not Available extramurally.

Assessment:

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

Textbook: No set textbook

Research

Massey University 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 each year. Check on the IMBS website: http://imbs.massey.ac.nz/Teaching/Summer_Fellowships.htm

Research Interests of Academic Staff in Microbiology and Related Disciplines

Bernd Rehm	Microbial biosynthesis of polymers and biosurfactants
Jan Schmid	Cellular and molecular biology of symbiotic and pathogenic microbe-host interactions
Jasna Rakonjac	Molecular biology of bacteriophage/bacteria; phage display
Barry Scott	Gene regulation and expression in plant-microbe interactions
Rosie Bradshaw	Fungal molecular genetics
Zoe Jordens	Molecular epidemiology, medical microbiology and adult education.
Steve Flint	Dairy foods, biofilms in industry
Mary Nulsen	Infectious disease, medical bacteriology, pathogenic bacteria, antibiotic resistance, host defences, human vaccines

General Information

Student Services

Student Services at Massey University Palmerston North 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/

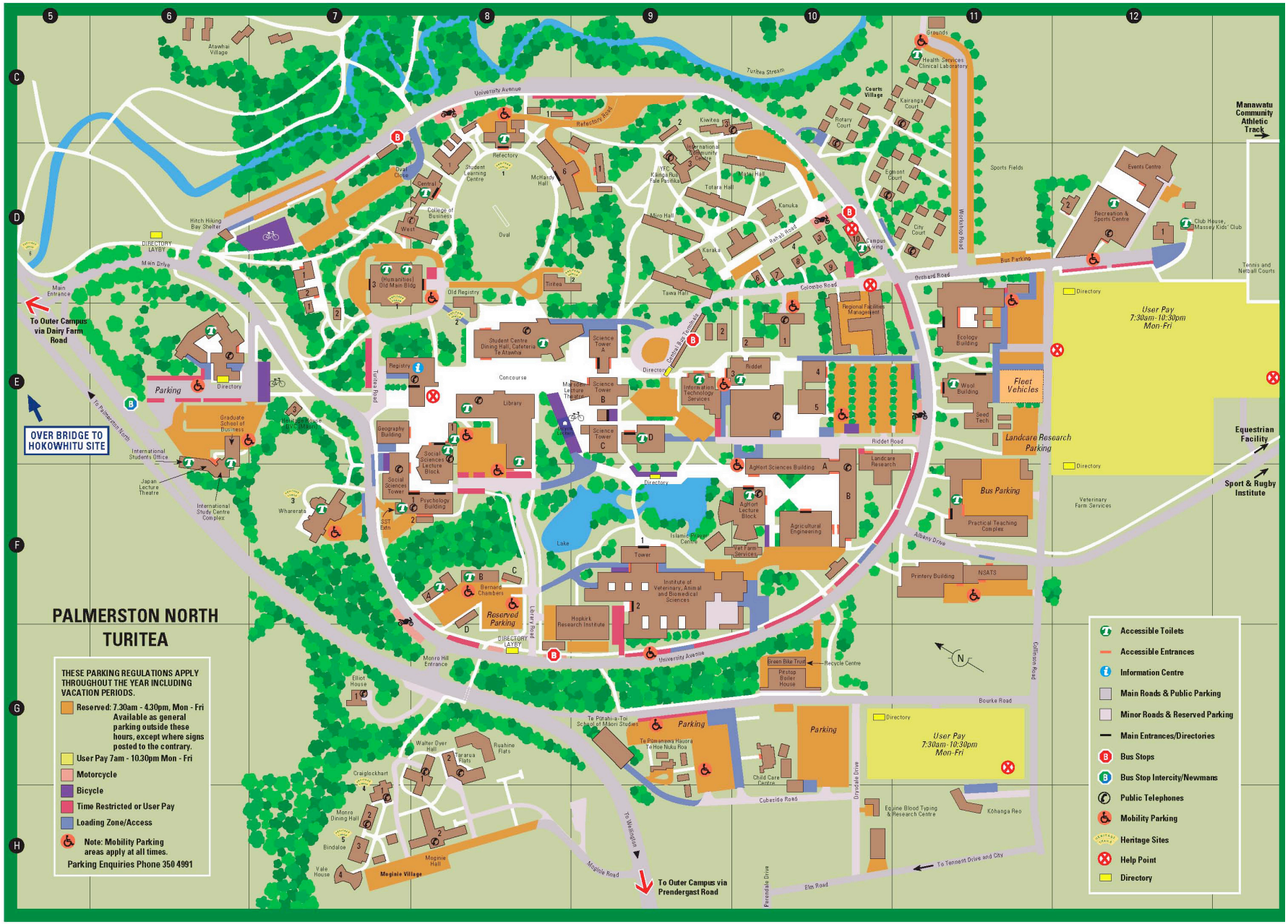
Student Learning Centre

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
Manawatu Community Athletic Track
Equestrian Facility
Sport & Rugby Institute
User Pay 7:30am-10:30pm Mon-Fri
Fleet Vehicles
Landcare Research Parking
Bus Parking
Reserved Parking
Parking
Concourse
Library
Student Centre Dining Hall, Cafeteria Te Atawhai
Refectory
Student Learning Centre
Oval
Lake
University Avenue
Turitea Stream
Main Drive
Riddet Road
Albany Drive
Bourke Road
Cubeside Road
Elm Road
Moginie Road
Turitea Road
Library Road
Collinson Road
Dryden Road
Orchard Road
Colombo Road
Workshop Road
Sports Fields
Tennis and Netball Courts
Veterinary Farm Services
Equine Blood Typing & Research Centre
Kōhanga Reo
Child Care Centre
Recycle Centre
Green Bike Trust
Pitstop Boiler House
Printery Building
NSATS
Practical Teaching Complex
Agricultural Engineering
Agriculture Sciences Building
Agriculture Lecture Block
Institute of Veterinary, Animal and Biomedical Sciences
Hopkirk Research Institute
Bernard Chambers
Geography Building
Social Sciences Lecture Block
Social Sciences Tower
Psychology Building
Graduate School of Business
International Students Office
Japan Lecture Theatre
International Study Centre Complex
Wharerata
Hitch Hiking Bay Shelter
Main Entrance
Atawhai Village
Moginie Village
Moginie Hall
Monro Hill Entrance
Monro Dining Hall
Craiglockhart
Walter Dyer Hall
Tararua Flats
Ruahine Flats
Te Pūrahi-a-Tōi School of Māori Studies
Te Pūnanawa Hauora Te Hoe Nuku Roa
Science Tower A
Science Tower B
Science Tower C
Tower
Ecology Building
Wool Building
Seed Tech
Landcare Research
Regional Facilities Management
Information Technology Services
Riddet
Kanuka
Karaka
Tawa Hall
Totara Hall
Micro Hall
Kiwitea
Kairanga Court
Egmont Court
City Court
Rotary Court
Courts Village
Health Services Clinical Laboratory
Grounds
Events Centre
Recreation & Sports Centre
Club House, Massey Kids' Club
Registry
Old Registry
(Humanities) Old Main Bldg
College of Business
Oval Close
Central
West
McHardy Hall
Mātai Hall
Trifea
Campus Parking
Bus Parking
Directory
To Palmerston North
To Wellington
To Tennent Drive and City

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

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Bachelor of Science (BSc)

Bachelor of Science (Microbiology)

Entry Requirements

All students must have a university entrance qualification. Students beginning their study of Microbiology 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.

For general entry requirements see Massey University entry requirements.

Bachelor of Science (Microbiology) Structure

The subject of Microbiology has been revolutionised in recent years by new techniques such as confocal and video-enhanced microscopy, atomic force microscopy, laser tweezers, genome sequencing (pioneered in bacteria), micro array technology and proteomics. This means that we now have an unprecedented array of tools available for gaining insights into how microbes function. Papers in Microbiology have therefore an increasing focus on whole-organism biology. Our curriculum (see the Microbiology website for an overview) teaches students to combine knowledge of microbial structure and metabolic diversity with up-to-date information on the research tools available to microbiologists, to gain understanding of how microbial cells function and impact on the environment and human affairs.

In their first year students intending to major in Microbiology should take 123.101 and 162.101 in Semester One and 122.102 in Semester Two. In addition students should also take papers in other biological sciences.

Majoring Requirements

123.101 Chemistry and Living Systems,
162.101 Biology of Cells,
122.102 Biochemistry of Cells;
162.211 Biology and Genetics of Microorganisms,
162.212 The Microbial World,

162.283 Medical Microbiology
122.231 Genes and Gene Expression;
203.300 DNA Technology

plus three of
162.301 Advanced Medical Microbiology,
162.303 Immunology,
162.304 Environmental Microbiology,
141.393 Food Microbiology and Safety
162.307 Microbial Biotechnology,
162.312 Molecular Microbiology.