

Microbiology and immunology

Microbiology is the study of microscopic organisms. Immunology is the study of the immune response to infection and other challenges. Both disciplines are exciting and rapidly developing sciences with new information constantly displacing older theories and assumptions. Microorganisms affect all areas of human endeavour and the principles and applications of microbiology are an integral part of medicine, biochemistry, agriculture, biotechnology, genetics, ecology, environmental bioremediation and even gold mining. Immunology embraces the host response to microorganisms, vaccine development, autoimmunity, tumour immunity and transplantation medicine. The Department also contributes significantly to the teaching of molecular biology. The aim of the subjects offered is to impart some of the excitement of the science, while providing a framework for students to build a career. Students will require a basic knowledge of biology and chemistry.

Although microbiology and immunology will be valuable to all students in the paramedical area and the natural sciences, four major streams of study can be identified:

- medical microbiology
- microbial biotechnology
- immunology
- environmental microbiology

Microbiology and immunology subjects may also form part of a co-major in either biotechnology or environmental science.

All students are expected to study the life sciences package in first year and at second year (except those enrolled in the immunology major) the introductory lecture and practical courses in microbiology and immunology 526-201 and 526-221.

Suggested subjects

100-level subjects (selections within the life sciences package)

- For majors A, B and C it is recommended that physics 640-141 and 640-142, or 640-161 and 640-162 be taken but this is not compulsory.
- For environmental microbiology include the mathematics and statistics 620-160 and the Earth sciences 625-101 courses.

200-level subjects

Major A: medical microbiology (for requirements see page 766)

Additional subjects in order of preference from: either biochemistry and molecular biology 521-211, 521-212 or genetics 652-214 and 652-215; then either biochemistry 521-221, 521-222 or genetics 652-216; anatomy 516-201; pathology 531-201; physiology 536-201, 536-211 and 536-202; microbiology 526-204; cell biology 606-205, and 606-206; pharmacology 534-201.

Major B: microbial biotechnology (for requirements see page 766)

Additional subjects in order of preference from: either biochemistry and molecular biology 521-211, 521-212, 521-221 and 521-222 or genetics 652-214, 652-215 and 652-216; chemistry 610-220 plus 610-260, 610-240; cell biology 606-205 and 606-206 instead of either biochemistry and molecular biology or genetics; anatomy 516-201; physiology 536-201 and 536-211; pharmacology 534-201.

Major C: immunology (for requirements see page 765)

Additional subjects from 200-level subjects in microbiology and immunology, biochemistry and molecular biology, chemistry, pathology, genetics, physiology, anatomy, and cell biology.

Major D: environmental (for requirements see page 766)

Additional subjects from: environmental sciences 600-201 and 600-203, mathematics and statistics 610-270 and either biochemistry and molecular biology 521-211 and 526-212 or genetics 652-214 and 612-215 or cell biology 606-205 and 606-206 plus an additional practical either biochemistry and molecular biology 521-221 or genetics 652-216.

Environmental science co-major (see page 770)

Include environmental sciences 600-201 and 600-203, mathematics and statistics 610-270 then select from the above.

Biotechnology co-major (see page 770)

Include biochemistry and molecular biology 521-211 and 521-212 then choose from the same subjects as for the microbial biotechnology major above.

300-level subjects

Major A: medical microbiology (for requirements see page 766)

Additional subjects selected in order of preference from microbiology 526-301, 526-304 and either 526-321 or 526-323 then from microbiology and

immunology 526-324; biochemistry and molecular biology 521-301, 521-302, 521-303, 521-321

Major B: microbial biotechnology (for requirements see page 766)

Additional subjects selected in order of preference from either biochemistry and molecular biology 521-301, 521-302, 521-303, 521-321, 521-322 or 521-323; or genetics 652-302, 652-303, 652-304, 652-306; microbiology 526-311, 526-312; chemistry 610-330; botany 606-306 in Semester 2 or cell biology 606-309 in Semester 1 to replace one biochemistry and molecular biology subject.

Major C: immunology (for requirements see page 765)

Additional subjects selected in order of preference within each department from: microbiology 526-311, 526-312, 526-321, 526-301; genetics 652-302, 652-303, (652-304 and 652-306), 652-305; biochemistry and molecular biology 521-301, 521-302, 521-303, 521-321, 521-322; pathology 531-301.

Major D: environmental (for requirements see page 766)

Additional subjects selected from: microbiology 526-301 or biochemistry and molecular biology 521-302; geomatics 451-312; environmental science 600-303 and 600-301; chemistry 610-280, 610-346, 610-323, 610-398; microbiology 526-311; cell biology 606-309; botany 606-311.

Environmental science co-major (see page 770)

Include geomatics 451-312; environmental science 600-303 and 600-301; chemistry 610-280.

Biotechnology co-major (see page 770)

Microbiology and immunology 526-302 can be replaced with 600-205 but those students who are completing their life sciences major in microbial biotechnology should enrol in microbiology and immunology 526-301, 526-307 and 526-321 and seek advice from the biotechnology coordinator on the choice of a second practical subject. Other choices are similar to those above for the microbial biotechnology major.

Bachelor of Science (Honours)

For information about the Faculty and departmental entry requirements for Honours, please refer to *Bachelor of Science (Honours) and Bachelor of Information Systems (Honours)* (p.883). These requirements should be considered when planning your course.

Microbiology 200-level subjects

526-201 Principles of Microbiology & Immunology

Credit points: 12.5

HECS-band: 2

Coordinator: Ms C J Power

Prerequisites: Biology 600-141 plus 600-142. 25 points of 100-level chemistry is not essential but is highly desirable.

Contact: 36 lectures (three a week), 12 computer tutorials (*Semester 1*).

Description: Upon completion of this course students should have:

- sufficient knowledge to form a foundation for future courses in microbiology and immunology;
- an understanding of fundamental life processes, microbial growth and its control, and host parasite relationships as illustrated in microorganisms;
- an appreciation of the biodiversity and significance of microorganisms in the environment, comparative properties of Eubacteria, Archeobacteria, eucaryotic microbial cells and viruses, and the significance of the contribution of microorganisms to the fields of biotechnology and genetic engineering; and
- a basic knowledge of the immune system and the ways in which it interacts with microorganisms

Assessment: A 1-hour mid-semester written examination (20%) and a 3-hour end-of-semester written examination (80%).

Prescribed texts: M T Madigan, J M Martinko and J Parker, *Brock, Biology of Microorganisms*, 9th ed., 2000. or L M Prescott, J P Harley and D A Klein, *Microbiology*, 4th ed., 1999.

526-205 Microbes: Infections and Responses

Credit points: 12.5

HECS-band: 2

Coordinator: Ms C Power; Ms S Uren

Prerequisites: Microbiology and immunology 526-201 and 526-221

Contact: 36 lectures (three a week) and 24 hours of practical work (2 hours a week) (*Semester 2*).

Description: Upon completion of this course students should have:

- sufficient knowledge to form a foundation for future courses in microbiology and immunology;
- an understanding of microbial life processes, microbial growth and its control, and host parasite relationships;

- an appreciation of the mechanisms by which microorganisms initiate infection, and the basis of the host response to infection;
- a knowledge of the some of the ways in which infectious disease can be controlled in individuals and in communities, including the use of antimicrobials and vaccines; and
- the ability to perform basic microbiological techniques safely and effectively and recognise valid clinical applications of these techniques.

Assessment: 3-hour end-of-semester examination (60%), practical examination (10%), oral presentation (10%) and practical reports (20%)

Prescribed texts: M Schaechter, et al, *Mechanisms of Microbial Disease*, 3rd ed., Williams & Wilkins, 1998.

526-221 Practical Microbiology

Credit points: 12.5

HECS-band: 2

Coordinator: Ms C J Power

Corequisites: Microbiology and immunology 526-201.

Contact: 12 lectures (one per week), 12 hours of computer assisted learning and 36 hours of practical work (3 hours per week) (*Semester 1, repeat 2*).

Description: Upon completion of this course students should have:

- acquired knowledge of the basic laboratory methods used in microbiology, when to use them and the ability to perform them safely and effectively;
- an understanding of how practical studies augment theoretical studies of the structure, function and activities of microorganisms;
- an experience of the laboratory as an interesting and stimulating environment in which to work;
- an appreciation of real life applications of microbiological techniques and their relevance to industry and community health and wellbeing; and
- developed observational, organisational and practical skills in obtaining data and in analysing, reporting, evaluating and interpreting experimental findings.

Assessment: A 1-hour end-of-semester practical examination (40%); continuous assessment of practical reports (50%) and assessment of computer assisted learning (10%)

Prescribed texts: University of Melbourne, *Department of Microbiology Techniques Manual*, 1999. • M T Madigan, J M Martinko and J Parker, *Brock Biology of Microorganisms*, 8th ed., 1997. or L M Prescott, J P Harley and D A Klein, *Microbiology*, 4th ed., 1999.

Microbiology 300-level subjects

526-301 Biotechnology 1: Microbial Genes & Cells

Credit points: 12.5

HECS-band: 2

Coordinator: Dr D Tribe

Prerequisites: Microbiology and immunology 526-201 and 526-221; either biochemistry and molecular biology 521-211 and 521-212, or genetics 652-214 and 652-215.

For BBiomedSc students, microbiology and immunology 526-201 or 526-205; biochemistry and molecular biology 521-213 plus physiology 536-250.

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

Description: By the end of the subject students should:

- understand those fundamental principles of microbial genetics and physiology that underpin the new developments in biotechnology, such as those that enable genetic material to be cloned and transferred between cells and those that allow molecules to move through cell membranes and act as substrates for carbon and energy sources;
- be able to describe the ways in which microorganisms function and interact with their environment and each other and regulate their genetic and metabolic potential to ensure their continued existence;
- appreciate how microbial behaviour can be modified by changes to genotype or environment to facilitate their use in biotechnological processes; and
- have developed the skills necessary to read and comprehend scientific papers.

Assessment: A 2-hour end-of-semester written examination (80%) and written assignments during semester not exceeding a total of 3000 words (20%).

526-302 Biotechnology 2: Commercial Innovation

Credit points: 12.5

HECS-band: 2

Coordinator: Dr D Tribe

Prerequisites: Microbiology and immunology 526-201; biochemistry and molecular biology 521-211 and 521-212; at least one of microbiology and immunology 526-221, biochemistry and molecular biology 521-221, and

521-222, genetics 652-216. Microbiology and immunology 526-301 is desirable but not essential.

For BBiomedSc students, microbiology and immunology 526-201 or 526-205; biochemistry and molecular biology 521-213 plus physiology 536-250.

Contact: 30 lectures and 6 hours of tutorials that require submission of written reports (*Semester 2*).

Description: By the end of the subject students should be able to:

- comprehend many of the issues, concepts and difficulties involved in developing new biotechnology products (for instance hormones, cytokines, vaccines, DNA probes, and biosensors), and in developing biotechnology based manufacturing processes;
- describe the principles underlying microbial processes currently in operation in industry, such as for example those used in manufacture of amino acids, enzymes, sugars, antibiotics and related biochemical products;
- recognise the difficulties involved in transition between laboratory and larger modes of operation;
- appreciate the importance of rational, independent and critical thought in developing new biotechnology products, such as is needed when assessing the consequences of deliberate releases of genetically modified organisms into the environment; and
- recognise the past contributions of biotechnology to society (for example in the food and health-care industries, and its potential for further improvement of human welfare) as illustrated by the ongoing contribution of molecular biology to advances in medicine.

Assessment: A 2-hour end-of-semester written examination (80%) and written assignments not exceeding a total of 3000 words (20%).

526-304 Principles of Immunology

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc Prof C Cheers; Assoc Prof F Carbone

Prerequisites: At least 31.25 points of theory and 12.5 points of practical 200-level subjects from microbiology and immunology, biochemistry and molecular biology, pathology, physiology, anatomy, cell biology or genetics.

For BBiomedSc students, biochemistry and molecular biology 521-213 plus physiology 536-250.

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

Description: By the completion of the course the students should understand and be able to describe:

- the development, function and regulation of cells of the immune system;
- the relationship between structure and function of antibodies;
- the molecular basis of cell interactions in the immune response; and
- the basis of immune mechanisms underlying immunity to infection and autoimmune disease, hypersensitivity reactions, immunodeficiency diseases and transplant and tumour rejection.

The course will include coverage of the development, function and regulation of cells of the immune system; immunoglobulins; cytokines; immunological mechanisms operating in immunity to infectious disease; autoimmunity; hypersensitivity; and transplantation and tumour immunology.

Assessment: A 3-hour end-of-semester written examination.

Prescribed texts: I Roitt et al, *Immunology*, 5th ed., 1999. or C A Janeway and P Travers, *Immunobiology*, 4th ed. or A K Abbas et al, *Cellular and Molecular Immunology*, 4th ed.

526-305 Medical and Applied Immunology

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc Prof C Cheers; Assoc Prof F Carbone

Prerequisites: Microbiology and Immunology 526-304.

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

Description: The subject provides an in depth study of cell interactions in the immune response: natural and acquired immunity to bacteria, viruses and parasites; design of vaccines; immunodeficiency, including HIV/AIDS; immunopathology of infection; autoimmunity, its aetiology, pathogenesis and treatment; and current practice and future perspectives in transplantation and tumour immunology.

By the end of the subject students should be able to understand and discuss:

- cell interactions in immunity as they relate to medical and applied aspects of immunology;
- the mechanisms of natural and acquired immunity to bacteria, viruses and parasites, and mechanisms of evasion of these responses, and how this knowledge relates to vaccine design;
- the problems of immunopathology and immunodeficiency in infection;
- the aetiology, pathogenesis and treatment of autoimmunity;
- the problems of transplantation and how they are overcome; and
- the potential of immunotherapy and vaccines against cancer.

Students should have developed skills in analysing experimental evidence for immunological concepts.

They should appreciate the experimental basis of our knowledge of the immune response and how this knowledge can be extrapolated to practical applications.

Assessment: A 3-hour end-of-semester written examination.

Prescribed texts: I Roitt et al, *Immunology*, 5th ed., 1999. or C A Janeway and P Travers, *Immunobiology*, 4th ed. or A K Abbas et al, *Cellular and Molecular Immunology*, 4th ed.

526-306 Microbiology (Optometry)

Note: Only available to B Optom students.

Credit points: 6.25

HECS-band: 2

Coordinator: Ms S Uren

Prerequisites: Enrolment in the third year of the optometry course.

Contact: 24 lectures (two a week) and 4 hours practical work (*Semester 2*).

Description: By the end of the subject students should have an appreciation of:

- the range of infections of the eye that may be caused by bacteria, viruses, chlamydiae, fungi and protozoa;
- how infections spread from person to person and may be transmitted by optometrists;
- how infection is prevented in the optometrist's practice by appropriate aseptic technique and methods of sterilisation and disinfection;
- the principles of antimicrobial chemotherapy; and
- the principles of immunity and epidemiology.

Assessment: A 2-hour end-of-semester written examination.

526-307 Applied Environmental Microbiology

Credit points: 12.5

HECS-band: 2

Coordinator: Dr P Janssen

Prerequisites: Microbiology and immunology 526-201 and 526-221; biochemistry and molecular biology 521-212; plus either genetics 652-214 and 652-215, or botany 606-205 and 606-206.

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

Description: By the end of this subject students should be able to:

- appreciate the diversity of the microbial world as the basis for maintaining life on earth and as a source of biotechnological innovation;
- describe the ways in which different microorganisms satisfy their basic requirements for growth and in so doing catalyse the biogeochemical cycles for carbon, nitrogen, phosphorus, and sulfur;
- describe the interactions of microorganisms with each other and in symbiotic or pathogenic relationships with animals and plants;
- understand the molecular basis of the interactions between plants and microorganisms important to human activities;
- understand the roles of microorganisms in processes such as biofilm formation, microbially induced corrosion, wastewater treatment and bioleaching;
- appreciate how to exploit microorganisms as agents for bioremediation; and
- appreciate the roles of microorganisms in extreme environments and their use as sources of biotechnologically useful enzymes.

Assessment: A 3-hour end-of-semester written examination (80%); a 1-hour mid-semester written examination (20%)

526-311 Medical Microbiology & Virology 1:Agents

Note: Credit cannot be obtained for this subject if credit has already been obtained for either 526-303 or 526-308 (1999 Handbook).

Credit points: 12.5

HECS-band: 2

Coordinator: Dr H Billman-Jacobe

Prerequisites: Microbiology and immunology 526-201 and 526-211 and one or more of the following: biochemistry and molecular biology 521-211 and 521-212, or genetics 652-214 and 652-215, or cell biology 606-205 and 606-206.

For BBiomedSc students, microbiology and immunology 526-201 or 526-205; biochemistry and molecular biology 521-213 plus physiology 536-250.

Contact: 36 lectures and 3 hours of tutorials (*Semester 1*).

Description: Upon completion of this course, students should be able to:

- understand the basic principles of viral, bacterial, fungal, protozoan and helminth structure, molecular taxonomy, replication and gene expression;
- apply information obtained from microbial genomics to the investigation of infectious diseases;

- show how etiological relationships are established and how molecular techniques are being used in the diagnosis of infections; and
- understand the rational basis of anti-microbial therapy using their knowledge of microbial structure and replication, and how new anti-microbials might be developed in the post-genomic era.

Assessment: A 3-hour end-of-semester written examination (80%); a 1-hour mid-semester written examination (20%)

Prescribed texts: C Mims et al, *Medical Microbiology*, 2nd ed., Mosby, 1998. or Schaechter et al, *Mechanisms of Microbial Disease*, 3rd ed., Williams and Wilkins, 1998.

Recommended texts: A A Salyers and D D Whitt, *Bacterial Pathogenesis - A Molecular Approach*, ASM Press, 1994. • D O White and F Fenner, *Medical Virology*, 4th ed., 1994.

526-312 Med.Micro. & Vir. 2:Infection/Immunity

Note: Credit cannot be obtained for this subject if credit has already been obtained for either 526-303 or 526-308 (1999 Handbook)

Credit points: 12.5

HECS-band: 2

Coordinator: Assoc Prof R Strugnelli; Dr B Crabb

Prerequisites: Microbiology and immunology 526-311.

Contact: 33 lectures and 3 hours of tutorials (*Semester 2*).

Description: Upon completion of this course, students should be able to:

- comprehend the basic principles of microbial pathogenesis i.e. how microbes cause disease;
- show how innate and adaptive host immune responses can both limit disease caused by infectious agents, and lead to pathology;
- use principles of epidemiology to understand the spread of infectious diseases;
- appreciate the differences in vaccination approaches and the humanitarian and commercial issues which impact on vaccine development; and
- to integrate an understanding of microbial pathogenesis, immunity and epidemiology to determine appropriate new vaccination strategies.

Assessment: A 3-hour end-of-semester written examination (80%); a 1-hour mid-semester written examination (20%)

Prescribed texts: C Mims et al, *Medical Microbiology*, 2nd ed., Mosby, 1998. or Schaechter et al, *Mechanisms of Microbial Disease*, 3rd ed., Williams and Wilkins, 1998.

Recommended texts: A A Salyers and D D Whitt, *Bacterial Pathogenesis - A Molecular Approach*, ASM Press, 1994. • D O White and F Fenner, *Medical Virology*, 4th ed., 1994.

526-321 Molecular Microbiology Techniques

Credit points: 12.5

HECS-band: 2

Coordinator: Dr M Dyall-Smith; Assoc Prof R Strugnelli

Prerequisites: Microbiology and immunology 526-201 and 526-221.

Corequisites: At least one of microbiology and immunology 526-301, 526-307, 526-311.

Contact: 54 hours practical work and 6 hours of lectures in the first six weeks of semester only (total of 10 hours a week) (*Semester 1*).

Description: Upon completion of the course, students should have:

- understood the principles and procedures involved in the culture, isolation and identification of microorganisms (particularly those of medical and environmental importance) based on principles of microbial physiology;
- gained expertise in retrieving published scientific data using computer searches and library facilities (e.g. Medline); and
- used molecular microbiological techniques and bioinformatics (e.g. DNA and rRNA sequences) to identify microorganisms, infer evolutionary relationships, and/or to identify potential targets for drug therapy.

This subject covers various aspects of practical microbiology including conventional isolation and identification methods and molecular microbiology techniques. Each student will do a series of short experimental exercises and write up the results for assessment.

Assessment: Weekly written reports of laboratory work completed totalling no more than 3000 words (50%) and a 2-hour written examination at the end of semester (50%).

526-322 Project Prac: Biotech/Environmental

Note: There are two options from which to choose. Each area has its own requirements and for each option there will be a choice from a number of individual projects.

Students with credit for 526-322 prior to 1998 will not be accepted into the 526-322 biotechnology option.

Credit points: 12.5

HECS-band: 2

Coordinator: Dr D Tribe (Biotech); Dr P Janssen (Env)

Pre or Corequisites:

- The biotechnology option requires microbiology and immunology 526-301 and preferably an enrolment or pass in 526-302.
- The environmental option requires microbiology and immunology 526-307.

Contact: 60 hours practical work for either project in the second 6 weeks of the semester (up to 10 hours a week) (*Semester 2*).

Description: By the end of the subject students should:

- appreciate the need to keep clear laboratory notes as experiments progress;
- have developed skills in the design, conduct and interpretation of experiments;
- have developed the expertise to critically evaluate experimental proposals and findings; and
- be able to communicate effectively both orally and in written reports an experimental proposal and the main findings.

Assessment: Laboratory work; a written report of up to 3000 words and an oral presentation

526-323 Project Prac: Medical/Immunology

Note: There are two options from which to choose. Each area has its own requirements and for each option there will be a choice from a number of individual projects.

Students with credit for 526-323 prior to 1998 will not be accepted into the 526-323 medical option. Students with credit for 526-325 prior to 1998 will not be accepted into the 526-323 immunology option.

Credit points: 12.5

HECS-band: 2

Coordinator: A/Prof R Strugnell (Med); Ms S Uren (Imm)

Pre or Corequisites:

- The medical option requires microbiology and immunology 526-311 and enrolment in microbiology and immunology 526-312, or 526-303 and/or 526-308 (1999 Handbook)
- The immunology option requires microbiology and immunology 526-324 and an enrolment or pass in 526-305

Contact: 60 hours practical work for either project in the first 6 weeks of the semester (up to 10 hours a week) (*Semester 2*).

Description: By the end of the subject students should:

- appreciate the need to keep clear laboratory notes as experiments progress;
- have developed skills in the design, conduct and interpretation of experiments;
- have developed the expertise to critically evaluate experimental proposals and findings; and
- be able to communicate effectively both orally and in written reports an experimental proposal and the main findings.

Assessment: Laboratory work; a written report of up to 3000 words and an oral presentation of results.

526-324 Immunological Techniques (Practical)

Credit points: 12.5

HECS-band: 2

Coordinator: Ms S Uren; Assoc Prof C Cheers

Corequisites: Microbiology and immunology 526-304.

Contact: 54 hours practical work and six hours of lectures in the last 6 weeks only (*Semester 1*).

Description: The subject provides an overview of immunological methods, including preparation, characterisation, separation and assay of lymphocyte populations; characterisation, separation and assay of antigens and immunoglobulins; assay of the immune response to infection; and detection of normal and abnormal antigens in tissues.

By the end of the subject students should have developed:

- skills in the in vitro manipulation and quantification of cells belonging to the immune system;
- skills in the measurement of cell function;
- skills in separation, detection and quantification of immuno-globulins and antigens; and
- an understanding of the basis of the serological diagnosis of disease.

Students should have an enhanced understanding of the experimental basis of our knowledge of the immune response. They should understand the role of controls in interpretation of experiments. They should appreciate the necessity to keep clear laboratory notes as experiments progress.

Assessment: Weekly written reports of laboratory work completed totalling no more than 3000 words (50%) and a 2-hour written examination at the end of semester (50%).