

# 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, three major streams of study can be identified:

- medical microbiology
- microbial biotechnology
- immunology

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

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 526-201 and 526-221.

## Suggested subjects

### 200-level subjects

Microbiology major A: medical microbiology (for requirements see page 12)  
Additional subjects in order of preference from: either biochemistry 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; pharmacology 534-201.

Microbiology major B: microbial biotechnology (for requirements see page 12)

Additional subjects in order of preference from: either biochemistry 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 or genetics; anatomy 516-201; physiology 536-201 and 536-211; pharmacology 534-201.

Immunology major C: immunology (for requirements see page 11)

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

Biotechnology co-major (see page 15)

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

### 300-level subjects

Microbiology A: medical microbiology (for requirements see page 12)

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

Microbiology major B: microbial biotechnology (for requirements see page 12)

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.

Immunology major C: immunology (for requirements see page 11)

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.

Students who are completing a life sciences major in microbiology (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 microbiology major (microbial biotechnology).

## Bachelor of Science (Honours)

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

### Further Information

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## Subject descriptions

### 200-level subjects

#### 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.

**BBiomedSc students:** 600-131 and 600-132.

**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 Bacteria, Archaea, 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 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 and microbial growth and its control;
- an appreciation of the mechanisms by which microorganisms initiate infection, and the basis of the host immune 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 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 well-being; and
- developed observational, organisational and practical skills in obtaining data and in analysing, reporting, evaluating and interpreting experimental findings.

**Assessment:** A 2-hour end-of-semester practical examination (40%); continuous assessment of practical reports (50%) and exercises in 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*, 9th ed., 2000. or L M Prescott, J P Harley and D A Klein, *Microbiology*, 4th ed., 1999.

### 300-level subjects

#### 526-301 Biotechnology 1: Microbial Genes & Cells

**Credit points:** 12.5 **HECS-band:** 2

**Coordinator:** Dr D Tribe; Dr M Dyll-Smith

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

BBiomedSc students: microbiology 526-201 or 526-205; 521-213 and 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: Processes & Innovations

**Credit points:** 12.5 **HECS-band:** 2

**Coordinator:** Dr D Tribe; Dr P Janssen

**Prerequisites:** Microbiology 526-201; biochemistry 521-211 and 521-212; at least one of microbiology 526-221, biochemistry 521-220, genetics 652-216. Microbiology 526-301 is desirable but not essential.

BBiomedSc students: microbiology 526-201 or 526-205; 521-213 and 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 and environmental management, 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 biotechnology, 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, health care and waste-management industries, and its poten-

tial 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 37.5 points of theory and 12.5 points of practical 200-level subjects from microbiology and immunology, biochemistry, pathology, physiology, anatomy, cell biology or genetics.

BBiomedSc students: 521-213 and 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 1-hour mid-semester written examination (30%) and a 2-hour end-of-semester written examination (70%).

**Prescribed texts:** A K Abbas et al, *Cellular and Molecular Immunology*, 4th ed., 2000.

#### 526-305 Medical and Applied Immunology

**Credit points:** 12.5 **HECS-band:** 2

**Coordinator:** Assoc Prof C Cheers; Assoc Prof F Carbone

**Prerequisites:** 526-304 Principles of Immunology (*p.2*)

**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:** A K Abbas et al, *Cellular and Molecular Immunology*, 4th ed., 2000.

#### 526-306 Microbiology (Optometry)

**Note:** Only available to BOptom students.

**Credit points:** 6.25 **HECS-band:** 2

**Coordinator:** Ms S Uren

**Prerequisites:** Enrolment in the third year of the Bachelor of 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.

### 526-311 Medical Microbiology: Pathogens

**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; Dr D Purcell

**Prerequisites:** Microbiology 526-201 and 526-221 and one or more of the following: biochemistry 521-211 and 521-212, or genetics 652-214 and 652-215.

BBiomedSc students: microbiology 526-201 or 526-205; 521-213 and 536-250.

**Contact:** 33 lectures and 3 hours of tutorials (*Semester 1*).

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

- understand the basic principles of virology, bacteriology and parasitology in terms of the structure, molecular taxonomy, replication and gene expression of infectious agents;
- 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.

**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 Medical Microbiology: Infections

**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 Strugnell; Dr L Brown

**Prerequisites:** 526-311 Medical Microbiology: Pathogens (*p.3*)

**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 viruses, bacteria and parasites 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
- 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 Dyal-Smith; Assoc Prof R Strugnell

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

**Corequisites:** At least one of microbiology 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:

- gained some understanding of the principles and procedures involved in the culture, isolation and identification of bacteria (particularly those of medical and environmental importance) based on principles of microbial physiology;
- used molecular microbiological techniques (e.g. PCR, DNA sequencing, western blot probing) to identify important characteristics of bacteria (e.g. virulence factors);
- used common bioinformatics methods to analyse DNA and protein sequence data (e.g. BLAST searches, translation of DNA sequences, *emm* virulence types of streptococci); and
- gained expertise in retrieving published scientific data related to the project using computer searches and library facilities (e.g. Medline).

This subject covers various aspects of practical and molecular microbiology including conventional isolation and identification methods, PCR and DNA sequencing, antigen detection using western blots.

**Assessment:** Regular written reports of laboratory work, including answers to discussion questions given out in class (60%) and a 2-hour written examination (40%).

### 526-322 Projects: Biotechnology

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Dr D Tribe; Dr P Janssen

**Prerequisites:** 526-301 Biotechnology 1: Microbial Genes & Cells (*p.2*) and preferably an enrolment or pass in 526-302 Biotechnology 2: Processes & Innovations (*p.2*). Other subjects may be accepted as equivalent prerequisites at the discretion of the supervisors.

526-321 is strongly recommended.

**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:** This subject allows students to carry out experimental work in an area of microbial biotechnology, environmental biotechnology or broader biotechnological applications in medical microbiology or immunology.

There will be a range of projects available.

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 Projects: Medical/Biomedical/Immunology

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

The biomedical option is offered over the summer vacation at a research institute (e.g. The Walter and Eliza Hall Institute of Medical Research). The medical microbiology and immunology options are offered over six weeks in Semester 2 in the department. Students wishing to undertake more than one option should consult the coordinators.

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** A/Prof R Strugnell; Ms S Uren

**Pre or Corequisites:**

- The medical microbiology option requires 526-311 Medical Microbiology: Pathogens (*p.3*) and enrolment in 526-312 Medical Microbiology: Infections (*p.3*). The completion of 526-321 Molecular Microbiology Techniques (*p.3*) prior to the commencement of 526-323 is also strongly recommended.
- The immunology option requires 526-324 Immunological Techniques (*p.4*) and an enrolment or pass in 526-305 Medical and Applied Immunology (*p.2*).
- The biomedical option requires that students be undertaking Stream 7 in the BBiomedSc course or a major in the Department of Microbiology and Immunology. Preference will be given to students who have completed two second year microbiology subjects (526-201 and 526-221, or 526-201 and 526-205)

**Contact:** Medical microbiology and immunology options: 60 hours practical work for either project in the first 6 weeks of the semester (up to 10 hours a week). Biomedical option: two to four weeks full-time practical work over summer term (a minimum of 60 hours) or by arrangement (*Semester 2, repeat Summer*).

**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.

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### 526-324 Immunological Techniques

**Credit points:** 12.5

**HECS-band:** 2

**Coordinator:** Ms S Uren

**Corequisites:** 526-304 Principles of Immunology (p.2)

**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%).