# 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 15)

Additional subjects in order of preference from: either biochemistry 521-211, 521-212 or genetics 652-214 and 652-215; then either biochemistry 521-220 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 15)

Additional subjects in order of preference from: either biochemistry 521-211, 521-212, 521-220 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 13)

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

Biotechnology major (for requirements see page 10)

### 300-level subjects

Microbiology major A: medical microbiology (for requirements see page 15)

Additional subjects selected in order of preference from microbiology 526-301, 526-304 and either 526-321 or 526-327 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 15)

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 526-313, 526-314; 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 13)

Additional subjects selected in order of preference within each department from: microbiology 526-313, 526-314, 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 526-301 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 desciptions

### 200-level subjects

#### 526-201 Principles of Microbiology & Immunology

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

**Coordinator:** Ms C J Power

**Prerequisites:** Biology 650-141 and 650-142 (prior to 2004: 600-141 and 600-142). 25 points of 100-level chemistry is not essential but is highly desirable.

BBiomedSc students: 650-131 and 650-132 (prior to 2004: 600-131 and 600-132).

**Contact:** 36 lectures (three per week); problem-solving sessions (one per week *(Semester 1)*.

**Description:** Upon completion of this subject, students will have acquired a foundation for future courses in microbiology and immunology. Students will comprehend the terminology used and have an insight into the type of investigations fundamental to the development of basic microbiological concepts. Students will be able to describe simple microbial life processes and correlate these with processes involved in infectious disease and interactions with hosts' immune systems, adaptation and survival of microorganisms, and the promotion or control of the growth of microorganisms. Students will be able to describe the comparative properties of Bacteria, Archea, and eucaryotic microbial cells and viruses and their significance in the environment, in particular the contribution of microorganisms to the fields of biotechnology and genetic engineering.

Upon completion of this subject, students will have an enhanced ability to:

- seek information from textbooks and computer-based sources;
- comprehend a question, evaluate the relevant information and communicate an answer in writing; and
- effectively manage time to ensure attendance at lectures, tutorials and examinations.

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

**Prescribed texts:** L M Prescott, J P Harley and D A Klein, *Microbiology*, 5th edn, 2002.

#### 526-205 Microbes: Infections and Responses

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

**Coordinator:** Ms C Power; Ms S Uren

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

**Contact:** 36 lectures (three per week) and 24 hours of practical work (two 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:** A 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 edn, 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 (three 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 laboratory notebook (10%).

**Prescribed texts:** University of Melbourne, *Department of Microbiology Techniques Manual*, 1999. • L M Prescott, J P Harley and D A Klein, *Microbiology*, 5th edn, 2002.

## 300-level subjects

### 526-301 Microbial Cells and Genomes

**Note:** Formerly known as 526-301 Biotechnology 1: Microbial Genes and Cells.

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

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

**Prerequisites:** Microbiology 526-201; either biochemistry 521-211 and 521-212, or genetics 652-214 and 652-215; one of microbiology 526-221, biochemistry 521-220 or genetics 652-216.

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 fundamental concepts of cell division, cell growth, and the transfer of substrates, macromolecules and signals across cell membranes;
- 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;
- be familiar with techniques and strategies such as mutant construction, and molecular cloning that are used to dissect microbial function;
- appreciate how microbial behaviour can be modified by changes to genotype or environment to facilitate use of microbes in biotechnological processes; and
- have developed the skills necessary to read and comprehend scientific papers and interpret genomic data in electronic databases.

Students will enhance their ability to utilise information from textbooks, scientific literature and computer-based sources and logically apply broad principles to address a particular scientific question.

**Assessment:** A 3-hour end-of-semester written examination (80%) and written assignments during semester not exceeding a total of 3000 words (20%).

### 526-302 Microbial Biotechnology

**Note:** Formerly known as 526-302 Biotechnology 2: Processes and 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 or genetics 652-214 and 654-215.

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

**Contact:** 36 lectures (three per week) *(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 for environmental management, such as 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 the application and commercialisation of 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 microbial biotechnology to society (for example in the food, health care and waste-management industries, and its potential for further improvement of human welfare) as illustrated by the ongoing contribution of molecular biology to advances in medicine.

Upon completion of this subject students will have an enhanced ability to:

- seek information from textbooks, scientific literature and computer-based sources; and
- identify relevant issues and think critically about information so that broad principles and relevant evidence can be applied to problem solving.

**Assessment:** A 3-hour end-of-semester written examination (80%) and written assignments during semester not exceeding a total of 3000 words (20%).

### 526-304 Principles of Immunology

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

**Coordinator:** A/Prof F Carbone; Ms S Uren

**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.

Upon completion of this subject students will have an enhanced ability to:

- seek information from textbooks, scientific literature and computer-based sources;
- identify relevant issues and think critically about information so that broad principles and relevant evidence can be applied to problem solving;
- comprehend a question, evaluate the relevant information and communicate an answer, either orally or in writing; and
- effectively manage time to ensure attendance at lectures, tutorials and examinations.

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

**Prescribed texts:** A K Abbas and A H Lichtman., *Cellular and Molecular Immunology*, 5th edn, 2003.

### 526-305 Medical and Applied Immunology

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

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

**Prescribed texts:** C A Janeway et al, *Immunobiology*, 5th edn, 2001.

## 526-306 Microbiology and Immunology (Optometry)

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

Formerly known as 526-306 Microbiology (Optometry).

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

**Coordinator:** Ms S Uren

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

**Contact:** 24 lectures and 12 hours practical of work/tutorials *(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 3-hour end-of-semester written examination.

## 526-313 Medical Microbiology: Cellular Pathogens

**Note:** Credit cannot be obtained for this subject if credit has already been obtained for 526-308 (1999 Handbook) or for both 526-311 and 526-312 (2002 Handbook).

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

**Coordinator:** Prof R Strugnell; Dr H Billman-Jacobe

**Prerequisites:** Microbiology 526-201 and 526-221 and preferably one or more of the following: microbiology 526-205, 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 three hours of tutorials *(Semester 1)*.

**Description:** Upon completion of this subject students should be able to describe how bacteria and parasites cause disease and how infectious diseases caused by bacteria and parasites are spread, diagnosed, treated and/or prevented. Students should also be able to apply relevant knowledge of microbial pathogenesis, immunity and epidemiology to the determination of appropriate strategies for developing new diagnostic protocols, treatments or vaccines.

Upon completion of this subject students will have an enhanced ability to:

- seek information from textbooks, scientific literature and computer-based sources;
- identify relevant issues and think critically about information so that broad principles and relevant evidence can be applied to problem solving;
- comprehend a question, evaluate the relevant information and communicate an answer, either orally or in writing; and
- effectively manage time to ensure attendance at lectures, tutorials and examinations.

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

**Prescribed texts:** A A Salyers and D D Whitt, *Bacterial Pathogenesis - A Molecular Approach*, 2nd edn, 2002.

## 526-314 Medical Microbiology: Viruses and Prions

**Note:** Credit cannot be obtained for this subject if credit has already been obtained for 526-303 (1999 Handbook) or for both 526-311 and 526-312 (2002 Handbook).

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

**Coordinator:** Dr D Purcell; Dr L Brown

**Prerequisites:** Microbiology 526-201 and 526-221 and preferably one or more of the following: microbiology 526-205, 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 three hours of tutorials *(Semester 2)*.

**Description:** Upon completion of this subject students should be able to explain how medically important viruses cause disease. Students should be able to describe how viruses replicate, are transmitted and detected and how the host's immune response acts to limit viral infection and how, in some cases, this can lead to pathology. Finally, students should be able to apply relevant knowledge of viral pathogenesis, immunity and epidemiology to the determination of appropriate strategies for developing new vaccines.

Upon completion of this subject students will have an enhanced ability to:

- seek information from textbooks, scientific literature and computer-based sources;
- identify relevant issues and think critically about information so that broad principles and relevant evidence can be applied to problem solving;
- comprehend a question, evaluate the relevant information and communicate an answer, either orally or in writing; and
- effectively manage time to ensure attendance at lectures, tutorials and examinations.

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

**Prescribed texts:** D O White and F J Fenner, *Medical Virology*, 4th edn, 1994.

## 526-321 Molecular Microbiology Techniques

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

**Coordinator:** Dr M Dyall-Smith; Prof R Strugnell

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

**Corequisites:** At least one of microbiology 526-301 or 526-313.

**Contact:** 54 hours of practical work and six hours of lectures in the first six weeks of semester only (total of 10 hours per 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 (eg. PCR, DNA sequencing, western blot probing) to identify important characteristics of bacteria (eg. virulence factors);
- used common bioinformatics methods to analyse DNA and protein sequence data (eg. 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 (eg. Medline).

This subject covers various aspects of practical and molecular microbiology including conventional isolation and identification methods, PCR and DNA sequencing, and 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%).

## 526-324 Immunological Techniques

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

**Coordinator:** Ms S Uren

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

**Contact:** 54 hours of practical work and six hours of lectures in the last six 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%).

## 526-326 Projects: Immunology

**Note:** Students who have completed 526-322 and/or 526-323 in any year must contact the coordinator to ensure they are not repeating subject material for which they were previously awarded credit.

Formerly known as 526-326 Projects: Immunology/Biotechnology.

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

**Coordinator:** Ms S Uren

**Prerequisites:** 526-324.

**Corequisites:** 526-305.

**Contact:** Six lectures and 54 hours of practical work *(Semester 2).*

**Description:** Students will carry out experimental work in an area of immunology.

On completion of the subject, students should:

- appreciate the nature of scientific research, including the way in which progress is made and the realities of laboratory-based work;
- be able to work effectively as a team member in a small scientific project;
- be able 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 scientific ideas and findings effectively in both oral and written form.

**Assessment:** Laboratory work (15%), a written report of up to 3000 words (70%) and an oral presentation of results (15%).

## 526-327 Projects: Microbiology

**Note:** Students who have completed 526-322, 526-323 and/or 526-326 prior to 2004 must contact the coordinators to ensure they are not repeating subject material for which they were previously awarded credit.

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

**Coordinator:** Ms H Cain; Prof R Strugnell;Dr P Janssen

**Prerequisites:** Preference will be given to students enrolled in subjects leading to a major in microbiology.

BBiomedSc students must be enrolled in stream 7.

**Contact:** Six lectures and 54 hours of practical work *(Semester 2).*

**Description:** Students will carry out experimental work in an area of microbiology selected from topics in medical and general bacteriology, virology, biotechnology and environmental microbiology.

On completion of the subject, students should:

- appreciate the nature of scientific research, including the way in which progress is made and the realities of laboratory-based work;
- be able to work effectively as a team member in a small scientific project;
- be able 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 scientific ideas and findings effectively in both oral and written form.

**Assessment:** Laboratory work (15%), a written report of up to 3000 words (70%) and an oral presentation of results (15%).