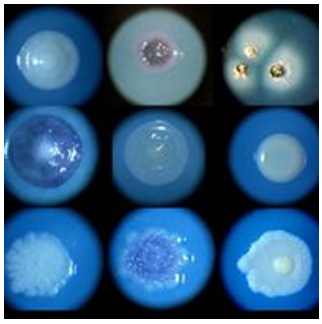
MICR335: Molecular Microbiology

Semester One 18 points



Course overview

Prokaryotes display a wide range of metabolic diversity and the control of gene expression under different conditions is an important component of understanding and exploiting microbes. Whether it be physiological adaptation to different environments or the mechanisms by which pathogens evolve through the acquisition and regulation of virulence genes, an understanding of Molecular Microbiology is an important component of modern Microbiology.

This course in Molecular Microbiology provides fundamental knowledge in gene regulation, underlying genetic regulatory mechanisms and microbial genomics and you will:

1. become familiar with the key systems bacteria use to regulate expression from their genomes
2. explore specific regulatory systems that respond to different stimuli and the technologies that can be used to explore gene expression.

This paper provides a strong framework in molecular microbiology that is underpinned by a laboratory course that provides hand-on experience with many of the skills and techniques that are used in a microbial genetics laboratory.

Learning outcome

Demonstrate an in-depth knowledge of central concepts and current developments in molecular microbiology.

Lecture course overview

MICR335 provides fundamental knowledge of gene regulation in bacteria through analysis of the physiological adaptations of bacteria to their environment and the underlying genetic regulatory mechanisms. Throughout the course, general principles are emphasized and their application illustrated through the use of topical examples. Course readings are selected chapters from advanced texts, and reviews and original papers from the literature. PDFs of these will be placed on Blackboard when available.

Section A: General overview of genetic regulatory mechanisms
(Lectures 1-9, Professor Clive Ronson)

1. The E. coli chromosome: physical and genetic structure; role of DNA supercoiling and chromosome-organising proteins. H-NS and FIS as transcriptional regulators.
2. Organisation and structure of regulatory elements; transcriptional versus translational control; promoter structure; RNA polymerase; Sigma factors; mechanism of transcriptional initiation; how regulatory proteins may affect transcriptional initiation.
3. Regulation via Sigma factors – motility and heat shock.
4. ppGpp and the stringent response
5. Regulation by extracellular stimuli; overview of two-component regulatory systems; critical control points; the Dct system.

Section B: Global regulation of respiration and molecular responses to oxidative stress
(Lectures 10-16, Professor Greg Cook and Kiel Hards)

6. Sensing the absence of oxygen using ArcBA and Fnr.

7. Anaerobic respiration: hierarchal control of electron acceptor utilisation in E. coli.
8. Response to oxidative stress: Oxygen, friend or foe?

Section C: Regulatory RNAs and CRISPR-Cas
(Lectures 17-22, Associate Professor Peter Fineran)

9. Gene regulation by regulatory RNAs and riboswitches
10. Small RNA-mediated CRISPR-Cas adaptive immunity

Section D: Gene regulation by toxin-antitoxin modules and stationary phase adaptation
(Lectures 23-16, Dr Jennifer Robson)

11. The regulation and role of bacterial TA systems: Molecular switches that lead to persistence.
12. Stationary phase adaptation - regulation at all levels

Lab course overview

The objectives of the lab course are to provide hands-on experience with many of the skills and techniques that are used in a microbial genetics laboratory, and to develop skills in scientific record-keeping and reporting. The lab course is in the form of a research project that runs for two periods per week for four weeks, for a nominal total of 36 hours, but small amounts of work will also be required on additional days. The opportunity is provided for you to learn from your mistakes and repeat steps as required. You are required to maintain careful laboratory records and to write your experiment up in the form of a short scientific paper for assessment.

Assessment

1. Internal assessment based on laboratory report: 25% (due end of week 5 of semester, one week after final lab)
2. Assignment: 5% (given out week 3 of semester, due 28th April)
3. A written three-hour final examination comprising four either/or essay questions: 70%

To pass the paper, you must achieve a minimum of 50% overall.

Textbook

There is no recommended text for MICR 335 but you will be directed to and discuss relevant scientific papers during lectures.

Teaching staff

- Professor Greg Cook (Convenor)
- Professor Clive Ronson
- Dr Jen Robson
- Professor Peter Fineran
- Dr Kiel Hards

Workload expectations

An 18 point paper has a minimum expectation of 14 hours per week per paper (180 per semester). This is made up of formal contact times (lectures, tutorials, laboratories etc.) and independent study (studying, revision, assignments, reading etc.).

Responsibilities of students

- Students are responsible for making themselves aware of all University rules and regulations pertaining to their rights and responsibilities as students and to the degree in which they are enrolled.
- Students shall be deemed to have received any information:
    - provided in scheduled classes, regardless of attendance;
    - sent to their student email address;
    - made available via Blackboard or other University-approved learning management systems.
- Students are expected to be aware of all information related to a paper that is made available to them, and, in a timely manner, to raise with staff any questions or concerns relating to this information.
- Students are expected to be aware of, and to act in accordance with, the University's Academic Integrity Policy.

Academic integrity and academic misconduct

Academic integrity means being honest in your studying and assessments. It is the basis for ethical decision-making and behaviour in an academic context. Academic integrity is informed by the values of honesty, trust, responsibility, fairness, respect and courage. Students are expected to be aware of, and act in accordance with, the University's Academic Integrity Policy.

Academic Misconduct, such as plagiarism or cheating, is a breach of Academic Integrity and is taken very seriously by the University. Types of misconduct include plagiarism, copying, unauthorised collaboration, taking unauthorised material into a test or exam, impersonation, and assisting someone else's misconduct. A more extensive list of the types of academic misconduct and associated processes and penalties is available in the University's Student Academic Misconduct Procedures.

It is your responsibility to be aware of and use acceptable academic practices when completing your assessments. To access the information in the Academic Integrity Policy and learn more, please visit the University's Academic Integrity website at www.otago.ac.nz/study/academicintegrity or ask at the Student Learning Centre or Library. If you have any questions, ask your lecturer.

- Academic Integrity Policy (www.otago.ac.nz/administration/policies/otago116838.html)
- Student Academic Misconduct Procedures (http://www.otago.ac.nz/administration/policies/otago116850.html)

MICROBIOLOGY & IMMUNOLOGY
Te Tari Moromoroiti me te Ārai Mate