

**GENERAL INFORMATION FOR
2ND SCIENCE MICROBIOLOGY (MI201) 2011-2012**

**Semester I: MI211
Semester II: MI212**

Updates will be added to this information on the course Blackboard site.
NB: Sign-in frequently for updates, marks and announcements

WELCOME:

On behalf of the Department of Microbiology I would like to welcome you all to second year! We have designed a Microbiology course which we hope you will find stimulating and rewarding. The aim of the course is to provide you with a solid grounding in the fundamentals of Microbiology. Much of the information will be presented to you at the weekly lectures (3 per week) and these will be delivered by several different members of staff from the Department of Microbiology, including myself. In addition to the lectures the basic skills of a microbiologist will be taught at weekly practical sessions. The aim here is to give you as much "hands-on" experience as possible. We hope that you all enjoy the course and through it gain an understanding of the many ways that microbiology impacts our daily lives.

This handout contains all the general information that you will need to know about how the Microbiology course is organised. It includes information on: (i) where and when the lectures take place; (ii) where and when the practicals take place; (iii) how the lecture and practical courses are assessed; (iv) lecture content; (v) the recommended course textbook; and (vi) where to find additional information. Please read it carefully and retain it throughout the year for reference.

If you have difficulties with any aspect of the course please feel free to contact me. You can find me on the ground floor of the Department of Microbiology, either in my office (Room 105B) or in my lab (Room 113).



Course Director,
Dr Conor P O'Byrne.

LECTURES - VENUE AND TIMES:

The venues and times for 2nd Year Microbiology are as follows:

- **Monday, 9.00 am**, Lecture Hall AM200, Patrick F Fottrell Theatre, Arts Millennium Building.
- **Wednesday, 11.00 am**, Lecture Hall AM250, Colm O h'Eocha Theatre, Arts Millennium Building.
- **Thursday, 10.00 am**, Lecture Hall AC003, D'Arcy Thompson Theatre, Concourse.

Students are requested, and expected, to attend all lectures.

LABORATORY PRACTICALS - VENUE AND TIMES:

All Laboratory Practicals in both semesters take place in the 2nd Year laboratory, located on the first floor of the Department of Microbiology, NUI Galway.

For Laboratory Practicals, the 2nd Year Microbiology class is divided into three groups. Placement in a particular group is determined by the Department and is based on the students timetable with respect to their other 2nd Year subjects. The times for the 2nd Year Microbiology Laboratory Practicals are:

- Group A: Monday from 2.00 pm – 5.00 pm
- Group B: Tuesday from 10.00 am – 1.00 pm
- Group C: Wednesday from 1.00 pm – 4.00 pm

Attendance at Laboratory Practicals is compulsory. All students will need a hard-cover laboratory note-book (the "Day Book") and a white laboratory coat. Laboratory manuals are necessary and can be obtained from the Department of Microbiology.

RECOMMENDED TEXTBOOKS:

2nd Year Microbiology students are recommended to obtain either of the following textbooks for the 2nd Year Microbiology Lecture course:

Brock "Biology of Microorganisms", 12th Edition , by Madigan, Martinko & Parker.

This book is published by Prentice Hall International Inc. (ISBN 0-13-196893-9), and can be obtained from the University Bookshop, NUI Galway at a cost of €66.45. (Note: The 10th or 11th editions will also be ok for this course.)

Microbiology; An evolving Science, By Slonczewski & Foster

This book is published by Norton. (ISBN 0-39-397857-5) and is also available for purchase as an ebook at a reduced price.

Students are encouraged to purchase their own copy of one of these textbooks as an aid to revision, however there are 30 copies of each in the library (10 of which are on desk reserve).

COURSE ASSESSMENT:

The breakdown of marks for the year are as follows:

- Semester I Written Exam Paper = 35%
- Semester I MCQs = 5%
- Semester II Written Exam Paper = 35%
- Semester II MCQs = 5%
- All Laboratory Practical Sessions = 20%

Progression to Honours Microbiology: Students wishing to progress to honours Microbiology in 4th year must achieve at least 40% overall in 2nd year Microbiology. In third year a minimum mark of 45% must be achieved in order to guarantee entry to 4th year Microbiology. These are minimum requirements – students should be aiming to achieve honours marks on all courses.

IMPORTANT: 5% of your final degree mark will be calculated based on your 2nd year mark. Therefore if you want to qualify with a good honours degree you should be aiming to achieve a good honours mark in 2nd year.

WRITTEN EXAM PAPERS:

The examination format for the **Semester I** Written Exam Paper is:

Question 1: Cytology, Dr. Cyril Carroll
Question 2: Genetics, Dr. Aoife Boyd
Question 3: Physiology, Dr. Conor O'Byrne
Question 4: Metabolism, Dr. Thomas Barry
Question 5-7: From any part of the lecture course

Students must answer **any five** of these seven questions within three hours.

The examination format for the **Semester II** Written Exam Paper is:

Question 1: Classification and Evolution, Dr Aoife Boyd & Dr Ger Fleming
Question 2: Microbial Ecology & Waste Treatment Systems, Dr Vincent O'Flaherty
Question 3: Virology, Dr Gerard wall
Question 4: Microbes and Disease, Dr. Conor O'Byrne
Questions 5-7: From any part of the lecture course

Students must answer **any five** of these seven questions within three hours.

The Examination Result Grades applicable are:

% Range:	100-70%	69-60%	59-55%	54-50%	49-40%	39-35%	34-30%	29-0%
Grade:	A	B	C+	C-	D	E+	E-	F

- The pass standard is 40% or greater
 - First class honour is 70% or greater
 - Second class honour, grade I is 60-69%
 - Second class honour, grade II is 50-59%
-

LABORATORY PRACTICALS - ASSESSMENT:

One third of the marks allocated to the practicals are awarded for attendance (i.e. you can obtain 6.7% of the total marks for the year by attending all your practicals). If you have a legitimate excuse (e.g. medical reason) you will not lose marks, provided that you supply a medical certificate. **Please give medical certs to the Microbiology secretary – Ms Caroline O’Connell, room 202** (do not give medical certs to the practical demonstrators). The remaining two thirds of the marks are allocated for practical write-ups in your Day Book (i.e. 13.3% of total years marks). These are to be written up on the day of the practical, and signed by a demonstrator. Please note, write-ups that are not signed and stamped by a demonstrator will not be marked. Day Books must be submitted for correction at the end of each semester. **Failure to hand your Day Book in on time will lead to a loss of all marks for that semester (i.e. 6.7% of total years marks)**. Please note, it is the responsibility of the student to ensure that their Day Book is handed in to the Department and that their submission is registered in our records.

IMPORTANT: Please note that if you fail to attend a practical session your Day Book write-up will not be marked for that practical. You will therefore lose both the attendance marks and write-up marks allocated to that practical. (Again, this excludes students who have a legitimate medical reason for their absence.)

OTHER INFORMATION:

Notices relevant to 2nd year Microbiology will be posted on Blackboard and on the 2nd year notice board, which is located on the first floor of the Microbiology Department, next to the Tyndall lecture theatre.

SEMESTER I : MI211

"THE MICROBIAL CELL"

INTRODUCTION

Lecture 1 - Introduction.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: Monday September 12th

This lecture will provide an overview of the first semester course. Information will be given on the schedule and requirements for the 2nd Year Microbiology laboratory practical course. It will also contain important information on how the course is assessed.

MICROBIAL CYTOLOGY

Lectures 2 & 3. - Cell types and techniques to study cell cytology.

LECTURER: Dr. Cyril Carroll

LECTURE DATES: September 14^h & 15th

Prokaryotic and Eukaryotic cells. Bacterial cell size, shape and arrangement. Cytological methods include microscope types, bacterial staining techniques, and cell disruption techniques.

Lecture 4. - Bacterial cell envelope components.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 19th

The cell envelope, Gram positive & Gram negative. The cell wall structure. Peptidoglycan.

Lecture 5. - The bacterial cell membrane.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 21st

Bacterial cell membrane structure and function. Phospholipids and proteins. Biosynthesis. Diffusion and transport. ATP synthesis. Electron transport chain. The outer membrane, structure and function. Lipopolysaccharides. Zones of adhesion. Periplasmic space. The cell capsule.

Lecture 6. - Prokaryotic & Eukaryotic intercellular components.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 22nd

Differences between Prokaryotic & Eukaryotic intercellular components. Plasma membranes. DNA structure, replication and segregation. Ribosome structure and function. Endoplasmic reticulum. Plasmids. Mesosomes. Gas vacuoles. Inclusion bodies.

Lecture 7. - Bacterial endospores.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 26th

Endospore structure, function and formation.

Lecture 8. - Bacterial cell motility.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 28th

Methods of study. Flagellar structure, Gram positive & Gram negative. Chemotaxis. Pili.

Lecture 9. - The cell cycle.

LECTURER: Dr. Cyril Carroll

LECTURE DATE: September 29th

The Prokaryotic cell cycle. The Eucaryotic cell cycle, G1, S, G2 & M phases.

MICROBIAL PHYSIOLOGY

Lecture 10 - Nutritional Requirements

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: October 3rd

Microbial nutritional types. Elemental requirements of micro-organisms including carbon, hydrogen, phosphorous and sulphur. Requirement in metallic elements and their role in metabolism. Accessory growth requirements.

Lecture 11 - Isolation of Microorganisms

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: October 5th

Survival and growth of micro-organisms in oligotrophic environments. Laboratory culture in liquid and solid media. Isolation of bacteria and the techniques employed. Selective methods, including selective enrichment and selective repression. Differential media.

Lectures 12, 13 & 14 - Physical Conditions Affecting Growth

LECTURER: Dr. Conor O'Byrne

LECTURE DATES: October 6th, 10th & 12th

The effects of temperature, gaseous atmosphere, pH, osmotic concentration, water activity, electromagnetic radiation and hydrostatic pressure on microbial growth will be discussed. Classification of micro-organisms based on these parameters will be elucidated, as will their influence on the metabolism and the occurrence of various species in different environments.

Lecture 15 - Microbial Growth

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: October 13th

Microbial replication including binary fission of bacteria, budding of yeasts and filament formation in fungi. Bacterial growth in batch culture and the mathematics of exponential growth. Continuous culture by chemostat and turbidostat.

Lectures 16 & 17 - Quantitative Measurement of Microbial Growth

LECTURER: Dr. Conor O'Byrne

LECTURE DATES: October 17th & 19th

Measurement of the microbial population by (i) quantification of cell numbers, (ii) quantification of cell mass, and (iii) microbial activity will be discussed. The techniques involved such as plate counting, membrane filtration, end-point dilution, microscopic counts, electronic cell counter, dry weight and turbidimetric measurements, radiometric methods, electrical impedance, ATP levels and dye reduction tests will be reviewed.

MICROBIAL METABOLISM

Lecture 18 - Introduction to Metabolism.

LECTURER: Dr. Thomas Barry

LECTURE DATE: October 20th

Introduction to biological energy systems, with emphasis on integrated systems of metabolism in living organisms. Central metabolic systems. Introduction to concepts such as nutrients, catabolism and anabolism. The placement of microorganisms into metabolic classes such as phototrophs, chemotrophs and chemoorganotrophs.

Lecture 19, 20 & 21 - The Fundamentals of Metabolism.

LECTURER: Dr. Thomas Barry

LECTURE DATES: October 24th, 26th & 27th

The three fundamentals of metabolism. (1) The laws of thermodynamics, free energy

reactions. (2) Enzyme catalysis. (3) Oxidation-Reduction reactions. Release and harvesting of energy in metabolic systems. The currency of living cells. High energy compounds.

Lecture 22, 23 & 24 - Microbial Metabolic Systems.

LECTURER: Dr. Thomas Barry

LECTURE DATES: November 2nd, 3rd, 7th

Nutrient uptake, activation and streamlining in bacteria. Catabolic systems of bacteria. Fermentation systems, aerobic and anaerobic respiration systems. Substrate level phosphorylation. Energy conservation and the electron transport chain. Oxidative phosphorylation. Energy costs and energy balance sheets of metabolic systems. Oxygenic photosynthesis. The Light reactions, Photosystems I and II. High energy compound synthesis. Noncyclic photophosphorylation. Anoxygenic photosynthesis. The dark reactions, autotrophic CO₂ fixation. The Calvin cycle.

MICROBIAL GENETICS

Lectures 25 & 26 - DNA as Information Molecule

LECTURER: Dr. Aoife Boyd

LECTURE DATES: November 9th & 10th

Information flow in the cell. Information storage in DNA. DNA and genome structure. DNA replication during cell division.

Lectures 27 & 28 - Protein Synthesis

LECTURER: Dr. Aoife Boyd

LECTURE DATES: November 14th & 16th

Genes and gene expression. Transcription of genetic information from DNA to RNA. Translation of RNA into protein. The genetic code. The tRNA-amino acid complex as interpreter.

Lecture 29 - Genetic Variation and Spontaneous Mutation

LECTURER: Dr. Aoife Boyd

LECTURE DATES: November 17th

Inheritable changes in DNA. Importance of genetic variation. Spontaneous mutation. Consequences of mutations.

Lectures 30 & 31 - DNA Transfer

LECTURER: Dr. Aoife Boyd

LECTURE DATES: November 21st & 23rd

Genome rearrangements. Genetic recombination. Mobile genetic elements. Horizontal DNA transfer by transformation, transduction and conjugation.

EXAMINATION INFORMATION LECTURE

Lecture 32

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: November 24th

SEMESTER II : MI212

"MICROBES AND THE ENVIRONMENT"

MICROBIAL CLASSIFICATION AND EVOLUTION

Lecture 1: Microbial Classification Systems

LECTURER: Dr. Aoife Boyd

LECTURE DATE: January 9th

Importance of microbial classification systems. Domains of life: Bacteria, Archaea and Eukarya. Hierarchical organisation. Phenotypic Classification: Traditional and standard methods for classification and identification of microbes based on appearance, behaviour and cellular composition.

Lecture 2 & 3: Genotypic and Phylogenetic Classification

LECTURER: Dr. Aoife Boyd

LECTURE DATE: January 11th & 12th

Newer approaches to classification and identification of microbes based on genetic characteristics. Understanding and establishing evolutionary relationships between microbes. Small SubUnit RNA as target molecule for phylogenetics and for identification.

Lecture 4-7: Microbial Taxonomy and Nomenclature.

LECTURER: Dr Ger Fleming

LECTURE DATE: January 16th, 18th, 19th, & 23rd

The previous lecture series (Dr. Boyd) has given you an insight into how microorganisms are classified into their various groupings using classical and molecular techniques. Conventionally, bacteria are grouped (systematics) using criteria contained in Bergey's Manual of Systematic Bacteriology. These tomes (consisting of five volumes) provide the professional microbiologist with the foundations/details of microbial taxonomy. They are far too complex and are perceived as stoical when used as a teaching tool. This series of lectures is designed to give you an insight into the vast diversity of bacteria that are contained in this unique ecosystem called earth. The approach we are going to take is quite different. Whilst recognition will be paid to the taxonomic principles contained within Bergey's manual, we will investigate the characteristics of bacteria under the following headings: (1) Bacteria with industrial applications, (2) Bacteria that are relevant from an environmental perspective, (3) Medically important bacteria and, (4) the Cyanobacteria. The lecture series will mainly be based on chapter twelve of Brock and details will be provided throughout the course of the lecture series on how possible questions should be attempted in the summer examination.

VIROLOGY

Lectures 8 to 14 - Animal Viruses

LECTURER: Dr Gerard Wall

LECTURE DATES: January 25th, 26th, 30th, February 1st, 2nd, 6th, & 8th.

The composition, morphology and classification of animal viruses. The life cycle of typical animal viruses. Viral disease of Man and animals (including influenza, measles, chickenpox, smallpox, German measles, hepatitis, herpes, rabies, myxomatosis, etc.). Chronic viral infections. "Slow" viruses and prions. Viruses and cancer.

BIOGEOCHEMISTRY & MICROBIAL WASTE TREATMENT SYSTEMS

Lectures 15 and 16:

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATES: February 9th & 13th

The microbial planet. Ecosystems and habitats. What roles do microbes play in the environment? Introduction to microbial ecology.

Lecture 17:

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATES: February 15th

Biogeochemistry and biogeochemical cycles – how do they drive the biosphere? The role of microorganisms in primary production and decomposition.

Lectures 18 & 19 - Biogeochemical cycling of Carbon, Nitrogen & Phosphorus (1).

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATE: February 16th & 20th

The biological Carbon cycle in terrestrial and aquatic ecosystems. The impact of humans on the carbon cycle – global warming.

Lectures 20 & 21 - Biogeochemical cycling of Carbon, Nitrogen & Phosphorus (2).

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATE: February 22nd & 23rd

The biological nitrogen and phosphorus cycles. Primary microorganisms involved. Environmental consequences of these cycles.

Lectures 22 & 23 - Waste and wastewater treatment (1).

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATE: February 27th & 29th

Waste treatment - why? Objectives of waste treatment: 1. To destroy/improve organic compounds in waste materials. 2. To destroy pathogens. 3. Biotransformation to maintain environmental quality.

Lecture 24 - Waste and wastewater treatment (2).

LECTURER: Dr. Vincent O'Flaherty

LECTURE DATE: March 1st

Aerobic and anaerobic wastewater treatment systems and biology. The role of biofilms in these systems.

MICROBES AND DISEASE

Lecture 25 - 27: – Pasteur and Koch; the founding fathers of Medical Microbiology.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 5th, 7th, & 8th

A historical overview of the roles played Louis Pasteur and Robert Koch in establishing that microorganisms are responsible for decay and disease. Pasteur's Swan-neck flask experiments and the debunking of the theory of "Spontaneous generation". "Koch's postulates" in the context of anthrax and tuberculosis.

Lecture 28 – The commensal microflora of man.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 12th

The normal (commensal) flora of humans. Factors affecting the profile of microorganisms found on host surfaces. Examination of the microflora found at different anatomical locations including, skin, upper and lower respiratory tract, eye (conjunctiva), gastrointestinal tract and the urogenital tract. Highlight members of the normal flora that are known pathogens.

Lecture 29 – Host defence against invading microorganisms: The immune system.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 14th

The human immune system. Specific and non-specific defence mechanisms against microorganisms. Phagocytosis. Antibodies and antigens. The structures and roles of the different classes of antibodies. The complement system. Primary versus secondary immune responses.

St Patrick's Day (Wednesday 17th March)

Lecture 30 – Anthrax and Bio-terrorism

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 15th

A historical overview of bio-terrorism. Routes of infection by *Bacillus anthracis* and clinical manifestations of anthrax. Practical implications of using *B. anthracis* as an agent of biological warfare.

Lectures 31 – GI infections: Escherichia coli.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 21st

Commensal versus pathogenic *E. coli* strains. How *E. coli* strains are characterised by serotype. Enteropathogenic *E. coli* (EPEC), Enterotoxigenic *E. coli* (ETEC) and Enterohemorrhagic *E. coli* (EHEC). Symptoms and prevention of infection.

Lectures 32 - *Helicobacter pylori* and ulcers.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 22nd

Recent discovery of the causative agent of stomach ulcers in humans: *Helicobacter pylori* and Koch's postulates. Clinical symptoms of infection with *H. pylori*. Strategies used by *H. pylori* to survive in the human stomach. Detection and treatment of the disease.

Lecture 33 – Summary and exam tips.

LECTURER: Dr. Conor O'Byrne

LECTURE DATE: March 26th

Summary and conclusion of the "Microbes and disease" lectures. Advice on how to approach the end of year written exam in Microbiology. Course feedback questionnaires.
