College of Biological Sciences
DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY

COURSE OUTLINE
MICR*2420 INTRODUCTION TO MICROBIOLOGY - Fall 2015 (3-2)

CALENDAR DESCRIPTION (3-2) [0.5 credits]
This course will introduce students to the diversity of microorganisms, including, bacteria, viruses and fungi, and their impact on everyday life. The interactions of these organisms with both the biotic and abiotic worlds will be discussed. Topics will include the roles of microorganisms in host-pathogen interactions in disease, the beneficial aspects of microorganisms in bioremediation and food production, and their application in biotechnology.
Prerequisite(s): Four (*4.0)* credits (1 of BIOL*1040, BIOL*1070, BIOL*1080, BIOL*1090, CHEM*1040)
Restrictions: MICR*2020

INSTRUCTORS:

1. **Dr. Lucy Mutharia,** Course Instructor /Coordinator, Office: SSC 3253 (Summerlee Science Complex), **lmuthari@uoguelph.ca**
2. **Mr. Rohan van Twest,** Lab Coordinator / Demonstrator, Office: SSC 4113, **rvantwes@uoguelph.ca**

Course Schedule:

1. *Lectures*: Mon / Wed / Fri. TIME 9.30 am – 10.20 am. Room: MACN 105 (MacNaughton)
2. *Labs*: Mon / Tues / Wed. TIME 2.30 pm – 4.20 pm. Room: SSC 4102

Course Instructor office hours- Thursdays 2:30 – 3:30 (drop-in; SCIE3253), additional drop-in or virtual office hours tba. Also by appointment.

* In order to meet with the instructors outside of class hours, students *must* make an appointment with the instructor *by e-mail or in person*. Likewise you must e-mail your lab TA to make an appointment to see them outside of the set lab hours.

Important dates:
Classes begin / end: Friday Sept 11th to Friday Dec 4, 2015; *Thanksgiving*: Mon. Oct 12; *40th day* – Friday Nov 6/2015. *Final Course Exam*: Wednesday 11.30 am – 1.30 pm December 9, 2015 (2015/12/09).
➢These & other dates are also identified in the Courselink Calendar

Course Goals and Learning Outcomes
This course serves as the foundation of the Microbiology Program. The course is designed to capture your interest by introducing you to the relevance of Microbiology in your everyday life, discussing the global impact of microbes, and by providing opportunity for hands on experience with microbes in a laboratory setting.
The Course Learning Outcomes (LO) and the specific conceptual details associated with these LO are listed **Appendix A** (of this course outline). Specific LO and concepts maybe identified as we progress through the lecture topics and collectively will be assessed through the various graded components of the course. The list maybe updated periodically during the semester, through deletion and addition, depending upon the pace and depth of coverage of a given topic. Course readings, class discussions and/or group work, will also further develop the broader MCB Program Learning Outcomes and the UoG learning outcomes

COURSE CONTENT

a. Lectures

[a]# Lectures	Lecture Topic	textbook chapters[b]
2-3	**1. Introduction** - relevance of microbes to health, industry and the environment; how microbes have shaped history; Tree of Life & the microbes **2. Microscopic visualization of the microbes**	1, 2
3-4	**3. Specific characteristics of cellular microbes** - distinguishing characteristics of bacteria, archaea, fungi and protists (size/structure, metabolism)	3, 19, 20[a] & appendix 2
MIDTERM 1 on Friday October 2, 28 during class hour on topics 1-3		
3-4	**4. Specific characteristics of acellular microbes - Viruses/bacteriophages**: Case Study #1 - size/structure, unique properties, how they grow; viruses as biocontrol agents	Ch. 6 + case study readings
1	Conclusion of viruses **Introduction to microbial ecology**	6
4	**5. Microbial ecology** - microbes in different niches, factors that shape and define community structure; identifying the uncultivated	21, 4 (pp.119-127), 14[c], 21[c] , 22[c]
4-5	**6. Biotechnological applications of microbes** – bioremediation, biocontrol, food/beverage industries, vaccines and antibiotics	16, 22, 27
MIDTERM II on Monday November 9 during class hour on Topics 4-6		
3-4	**7. Microbial Associations** – biofilms, quorum sensing, symbioses, human microflora	Sec. 4.6, Sec. 10.8, 21, 23.1 & 23.2
6-8	**8. Microbes in health and disease** - innate vs. acquired immunity, Koch's postulates, characteristics of a pathogen, *Select* infectious diseases – diagnosis, treatment, control, resistance. -Case study #2	23, 24, 25, 26[c], 27[c], 28[c], + case study readings
Friday December 4- Review class		

[a] these are approximate lecture # & dates and are subject to some alteration

[b] these are subject to minor change. Additional readings related to the Case studies are provided with each case study.

[c] select pages to be posted on the relevant slides

b. Labs[1]: Four 2-h labs designed to provide hands-on experience as well as demonstrations.

Week	***Laboratory Topic & Hands-on activities***
1	General rules and regulations, Biosafety; standard operating procedures, Aseptic techniques, steak plate isolation, brightfield microscopy, Yeast cellular morphology, Gram-stain *Hands on*: Microscopy. Observation of live organisms
2	Culturing microorganisms, preparation of agar medium, direct isolation with selective and differential media, enrichment & isolation of *Halobacterium*, efficacy testing of handwashing & alcohol-based gel disinfectation of hands. *Hands on*: use of simple stains & observations of microbe cell morphologies
3	Pour plate count, enrichment & isolation of bacteriophages from soil Hands *on*: Aseptic Transfer, Pure cultures, Enumeration.
4	Bioluminescence of *Vibrio fischeri* , bacterial swimming & swarming motility, complete *Halobacterium* isolation. *Hands on*: Microscopy, recording, Plaque assays. Enumeration.
5	Complete all observations and laboratory data sheets

[1] Students without lab coats or wearing open shoes (exposing skin on tops of feet, soles, toes or heel) will **not** be allowed in the lab. Bring your lab manual to every lab class. ***Lab attendance is compulsory*.**

c. Method of presentation:
This course is designed to capture students' attention and interest, as such classroom teaching will be interactive whenever possible and centered on microbiology as it pertains to everyday life, current affairs & news items. The lab component consists of hands-on experience and demonstrations. On-line and in-class quizzes, 1-2 case studies and associated quizzes, as well as videos and animations (posted on CourseLink) will help you to master the material and identify to the instructors any collective stumbling blocks

Course resources

Textbook: The **required** textbook is 'Microbiology – An evolving Science', *3rd edition* (2014) by J L Slonczewski and JW Foster (WW Norton Inc, ISBN 0-393-91929-5). This is available from the bookstore or as an e-book (6- or 12 month or permanent access) through the publisher's website (http://books.wwnorton.com/nortonebooks/), or in the library on 2h reserve.

Laboratory manual- is **required** and may be purchased from room SSC 3115 on Sept. 10, 11, 15 & 15 (4 days only) from 9.30 am – 12:00pm and 1:00 pm – 3.30 pm. *Cash only* ($10).

CourseLink: the course webpage will be used extensively and will include all relevant course materials, discussion boards, quizzes, links for additional readings & a course calendar.

Methods of assessment

Activity	*Details & Date*	*Weight of assessment*
Lecture quizzes[a]	5 quizzes, 2.5 marks. N*on-cumulative.* **Dates**: *Sept. 23, Oct. 16, Oct 30, Nov. 20, Nov. 30*	10
Midterm exam 1[b]	During regular class time on ***Friday, October 2.*** Lecture Topics 1-3. *No make-up exam*	15[b] (The best of 2 midterm exams each 15%)
Midterm exam II[b]	During class time on ***Monday, November 9.*** Topics 4-6. *No make-up exam*	
Independent study assignment	Independent research on a chosen organism. Tested in the final exam (3.5 marks).	
Lab component[c]	See Lab manual for report due dates & mark distribution	20
Final Exam[d]	Cumulative, includes questions on the Independent Assignment and on the labs	55 or 70%

[a] **Lecture quizzes** are online, *non-cumulative on preceding lecture material* (best 4 of 5). Once begun, every student will have 45 min to complete the quiz; the time allowed is at least 3x longer than the time deemed necessary for successful completion (assuming you have done the reading and attended class) – *NO extra time will be provide*. Each quiz is open for a 24h period / window (e.g. 6am Sept. 23 -to- 6am Sept. 24)

[b] **Writing midterm exams is *optional but strongly encouraged.*** *NO makeup exams.* You are encouraged to write the midterms rather than gamble on performing well on the final exam. The midterm grade is worth 15% of the course grade. Students write 2 midterm exams (15 marks each). The lower grade mark will be dropped and the BEST / HIGHEST grade will be included in calculating the final course grade. **The midterm paper will not be handed back,** however students may view the exam after grades are released. If you wish to view your midterm exams post-grading, please check Courselink for posted details of viewing dates/times for each exam.

[c] Students **must pass the lab component on its own** and the lecture component on its own in order to pass the course.

[d] Students who miss the midterms will write a 70% (Cumulative) final examination. For students who **DO** write the midterm exam but perform better on the final, the midterm grade will be dropped and the grade weight (15%) transferred to the final exam. You are encouraged to write the midterms rather than gamble on performing well on the final exam.

Student ID presentation: You MUST bring your valid student ID card to EVERY exam, and present it to an invigilator when handing in your paper.

Standard University Course policies

Electronic recording

Electronic recording of lectures or presentations which are made in relation to course work -is expressly forbidden except with prior consent of the instructor. When permitted, the recordings are to be used solely for the use of the authorized student and may not be reproduced or transmitted to others without the express written permission of the instructor. Please do not use electronic media in the class except for the sole purpose of the material covered (e.g. following the lecture slides or taking lecture notes)

E-mail communication:

As per University regulations, students are required to check their UoGuelph email account regularly: email is the official route for communication between the University (instructors) and the students.

ABSENCE AND ILLNESS & when a student cannot meet the course requirements:

Students who miss lectures are expected to obtain the materials through reading or discussion with their colleagues. Where requested, Academic Consideration can only be given for ***missed labs*** providing appropriate supporting / written (and signed) documentation is submitted as soon as possible following the event/circumstance for which consideration is requested.

In the case of a missed final exam, the student must fill out a "Request for Academic Consideration" form, available in the BSc academic advising office. Consideration is only granted by the Academic Review Subcommittee, as described in section VIII of the UofG Undergraduate Calendar, **Undergraduate degree regulations & procedures:** Undergraduate Calendar. In addition to providing information on the university academic policies and procedures, the section describes **what constitutes Academic misconduct, plagiarism & associated penalties**. Students are strongly encouraged to become familiar (and understand) this information as **ignorance of the rules is not an accepted defense for committing academic misconduct.**

Drop Date

The last date to drop one-semester courses, without academic penalty, is the 40th class day. To confirm the actual date please see the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar: Undergraduate Calendar - Dropping Courses

Accessibility

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: Centre for Student with Disabilities/ Student Accessibility Services (SAS).

Other useful sites and services include, Student Health Services, Counselling Services and CBS BSc student academic advising bscweb@uoguelph.ca

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
Undergraduate Calendar - Academic Misconduct

Copies of out-of-class assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Campus Resources

If you are concerned about any aspect of your academic program:

- make an appointment with a program counsellor in your degree program. B.Sc. Academic Advising or Program Counsellors

If you are struggling to succeed academically:

- There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. The Learning Commons

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. Counselling Services
- Student Health Services is located on campus and is available to provide medical attention. Student Health Services
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. Stress Management and High Performance Clinic

If you have a documented disability or think you may have a disability:

- The Centre for Students with Disabilities (CSD) can provide services and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability. For more information, including how to register with the centre please see: Centre for Students with Disabilities

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Appendix A

MICR*2420 Course Learning Outcomes (LO A-D) and associated conceptual details

A. ENERGY IN BIOLOGICAL SYSTEMS; METABOLIC PATHWAYS

By the end of the course, successful students will be able to:

A1. Demonstrate an understanding that metabolic diversity exists among eukaryotes, prokaryotes and viruses, by

a. describe the metabolic diversity of the microorganisms, recognizing the distinction between lithotrophy, heterotrophy, phototrophy and autotrophy, and the prevalence of extremophiles throughout the biosphere
b. identify the types of microbes and their functions in example communities
c. recognize how the metabolic activities of the bacteria and archaea compare to those of the eukaryotic microbes, including their dominant roles in biogeochemical cycling (e.g. nitrogen fixation)
d. explain, using specific examples, why viruses are obligate intracellular parasites
e. relate the selective toxicity of various antibacterial and antiviral agents to pathogen-specific processes

B. STRUCTURE-FUNCTION RELATIONSHIPS IN BIOLOGICAL SYSTEMS

By the end of the course, successful students will be able to:

B1. Demonstrate an understanding of macromolecular interactions, structure and function, by

a. describe the inhibitory activities of various antimicrobials on their cellular targets
b. describe the enzymatic or structural basis for resistance to various antimicrobial agents
c. explain the basis for classification of viruses
d. explain, with specific examples, how viruses enter, replicate and are released from bacterial and animal host cells
e. describe the molecular interactions and processes in the innate and acquired immune responses

B2. Demonstrate an understanding that the properties of cells are a function of the chemical structures of their constituent macromolecules, by

a. explaining how the bacterial and archaeal plasma membranes fulfill many of the functions of eukaryotic organelles
b. describing the basic principles of bacterial and viral pathogenesis, including protection from the immune response
c. describing how microbial structures and processes are used for diagnostics and vaccine development
d. comparing and contrasting the various cells of the human immune system
e. describing the processes of quorum sensing and biofilm formation, and the effects on cellular physiology
f. explaining, with examples, how microbes, their structures or processes are exploited for biotechnology and food processing

B3. Demonstrate a deep understanding of the roles of cells as the fundamental unit of life, by

a. comparing and contrasting the basic features of bacterial, archaeal, fungal, algal and protozoal microbes
b. relating cell structures/organelles to cell function in the major types of microorganism
c. identifying the essential differences between the cellular microorganisms and the viruses
d. describing how various microscopic techniques can reveal the structure and function of microorganisms
e. describing how SSU RNA provides a method of identifying and classifying all life forms

B4. Demonstrate an understanding of how cells, organelles and all major metabolic pathways evolved from early prokaryotic cells, by

a. providing examples of, and explanations for, the shared features within and between bacteria, archaea and eukaryotes
b. describing the Endosymbiont Theory and explain the presence of a chloroplast and mitochondrial branch on the bacterial portion of the Universal Tree of Life (ToL)
c. explaining the evolutionary information in the ToL
d. relating the vast diversity and ubiquity of extant bacteria and archaea to their evolutionary history

B5. Demonstrate an understanding of communication within and between cells and their environment, by

a. describing, with examples, the principles, and different forms, of microbial associations (including parasitism)

B6. Demonstrate an understanding of intracellular trafficking and cellular motility, by

a. describe the role of flagella in bacterial motility

C. EVOLUTION AND THE FLOW OF GENETIC INFORMATION

By the end of the course, successful students will be able to,

C1. Demonstrate an understanding that mutations, recombination and horizontal gene transfer have selected for a huge diversity of organisms, by

a. describing the mechanisms of acquisition and spread of antibiotic resistance
b. describing, with examples, how horizontal gene transfer among or between bacteria, viruses and eukaryotes can lead to phenotypic changes

C2. Demonstrate an understanding that related organisms have a common ancestor, by

a. describing the relevance of a root and branching events in the ToL

C3. Demonstrate an understanding of the factors that affect the frequency of genotypes and phenotypes in a population over time, by

a. explaining how man's impact on the environment can affect microbial community composition
b. describing how human behavior has impacted the evolution of microbes (including antibiotic resistance and emerging diseases)

D. SCIENTIFIC METHOD

By the end of the course, successful students will be able to,

D1. Describe or assess the appropriate method of visualization and identification of example microbes
D2. Perform experiments using appropriate safety precautions, and microbiological techniques for the isolation, identification and enumeration of representative groups of bacteria, archaea and fungi
D3. Use appropriate and accurate mathematical calculations for microbial enumeration
D4. Successfully interpret and communicate scientific data