COLLEGE OF BIOLOGICAL SCIENCE
Department of Molecular and Cellular Biology (MCB)

MICR*2420 Introduction to Microbiology - Winter 2016

Lectures: Tuesdays and Thursdays TIME: **10 am - 11.20 am** Room: **RICH 2520**

Labs: Monday and Tuesday TIME: **2.30 pm – 4.20 pm**. Room: **SCIE4102**

Dates: ***Tuesday January 12th-Thursday April 7th, 2016;*** Final Course Exam***: Saturday April 16th 19.00-21.00*** **(**Venue **–** TBA)

CALENDAR DESCRIPTION: 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) First year science credits. Restrictions*: MICR*2020

INSTRUCTORS:

Dr. Emma Allen-Vercoe*	**Mr. Rohan van Twest***
Course Instructor/Coordinator Office: SCIE 3252	Lab Demonstrator Office: SCIE 4113
eav@uoguelph.ca	rvantwes@uoguelph.ca

*** 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.**

LEARNING OUTCOMES:
1. ENERGY IN BIOLOGICAL SYSTEMS; METABOLIC PATHWAYS
a. Metabolic diversity exists among eukaryotes, prokaryotes and archaea.
By the end of this course, students should be able to:
• Describe the metabolic diversity of the microorganisms, in particular, the distinction between lithotrophy, heterotrophy, phototrophy and autotrophy, and the prevalence of extremophiles
• Recognize how the metabolic activities of the bacteria and archaea compare to that of the eukaryotic microbes, including their dominant roles in biogeochemical cycling (e.g. nitrogen fixation)
• Explain why viruses are obligate intracellular parasites
• Relate the inhibitory function of various antimicrobials with their unique metabolic processes (e.g. protein synthesis)

2. STRUCTURE-FUNCTION RELATIONSHIPS IN BIOLOGICAL SYSTEMS
a. Macromolecular interactions, structure and function
By the end of this course, students should be able to:
• Describe the basic structure and function of various microbial cellular components: e.g. organelles and what they do (this includes recognizing how the prokaryotic plasma membrane fulfills many of the functions of eukaryotic membrane-bound organelles)

• Describe the inhibitory activities of various antimicrobials on unique microbial structures
• Describe the different classes of viruses and the molecular interactions involved in different viral life cycles, including lysogenic and lytic
• Demonstrate a basic understanding of the molecular interactions and processes in the innate and acquired immune responses

b. The properties of cells are a function of the chemical structures of their constituent macromolecules
By the end of this course, students should be able to:
• Identify the distinguishing features of microorganisms, focusing on bacteria, fungi and viruses.
• Describe the basic principles of bacterial and viral pathogenesis
• Demonstrate an understanding of how microbial structures and processes are used for diagnostics
• Demonstrate a basic understanding of the roles of microbial structures in vaccines
• Describe the differences between the various types of cells of the human immune system
• Describe how various microbial structures help elude the human immune response
• Describe the processes of quorum sensing and biofilm formation, and the physiological results
• Provide some examples of how microbes, their structures or processes have been exploited for biotechnology and food processing

c. Cells are the fundamental unit of life
By the end of this course, students should be able to:
• Compare and contrast cellular microorganisms with viruses
• Describe how various microscopic techniques have revealed the structure and function of microorganisms

d. Cells, organelles and all major metabolic pathways evolved from early prokaryotic cells
By the end of this course, students should be able to:
• Relate the cell structures, metabolic diversity and distribution of bacteria, archaea and eukaryotes to their evolutionary history (including a discussion of the endosymbiont theory)

e. Communication within and between cells and their environment
By the end of this course, students should be able to:
• Demonstrate an understanding of the essential roles of microbes in the environment & agriculture
• Discuss the environmental niches to which microbes adapt and how this is done.
• Describe, with examples, the principles, and different forms, of microbial associations (including parasitism)

f. Intracellular trafficking, cellular motility
By the end of this course, students should be able to:
• Describe the role of flagella in bacterial motility

3. EVOLUTION AND THE FLOW OF GENETIC INFORMATION
a. Mutations, recombination and horizontal gene transfer have selected for a huge diversity of organisms
By the end of this course, students should be able to:
• Describe the mechanisms of acquisition and spread of antibiotic resistance
• Describe, at a basic level, the various mechanisms of horizontal gene transfer among bacteria and archaea

b. Related organisms have a common ancestor
By the end of this course, students should be able to:
• Demonstrate an understanding of the basic information in the Tree of Life, including the positions of chloroplasts and mitochondria in the bacterial domain.

c. Different factors affect the frequency of genotypes and phenotypes in a population over time
By the end of this course, students should be able to:

• Demonstrate an understanding of how human behavior has impacted the evolution of microbes (including antibiotic resistance and emerging diseases)

4. SCIENTIFIC METHOD
a. Experiments: isolation and characterization techniques
By the end of this course, students should be able to:
• Understand and appreciate the need for laboratory safety.
• Be competent with aseptic technique.
• Understand and be competent in basic axenic cultivation techniques.
• Understand the various microbiological cultivation and enumeration techniques

b. Interpret and communicate scientific data
• By the end of the course, students should have further developed this ability through performing and reporting the results of laboratory experiments

APPROACH

This course is designed to capture students' attention and interest; as such classroom teaching will be interactive wherever possible, and centered on microbiology as it pertains to everyday life, current affairs and news items. The lab component consists of five 2-hour labs and will provide hands-on experience as well as demonstrations.

TEXTBOOK: ***Microbiology – An evolving Science, 3rd edition*** *by J L Slonczewski and JW Foster* (WW Norton Inc, ISBN-13: 978-0393123678). You can also purchase access to the **E-book** if you prefer this format: to The eBook can be purchased through the publisher's website (http://books.wwnorton.com/nortonebooks/) or directly through the Bookstore. A copy of the book will be available on Library Course Reserve. *Note: this textbook will also be used in MICR*2430 Microbiology Methods I.*

LABORATORY RESOURCES: Students are required to purchase a Laboratory manual & to bring a lab coat to every lab period. Safety glasses are required for contact lens wearers and highly recommended for all others. The Lab Manual will be available for purchase at the start of the semester. 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. ***Lab attendance is compulsory.***

COURSE WEBSITE
There is a CourseLink website set up for this course. Students can access course materials including animations from the textbook, lecture slides, check grades, write on-line quizzes, post questions, and see other students' replies. Students are encouraged to post links to news items on microbes relevant to the course. *Note:* instructors *may* post lecture slides on CourseLink. These slides provide *basic outlines* (are NOT notes) of the topic and selected diagrams from the text. Many important points & concepts that are not on the slides will be discussed during the lectures. Instructors will not post summaries of in-class discussions, so it is in your interest to be present in class (or obtain notes from other students if you are absent for any reason).

IMPORTANT DATES
Tuesday January 12th - First day of class
Monday February 15th to Friday February 19th – (Winter break - no class)
Thursday March 3rd Course midterm exam (during the regular class time)
Friday March 11th – 40th day of class; last day to drop courses
Saturday April 16th (19.00-21.00) Final Exam, Venue TBA

EVALUATION OF STUDENTS:
a. Independent assignment
Each student will be required to complete an *independent* study assignment on a specific microorganism;

students will 'adopt' a microbe from a list of choices. Instructions on the assignment will be available to download from the course CourseLink site in the first week of the semester. This assignment will allow students to develop independent thinking skills; *it will be graded as a component of the final exam.*

b. Midterm
The midterm exam is set during regular class time on March 3rd 2016, as shown on the course schedule. The midterm is worth 25% of the final course grade ***No alternate date or time will be set for any reason***. Conflicts (e.g. due to pre-scheduled UoG related academic trips) must be reported to the instructor before or on Jan 13, 2015. Please submit a note from the responsible instructor /coach indicating the dates the student is away and the nature of the event. Midterms / assignments in other courses are NOT considered conflicts!

Re-grading of exams: As well as Scantron sheets you will be asked to mark your responses to questions directly on the exam paper. Scantron sheets should be marked with pencil, however please note that exam papers marked with pencil *cannot* be re-graded.
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.

c. Laboratories
Lab reports, flow charts and performance

d. **REEF polling is required for this course**.
You will be required to purchase a 1-semester subscription to REEF Polling 2.0 (by iclicker), to allow participation in class polling (participation marks are shown below). This is a cloud-based platform that allows you to use your laptop or digital device to respond to MCQs or short/long answer questions. The cost is $9.99 USD. Register at http://support.reef-education.com, and search for MICR*2420 to join the course. The first 14 days are a free trial, then you will be prompted to buy the subscription. Use of REEF polling helps to increase engagement and thus understanding in the classroom and hence the focus will not be placed on answers that are right or wrong, but on *participation in class*. If you do not come to class, you will be unable to respond to the questions posed in class. Questions will be posed an average of 3 times per class, but not necessarily in all classes. Recorded responses will be graded thus:

% of REEF polling response throughout course	% of final grade
0-25	0
25-50	4
50-75	7
75-100	10

Note that bringing of other student(s)' REEF polling devices to class to record participation in their absence will result in forfeit of **all** REEF polling grades for the course for **all** parties involved, and may result in sanctions under the university's policy on academic misconduct, see:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml.

e. Final exam
The **Final examination** is ***compulsory*** and will be comprehensive, i.e. the exam *will cover **all** lecture materials and readings BEFORE & AFTER the midterms; the final exam will also include questions based on the lab exercises, lab content & information presented in the lab manual and questions pertaining to the independent study assignment (**5% of final exam grade**).*

Activity	Dates and notes	Grade weightings	
		A	B
Midterm[a]	During class time. Thursday March 3rd *Writing the exam is highly recommended, but it is optional. No penalties if missed.*	25	
Lab	See lab manual for report due dates	20	20
REEF polling	Recorded use of REEF polling in the classroom	10	10
Final exam	19.00-21.00. Saturday April 16th	45	70

[a]Students may view the exam after grades are released but *may not keep the exam.* If you wish to view your midterm exam post-grading, please check D2L for posted details of viewing dates/times.

ABSENCE AND ILLNESS:

Students who miss lectures are expected to obtain the materials through reading or discussion with colleagues. Where requested, Academic Consideration can only be given for missed labs or lecture questions, 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 U of G Undergraduate Calendar, **Undergraduate degree regulations & procedures**: http://www.uoguelph.ca/registrar/calendars/undergraduate/2010-2011/c08/index.shtml**.** 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.**

Electronic recording of lectures 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, participating in REEF polling, or taking lecture notes)

LECTURES:

Note that the sequence and nature of topics within each section may be subject to minor modifications.

Date	**Topic**	**Lecturer**	**Chapter/sections**
Tuesday January 12th	First day of class bits & pieces. Introduction. Test-your-knowledge quiz (don't worry: for fun only!). Description of course outline & independent assignment. Milestones in microbiology – a discussion of some of the more important historical foundations of microbiology research.	Allen-Vercoe	1.1-1.3
Thursday January 14th	The tree of life and the microbes. Bacteria, archaea, viruses, fungi and protists - size/structure, unique properties, how they grow, other basic characteristics		1.4-1.5; 3.1, 3.2 (parts), 3.3, 3.4 (parts); 3.7, 6.1-6.3; 19.1, 20.1-20.5 (parts)
Tuesday January 19th			
Thursday January 21st			
Tuesday January 26th			
Thursday January	Microbial associations 1: introduction to		21.1-21.3

28th	microbial ecology		
Tuesday February 2nd	Microbial associations 2: Biofilms and quorum sensing		4.6; 10.8
Thursday February 4th Tuesday February 9th Thursday February 11th	Microbes in different niches: water, soil, humans and extreme environments -factors that shape and define these communities		21.4-21.5; 19.2-19.3 (parts); 23.1-23.2
Tuesday February 16th Thursday February 18th	**<u>Reading Week: no classes</u>**		
Tuesday February 23rd	Observing microbes: light, electron and atomic force microscopy	Allen-Vercoe	Chapter 2 (selected sections)
Thursday February 25th Tuesday March 1st	Microbes in Health and Disease part 1: introducing the immune system • Innate immunity • Acquired immunity		23.3-23.9 (parts); 24.1-24.3
Thursday March 3rd	MIDTERM EXAMINATION		
Tuesday March 8th Thursday March 10th	Microbes in Health and Disease part 2: Example bacterial pathogens • *E.coli* O157:H7 • *Vibrio cholerae*	Allen-Vercoe	25.1-25.4 (parts),
Tuesday March 15th Thursday March 17th	Microbes in health and disease part 3: Example viral pathogens • Influenza A • HIV		11.3-11.4
Tuesday March 22nd	Infection Control	Dr. Devon Metcalfe, Guelph General Hospital	27.1-27.4 (parts)
Thursday March 24th	Biotechnological applications of microorganisms 1: biocontrol	Allen-Vercoe	Reading material will be provided
Tuesday March 29th	Biotechnological applications of micro-organisms 2: microbes as medicine		
Thursday March 31st	Biotechnological applications of microorganisms 3: bioremediation	Mr. Phil Dennis, SiREM, Guelph	
Tuesday April 5th	Biotechnological applications of microorganisms 4: food and beverage industry	Allen-Vercoe	16.1-16.4 (parts)
Thursday April 7th	Last day of class: review/catch-up		-

*** Reading material supplementary to the textbook will be provided. Please check CourseLink.**

LABORATORY COMPONENT:

OBJECTIVES

The laboratory component of MICR*2420 will introduce some basic microbiological techniques that are important for proper handling and growth of microorganisms. These techniques include bright field microscopy, asepsis, Gram staining, viable counting, selective and differential growth media, and isolation from natural sources. Moreover, concept of microbial communities and communication will also be introduced. Mastering of these concepts and techniques will be essential for future participation in the microbiology program (e.g. MICR*2430). It is important to come prepared for each lab session by reading and understanding the concepts as this will save much time and also reduce frustration.

Laboratory content	
Introduction & Laboratory Safety	General rules and regulations; standard operating procedures Handling cultures of live microbes. Avoiding creating aerosols. Cleaning and disposal of biohazards. *Hands on*: Microscopy. Observation of live organisms
Microscopy, preparation of specimens and staining of bacteria.	Handling, Use and Care of a microscope *Hands on*: use of simple stains & observations of microorganisms. Morphological features of microbes
Cultivation techniques & concepts of colonial growth & selection	*Hands on*: Culture Media preparation; Aseptic Transfer. Streak plate techniques for isolation of Pure Cultures. Enumeration. Introduction to concepts of diagnostic microbiology
A survey of the microbial world	Viruses and Bacteriophages & Halophiles *Hands on*: Plaque isolation.
	Hands on: Sampling methods. Microbe diversity on skin and water.
Microbial sensing and communication strategies	Hands on: Motility, Quorum-sensing and bioluminescence.

LABORATORY SCHEDULE FOR ROOM SSC4102

	Day	**Section #**	**Start Date**
Lab Cycle One	**Monday**	**0101**	**18 Jan**
	Tuesday	**0103**	**19 Jan**
Lab Cycle Two	**Monday**	**0102**	**29 Feb**
	Tuesday	**0104**	**1 Mar**

EVALUATION OF LABORATORY WORK

The laboratory experience will constitute 20% of the final course mark, and it is comprised of:

Pre-lab participation on CourseLink	5%
Laboratory quizzes	5%
Lab exercises	10%

PRE-LABORATORY QUIZZES HOSTED BY CourseLink

These are done online, through the course CourseLink site and **must be attempted prior** to the commencement of the laboratory (i.e. before 2:30 p.m. on lab day). Each question is assigned a *number of*

points and the range of points accumulated will be assigned a mark (out of 5%) at the end of the Week 5 according to the following point distribution:

5% for 90-100 points accumulated
4% for 80-89 points accumulated
3% for 70-69 points accumulated
2% for 50-59 points accumulated
0% for less than 50 points accumulated

LABORATORY QUIZZES

Four quizzes, 5 minutes in duration will be conducted at the *beginning of the lab period on Week 2 through Week 5.* Therefore, attempt the pre-lab questions on CourseLink and carefully **read** through the exercises before each laboratory session.

LAB EXCERCISES

The results you obtained from each laboratory exercise must be recorded in your manual. **You will hand in your laboratory manual for marking at the end of your Week 5 laboratory session.**

LABORATORY RESPONSIBILITIES

- **Working in the lab -** You will share an equipment locker with a fellow student, and carry out experimental work cooperatively. It is important that both you and your partner fully participate in all laboratory experiments in order to obtain the maximum benefit. You should *always monitor your partner's work to ensure that you do not miss any important experimental techniques and observations*.
- **Attendance –** Laboratories form an essential and integral part of this course. **In order to pass the course, you must attend the scheduled labs.** Attendance at the scheduled laboratories will be checked at each laboratory session.
  - If you are ill, or have an unexpected reason to miss a lab, please try to e-mail Rohan to let him know that you will not be present that day. Documentation to support your absence may be requested and failure to provide documentation will result in a grade of zero for that lab. In the event of an unavoidable absence, we also strongly encourage you to enquire about making up that material another day and time.

Course and University Policies

When You Cannot Meet a Course Requirement When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

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 Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.csd.uoguelph.ca/csd/

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:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml
E-mail Communication As per university regulations, all students are required to check their e-mail account regularly. E-mail is the official route of communication between the University and its students.

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:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

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.

Recording of Materials Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index

Technology in the classroom Feel free to bring your laptop to lectures, but only use it in a manner that will not disturb those around you. Please do not use your laptop for anything other than activities related to this course. Turn your cell phones off, or put them on silent, and do not text-message during class

Campus Resources

If you are concerned about any aspect of your academic program:
• make an appointment with a program counsellor in your degree program.
http://www.bsc.uoguelph.ca/index.shtml or https://www.uoguelph.ca/uaic/programcounsellors

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.
http://www.learningcommons.uoguelph.ca/

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. https://www.uoguelph.ca/counselling/
• Student Health Services is located on campus and is available to provide medical attention. https://www.uoguelph.ca/studenthealthservices/clinic
• 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. http://www.uoguelph.ca/~ksomers/

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: https://www.uoguelph.ca/csd/