

**University of Guelph**  
**College of Biological Science**  
Department of Molecular and Cellular Biology (MCB)  
**COURSE OUTLINE**  
Methods in Microbial Growth and Culture, MICR\*2430  
Fall 2015

**Course description (1.5-3) [0.50]**

This course uses a hands-on approach to investigate microbial growth and factors that impact growth and the interactions of microbes with biotic and abiotic environments. This course will explore the ecological diversity of microorganisms of selected environments. Students will develop a wide range of microbiology-related laboratory skills.

Prerequisite(s): MICR\*2420

**Teaching Team**

1. Dr. Wendy J. Keenleyside, Course Instructor/Coordinator. Office SSC3506 (Summerlee Science Complex), [wkeenley@uoguelph.ca](mailto:wkeenley@uoguelph.ca)
2. Deb Flett, Lab Demonstrator. Office SSC3504, [dflett@uoguelph.ca](mailto:dflett@uoguelph.ca)
3. Kaitlyn Oliphant, Graduate Teaching Assistant (GTA).
4. Julia Hooker, GTA
5. Megan Brasher, GTA

**Course Schedule**

1. Seminars Tues. 1:00 - 2:20 pm, CRSC116
2. Labs Thurs. 2:30-5:30 pm, SSC4102 & Fri. 2:30-5:30 pm, SSC4102  
➤ **labs begin Thurs Sept. 10 & Fri. Sept. 11 (prior to 1<sup>st</sup> seminar)**

**Course Goals**

The learning outcomes for this course are listed below; these will be assessed through the various graded components of the course. They may be updated periodically, through deletion or addition, depending upon the pace and depth of coverage of a given topic. Note that categories A-D and their associated outcomes are discipline-specific. The last category, E: SELF-REGULATED LEARNING, specifically relates to your learning skills, self-awareness of your knowledge as well as behaviours and environmental conditions for enhancing learning, both individually and in a learning team. All of the learning outcomes will be taught, modelled and assessed. The material in this course will also further develop the broader MCB Program Learning Outcomes ([MCB Learning Outcomes](#)) and the University of Guelph learning outcomes ([UofG Learning Outcomes](#)).

**A. ENERGY IN BIOLOGICAL SYSTEMS; METABOLIC PATHWAYS**

*By the end of the course, successful students will:*

- A1. Demonstrate an understanding that chemical transformations of biological molecules are catalyzed by enzymes organized in metabolic pathways
- A2. Demonstrate an understanding that metabolic pathways are regulated
- A3. Demonstrate an understanding that metabolic diversity exists among eukaryotes, prokaryotes and archaea
- A4. Demonstrate an understanding of how thermodynamically unfavourable processes occur
- A5. Demonstrate an understanding of the synthesis, storage and transformation of macromolecules

**B. STRUCTURE-FUNCTION RELATIONSHIPS IN BIOLOGICAL SYSTEMS**

*By the end of the course, successful students will:*

- B1. Demonstrate an understanding of macromolecular interactions, structure and function
- B2. Demonstrate an understanding that the properties of cells are a function of the chemical structures of their constituent macromolecules
- B3. Demonstrate a deep understanding of the roles of cells as the fundamental unit of life
- B4. Demonstrate an understanding of how cells, organelles and all major metabolic pathways evolved from early prokaryotic cells
- B5. Demonstrate an understanding of communication within and between cells and their environment

**C. EVOLUTION AND THE FLOW OF GENETIC INFORMATION**

*By the end of the course, successful students will:*

- C1. Demonstrate an understanding of the molecular structure, function and regulation of genes and genomes
- C2. Demonstrate an understanding of the factors that affect the frequency of genotypes and phenotypes in a population over time

**D. SCIENTIFIC METHOD**

*By the end of the course, successful students will:*

- D1. Successfully design, explain or predict the results of experiments for the isolation, identification and enumeration of microbes or assess such proposals
- D2. Perform experiments using appropriate safety precautions, and microbiological techniques for the isolation, identification and enumeration of representative groups of bacteria and fungi
- D3. Use appropriate and accurate mathematical calculations and statistical analyses and assess the reliability of data using biological and technical replicates
- D4. Successfully interpret and communicate scientific data in laboratory reports, group assignments and tests

**E. SELF-REGULATED LEARNING**

*Over the course of the semester, successful students will:*

- E1. Develop an understanding of what is required to learn, and the relationship between understanding and remembering
- E2. Identify and plan the behaviours necessary for deep learning
- E3. Set learning goals and periodically assess progress towards attaining those goals
- E4. Critically assess performance on course assessments, and draw connections between performance, learning strategies and effort
- E5. Accurately interpret peer and instructor feedback on assignments, and make appropriate revisions
- E6. Develop an effective learning team, recognize the differences between group work and teamwork and the value of team skills beyond course work
- E7. Describe the learning skills that were acquired, or further developed, and explain their application to future endeavors

## Course Content

## Seminars –

Seminar # <sup>a, b</sup>	Seminar Topic # and description	Readings <sup>c</sup>
<b>Term 1</b>		
S1-S2 (Sept. 15-22)	1. Cellular composition and nutrition: molecular composition of bacterial cells; macronutrients, micronutrients, growth factors; growth media, oligotrophy vs copiotrophy (Lectures) ➤ S1: ~20 min discussion of university learning expectations & self-regulated learning	Sect. 1.4-1.5, 3.1, 4.1 & 4.3, pp. 270–272 Leamson (2002)
S2-S3 (Sept. 22-29)	2. Microbial growth and enumeration: batch culture & growth curve; continuous culture; cellular enumeration methods (Lectures) ➤ S2: ~20 min discussion about how to use learning outcomes to guide and assess your learning	Sect. 4.4 & 4.5
S3-S4 (Sept. 29-Oct. 6)	3. The cell membrane and transport: fluid mosaic membrane; diffusion, primary and secondary transport systems (Lectures) ➤ S3: ~20 min discussion of strategies for critical reading	Sect. 3.2 & 4.2
S4 (Oct. 6)	4. (Introduction) Environmental influences on microbial growth: temperature, water activity and salt, pH, oxygen, antimicrobials (Lectures) ➤ S4: ~20 min discussion on how to study and assess your knowledge	Sect. 5.1-5.2, 5.4-5.6, 5.8, Ch. 27 & Case study <sup>c</sup>
S5 Oct. 20* * no classes Oct. 13	<b>midterm</b> ➤ Midterm followed by a ~20 min. discussion on learning teams & the “Team Charter”	
<b>Term 2</b>		
S6 Oct. 27	4. (completion) Environmental influences on microbial growth: temperature, water activity and salt, pH, oxygen, antimicrobials (active learning)	
S7-S9 (Nov. 3 – 17)	5. The biochemistry of catabolism: energy and entropy, energy carriers and electron transfer, energy acquisition in bacteria and archaea	Ch. 13 & 14, Case study <sup>c</sup>
S9-S12 (Nov. 17 – Dec. 4*) * Fri. seminar & last day of classes	6. Microbial diversity and ecology: microbes in ecosystems, biogeochemical cycling	Ch. 21 & 22 (+ parts of Ch. 18 & 19) & Case study <sup>c</sup>

<sup>a</sup> these are approximate dates and are subject to minor alteration.

<sup>b</sup> Seminars 1 → 5 begin with short discussions on different aspects of self-regulated learning

<sup>c</sup> Readings beyond the textbook are identified in the case study (in the lab manual) and provided via link or pdf on Courselink

## Labs –

Week	Lab Topic	Readings <sup>a</sup>
<b>Term 1</b>		
1 Sept. 10/11	Introduction to flipped course & self-regulated learning; pre-test on course learning outcomes for baseline <sup>b</sup>	Course outline, Leamnson (2002)
2 Sept. 17/18	Exp. 1 - Soil microbiology: - growth media, isolation and enumeration techniques	Laboratory 1
3 Sept. 24/25	Exp. 2 - Bacterial physiological diversity: - effect of environmental & nutrient conditions on growth	Laboratory 2
4 Oct. 1/2	Exp. 3 - Water quality testing: - diagnostic media and tests for identification and enumeration of coliforms & fecal coliforms	Laboratory 3
5 Oct. 8/9	Exp. 4 - Comparative cell counting & <i>E. coli</i> growth curve	Laboratory 4
6 Oct. 15/16	Exp. 5 - Bacterial identifications using diagnostic media & tests	Laboratory 5
<b>Term 2</b>		
7 Oct. 22/23	Case study: <i>Delicate Balance, Deadly Obsession</i> Lab exercise CS1 - Triclosan in aquatic environment, selection of triclosan resistance	Lab manual: Introduction to Microbial ecology & the Winogradsky column; Case Study Ch. 1 & Ch. 1 readings
8 Oct. 29/30	IF-AT quiz (Ch. 1 concept questions) Case study Ch. 2 Lab exercise CS2 - Microbial catabolic & physiological diversity; isolations from Winogradsky columns	Lab manual: Case Study Ch. 2 & Ch. 2 readings
9 Nov. 5/6	Case study Ch. 1 – CS1 conclusions & team discussion Case Study Ch. 2 – CS2 conclusions & team discussion	Lab manual: Case Study Ch. 2 & Ch. 2 readings
10 Nov. 12/13	Team presentations of Ch. 2 concept question answers Case Study Ch. 3 – team work/discussions	Lab manual: Case Study Ch. 3 & Ch. 3 readings
11 Nov. 19/20	Case Study Ch. 3 – team discussion of concept question answers, followed by IF-AT quiz on answers	Lab manual: Case Study Ch. 1-3 & all associated readings
12 Nov. 26/27	Lab exam - individual bell-ringer + team written component	

<sup>a</sup> Case study readings are given in the case study, published in the course manual. Other readings are provided via link or pdf on Courselink

<sup>b</sup> Pre-test on learning outcomes: earns **participation marks**. Designed to provide a measure of learning gains and effectiveness of course design.

- b. Method of presentation - Students will learn the techniques and concepts through lab sessions and seminars and will use a combination of independent reading, lectures, screencasts (PowerPoint with audio), laboratory exercises, online reading quizzes (for the labs), group/team discussions (online and face-to-face), team work on an interrupted case study, clicker questions and collaborative tests/test questions. Lectures in term 1 (prior to midterm) will be recorded and made available after the lecture.

*Group work:* During term 1, students will work in pairs in the lab, and *ad hoc* groups for group discussions in the seminar. During term 2 (after the midterm), students will continue to work in the seminars in *ad hoc* groups for group discussions/activities, which will comprise the majority of the class period, but will work in teams of 3 lab pairs in the lab and outside of class on an interrupted case study (published in course manual). Group work will allow students to apply the concepts that they are learning. During term 2, students will be responsible for covering the basic concepts in advance of seminars and labs, using screencasts and readings. Team member accountability will be ensured through a Team-written “Team Charter”, an initial “Team Effectiveness” group report, and finally, through anonymous peer evaluations using the UofG PEARTool. **The average scores from those anonymous assessments will be used to assign individual grades from the group grade.**

### Course Resources

*Textbook* – the required textbook for this course is “Microbiology - An evolving Science”, 3rd edition by J L Slonczewski and JW Forster (WW Norton Inc, ISBN 0- 393-91929-5). This is available from the bookstore, in hard copy or as an E-book (6 months, 12 months or permanent access) or in the library on 2h reserve (<http://www.bookstore.uoguelph.ca/courselistbuilder.aspx>).

*Laboratory manual* – this is required and may be purchased from SSC3115 Sept. 10, 11, 14 & 15; 9:30am-12:00pm and 1:00-3:30pm cash only (\$20.00)

*Courselink* – the course website will be used extensively and will include all relevant course materials, including lecture videos, online quizzes, discussion boards, group lockers, links for additional readings, a course calendar and group drop boxes.

*Lab schedule & Information handout* - detailed breakdown of weekly activities, due dates, marking schemes, (specifically for the case study). This will also be posted.

*Instructor’s office hours* - times tba or by appointment

*Clickers* – 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 attached). 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>. The first 14 days are a free trial, then you will be prompted to buy the subscription.

*PEARTool* – UofG online platform for **P**eer **E**valuation, **A**ssessment and **R**eview. This will be used for the peer evaluation component of the Case Study Ch. 2 concept questions, and for the final anonymous evaluation of the distribution of effort among team members.

<https://www.uoguelph.ca/peartool/user/signon.cfm?destination=index%2Ecfm>

Qualtrics survey –20 likert-scale statements relating to approach and motivation re. studying. Completed online at the beginning and the end of the semester, using any digital device and UofG login and password.

### Methods of Assessment

Form of Assessment	Weight of Assessment	Due Date of Assessment	Course Content /Activity	Learning Outcomes Addressed
Participation	a. 2.5% b. 0.5%  TOTAL: 3.0%	a. Seminars 1-12 b. LAB 1 (LOs) & WEEKS 1/12 (SPQ)	a. Clicker questions b. Pre/post-testing on LOs, study process questionnaire (SPQ)	A-E
Pre-lab quizzes <sup>a</sup>	2.0%	Weeks 2-6	Laboratory exercises	A1-5; B1-3, B5; C2; D1, D3 See “Lab Schedule & Information”
Laboratory quizzes <sup>b</sup>	2.0%	Weeks 2-7	Safety; Dilutions; biochemical tests (from lab manual)	A1, A5, D3 See “Lab Schedule & Information”
Laboratory reports I-VI	18.0%	Weeks 4-8	Laboratory exercises	A1-5; B1-3, B5; C2; D1, D3-4 See “Lab Schedule & Information”
Midterm <sup>c</sup> (in class)	10% (8.5% individual + 1.5% group)	Oct. 20	Lecture topics (1-4)	A1-4; B1-3; B5; C1-2; D1, D4; E1-5
Case study	20%	Weeks 6-12	Case study	A1, 3-4; B1-3; C1-2; D1-D4; E1-7 See “Lab Schedule & Information”
Laboratory exam <sup>d</sup>	15%	Nov. 26/27	Techniques/ concepts from lab exercises & case study lab exercises	A1-5; B1-3, B5; C2; D1-D4
Final exam <sup>e</sup> Location tba	30% (25.5% individual + 1.5% group)	Tues. Dec. 8 2:30-4:30	Cumulative	All but D2-3

<sup>a</sup> online, available M-T, on that week’s lab

<sup>b</sup> written during 1<sup>st</sup> few minutes of lab period; see “Lab Schedule & Information” for details on specific topics and dates

<sup>c</sup> 2-stage midterm: consists of individual, followed by group test using IF-AT cards (<http://www.epsteineducation.com/home/>). Group grade will only be used if it is no lower than the individual grade. **Students writing in SAS need to talk to Dr. Keenleyside ASAP**

<sup>d</sup> individual bell-ringer + written (in case study groups)

<sup>e</sup> cumulative 2-stage final exam (with IF-AT cards). Group grade will only be used if it is no lower than the individual grade. **Students writing in SAS need to talk to Dr. Keenleyside ASAP**

## Important Dates

➤ these are also identified in the Courselink calendar & “Lab Schedule & Information”

	DATE	DESCRIPTION
1	Sept. 10/11	Lab 1: Introduction to course flipped course, self-regulated learning - Learning outcomes pre-test
2	Sept. 15	Study process questionnaire (R-SPQ-2f) due via qualtrics
3	Oct. 1/2	Lab Report I due
4	Oct. 8/9	Lab Report II due
5	Tues. Oct. 13	Fall Study Break day – no seminar
6	Oct. 15/16	Lab Report III & IV due - introduction to team members
7	Oct. 20	2-stage midterm
8	Oct. 22/23	Lab Report V; signed team charter due
9	Oct. 29/30	Lab Report VI; Case study Ch. 1 concept questions draft/final answers due to dropbox by 2:30 of lab period; IF-AT quiz in lab
10	Nov. 5/6	Team effectiveness feedback due to dropbox - Case study Ch. 2 concept questions peer review of draft answers (via PEAR) – deadline 2:30 of lab period
11	Nov. 6	40 <sup>th</sup> class day – drop deadline
12	Nov. 12/13	Case study Ch. 2 concept question group presentations
13	Nov. 19/20	Case study Ch. 3 concept questions draft/final answers due to dropbox by 2:30 of lab period; IF-AT quiz in lab
14	Nov. 26/27	Lab exam
15	Th. Dec. 3	Last seminar (rescheduled from Oct. 13); team distribution of effort evaluations due via PEARtool; post-testing study process questionnaire due via Qualtrics
16	Tues. Dec. 8 2:30-4:30	Final exam

## Course and University Policies

### Grading:

1. *Midterm* - students who miss the *midterm* write an 80% (cumulative) final exam. For students who **DO** write the midterm, but perform better on the final, the midterm grade will be dropped and the grade weight transferred to the final exam.
2. *Assignments/reports* – lab reports are due by 2:30 pm on the due date; the time for submission of other assignments will be announced and may be identified above. For lab reports, deductions for late submissions will be 10% per day (the weekend counts as a 20% grade reduction), up to a 30% deduction. After 3 days, the submission will not be accepted.
3. *Quizzes* - pre-lab quizzes are online, available M-Th/F (they close before the student’s lab period) and students are expected to complete all 5. Students who fail to write 1 or more of these must provide documentation in support of academic consideration in order to obtain an adjustment to their distribution of marks. Lab quizzes are written at the beginning of 6 of the lab periods. Students with valid grounds for being unable to complete one or more of these must talk with the lab coordinator about

either writing the quiz at another time, or, provided with appropriate documentation, may have that quiz dropped from the calculation of the lab quiz grade.

4. *Collaborative tests* (midterm & final exams) - the individual grade will contribute 100% of that grade item if higher than the collaborative component. Students who choose to write the individual component only will similarly have that count as 100% of that grade item. *Students registered with SAS* may a) write early so that they can join the class for the collaborative portion, or b) write a 100% individual test or c) get the class average of the group test as their group component.

#### Student responsibilities:

1. Lab attendance is mandatory. If you cannot attend a laboratory session, and have valid grounds, please e-mail the lab coordinator to provide your documentation and enquire about making up the missed activities. Academic accommodations for instances where a student cannot meet a course requirement, are discussed below.
2. Laboratory preparedness: You must have read the relevant laboratory exercise in advance of the lab, and completed the online quiz for that week, prior to coming to the lab. A flow chart for what you will be doing in the lab is an excellent way to ensure you finish in less than 3h. You must bring with you: closed-toed shoes, a lab coat, your lab manual, an elastic band for long hair, and a notebook. If you wear contact lenses, you must also bring safety glasses.
3. Working in pairs or groups: Lab partners are expected to work collaboratively, to communicate effectively with each other and the GTAs/lab coordinator, and to hand in independent lab reports. During term 2, the 6-student teams will negotiate and sign the terms of a team charter and will discuss and provide preliminary feedback ("Team Effectiveness Feedback" and final anonymous distribution of effort evaluations of their team members. The results of the early evaluation will be used to identify problems that require intervention. The final evaluation will be used to assess individual grades which may result in an individual's grade for their group's work going UP or DOWN, relative to the group grade. If a problem is identified early and the problem fails to get resolved, according to the terms of the charter, the final resort may be to "fire" the offending student(s) from the group. From that point on, the student must complete all group work independently. This has not happened to date and hopefully this trend continues.

#### 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, and be prepared to provide supporting documentation. 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](mailto: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 <uoguelph.ca> 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 40<sup>th</sup> 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.

#### Campus Resources

The Academic Calendar is 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>

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/>

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For more information, contact CSD at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or refer to the [CSD website](#). The standard statements are available on the [AVPA website](#) (undergraduate courses) or from the Office of Graduate Studies (Graduate Courses).