

BIO380: Microbiology (Burrack)
Spring 2016

BIO380 – Microbiology Spring 2016

Meeting Times and Locations:

Classroom: Monday, Wednesday, Friday 10:30am – 11:20am in CON 125

Laboratory: Wednesday 2:30pm – 5:20pm in NHS - Rm. 225

Contact Information:

Professor: Laura Burrack

Office Location: NHS - Rm. 221A

Phone: x7325

Email: lburrack@gustavus.edu (Email is the preferred way to reach me. I try to respond to emails within 24 hours.)

Office hours: Monday 1:30-2:30pm, Tuesday 3:30-4:30pm, Thursday 10:30am-12:30pm

I am here to help you understand the material and be successful in the class (and beyond). I welcome talking with students outside of class and meeting in person is often the best way to communicate, especially for questions about the material. Feel free to come to me with specific questions about the class or with general questions about science or your future. You can drop by my office hours or e-mail to set up an appointment.

Course Materials:

- Textbook (required): *Brock Biology of Microorganisms*, 14th Edition, Madigan, MT, *et al.*
- Additional readings from the primary and secondary literature will be provided.
- Course website:
 - Please regularly check our class website for documents such as additional readings and assignments. <http://moodle.gac.edu>. Lecture PowerPoint files and homework assignments will be available on Moodle in the page titled “2016 s-bio-380-001.” Use your email username and password to log in.
 - If there is a problem with a *particular document*, please contact me. If you're having trouble getting Moodle to work *in general*, you should contact Gustavus Technology Services (GTS).
 - Course announcements will be made in class and via email. It is your responsibility to check your @gustavus.edu email regularly.
- Lab manual – will be provided as sections on Moodle and in class
- You must purchase a bound notebook or a three ring-binder to use as a lab notebook.

Course Description:

This course will focus on prokaryotic cell structure and function, bacterial growth and metabolism, the molecular genetics of bacteria and viruses, diversity among microbes (including single-celled eukaryotes), and the interactions between microbes and their environment. Lectures will include discussions of primary journal articles. The laboratory will emphasize food microbiology as a model system for identifying microbes, characterizing microbial metabolism, and understanding microbial community interactions. Students will have the opportunity to learn a variety of techniques such as 16S sequencing and biofilm assays as well as work in small groups to design an experiment and carry out this experiment in lab.

Course Learning Objectives:

After this class, you will be able to:

- Develop an understanding of the diversity of functions and metabolism in microbes.
- Describe the structure and maintenance of microbial and viral genomes and regulation of gene expression.
- Explain the interactions of viruses and microbes with multi-cellular organisms, and compare and contrast how different types of pathogens interact with their host.
- Read, evaluate and discuss primary literature on various areas of microbiology.
- Apply methods and approaches to identify and characterize microbes to characterization of an unknown microbe isolated from naturally fermented foods.
- Design and execute an independent project studying food microbiology. Write a grant proposal explaining the significance of this research and expanding the preliminary data into a fully developed long-term project proposal.
- Communicate scientific results in various formats including lab notebooks and oral presentation.

For a larger picture view of how BIO380 fits into the larger curriculum in the biology department and the college as a whole, please see: "BIO380: Learning Outcomes" posted on Moodle.

Weekly Summary Sheets:

A summary sheet will be handed out at the end of each week. The summary sheet is meant to highlight readings, assignments and laboratory details for the following week. Please note that the readings given for a particular day are to be completed in advance of the lecture for that day. A typical weekly summary sheet will contain:

1. Details on reading assignments for the upcoming week
2. Indication of upcoming assignments and exams
3. Laboratory activities for the week

Assessment:

Exams (3x50 points)	150 points
Primary literature response papers and discussion questions (5x15 points)	75 points
Class participation and paper discussions	25 points
Research proposals	125 points
Independent project presentations	25 points
Lab notebooks	25 points
Lab participation and citizenship	25 points
	Total = 450 points

Grading Scale:

93-100%	A	77-79%	C+
90-92%	A-	70-76%	C
87-89%	B+	60-69%	D
83-86%	B	below 60%	F
80-82%	B-		

Final grades will be based on the percentage scale provided above and not on a "curve". Thus, you will not be competing with your fellow students for a pre-determined allocation of grades. You can calculate your current grade at any time during the semester.

Further explanation of assessment categories:

Exams: There will be 3 exams covering specific content related to the concepts, techniques and application of microbiology. Experimental design, interpretation of data, and application of material will be stressed. Each exam will build on content and techniques as we move throughout the semester, but will focus on material covered more recently.

Response papers and discussion questions: For each paper discussion day indicated on the syllabus, you will submit a response paper and possible discussion questions for the in-class discussion by 9am before class. Prompts for response papers will be given at least one week prior to each paper discussion day.

Class discussions and participation: Participation in class discussions and activities is essential. I am not simply counting the number of times each student speaks, but rather participation is meant to reflect preparation and active engagement with the material. I will try to structure discussions so that each member of the class has an opportunity to participate in a way that works for them. I will give you feedback partway through the semester.

Independent project proposals: During the second half of the semester, you will be working individually on a concise NIH-style grant proposal describing the independent research projects you will carry out in a small group. The proposal will be written in parts and each part must be revised and compiled for the final research proposal, due at the end of the semester. As you are writing your proposal you will also be carrying out the beginning stages of your proposed project and your final research proposal will include a section on your preliminary results. See the lab schedule section for deadlines. Detailed instructions for each of these parts will be distributed at a later date.

Lab notebooks: Several times throughout the semester, I will check lab notebooks without warning. Lab notebooks are an essential record of your research and in this class will serve as your "lab reports". Make sure you are following the format and suggestions found in the lab manual handout given out on the first day of lab.

Lab participation and citizenship: This category will include lab effort, such as coming in outside of scheduled time when necessary and being prepared and focused during lab time, sharing plans and results informally during lab meetings, and lab citizenship, such as keeping your bench organized and clean, being courteous and helpful toward your peers, having a positive attitude, keeping pipette tip boxes filled, etc. I will give you feedback on partway through the semester, after you have spent some time in lab.

Attendance Policy:

Attendance and participation in class is required. Please notify me *at least* one week in advance if you anticipate a scheduled absence (such as an approved athletic event, a graduate school interview, or celebration of a religious holiday) or as soon as possible in case of illness.

Absences for medical or other emergencies may be considered excused at my discretion if they are verified by documentation. For all pre-arranged absences, any classwork due during the time of the absence must be turned in by the scheduled due date. Unexcused absences in lecture or in lab will have consequences for class and lab participation grades. Tardiness to class or to lab will also negatively impact participation points.

Late Policy:

Late assignments will be penalized 20% of the possible points per day. If an assignment is due at the beginning of class and you are late for class, your assignment will be considered late. Computer problems do not constitute a legitimate excuse for late work. Each student will be allowed one 48 hour extension per semester for any reason – use it wisely! To use this extension, you must contact me via email at least 12 hours before the assignment is due.

Technology:

I expect that cell phones will not be used in class.

Research has shown that for many individuals the processing and synthesis necessary to take notes on paper improves recall of concepts on tests compared to typed notes (Mueller and Oppenheimer 2013 - <http://pss.sagepub.com/content/25/6/1159.full>). I would encourage you to try to take notes by hand. However, not all students have the same needs, so if you prefer to use a laptop - that is fine, but please speak with me first. If you use a laptop to take notes, do not surf the net; it is rude to me and even more importantly, distracting to your peers. I will ask you to put away your computer for the class period if you are doing other types of work or are playing on it. Otherwise, computers should not be used in class unless we are specifically using them for a course-related purpose.

Reference Desk Assistance:

The library's Reference Desk provides one-on-one guidance to help you with your research. The reference librarians will help you find information on a topic, develop search strategies for papers and projects, search library catalogs and databases, and provide assistance at every step. No appointment necessary. Visit www.gustavus.edu/library/reference_question.html for hours, location, and more information.

Group Work and Academic Honesty:

As science is a collaborative process, it is my hope that you will discuss your readings, assignments, and laboratory work with each other. However, it is expected that all group members will participate in laboratory work and that graded work should be the unique product of the individual turning it in unless otherwise specified. You have agreed to abide by the academic honesty policy and you will sign this honor code on all assignments: "On my honor, I pledge that I have not given, received, or tolerated others' use of unauthorized aid in completing this work." Cheating on exams, parasitizing group members and plagiarism never will be tolerated. Plagiarism is defined as using the ideas and/or words of another and representing them as your own *and includes pasting material from web sites*. If you are dishonest in your work, I will discuss it with you and the Dean, and you will earn a zero for the assignment. Students fail the course if they repeat it a second time. "It is plagiarism if you use an author's key phrase or sentence structure in a way that implies they are your own, even if you cite the source. Instead, enclose the original wording in quotations and cite the source. Better yet, put the whole passage in your own words."¹ Excessive quotations (>2) and reliance on websites are not acceptable. To cite a source, use a technique that you are comfortable with (footnotes, parenthetical citations, etc). I am not picky about your citation method, but ask that you are thorough, honest and consistent. Full descriptions of the Academic Honesty Policy and the Honor Code can be found in the Academic Catalog (online at www.gustavus.edu/general_catalog/current/acainfo).

1. McMillan, V.1998. *Writing Papers in the Biological Sciences*. Bedford Books, New York. Pgs. 44-46.

Title IX

Title IX is federal legislation that makes clear that violence and harassment based on sex or gender are civil rights violations. Gustavus Adolphus College takes incidents of sexual misconduct and sexual harassment seriously. For examples and more details, please see www.gustavus.edu/deanofstudents/policies/gustieguide/sexualassault.php#misconduct. Sexual Harassment is any behavior of a sexual nature that is unwelcome, offensive or fails to respect the rights and dignity of another person whether of the same or opposite sex. (Please see: www.gustavus.edu/facultybook/allcollegepolicies/#Anchor-Sexua-60443.) Not all college employees are mandatory reporters. However, all faculty are legally mandatory reporters and must make a formal report to the Dean of Students Office within twenty-four hours. The college will respect the confidentiality of the victim and alleged offender(s) as much as possible consistent with the College's legal obligations. Students also always have a choice as to whether to participate in an investigation or not. The only exception to this reporting responsibility for Gustavus employees is that conversations with SART/CADA, Chaplains, Counseling Center staff, and professional health care staff may be kept strictly confidential. SART/CADA can be reached 24 hours a day at 507-933-6868. If you have any questions, contact the Title IX Coordinator (Paula O'Loughlin, Associate Provost, at 507-933-7541) or Deputy Coordinators (Stephen Bennett, Associate Dean of Students, at 507-933- 7526 or Ken Westphal, Vice President for Finance, at 507-933-7499).

Accessibility (Resources for Students with Disabilities and ELL):

I am committed to ensuring that all students fully participate. We will work together to ensure this class is as accessible and inclusive as possible. Gustavus Adolphus College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or you think you may have a disability of any nature) and, as a result, need reasonable academic accommodation to participate in class, take tests or benefit from the College's services, then you should speak with the Disability Services staff, for a confidential discussion of your needs and appropriate plans. Course requirements cannot be waived, but reasonable accommodations may be provided based on disability documentation and course outcomes. Accommodations cannot be made retroactively; therefore, to maximize your academic success at Gustavus, please contact Disability Services as early as possible. Disability Services (www.gustavus.edu/advising/disability/) is located in the Academic Support Center. Disability Services Coordinator, Kelly Karstad, (kkarstad@gustavus.edu or x7138), can provide further information.

Support for English learners and multilingual students is available through the Academic Support Center's Multilingual Learner Academic Specialist, Jody Bryant (jbryant2@gustavus.edu or x7197). The MLAS can meet individually with students for tutoring in writing, consulting about academic tasks, and helping students connect with the College's support systems. In addition, English learners and multilingual students can seek help from peer tutors in the Writing Center (www.gustavus.edu/writingcenter/). I am also happy to be a resource for you. Please stop by office hours or set up an appointment.

Tentative Class Schedule and Readings (Subject to change if necessary)

<u>Date</u>	<u>Discussion Topic</u>	<u>Reading from textbook (or Moodle)</u>
<u>Unit 1: Introduction to microorganisms and microbial diversity</u>		
M Feb 8	Introduction to microorganisms	Brock 1.1-1.5
W Feb 10	Introduction to microbiology techniques	Brock 1.6-1.10, 2.1-2.4, 3.1-3.2
F Feb 12	Microbial genomes and genomics	Brock 4.1, 6.1-6.6, 6.10
M Feb 15	Microbial phylogenetics	Brock 12.4-12.5
W Feb 17	Paper discussion #1 Cheese microbes	Wolfe <i>et al.</i> 2014 <i>Cell</i>
F Feb 19	Microbial cell function and structure	Brock 2.5-2.12
M Feb 22	Microbial cell function and structure (cont)	Brock 2.13-2.22
W Feb 24	Introduction to microbial metabolism	Brock 3.3, 3.8-3.13
F Feb 26	Cell division and characterization of growth	Brock 5.1-5.10
M Feb 29	Factors that affect microbial growth	Brock 5.11-5.19
W Mar 2	Paper discussion #2 Biofilms	Beauregard <i>et al.</i> 2013 <i>PNAS</i>
F Mar 4	Metabolic diversity	Brock 13.1-13.10
M Mar 7	Metabolic diversity (cont)	Brock 13.11-13.24
W Mar 9	Microbial diversity	Brock 14.1, 17.1-17.2, 17.9-17.14
F Mar 11	Unit 1 Exam	
<u>Unit 2: Molecular Biology of Microbes and Viruses</u>		
M Mar 14	Microbial molecular biology review	Brock 4.1-4.14
W Mar 16	Mechanisms of regulation	Brock 7.1-7.6, 7.14-7.18
F Mar 18	Signaling and signal transduction	Brock 7.7-7.10
M Mar 21	Bacterial development/differentiation	Brock 7.11-7.13
W Mar 23	Paper discussion #3 Sporulation	Fimlaid <i>et al.</i> 2015 <i>PLoS Path</i>
F Mar 25 – F Apr 1	NO CLASS – Spring Break	
M Apr 4	Introduction to viruses and virology	Brock 8.1-8.11
W Apr 6	DNA viruses	Brock 9.1-9.7

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F Apr 8	RNA viruses	Brock 9.8-9.11
M Apr 11	Mutation	Brock 10.1-10.4
W Apr 13	Gene transfer and protecting the genome	Brock 10.5-10.12
F Apr 15	Paper discussion #4 CRISPR	Deltcheva <i>et al.</i> 2011 <i>Nature</i>
M Apr 18	Genetic engineering in microorganisms	Brock 11.11-11.17
W Apr 20	Unit 2 Exam	

Unit 3: Interactions of viruses and microbes with multi-cellular organisms

F Apr 22	Symbiosis	Brock 22.3-22.7, 22.9-22.14
M Apr 25	Beneficial human-microbe interactions	Brock 22.8, 23.1-23.4
W Apr 27	No class – MAYDAY! (Lab projects should be continued independently.)	
F Apr 29	Overview of microbial pathogenesis	Brock 23.6-23.10
M May 2	Host factors and overview of immunity	Brock 23.11-23.12, 24.1-24.7
W May 4	Antimicrobial drugs	Brock 27.11-27.18
F May 6	Paper discussion #5 New antibiotics	Ling <i>et al.</i> 2015 <i>Nature</i>
M May 9	Person-to-person infections	Brock 29.1-29.14
W May 11	Vectorborne infections	Brock 30.1-30.7
F May 13	Water and foodborne infections	Brock 31.1-31.14
M May 16	Eukaryotic pathogens	Brock 32.1-32.7
W May 18	Epidemiology and public health	Brock 28.1-28.7
F May 20 (1:00-3:00pm)	Unit 3 Exam	

Detailed reading information (readings will be posted on Moodle):

- Beauregard, P.B., *et al.* 2013 *Bacillus subtilis* biofilm induction by plant polysaccharides *PNAS* 110: E1621-E1630
- Deltcheva, E., *et al.* 2011 CRISPR RNA maturation by *trans*-encoded small RNA and host factor RNase III. *Nature* 471:601-607
- Fimlaid, K.A. *et al.* 2015 Identification of a Novel Lipoprotein Regulator of *Clostridium difficile* Spore Germination. *PLoS Pathogens* DOI:10.1371/journal.ppat.1005239
- Ling, L.L. *et al.* 2015 A new antibiotic kills pathogens without detectable resistance. *Nature* 517:455-9
- Wolfe, B.M., *et al.* 2014 Cheese rind communities provide tractable systems for *in situ* and *in vitro* studies of microbial diversity. *Cell* 158(2):422-433.

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Tentative Lab Schedule (Subject to change if necessary)

<u>Lab date</u>	<u>Lab activities (Wednesday 2:30-5:20pm)</u>
Feb 10 th	Lab safety, microscopy introduction, colony isolation and serial dilutions
Feb 17 th	Microscopic evaluation of colonies, genomic DNA prep, set up 16S PCR
Feb 24 th	Check, purify PCR, send for sequencing
Mar 2 nd	DNA sequence analysis and bioinformatics
Mar 9 th	Lab meeting, Fermentation assays
Mar 16 th	Biofilm assays, Start project planning
Mar 23 rd	Project planning
Mar 30 th	– NO CLASS SPRING BREAK
Apr 6 th	Independent project
Apr 13 th	Independent project
Apr 20 th	Lab meeting, Independent project
Apr 27 th (May Day)	Independent project
May 4 th	Independent project data analysis
May 11 th	Lab presentations
May 18 th	No lab – final proposal due

Important Lab and Proposal Assignment due dates:

Pre-proposal (one per lab group) – due Thursday 3/24 by noon

Annotated bibliography – due Monday 4/11 5pm

Specific aims – due Monday 4/18 5pm

Research design and methods – due Monday 4/25 5pm

Background and significance – due Monday 5/2 5pm

Group presentations on preliminary results – in class presentations 5/11 2:30-5:30pm

Final proposal (including preliminary results and general audience summary) – due Wednesday 5/18 at 5pm (last day of class)