BIOL473/685A: Environmental Microbiology

Winter 2017 • Wednesday & Friday 10:15-11:30 in CJ 1.121

Instructor

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Course Description: We live in a microbial world. There are billions of times more microbes on Earth than stars in the universe and microbial metabolisms are critical to the maintenance of life on our planet. The objective of this course is to provide an overview of microbial diversity and ecophysiology with special emphasis on how the activities and interactions of microorganisms influence biological systems ranging from humans to the planet as a whole. Special emphasis will be placed on the microbiology of aquatic ecosystems, including the ocean. The course structure will consist mainly of lectures. However, students will be required to summarize the findings of a research article by both oral presentations as well as by written assignments (detailed below). Students are expected to have a strong background understanding of basic microbiology, molecular biology, biochemistry, genetics, and the general structure and function of cells and their components.

Course Textbook: Kirchman, D. Processes in Microbial Ecology. The textbook is not required but strongly suggested. The course will follow the textbook, but is also developed from the primary scientific literature. Lecture material (*i.e.* power point slides) will be made available at the Moodle site prior to the beginning of each lecture.

Office Hours: Office hours with Dr. Walsh are held in GE 330.17 on Mondays at 1:00-2:00. Alternatively, please schedule an appointment if you wish to discuss the course outside of these hours.

Student Evaluation

25%	Midterm exam	10%	Written assignments (and class participation)
15%	Student presentation	50%	Final exam (cumulative)

Plagiarism: The most common offense under the Academic Code of Conduct is plagiarism, which the Code defines as **"the presentation of the work of another person as one's own or without proper acknowledgement."** This could be material copied word for word from books, journals, internet sites, professor's course notes, etc. It could be material that is paraphrased but closely resembles the original source. It could be the work of a fellow student, for example, an answer on a quiz, data for a lab report, a paper or assignment completed by another student. It might be a paper purchased through one of the many available sources. Plagiarism does not refer to words alone - it can also refer to copying images, graphs, tables, and ideas. "Presentation" is not limited to written work. It also includes oral presentations, computer assignments and artistic works. Finally, if you translate the work of another person into French or English and do not cite the source, this is also plagiarism. In Simple Words: ***Do not copy, paraphrase or translate anything from anywhere without saying where you obtained it!***

Course topics and tentative lecture schedule:

Dates	Topic	Chapter in Kirchman
	Introduction to environmental microbiology	Ch. 1
	Biochemical and structures of microbes	Ch. 2
	Physical-chemical environment of microbes	Ch. 3
	Primary production and phototrophy	Ch. 4
	Degradation of organic material	Ch. 5
	Growth, biomass production, and controls	Ch. 6
	Processes in anoxic environments	Ch. 11
Feb 17	***Midterm Exam***	**-**
Feb 20-24	**Midterm Break**	**-**
	Predation and protists	Ch. 7
	Ecology of viruses	Ch. 8
	Symbiosis and microbes	Ch. 14
	Community structure in natural environments	Ch. 9
	Genomics and metagenomics	Ch. 10
	Nitrogen cycle	Ch. 12
Mar 29 Mar 31	**Student symposium I: The human microbiome**	**-**
Apr 05 Apr 07	**Student symposium II: Antibiotic resistance and discovery**	**-**
	Course review	-

Oral presentations (BIOL473 students)

Near the end of the semester, we will have two student symposiums on special topics in environmental microbiology. This year, those topics will be 1) **the human microbiome** and 2) **antibiotic resistance and discovery**. Working in pairs, students will present the findings of a recent research article on one of the two topics. The research articles are posted at the Moodle site and listed below. Students are asked to look through the research articles, select one of interest, and then sign up for the presentation on the sheet posted outside Dr. Walsh's office in GE330.17. **Please sign up no later than 27-Jan-2017.** Sign up early to ensure you get the article that most interests you!

The presenters: Students will work in pairs to present the findings of a recent research article. Presentations on the human microbiome will take place on Mar 29th and Mar 31st. Presentations on antibiotic resistance and discovery will take place on Apr 5th and Apr 7th. Student presentations will be 10 minutes in length, followed by a 5 minute question/discussion period.

Preparing the presentation: Students are strongly encouraged to visit Dr. Walsh's office for help and input as they prepare their presentations. The content of the oral presentation should be as follows:

01. *Introduction of the topic:* Concisely present the background information that frames the current research article and the question/problem being examined. Most of this information will be referenced in the introduction of your paper. **Read some of these key references to increase your familiarity with the topic** and use NCBI pubmed to explore the topic more thoroughly. Be sure to describe the goal/objective of the research.
02. *The methodology:* Provide an adequate description of the methods such that the results can be properly understood and interpreted. Given the time constraint, you do not need to present a detailed description, only a general overview.
03. *The results and discussion:* This is the most important part of the research and your presentation. Clearly and logically present a summary of the major findings of the research article. **If nothing else, get the results right!** Pay special attention to the order in which the results are presented in the article as they are most likely presented in a logical manner, the latter building on the former. Be sure to discuss the implications of the results. This is typically the most interesting part of the research article (and your presentation) because it is where the results are interpreted and their impact on our state of knowledge is presented.
04. *The conclusions:* Be sure to point out the major strength and weakness of the study. Also, many of the selected research articles were published a few years ago, therefore certain questions raised in the discussion of your paper may have already been addressed in the literature. Don't be afraid to investigate the impact of your research article by looking for additional articles where it has been referenced. Science is a continuum!

In preparing the presentation, students are **STRONGLY encouraged to meet with Dr. Walsh for help and input.

The audience and written summaries (473/685A students): All students are expected to have read the research articles prior to the presentations **(this material will be tested on the final exam)**. In addition, each student will be assigned **a total of 4 papers** for which they will be required to summarize and critique in written format. Papers for written summaries will be assigned once students have signed up for their oral presentations. The written summaries are expected to be between 400-600 words in length. The content of the written summaries should be the same as for the oral

presentations (see above). The summaries are due before the oral presentation of the research article. **Late assignments will be docked by 50%.**

Written minireviews (685A students only)

Graduate students will not be required to present a research article orally, but instead will be asked to compose a written minireview of a special topic that is of particular interest to them. This will allow students to explore a topic more deeply. The review should be focused and concise, can be somewhat speculative, and should suggest potential new lines of experimentation. There will be no strict format for the review, however it is suggested that students follow the general format for Minireviews published in the journal *Environmental Microbiology*. These short reviews consist of a Summary, Introduction and Concluding Remarks, which bracket the main text. See the following website for examples: http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1462-2920/homepage/minireviews.htm

Preparing the review: In preparing the review article, graduate students are **STRONGLY** encouraged to meet with Dr. Walsh for help and input. You should think of this as a publication quality review. In general, the review article should be prepared in the following stages (feel free to use Dr. Walsh as a critical reviewer of your work at any time in the process):

01. Selection of the topic: Students can either review a topic closely aligned with their thesis project OR take this opportunity to explore an additional topic of interest outside of their current area of training. It is suggested that students select a topic and inform Dr. Walsh within the first three weeks of the course.

02. Outline and organization of key references: A good place to start when reviewing a topic is to construct a 1-2 page outline (point form) of the main sections of the review. Also organizing the key references in the order in which you'd like to introduce them can help frame the review.

03. First written draft: From a solid outline, it can be reasonably simple to create the first draft of the review. Have other students or researchers in your lab read your first draft for comments. At this point what is important is the content of the review and that the ideas are presented in a logical manner. It doesn't have to sound pretty yet!

04. Final written draft: After incorporating the comments of others, you are now ready to finalize the draft. Be sure your grammar, spelling, and references are correct.

Student Symposium I – The human microbiome (Mar 29th & Mar 31st)

Mar 29th

01. Samuel and Gordon (2006). A humanized gnotobiotic mouse model of host-archaeal-bacterial mutualism. PNAS. 103:10011.

02. Fukuda et al. (2011). Bifidobacteria can protect from enteropathogenic infection through production of acetate. Nature. 469:543.

03. Costello et al. (2009). Bacterial community variation in human body habitats across space and time. Science. 326:1694.

04. Koenig et al. (2011). Succession of microbial consortia in the developing infant gut microbiome. Proceedings of the National Academy of Sciences. 4578 4585.

05. Turnbaugh et al. (2006). An obesity-associated gut microbiome with increased capacity for energy harvest. Nature. 444:1027.

Mar 31st

06. Hehemann et al. (2010). Transfer of carbohydrate-active enzymes from marine bacteria to Japanese gut microbiota. Nature. 464:908.

07. Smillie et al. (2011). Ecology drives a global network of gene exchange connecting the human microbiome. Nature. 480:241.

08. Stecher et al. (2011). Gut inflammation can boost horizontal gene transfer between pathogenic and commensal Enterobacteriaceae. Proceedings of the National Academy of Sciences. 1269-1274.

09. Desbonnet et al. (2014). Microbiota is essential for social development in the mouse. Molecular Psychiatry. 146-148.

10. Hsiao et al. (2013). Microbiota modulate behaviour and physiological abnormalities associated with neurodevelopmental disorders. Cell. 1451-1463.

Student Symposium II – Antibiotic resistance and discovery (Apr 5th and Apr 7th)

Apr 5th

01. Holden et al. (2013). A genomic portrait of the emergence, evolution, and global spread of a methicillin-resistant Staphylococcus aureus pandemic. Genome Research. 653:664.

02. Macia et al. (2005). Hypermutation is a key factor in development of multiple-antimicrobial resistance in Pseudomonas aeruginosa. Antimicrobial Agents and Chemotherapy. 3382:3386.

03. Lee et al. (2010). Bacterial charity work leads to population-level resistance. Nature. 82:85

04. Goh et al. (2002). Transcriptional modulation of bacterial gene expression by subinhibitory concentrations of antibiotics. 17025:17030.

05. Abrudan et al (2015). Socially mediated induction and suppression of antibiosis during bacterial coexistence. Proceedings of the National Academy of Sciences. 11054:11059.

Apr 7th

06. D'Costa et al. (2011). Antibiotic resistance is ancient. Nature. 457:461

07. Topp et al. (2012). Accelerated biodegradation of veterinary antibiotics in agricultural soil following long-term exposure, and isolation of sulfamethazine-degrading Microbacterium sp. Journal of Environmental Quality. 173-178

08. Ling et al (2015). A new antibiotic kills pathogens without detectable resistance. Nature. 455:459.

09. Thaker et al. (2013). Identifying producers of antibacterial compounds by screening for antibiotic resistance

10. Yamanaka et al. (2014). Direct cloning and refactoring of a silent lipopeptide biosynthetic gene cluster yields the antibiotic taromycin A. Proceedings of the National Academy of Sciences. 1952:1962.