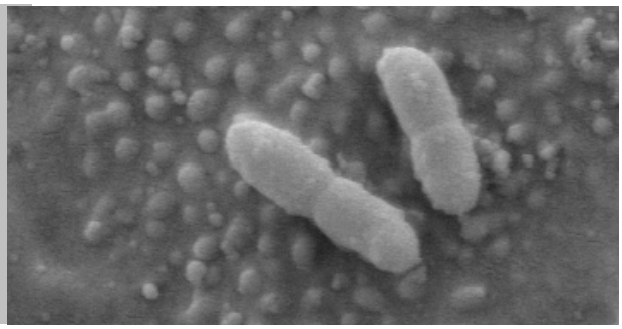
Biology 433/533
Bacterial-Host Interactions

Instructor: Karen Guillemin
Class meeting: Tues, Thurs 2:00-3:20 PM
307 Chapman
Office hours: Monday 1:30-2:30 PM
Klamath 249C or by appointment
(kguillem@uoregon.edu)



Course description: Bio 433/533 will examine how animals co-exist with microorganisms. We will investigate the molecular mechanisms by which animal cells and associated microorganisms communicate, and how these communications affect the microbial community structure and the health of the host. The course is based on primary research literature, drawing on examples of different bacterial-host interactions in a number of model systems to illustrate basic principles about the molecular and cellular natures of these interactions. The course will emphasize critical reading of the literature and critical thinking. Students will be required to complete regular homework assignments on the readings. The midterm exam will cover material from the readings and lectures. At the end of the course each student will write and present an original research proposal that addresses an unanswered question in the field, using experimental approaches covered in the course.

Learning Objectives:

- Gain a sophisticated understanding of the emerging field of bacterial-host interactions in biology.
- Gain a working knowledge of modern molecular genetic experimental approaches using model eukaryotes and prokaryotes.
- Become a critical reader of scientific research articles in the biomedical literature.
- Develop the ability to formulate hypotheses about the mechanistic bases for biological phenomena.
- Become proficient at designing experimental strategies to test hypotheses about the mechanistic bases for biological phenomena.
- Learn to give a concise and compelling oral presentation that identifies a scientific question, proposes a hypothetical answer to this question, and lays out a novel strategy to test this hypothesis.
- Learn to write a compelling research proposal that identifies a scientific question, proposes a hypothetical answer to this question, and lays out a novel strategy to test this hypothesis.

Course website: All course material will be available through Blackboard (blackboard.uoregon.edu).

Assigned reading: For each topic covered, the assigned reading will consist of a current review article by leaders in the field and one or two original research articles. These will be posted, organized by week, in the Blackboard Course Documents Folder.

Homework assignments: Homework questions on the assigned reading will be posted as quizzes on Blackboard in the Course Assignments folder. These will consist of multiple choice and short essay questions that insure that students carefully read and understand the course material. The homework questions will usually be posted Friday morning. Students may save their answers and return to the questions as many times as they wish, but they must submit their answers by 1:45 PM on Tuesday. Students are permitted to discuss the questions with each other, but their answers must be their own independent work.

Lecture notes: The course format will be a combination of lectures and discussions. I will post my lecture notes on Blackboard AFTER the lecture. These notes are NOT a substitute for coming to class. If you must miss class, it is your responsibility to obtain detailed notes of the class discussion from a classmate.

Office hours: My office hour will be held on Mondays 1:30-2:30 PM in Klamath 249C. If you are not free at this time, you may schedule an appointment to meet with me at another time. You may also email me with questions or comments (kguillem@uoregon.edu). Your email correspondences are an extension of your class participation, so please maintain a professional tone. I will generally respond to email messages within a day.

Students with disabilities: The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in barriers to your participation. You may also wish to contact Disability Services in 164 Oregon Hall at 346-1155 or disabsrv@uoregon.edu.

Grading policy:
Homework (30%): Homework questions on the assigned reading will be posted on Blackboard. There will be six assignments total. No late homeworks will be accepted.

Midterm: (20%): The midterm exam will be a take home exam that will cover material from the readings and lectures. The midterm will be available Tuesday October 22 at 5 PM and will be due Friday October 25 at 9 AM. There will be no class meeting on Thursday October 24.

Proposal: (15% oral presentation; 25% written proposal): Each student will be required to write and present a short research proposal that uses approaches covered in the course to address an unanswered question in the field of bacterial-host interactions. Detailed information about the proposal will be provided later in the course. The proposal abstract and specific aims will be due before class on October 31. Students will participate in a proposal writing workshop during the 8th week of class. Each student will present his or her proposal during the 10th week of class. The final written proposal will be due Wednesday December 11 at 5 PM to be submitted via Blackboard. No late proposals will be accepted.

Class participation: (10%)*:* Class participation is crucial for the success of this course. Attendance will be taken and students will be expected to come to class having read and thought about the assigned material and to participate in all class activities. Much of the assigned reading is recent and by no means accepted dogma. Students should read the papers critically and continually question how the authors derive their conclusions, what assumptions they made, and what future experiments could support or refute their conclusions. Such critical thinking will be required for the original research proposal.

Grading for undergraduates versus graduate students: Undergraduate and graduate students will be graded separately, based on different expectations of their background knowledge in scientific approaches. The expectations for the research proposal and scope of the project will be very different for the undergraduate and graduate students. The expectation for the undergraduate research proposal will be that the student describes a single experimental strategy to address an unanswered question. The graduate students will be required to write a longer proposal that employ several independent approaches to address a well-defined research question, similar in scope to a professional predoctoral research fellowship proposal.

Academic integrity: All students will be expected to adhere to the University's guidelines on academic integrity as outlined in the Student Conduct Code:
http://studentlife.uoregon.edu/programs/student_judi_affairs/conduct-code.htm
Students are encouraged to discuss class material with one another, including the reading and homework questions. However, all submitted written work, including answers to homework questions and components of the research proposal, must be the original work of each student. Proper citation of sources is required in all written work and oral presentations.

BI433/533 Class Schedule 2010

Week	Date	Topic	Reading and assignments
1	Oct 1	A new field of biology: host-bacterial interactions	Review article: McFall-Ngai, et al., 2013
1	Oct 3	Why we should care about microbial-host interactions	Review article: Blaser and Falkow, 2009
2	Oct 8	How to study host-microbes interactions: a historical perspective	Review article: Beutler and Rietschel, 2003 **Homework 1 due 1:45 PM on Blackboard**
2	Oct 10	A simple model of bacterial-regulated morphogenesis: squid	Review article: Nyholm and McFall-Ngai, 2004 Research article: Koropatnick, et al., 2004
3	Oct 15	A model for bacterial-regulated energy harvest: fruit flies	Review article: Lee and Brey, 2013 Research article: Shin, et al., 2011 **Homework 2 due 1:45 PM on Blackboard**
3	Oct 17	A model for bacterial-regulated immune maturation: mouse	Review article: Chu and Mazmanian, 2013 Research article: Bouskra, et al., 2008
4	Oct 22	A model for bacterial-regulated immune tolerance: zebrafish	Review article: Kanther and Rawls, 2010 Research article: Bates, et al., 2007 **Homework 3 due 1:45 PM on Blackboard**
4	Oct 24	**Midterm exam (to be completed at home; no class meeting)**	
5	Oct 29	Methodologies for analyzing microbial communities	Review article: Lozupone, et al., 2012 Research article: Turnbaugh, et al., 2006
5	Oct 31	Microbial communities and antibiotics	Research article: Cho, et al., 2012 **Proposal abstracts and specific aims due 1:45 PM on Blackboard**
6	Nov 5	Host genetic determinants of microbial community assembly	Review article: Spor, et al., 2011 Research article: Ryu, et al., 2008 **Homework 4 due 1:45 PM on Blackboard**
6	Nov 7	Ecological determinants of microbial community assembly	Review article: Costello, et al., 2012 Research article: Goodman, et al., 2009
7	Nov 12	Pathologic shifts in microbial communities: invasion by pathogens	Review article: Stecher and Hardt, 2011 Research article: Winter, et al., 2013 **Homework 5 due 1:45 PM on Blackboard**
7	Nov 14	Pathologic shifts in microbial communities: invasion by pathogens	Research article: Ng, et al., 2013
8	Nov 19	Proposal writing workshop	**Revised abstracts and specific aims due 9:00 AM on Blackboard and emailed to group**
8	Nov 21	Proposal writing workshop	**Outlined experimental design and expected outcomes due 9:00 AM on Blackboard and emailed to group**
9	Nov 26	Environmental interactions with host genetics and microbial factors	Research article: Ridaura, et al., 2013 **Homework 6 due 1:45 PM on Blackboard**
9	Nov 28	**Thanksgiving holiday**	
10	Dec 3	Research proposal presentations (extended class time to be determined)	
10	Dec 5	Research proposal presentations (extended class time to be determined)	
11	Dec 11	**Research proposals due at 5 PM via Blackboard**	

Reading (available on Blackboard)

1. **McFall-Ngai, M., M. G. Hadfield, T. C. Bosch, H. V. Carey, T. Domazet-Loso, A. E. Douglas, N. Dubilier, G. Eberl, T. Fukami, S. F. Gilbert, U. Hentschel, N. King, S. Kjelleberg, A. H. Knoll, N. Kremer, S. K. Mazmanian, J. L. Metcalf, K. Nealson, N. E. Pierce, J. F. Rawls, A. Reid, E. G. Ruby, M. Rumpho, J. G. Sanders, D. Tautz, and J. J. Wernegreen.** 2013. Animals in a bacterial world, a new imperative for the life sciences. Proc Natl Acad Sci U S A **110:**3229-36.

2. **Blaser, M. J., and S. Falkow.** 2009. What are the consequences of the disappearing human microbiota? Nat Rev Microbiol **7:**887-94.
3. **Beutler, B., and E. T. Rietschel.** 2003. Innate immune sensing and its roots: the story of endotoxin. Nat Rev Immunol **3:**169-76.
4. **Nyholm, S. V., and M. J. McFall-Ngai.** 2004. The winnowing: establishing the squid-vibrio symbiosis. Nat Rev Microbiol **2:**632-42.
5. **Koropatnick, T. A., J. T. Engle, M. A. Apicella, E. V. Stabb, W. E. Goldman, and M. J. McFall-Ngai.** 2004. Microbial factor-mediated development in a host-bacterial mutualism. Science **306:**1186-8.
6. **Lee, W. J., and P. T. Brey.** 2013. How Microbiomes Influence Metazoan Development: Insights from History and Drosophila Modeling of Gut-Microbe Interactions. Annu Rev Cell Dev Biol.
7. **Shin, S. C., S. H. Kim, H. You, B. Kim, A. C. Kim, K. A. Lee, J. H. Yoon, J. H. Ryu, and W. J. Lee.** 2011. Drosophila microbiome modulates host developmental and metabolic homeostasis via insulin signaling. Science **334:**670-4.
8. **Chu, H., and S. K. Mazmanian.** 2013. Innate immune recognition of the microbiota promotes host-microbial symbiosis. Nat Immunol **14:**668-75.
9. **Bouskra, D., C. Brezillon, M. Berard, C. Werts, R. Varona, I. G. Boneca, and G. Eberl.** 2008. Lymphoid tissue genesis induced by commensals through NOD1 regulates intestinal homeostasis. Nature **456:**507-10.
10. **Kanther, M., and J. F. Rawls.** 2010. Host-microbe interactions in the developing zebrafish. Curr Opin Immunol **22:**10-9.
11. **Bates, J. M., J. Akerlund, E. Mittge, and K. Guillemin.** 2007. Intestinal alkaline phosphatase detoxifies lipopolysaccharide and prevents inflammation in zebrafish in response to the gut microbiota. Cell Host Microbe **2:**371-82.
12. **Lozupone, C. A., J. I. Stombaugh, J. I. Gordon, J. K. Jansson, and R. Knight.** 2012. Diversity, stability and resilience of the human gut microbiota. Nature **489:**220-30.
13. **Turnbaugh, P. J., R. E. Ley, M. A. Mahowald, V. Magrini, E. R. Mardis, and J. I. Gordon.** 2006. An obesity-associated gut microbiome with increased capacity for energy harvest. Nature **444:**1027-31.
14. **Cho, I., S. Yamanishi, L. Cox, B. A. Methe, J. Zavadil, K. Li, Z. Gao, D. Mahana, K. Raju, I. Teitler, H. Li, A. V. Alekseyenko, and M. J. Blaser.** 2012. Antibiotics in early life alter the murine colonic microbiome and adiposity. Nature **488:**621-6.
15. **Spor, A., O. Koren, and R. Ley.** 2011. Unravelling the effects of the environment and host genotype on the gut microbiome. Nat Rev Microbiol **9:**279-90.
16. **Ryu, J. H., S. H. Kim, H. Y. Lee, J. Y. Bai, Y. D. Nam, J. W. Bae, D. G. Lee, S. C. Shin, E. M. Ha, and W. J. Lee.** 2008. Innate immune homeostasis by the homeobox gene caudal and commensal-gut mutualism in Drosophila. Science **319:**777-82.
17. **Costello, E. K., K. Stagaman, L. Dethlefsen, B. J. Bohannan, and D. A. Relman.** 2012. The application of ecological theory toward an understanding of the human microbiome. Science **336:**1255-62.
18. **Goodman, A. L., N. P. McNulty, Y. Zhao, D. Leip, R. D. Mitra, C. A. Lozupone, R. Knight, and J. I. Gordon.** 2009. Identifying genetic determinants needed to establish a human gut symbiont in its habitat. Cell Host Microbe **6:**279-89.
19. **Stecher, B., and W. D. Hardt.** 2011. Mechanisms controlling pathogen colonization of the gut. Curr Opin Microbiol **14:**82-91.
20. **Winter, S. E., M. G. Winter, M. N. Xavier, P. Thiennimitr, V. Poon, A. M. Keestra, R. C. Laughlin, G. Gomez, J. Wu, S. D. Lawhon, I. E. Popova, S. J. Parikh, L. G. Adams, R. M. Tsolis, V. J. Stewart, and A. J. Baumler.** 2013. Host-derived nitrate boosts growth of E. coli in the inflamed gut. Science **339:**708-11.
21. **Ng, K. M., J. A. Ferreyra, S. K. Higginbottom, J. B. Lynch, P. C. Kashyap, S. Gopinath, N. Naidu, B. Choudhury, B. C. Weimer, D. M. Monack, and J. L. Sonnenburg.** 2013. Microbiota-liberated host sugars facilitate post-antibiotic expansion of enteric pathogens. Nature.
22. **Ridaura, V. K., J. J. Faith, F. E. Rey, J. Cheng, A. E. Duncan, A. L. Kau, N. W. Griffin, V. Lombard, B. Henrissat, J. R. Bain, M. J. Muehlbauer, O. Ilkayeva, C. F. Semenkovich, K. Funai, D. K. Hayashi, B. J. Lyle, M. C. Martini, L. K. Ursell, J. C. Clemente, W. Van Treuren, W. A. Walters, R. Knight, C. B. Newgard, A. C. Heath, and J. I. Gordon.** 2013. Gut microbiota from twins discordant for obesity modulate metabolism in mice. Science **341:**1241214.