**BIOM 415: Microbial Diversity, Ecology, and Evolution**
Spring 2012
MWF 1:10-2:00, NAC 201

**Instructor**
John McCutcheon (HS 304A, john.mccutcheon@umontana.edu, 243-6071)

**Office Hours**
Mondays and Wednesdays, 2:15-3:15, or by appointment.

**Text**
The reading for this course will come from the primary literature and the *Brock Biology of Microorganisms* (BBoM), 13th ed., Pearson Education, Inc., 2012. I didn't make the 13th ed. of BBoM required, however, because I didn't want to make students buy the 13th ed. if they already had the 12th ed. We can discuss this the first day of class. I will put a copy of BBoM 13th ed. on hold at the Mansfield Library if any of you would prefer that.

**Course Overview and Goals**
This class will touch on some major themes in the areas of microbial diversity, ecology, and evolution. Each one of these topics by itself is a huge field; we therefore cannot possibly hope to cover all that is contained in the title of this course during a single semester. We will therefore take an approach that combines traditional lectures with more focused explorations of selected topics from the scientific literature. The lectures will be designed to help you understand the primary literature articles as well as highlight broader themes that arise during the semester. My overall goal for the course is to help you "see" the ubiquitous and critical influence of microbial processes on the functioning of nearly all ecosystems at all scales, to give you the skills to critically evaluate the scientific literature, and to help you understand how the process of science works. More specifically, the goals for this course are for you to:

- Understand the ecological and evolutionary forces that generate the enormous levels of microbial diversity on Earth
- Understand the complexity of the species concept for microbes
- Understand how modern molecular methods are used in the study of microbial diversity, ecology, and evolution
- Understand the microbial contribution to the functioning of biogeochemical cycles
- Understand the diversity of microbial lifestyles and metabolisms
- Understand the non-pathogenic roles that microbes play in animal biology
- Understand the basic structure and dynamics of microbial genomes
- Understand the basic mechanisms used in microbial communication
- Be able to understand and evaluate the primary scientific literature
- Develop skills in working in groups and explaining your ideas verbally and in writing

**Assessment**
Your final grade for the course will be based on in-class participation (300 points, 30%), several take-home assignments (500 points, 50%), and a comprehensive final (200 points, 20%). Most of your participation grade will come from the class meetings when we discuss the week's primary literature paper. In these discussions, different teams of students will explain various parts of that week's reading to the rest of the class. It will be impossible for you to get a decent

grade in this class if you do not come prepared to discuss the assigned reading. The take home assignments will deal with both the lecture and primary literature material, and you will have an opportunity to amend your answers after the in-class discussion sessions. The final exam questions will be similar in style and in scope to these take home assignments, so the types of questions and the material contained therein will not come as a surprise.

**Extra credit**
There will be several opportunities for extra credit, up to a maximum of 80 points. The primary way of getting extra credit points will be to write a one-page, double-spaced synthesis paper describing either an on-campus seminar or a paper you find in the primary literature, focusing on how the work discussed in the seminar or paper complements, expands on, or disagrees with something you learned the course. These synthesis papers should not simply reiterate what the speaker said or what the paper reported, but should show that you are integrating what you are learning in the course with other material. Each synthesis paper is worth up to 10 points each, and none will be accepted after the end of class on Friday 27 April.

There are several opportunities to attend seminars on campus. I will try to alert you to relevant ones as they arise. In general the IMB and OBE seminar series will probably be most appropriate, although some from Forestry and Biomedical and Pharmaceutical Sciences may sometimes be of interest:

IMB seminar series: 12:10-1pm Mondays, Skaggs 117
OBE seminar series, 4:10-5pm Wednesdays, ISB 110

**Late work policy**
This class will cover a lot of ground, and will require you to keep up with the assigned reading. If you have a problem understanding the material, or with turning an assignment in on time, I strongly encourage you to speak with me as early as possible. In general I won't accept late work, but I think you will find that I am a sympathetic and reasonable person if you deal with me in an upfront and honest manner. However you will also find that I can be pretty tough if you wait until the last minute or if I find that you have been disingenuous with me.

**Honor Code**
The work you turn in should be your own. You are of course free to discuss any aspect of the course with me or your classmates, including questions on the take-home assignments. You may come to consensus conclusions on the questions as a group, but at the point when you begin formulating your answer on paper (or on the computer), the work must become completely your own. If I see any evidence of a student copying the work of another I will ask the involved students about the incident; if no obvious explanation exists I will treat the matter extremely harshly. This may include receiving a failing grade for the entire course and filing a report with the Provost & Vice President for Academic Affairs, as described in The University of Montana Student Conduct Code:

http://life.umt.edu/vpsa/documents/StudentConductCode1.pdf

I don't expect this to be an issue with this course, but I do want you to know that I take plagiarism very seriously. If you are unsure about any of this, I urge you to ask me before turning something in.

This is the tentative course outline. I expect/hope that it will change in response to your interests. For example, we could equally well explore principles in microbial diversity and evolution by studying the global ocean or human gut ecosystems; how we focus our time will be largely up to you.

| Week | Date | Topic |
|---|---|---|
| | 23 Jan, Mon | Course overview and introductions |
| 1 | 25 Jan, Wed | Lecture: microbial life in deep evolutionary time |
| | 27 Jan, Fri | Lecture: metabolic diversity |
| | 30 Jan, Mon | Lecture: PCR, Sanger sequencing, next-gen sequencing |
| 2 | 1 Feb, Wed | Lecture: methods in microbial ecology; 16S |
| | 3 Feb, Fri | Dicussion: Morris |
| | 6 Feb, Mon | Lecture: measuring species abundance and richness |
| 3 | 8 Feb, Wed | Lecture: how do we enumerate microbes? |
| | 10 Feb, Fri | Discussion: Sogin |
| | 13 Feb, Mon | Lecture: basic principles of microbial ecology |
| 4 | 15 Feb, Wed | Lecture: biogeochemical cycles |
| | 17 Feb, Fri | Discussion: Falkowski |
| | 20 Feb, Mon | No class, President's Day |
| 5 | 22 Feb, Wed | Lecture: microbial genome diversity |
| | 24 Feb, Fri | Lecture: LGT and recombination |
| | 27 Feb, Mon | Lecture: microbial genome evolution |
| 6 | 29 Feb, Wed | Lecture: microbial genomics and metagenomics |
| | 2 Mar, Fri | Discussion: Ward |
| | 5 Mar, Mon | Lecture: fungal microbes |
| 7 | 7 Mar, Wed | Lecture: the biofilm lifestyle and quorum sensing |
| | 9 Mar, Fri | Discussion: Bamford |
| | 12 Mar, Mon | Lecture: macrobe-associated microbes |
| 8 | 14 Mar, Wed | Lecture: the human microbiome project |
| | 16 Mar, Fri | Dicussion: Turnbaugh |
| | 19 Mar, Mon | Lecture: who makes up the gut microbiome? |
| 9 | 21 Mar, Wed | Lecture: what do they do? |
| | 23 Mar, Fri | Discussion: Arumugam |
| | 26 Mar, Mon | Lecture: insect-microbe symbioses |
| 10 | 28 Mar, Wed | Lecture: bark beetle-fungal symbioses |
| | 30 Mar, Fri | Discussion: Six |
| | 2 Apr, Mon | |
| | 4 Apr, Wed | Spring break, wahoo. |
| | 6 Apr, Fri | |
| | 9 Apr, Mon | Lecture: viral diversity |
| 11 | 11 Apr, Wed | Lecture: the SEED database |
| | 13 Apr, Fri | Discussion: Dinsdale |
| | 16 Apr, Mon | Lecture: Archaeal diversity |
| 12 | 18 Apr, Wed | Lecture: The root of the tree and the origins of Eukarya |
| | 20 Apr, Fri | Discussion: Forterre |
| | 23 Apr, Mon | Lecture: eukaryotic microbial diversity |
| 13 | 25 Apr, Wed | Lecture: the microsporidia: deep-branching eukaryote? |
| | 27 Apr, Fri | Discussion: Vossbrinck and Keeling |
| | 30 Apr, Mon | Lecture: the origin of multicellularity |
| 14 | 2 May, Wed | Lecture: case studies: Dictyostelium and Myxococcus |
| | 4 May, Fri | Discussion: Ratcliff |