

Evolution of Infectious Disease

Course Number: MCB 435

Credit Hours: 3

Instructor: Dr. Rachel Whitaker

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IGB 3402 (Tuesday, Wednesday, Thursday)

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Teaching Assistants: Danielle Campbell (Microbiome) campbe28@illinois.edu ; Samantha DeWerff (Genomics/Evolution) dewerff2@illinois.edu

Meeting Place and Time:

Class: Tuesdays and Thursdays 11:00-12:20 PM Mumford Hall 313
(Computer Workshops in 164d and e Burrill Hall)

Whitaker office hours: Wednesday 1:00-3:00 PM 3402 IGB (or by appointment)

DeWerff office hours: Monday 9:00 – 10:00 (or by appointment)

Campbell office hours: (by appointment)

Course website: Moodle MCB435

Course Summary: Understanding the evolution and ecology of infectious disease is of great importance to human health. We will illustrate critical applications of basic ecological evolutionary principles with examples from the recent primary literature. We will focus on what genomics and sequence analysis can tell us about the ecology of healthy and protective the human microbiome, spread and emergence of disease, the evolutionary basis for antibiotic resistance, effective vaccine design, and me.

Learning Objectives: A successful student in MCB435 will:

- Critically read the primary scientific literature and evaluate experimental design.
- Frame sophisticated biological questions and formulate testable hypotheses.
- Build a logical evidence-based argument and communicate your knowledge to others.
- Describe how a whole system works from the molecular to the organismal level.
- Analyze signatures of evolutionary and ecological processes in genomic data.
- Predict how human actions influence dynamic microbial communities in the
 - The stability and diversity of the human microbiome.
 - The spread, emergence or eradication of infectious disease.

Readings: Evolution of infectious disease based on genome sequence is new and rapidly progressing fields – no single textbook provides the background you will need. Articles to support lecture material and provide additional detailed, indepth, information will be provided on the website or handed out in class where applicable. Students are not responsible for these reading materials on examinations unless otherwise noted. These readings are meant to augment the classroom materials.

In addition, we will read and discuss seven articles from the primary literature. **Students are responsible for the material covered in these articles on quizzes.** For more information see Reading the Primary Literature on how to get started on the primary literature.

Evaluations:

Quizzes	350
Microbiome Workshop	175
Evolution Workshop	175
Debate	100
Semester Project	200
Total	1000

Late policy: Any assignments handed in after the posted deadline will be marked down 10 points each day to half the total points.

Quizzes – 7 x 50 pts each (drop two)

The majority of class work is lectures combined with current papers on a related topic. On nine Thursday when we are not doing workshops, debate or presentations, we will discuss an assigned paper from the current literature for the first 50 minutes of class. This discussion will be guided by the study guide and will include methods and approaches and will also be independent critical assessments of *What did you like about this paper? What did you dislike about it? What is the most interesting or important limitation or shortcoming in the study? What subsequent work do you think would be most informative? Why?* This discussion will be followed by a 50 pt quiz covering the lecture and paper(s) for that week. Of the nine possible 50 pt quizzes students are permitted to drop 2 with their lowest scores for a total of 350 possible points.

Workshops -- 175 pts each

Two in-class workshops will allow students to practice experimental design and data analysis. Cumulatively these workshops will add to 175 points. More detailed rubrics can be found on the website.

Debate -- 100 pts

Because of the impact of infectious disease on the human population, novel approaches to controlling disease emergence and spread are often hotly debated. We will debate one such issue in class. The class will be divided into two teams and assigned a position to argue. Each group will work together to research the literature and find at least *five figures from the primary scientific literature* to support their position these will be submitted to the opposite side on the Tuesday before the debate. On the day of the debate each team will present their position in a summary including at least five figures of data and question the opposing team on their results. Up to 50 pts will be given to each member of each team depending upon the quality of their scientific argument. Following the debate each team member will independently write a one-two page summary of their own position following the debate and justify it given the data as presented for an additional 50 pts.

Semester Project -- 200 points

After taking MCB435 you will have a responsibility to take what you learned and teach others about these important topics that impact everyone everyday. In groups of four you will work to research and answer a question posed by the general public. A list of questions will be provided here additional topics can be included if they are **approved by Dr. Whitaker**. Your group will be responsible for critically evaluating the data on the topic and composing a publically accessible report (5 minute video) to answer the question at a level that is understandable by the lay public written at a high school level. The presentation *must include a clear representation and explanation of the actual primary data and experimental design including figures modified from primary literature*. This report should provide the necessary background for the reader to understand the topic in question, the results, and why they are important. To do this well your group will need to read and reference additional background information (likely two papers each and reviews on the topic). These papers must be referenced in your presentation. All graphs and tables should be properly labeled and have figure legends. To optimize the accessibility and distribution of your report you will be connected with an Illinois Extension Educator who will read/watch drafts of your report and make substantive suggestions for modification before the final draft. Timeline for the project is outlined here.

Extra credit: Evolution of Infectious Disease in the news – Extra credit up to 30 pts (15 pts each article noted)

Everyday there are reports in the popular press about the evolution of infectious disease or the microbiome. For extra credit monitor this news and highlight one article from the population press that relates to topics we have discussed. Possible sources include: any major newspaper or news organization, (New York Times, Chicago Tribune, Washington Post, National Public Radio), news/science blogs for example HuffingtonPost, Science Daily, Science News, MicrobeWorld. News articles must be current being posted by you with a date and report in class within two weeks of when they are posted. To earn credit you must submit your report in the format described and present your article at the beginning of the following class. Please see Extra Credit for more information on the format

	Date	Topic
Week 1	Tuesday, January 17	The Microbial Revolution
	Thursday, January 19	Measuring Microbial Diversity
Week 2	Tuesday, January 24	The Healthy Microbiome
	Thursday, January 26	<i>Microbiome Paper 1</i>
Week 3	Tuesday, January 31	Changes in the Human Microbiome
	Thursday, February 2	<i>Microbiome Papers</i>
Week 4	Tuesday, February 7	American Gut/Exchange and read proposals
	Thursday, February 9	Experimental Design for Microbiome project
Week 5	Tuesday, February 14	Unhealthy microbiomes
	Thursday, February 16	<i>Microbiome Papers 3</i>
Week 6	Tuesday, February 21	Pathogen invasion
	Thursday, February 23	<i>Microbiome Papers 4</i>
Week 7	Tuesday, February 28	Tracking emergence spread
	Thursday, March 2	<i>Evolution Paper 5</i>
Week 8	Tuesday, March 7	Selection and drift
	Thursday, March 9	<i>Evolution paper 6</i>
Week 9	Tuesday, March 14	Evolution Workshop
	Thursday, March 16	Evolution Workshop
Spring break		
Week 10	Tuesday, March 28	Recombination and gene flow
	Thursday, March 30	<i>Evolution paper 7</i>
Week 11	Tuesday, April 4	Horizontal gene transfer
	Thursday, April 6	<i>Evolution papers 8</i>
Week 12	Tuesday, April 11	Vector interactions and symbiosis
	Thursday, April 13	<i>Evolution papers 9</i>
Week 13	Tuesday, April 18	Debate preparation
	Thursday, April 20	Debate: Gene drives against infectious disease
Week 14	Tuesday, April 25	Ecology Workshop
	Thursday, April 27	Ecology Workshop
Week 15	Tuesday, May 2	Project presentations
	Monday, May 8	Project presentations