

## Evolution of Infectious Disease Spring 2024

**Course Number:** MCB 435

**Credit Hours:** 3

**Meeting Place and Time:** 2:00 - 3:20 PM Tuesday  
In person: CIF 4039

2:00 - 3:20 PM Thursday  
Online: [MCB 435 Zoom](#)  
Meeting ID: 843 8671 9732  
Password: 174545

**Instructor:** Dr. Rachel Whitaker

**Office:** M, W, F IGB 3404  
Tuesday and Thursday CLSL C222

**Email:** [rwhitakr@illinois.edu](mailto:rwhitakr@illinois.edu) (Email is **not** the best way to reach me. I get 100s of emails a day and miss even important ones like yours. Please bring questions to office hours or talk to me after class where you will have my full attention).

**phone:** (217) 244-8420

Whitaker office hours: 1:00 – 2:00 Wednesday: In person IGB 3404  
11:00 – 12:00 Thursday (zoom)  
After class Tuesday (CIF) and Thursday (Zoom)

Teaching assistants: Izzy Lakis ([ilakis2@illinois.edu](mailto:ilakis2@illinois.edu))  
Jiayue Yang ([jiayuey5@illinois.edu](mailto:jiayuey5@illinois.edu))

TA office hours: 9:00 - 10:00 Mondays (Izzy Lakis) (hybrid, IGB 3410, and [zoom](#))  
2:00 - 3:00 Mondays (Jiayue Yang) (hybrid, IGB 3122 and [zoom](#))

**Course website:** [Moodle MCB435](#)

**Course participation requirements:** Attendance at lectures and discussions is the key to success in this class. There is a requirement that all who can have video cameras on during discussions.

**Disability statement:** To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-1970, e-mail [disability@illinois.edu](mailto:disability@illinois.edu) or go to the [DRES website](#).

**Course Summary:** The evolution of infectious disease is both scientifically exciting and of great relevance to human health and wellbeing. We will illustrate critical applications of basic evolutionary mechanisms and apply evolutionary principles to infectious disease with examples from the recent primary literature. We will focus on what genomics and sequence analysis can tell us about the spread and emergence of infections, the evolutionary basis for antibiotic resistance, and infection biology.

**Learning Objectives:** A successful student in MCB435 will learn to:

- Critically read the primary scientific literature and evaluate results.
- Build logical, evidence-based answers to critical questions about the evolution of infectious disease from primary data.
- Connect interactions of evolutionary processes to real-time evolutionary outcomes.
- Identify signatures of evolutionary processes in genomic data.

- Apply evolutionary theory to predict how human actions influence dynamic microbial communities to spread, emerge, or eradicate infectious disease and antibiotic resistance.

**Readings:** Genomic approaches to understanding the evolution of infectious disease is a powerful and rapidly progressing field – no single textbook provides the background you will need. Review articles will be provided to support lecture material and provide additional detailed and in-depth information when appropriate. These readings are meant to augment the classroom materials.

We will read and discuss ten articles from the primary literature. **Students are responsible for knowing the material covered in these articles, in addition to lectures. Reading from the primary literature and problem sets will be evaluated on weekly problem sets.** For more information, see [Reading the Primary Literature](#).

<b>Evaluation:</b>			
<b>Required assignments</b>	<b>Points</b>	<b>Number</b>	<b>Total available</b>
Problem sets	50	10	500
Quizzes	100	3	300
Organism shout-outs	50	1	50
Debate: Individual contributions.	100	1	100
Debate	50	1	50
<b>Total</b>			<b>1000</b>
<b>Extra credit</b>			
Participation points/cameras on during discussions	2	14	28
Seminar Summary	10	1	10
Winners of the debate	10	1	10
Questions during the debate	1	6	6
<b>Total</b>			<b>54</b>

### Overview of Evaluative Tools:

*Problem sets – 50 points each. 11 drop 1 for  $10 * 50 = 500$*

There will be 11 problem sets available throughout the course. You are allowed to drop 1 for a total of  $10 * 50 = 500$ . Each one (except the first) will be posted on Monday and completed by the following Monday (one week later). **No late problem sets will be accepted.** Problem sets aim to integrate the lecture material with the primary papers assigned for discussion on that Thursday. Students are expected to read the paper before the discussion so that they can participate in answering the questions. Collaborative discussion of problem sets will be provided for discussion every Thursday in randomly assigned breakout groups on zoom. The majority will be around 10 questions.

Problem sets are designed for thought and discussion and to apply the lecture material. **Problem sets are learning tools for the three quizzes that will follow a similar format and cover the same material *but will be different questions*. Therefore, careful reading and understanding of the paper especially as it relates to the lecture before the discussion is essential for success in this class.**

Please be thoughtful as to how you participate in these discussions and interact with other students, and familiarize yourself with [our discussion guidelines](#).

*Quizzes – 100 points each. 3 x 100 = 300 total*

While much of the class has to do with reading and interpreting the primary literature with respect to the lectures, three quizzes, 100 points each, are designed to test your understanding and ability to interpret the evolutionary concepts that underlie the phenomena observed in the primary literature. Quizzes will be *in person, on paper, and open-note* but without access to the internet or discussion with your classmates.

*Organism shout-outs – 50 points*

Three Thursday discussions will be dedicated to individual 3-minute presentations by students on infectious organisms of their choice. Students will sign up for an organism to discuss (no duplications there are plenty!). Students will present an overview of the basic evolutionary parameters of the organism, mutation rates, recombination and horizontal gene transfer, infection biology, transmission, where and why this organism is a problem, current control strategies and whether control strategies they are successful with citations. In addition, you will share a news/media reports about your organism in any major newspaper or news organization (New York Times, Chicago Tribune, Washington Post, National Public Radio) or news/science blogs (Discover, Science Daily, Science News, MicrobeWorld). News articles must be relatively current, meaning they were published within the last year. Citations are expected to be submitted on the day of presentation.

Students will sign up on a first-come, first-served basis for organisms and times. Students are encouraged to discuss and even practice their presentation with Dr. Whitaker or either of two TAs before presenting.

*Debate* -- 150 points (total)

The creation and/or rebuttal of persuasive, data-driven arguments is a vital ability to have as a scientist today. After your experience reading the primary literature this year, you can be a leader in evolutionarily informed discussion of policy at the dinner table and beyond. The following statement will be proposed to the class:

*Antibiotic resistance that evolves in industrial agriculture spills over into human clinical settings.*

For our debate, the class will be randomly divided into two main teams with opposite positions:

1. Support the claim: presenting data and an argument to support this statement and refuting data and arguments that don't support it.
2. Oppose the claim: presenting data that do not support this argument and arguing against data that do.

## **Assessment**

	<b>Points Total</b>	<b>Date Due</b>
Credit to individual student		
Primary Argument summary	25	Thursday, February 22, 2024
New paper summary and data	25	Thursday, March 21, 2024
Final Argument summary	50	Tuesday, April 30, 2024
Credit to team	100	
Opening Statement	10	Wednesday, May 8, 2024
Arguments (per subgroup or average)	20	Wednesday, May 8, 2024
Rebuttal	10	Wednesday, May 8, 2024
Closing statement	10	Wednesday, May 8, 2024
	50	
<b>Total</b>	<b>150</b>	
Extra credit to team		
Questions (2 per main point)	6	Wednesday, May 8, 2024
Winning team	10	Wednesday, May 8, 2024
<b>Total</b>	<b>16</b>	

Extra credit: Students may do any or all of the following extra credit options.

Participation points – 2 points per virtual lecture

You will receive one point for each class you attend and engage with your camera from beginning to end.

Debate: 10 points for every student on the winning side and 1 point per question (up to 2 per main argument total of 6 points).

Seminar Summary: Attend a Microbiology seminar (4:00 on Thursdays CLSL B102) or seminar discussion of MCB529-MGE (10 AM Friday IGB 3410 or zoom) and write a summary.

**Late policy:**

All due dates are by 11:55 PM on dates stated except when presented in class. **Problem sets will not be accepted late.**

**Grading Scale:**

A+	<966
A	933-965
A-	900-932
B+	866-899
B	833-865
B-	800-832
C+	766-799
C	733-765
C-	700-732
D+	666-699
D	633-665
D-	600-632

Week	Date	Topic	Format	Problem sets
Week 1	Tuesday, January 16, 2024	Course Overview and Objectives	Lecture	Problem Set 0: Finding papers
	Thursday, January 18, 2024		Discussion	
Week 2	Tuesday, January 23, 2024	The Sequence Revolution	Lecture	Problem Set 1: <i>In silico</i> Evolution Paper 1
	Thursday, January 25, 2024	AVIDA introduction	Discussion	
Week 3	Tuesday, January 30, 2024	Mutation	Lecture	Problem Set 2: Mutation Rates Paper 2:
	Thursday, February 1, 2024		Discussion	
Week 4	Tuesday, February 6, 2024	Reconstructing history	Lecture	Problem Set 3: Phylogenetic trees Paper 3:
	Thursday, February 8, 2024		Discussion	
Week 5	Tuesday, February 13, 2024	Quiz	Lecture	Shout-outs
	Thursday, February 15, 2024		Discussion	
Week 6	Tuesday, February 20, 2024	Stochastic Genetic Drift		Problem Set 4: Stochastic Genetic Drift Paper 4
	Thursday, February 22, 2024			
Week 7	Tuesday, February 27, 2024	Directional Selection	Lecture	Problem Set 5: Directional Selection Paper 5
	Thursday, February 29, 2024		Discussion	
Week 8	Tuesday, March 5, 2024	Diversifying Immune Selection	Lecture	Problem Set 6: Immune selection Paper 6:
	Thursday, March 7, 2024		Discussion	
Spring Break	Tuesday, March 12, 2024			
	Thursday, March 14, 2024			
Week 9	Tuesday, March 19, 2024	Recombination/reassortment	Lecture	Problem set 7: Recombination Paper 7:
	Thursday, March 21, 2024		Discussion	
Week 10	Tuesday, March 26, 2024	Quiz	Lecture	Shout-outs
	Thursday, March 28, 2024		Discussion	
Week 11	Tuesday, April 2, 2024	Mobile Genetic Elements	Lecture	Problem Set 8: MGE dynamics Paper 8:
	Thursday, April 4, 2024		Discussion	
Week 12	Tuesday, April 9, 2024	Fitness tradeoffs, Transmission, and Virulence	Lecture	Problem Set 9: Fitness tradeoffs, Transmissic Paper 9:
	Thursday, April 11, 2024		Discussion	
Week 13	Tuesday, April 16, 2024	Evolution informed strategies for control	Lecture	Problem Set: 10 Evolution informed strategies Paper 10:
	Thursday, April 18, 2024		Discussion	
Week 14	Tuesday, April 23, 2024	Quiz	Lecture	Shout-outs
	Thursday, April 25, 2024		Discussion	
Week 15	Tuesday, April 30, 2024	Debate Prep		
Final Exam	7:00 - 10:00 Wednesday, May 8, 2024	Debate		
Total points				11 problem sets (one dropped) x 50