



School of Molecular & Cellular Biology
MCB 430, Spring 2022
Molecular Microbiology, 3 cr. hrs.

Instructor/Instructional Team

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Class Meeting Schedule

Scheduled Class Time	MWF
Office Hours	TBD

Course Overview and Description

In biology, there are two fundamental conflicts: between organisms and between organisms and viruses. In addition, environmental stresses also play roles with both conflicts. During the conflicts, various offensive and defensive weaponry are employed for survival. This course will mainly focus on the conflicts between bacteria and environment, the conflicts between bacteria, and the conflicts between bacteria and viruses (phages). In this course, we will learn, from biochemical and structural points of view, how these offensive and defensive weaponry work. We will also learn biological processes employed by organisms to cope with environmental stresses.

In addition to provide molecular understanding of offensive and defensive weaponry employed during the conflicts, the course may inspire students in their future careers to invent new applications of the weaponry in biotechnology and medicine. This is because many powerful tools in biotechnology and medicine are the harvests of offensive and defensive weaponry employed for the conflicts. Among offensive weaponry, several small molecule biological toxins have been adopted as antibiotics. Among defensive weaponry, restriction enzymes employed in biotechnology are from R-M defensive systems, tools of genome editing are from CRISPR-Cas defensive systems, and RNA ligases essential for high throughput RNA sequencing are from RNA repair defensive systems.

Course Prerequisites

MCB 300 and credit or concurrent registration in MCB 354, or consent of instructor.

Student Learning Outcomes

At the end of the course, through assignments, discussions, and assessments, students will be able to:

- Understand the basic principles of nucleic acids and protein as well as their building blocks.
- Understand why the building blocks of nucleic acids have been employed to synthesize second messengers employed for the conflicts.

- Understand the mechanisms why nucleic acids are explored as the targets for the conflicts.
- Understand biochemistry and structures of protein employed as the effectors for the conflicts.

Course Text/Materials Information

Most of the materials for the lectures, and all materials for discussions will be from primary literature (see enclosed list of papers), which will be provided to the students. In addition, a general biochemistry textbook is useful. The following Biochemistry book is recommended.

"Lehninger Principles of Biochemistry, Eighth Edition" with Achieve & Access Code by Nelson and Cox
W. H. Freeman Publishing, 2021

Course Website, Course Tools (Canvas, Moodle, LON-CAPA, Zoom, etc.)

Moodle, address TBD
Moodle, login TBD

Grading Information and Breakdown

Homework Submission & Discussion Participate on Fridays 20%

Exam 1 40%

Exam 1 will cover the materials for the first half of the class.

Exam 2 40%

Exam 2 will cover the materials for the second half of the class.

Exams will be taken place in person in the classroom.

Course Calendar with Daily Schedule of Topics, Readings and Assignment Due Dates

Dates	Topics	Assigned Reading	Homework	Exams
19 Jan-W	Introduction to MCB 430; definition of microbes; major differences between microbes and higher organisms			
21 Jan-F	Molecular basis of important biological processes in bacteria, including DNA replication, RNA transcription, and protein translation			
24, Jan-M	Building blocks of DNA and RNA: Are they the inevitable consequence of biological evolution? or might they have had alternative choices over the course of evolution?			
26 Jan-W	The same questions for the building block of protein			

28 Jan-F	Becoming an expert of visualizing macromolecule structures and making professional structural figures			
31 Jan-M	Responses based on the signaling molecules cAMP and (p)ppGpp	Paper 1		
2 Feb-W	Responses based on the TA (toxin-antitoxin) systems			
4 Feb-F	Discussion: On a special TA system		HW 1	
7 Feb-M	Molecular basis of bacterial quorum sensing	Paper 2		
9 Feb-W	Molecular basis of bacterial biofilm formation			
11 Feb-F	Discussion: TBD		HW 2	
14 Feb-M	Small-molecule toxins as offensive weaponry	Paper 3		
16 Feb-W	Protein toxins as offensive weaponry			
18 Feb-F	Discussion: TBD		HW 3	
21 Feb-M	Molecular structures of bacterial cell wall	Paper 4		
23 Feb-W	Bacterial secretion systems			
25 Feb-F	Discussion: TBD		HW 4	
28 Feb-M	Plasmid-based delivery systems	Paper 5		
2 March-W	Contact-dependent growth inhibition (CDI) system			
4 Mar-F	Discussion: TBD		HW 5	
7 Mar-M	Direct inhibitions of the invading biological toxins	Paper 6		
9 Mar-W	Indirect inhibitions of the invading biological toxins			
11 Mar-F	Discussion: TBD		HW 6	
Spring Break	14-18 March			
21 Mar-M	Exam 1, no class, evening exam	Paper 7		Exam I
23 Mar-W	Primary antiphage system-1: DNA restriction-modification (R-M) systems			
25 Mar-F	Discussion: TBD		HW 7	
28 Mar-M	CRISPR-Cas lecture 1	Paper 8		
30 Mar-W	CRISPR-Cas lecture 2			
1 April-F	Discussion: Developing CRISPR-Cas technologies in genome editing		HW 8	
4 Apr-M	Possibly evolutionary origin of CRISPR-Cas	Paper 9		
6 Apr-W	RNAi-like systems in bacteria			
8 Apr-F	Discussion: TBD		HW 9	
11 Apr-M	Bacterial antiphage systems based on small molecule toxins	Paper 10		
13 Apr-W	AbiA-to-AbiZ and PrrC			
15 Apr-F	Discussion: TBD		HW 10	
18 Apr-M	CRISPR-Cas associated CBASS systems	Paper 11		

20 Apr-W	Independent CBASS systems			
22 Apr-F	Discussion: TBD		HW 11	
25 Apr-M	Adenosine deaminase acting on RNA (RADAR) antiphage systems	Paper 12		
27 Apr-W	Retron-based antiphage systems			
29 Apr-F	Discussion: TBD		HW 12	
2 May-M	Phages employing dG+-containing DNA as genome			
4 May-W	Phages with DNA genome where base A is replaced by base Z			
5 May-Th	Reading Day	No Classes	No Meetings	
6-13 May	Exam 2			Exam II

Academic Integrity:

- The Code of Policies and Regulations Applying to All Students will be applied in all instances of academic misconduct committed by students. This applies to all exams, presentations, assignments and materials distributed or used in this course. You can review these policies at the following website: <http://admin.illinois.edu/policy/code/index.html> and specifically here: <http://studentcode.illinois.edu/article1/part4/1-401/>
- Science cannot exist without honesty. The faculty and staff in MCB require students, as scientists-in-the-making, to hold the highest standards of scientific and academic conduct. Any form of cheating on any graded work in courses is unacceptable.
- We require that all graded work be entirely your own, and that anything you write using the words of other writers be correctly attributed. Some specific points follow.
- On exams, the answers that your turn in for grading must be your own, formulated during the exam from your own understanding of the material and without any supporting information, be it written, verbal or electronic. Copying the work of another student, or allowing another to copy your work, or copying work from any other source, is unacceptable. Since we cannot always monitor you as you complete your work, we must rely upon appearance of your work from which to judge. If the work you submit resembles that of another student or another source too closely, we may conclude that it was not your original work. Always make a conscious effort to complete your work on your own and to protect it from the view of others, in order to ensure that it will be seen as your own. Failure to adhere to these standards for any portion of an exam may result in a grade of zero for the entire exam or quiz for all persons involved.
- Texting, or the use of a cell phone or any other device for any purpose, during an exam is prohibited. Doing so may earn you a zero or a more extreme penalty on the exam at the discretion of the instructor.

Religious Observances and Practices:

- Students are required to submit the Request for Accommodation for Religious Observances Form (which can be found at www.odos.illinois.edu/.../Religious_Observance_Accommodation_Request_

Form.docx) to their instructors and the Office of the Dean of Students requesting accommodation by the end of the second week of the course. Requests that are not submitted within this time frame may not be granted. Information about accommodations can be found in the Student Code: <http://studentcode.illinois.edu/>.

DRES Accommodations:

- We are committed to providing a learning environment where our students can succeed. If you require special accommodations, please contact us and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak Street, Champaign, call 217.333.4603, or email disability@illinois.edu. We will try to meet all accommodations once the process has started. Please note that accommodations are not retroactive to the beginning of the semester, but begin the day you contact your professor, instructor or coordinator with a current letter of accommodation from DRES.
- If a student believes that they need DRES accommodations, they should contact DRES at disability@illinois.edu.

Exam Absences:

- If you must miss an exam due to unforeseen circumstances, you are required to contact your instructor within 24 hours of the absence. You will then have 48 hours from the absence in which to submit documentation to your instructor or course coordinator. Failure to follow this procedure may result in a zero for the exam.

University Information of Student Safety - Active Threats:

- **General Emergency Response Recommendations** ([Emergency Response Guide](#)):
- Security Threat. The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to any emergency on campus: **RUN > HIDE > FIGHT**
- **Only follow these actions if safe to do so.** When in doubt, follow your instincts - you are your best advocate!
- **RUN** – Action taken to leave an area for personal safety.
 - Take the time to learn the different ways to leave your building **before** there is an emergency.
 - Evacuations are mandatory for fire alarms and when directed by authorities! No exceptions!
 - Evacuate immediately. Pull manual fire alarm to prompt a response for others to evacuate.
 - Take critical personal items only (keys, purse, and outerwear) and close doors behind you.
 - Assist those who need help, but carefully consider whether you may put yourself at risk.
 - Look for **Exit** signs indicating potential egress/escape routes.
 - If you are not able to evacuate, go to an Area of Rescue Assistance, as indicated on the front page of this plan.
 - Evacuate to Evacuation Assembly Area, as indicated on front page of this plan.
 - Remain at Evacuation Assembly Area until additional instructions are given.
 - Alert authorities to those who may need assistance.

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- Do not re-enter building until informed by emergency response personnel that it is safe to return.
 - Active Threat: IF it is safe to do so, run out of the building. Get as far away as possible. Do NOT go to the Evacuation Assembly Area.
 - **HIDE** – Action taken to seek immediate shelter indoors when emergency conditions do not warrant or allow evacuation.
 - Severe Weather:
 - If you are outside, proceed to the nearest protective building.
 - If sheltering-in-place due to severe weather, proceed to the identified Storm Refuge Area or to the lowest, most interior area of the building away from windows or hazardous equipment or materials.
 - Active Threat:
 - Lock or barricade your area.
 - Get to a place where the threat cannot see you.
 - Place cell phones on silent.
 - Do not make any noise.
 - Do not come out until you receive an Illini-Alert advising you it is safe.
 - **FIGHT** – Action taken as a last resort to increase your odds of survival.
 - Active Threat: If you cannot run away safely or hide, be prepared to fight with anything available to increase your odds for survival.

Student Resources/Where to go for Help:

We Care at Illinois

- For sexual misconduct support, response and prevention visit: wecare.illinois.edu

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://oior.illinois.edu/sites/prod/files/SexualMisconduct_ResourceGuide.pdf

Safety and Emergency

University Police Department, Emergency, 9-911; Non-emergency, 217-333-8911

University Fire Department Emergency, 9-911

Crisis Line, 217-359-4141

Emergency Dean, 300 Turner Student Services Bldg., 610 E. John St., 217-333-0050

Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704

McKinley Health Center, General Information, 217-333-2701

McKinley Mental Health Center, 1109 S. Lincoln, 217-333-2705

Dean of Students, 300 Turner Students Services Bldg, 610 E. John St., 217-333-0050

Local Sexual Assault Center, RACES, 217-384-4444

Women's Resources Center, 703 South Wright Street, 2nd Floor, 217-333-3137

Rape Crisis 24-hour Hotline, 217-384-4444

Suicide & Psychological Emergency, Suicide Prevention Team, 217-333-3704

SafeRides (free nighttime campus ride program), 217-265-RIDE (265-7433)

SafeWalks (free walking escort service by Student Patrol), 217-333-1216

Student Services and Advocacy

Office of the Dean of Students, 300 Student Services Bldg., 610 E. John St., 217-333-0050

Classroom Support, Teaching Skills, and Instructional Strategies

Center for Innovation in Teaching & Learning, 249 Armory Building, 217-333-1462

Counseling Services

Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704

McKinley Mental Health Center, 1109 S. Lincoln Ave., 217-333-2701

Psychological Services Center, 3rd Floor, 505 E. Green St., 217-333-0041

Disability Services

Disability Resources and Educational Services (DRES), 1207 S. Oak St., 217-333-1970

Lesbian, Gay, Bisexual, Transgender Resource Center

LGTB Resource Center, 323 Illini Union, 1401 W. Green St., 217-244-8863

Veterans Services

Veteran Student Support Services, Office of the Dean of Students, 610 E. John St., 217-333-0050

Center for Wounded Veterans in Higher Education, 908 W. Nevada St., 217-300-3515

General Study Skills Assistance

Office of Minority Student Affairs, 130 Student Services Bldg., 610 E. John St., 217-333-0054

Office of Minority Student Affairs Tutoring Services, 701 S. Gregory Dr., Suite 1, 217-333-7547

Writer's Workshop, 251 Undergraduate Library, 1402 W. Gregory Dr., 217-333-8796

**Additional academic assistance may be available through individual departments

Health Resources

Health Education, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2701

Alcohol & Other Drug Office, 2nd Floor Counseling Center, 610 E. John St., 217-333-7557

Sexual Health Educator, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2714

Dial-A-Nurse, McKinley Health Center (24-hour), 1109 S. Lincoln Ave., 217-333-2700

Health Resource Center, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-6000

Health Resource Center, Room 40 Illini Union, 1401 W. Green St., 217-244-5994

McKinley Health Center, General Information, 1109 S. Lincoln Ave., 217-333-2701

Sexual Harassment/Assault & Acts of Intolerance/Hate Crimes

Office of the Dean of Students, 300 Students Services Bldg., 610 E. John St., 217-333-0050

The Office of Diversity, Equity and Access (ODEA):

- For non-academic support visit: diversity.illinois.edu
 - Discrimination & Harassment Prevention
 - Title IX
 - Accessibility & Accommodations
 - Inclusive Illinois