

## Syllabus of 2024 MCB 430—Molecular Microbiology

(L, Lecture; D, Discussion; E, Exam)

<b>Week 1: Overview of microbiology with the main focus on bacteria and phages</b>		
L1	01/17 (W)	Introduction to MCB 430; definition of microbes; major differences between microbes and higher organisms
L2	01/19 (F)	Building blocks of DNA and RNA: Are they inevitable consequence of biological evolution? or might they have had alternative choices over the course of evolution?
<b>Week 2: Evolutionary outcomes of the building blocks of three most important macromolecules (RNA, DNA, and protein) and their biosynthesis</b>		
L3	01/22 (M)	The same questions for the building blocks of protein
L4	01/24 (W)	Molecular basis of important biological processes in bacteria, including DNA replication, RNA transcription, and protein translation
D1	01/26 (F)	Tinkering and evolution of DNA
<b>Week 3: Bacteria coping with environmental stress</b>		
L5	01/29 (M)	Responses based on nucleotide-based second messengers
L6	01/31 (W)	Responses based on TA (toxin-antitoxin) systems
D2	02/02 (F)	Expanding amino acids of protein in living organisms
<b>Week 4: Cooperation among bacteria</b>		
L7	02/05 (M)	Molecular basis of bacterial quorum sensing
L8	02/07 (W)	Molecular basis of bacterial biofilm formation
D3	02/09 (F)	An unusual TA system associated with CRISPR-Cas systems
<b>Week 5: Conflicts between organisms—biological offensive weaponry</b>		
L9	02/12 (M)	Examples of small-molecule toxins—antibiotics and their biological targets
L10	02/14 (W)	Protein toxins and their biological targets
D4	02/16 (F)	A naturally inspired antibiotic to target multidrug-resistant pathogens
<b>Week 6: Bacterial secreting systems for the delivery of protein toxins</b>		
L11	02/19 (M)	Structures and biosynthesis of bacterial cell envelopes
L12	02/21 (W)	Bacterial secretion systems
D5	02/23 (F)	Mycobacterial type VII secretion systems
<b>Week 7: Other protein toxin delivery systems</b>		
L13	02/26 (M)	Other protein toxin delivery systems
L14	02/28 (W)	Human microbiome
D6	03/01 (F)	Open discussion with no limitation of topics

<b>Week 8: Conflicts between organisms—biological defensive weaponry</b>		
L15	03/04 (M)	Direct inhibitions of invading biological toxins
L16	03/06 (W)	Indirect inhibitions of invading biological toxins
O1	03/08 (F)	Office Hour for preparation of Exam 1
<b>Week 9: spring break, no classes</b>		
<b>Week 10: Class resumes on biological conflicts between bacteria and viruses</b>		
E1	03/18 (M)	Exam 1 will cover all Lectures <i>and</i> Discussions from Week 1 to Week 8.
L17	03/20 (W)	Primary antiphage system-1: R-M antiphage defense systems
D7	03/22 (F)	Phage therapy: From biological mechanisms to future directions
<b>Week 11: Primary antiphage systems-2: CRISPR-Cas antiphage defense systems</b>		
L18	03/25 (M)	CRISPR-Cas—Discoveries and mechanisms
L19	03/27 (W)	CRISPR-Cas—Structures
D8	03/29 (F)	Developing CRISPR-Cas technologies for genome editing and other applications
<b>Week 12: Non-standard CRISPR-Cas antiphage systems and anti-CRISPR</b>		
L20	04/01 (M)	Transposon-encoded CRISPR-Cas antiphage defense systems
L21	04/03 (W)	Phage encoded CRISPR and anti-CRISPR proteins
D9	04/05 (F)	IS200/IS605 encode diverse RNA-guided endonucleases
<b>Week 13: Antiviral defense systems employing nucleotide-based second messengers</b>		
L22	04/08 (M)	CRISPR-Cas-associated Abi systems employing cyclic oligoadenylates
L23	04/10 (W)	Eukaryotic innate immune systems based on cGAS and STING
D10	04/12 (F)	Protein delivery with a bacterial contractile injection system
<b>Week 14: Bacterial antiphage defense systems employing second messengers</b>		
L24	04/15 (M)	CBASS antiphage defense systems
L25	04/17 (W)	Antiphage systems employing second messengers other than CBASS
D11	04/19 (F)	Prokaryotic innate immunity via recognition of conserved viral proteins
<b>Week 15: Important antiphage systems without signaling molecules</b>		
L26	04/22 (M)	Retron and RADAR antiphage defense systems
L27	04/24 (W)	Phages modify their genomes to escape antiphage defense systems
D12	04/26 (F)	Expansion of global RNA virome reveals diverse clades of bacteriophages
<b>Weeks 16-17: Office hour and Exam 2</b>		
O2	04/xx (M)	Office hour to answer any questions in the classroom
E2	05/xx (M)	Exam 2 will cover Lectures <i>and</i> Discussions after Spring Break.