ANSC 499:
Antibiotics and Antibiotic Resistance
Spring 2026

Course Information

- Full Semester
- Contact Hours: T/R 11:00 am to 1:00 pm
- In-Person
- Course Location: Agricultural Bioprocess Laboratory, room 17
- Weekly Hours of Expected Student Work, apart from instruction time: 4
- 3 Credit Hours

Instructor Information

- Terence Crofts
- Assistant Professor
- Animals Sciences, College of ACES
- tcrofts@illinois.edu
- Animal Sciences Laboratory Rm 430
- Instructor drop-in hours for students: Friday, 1-2 pm, Animal Sciences Laboratory Rm 430
- croftsmicrolab.org

Course Description

This research-based laboratory course will teach practical aspects of microbiology through the lens of antibiotics, specifically their origins in the soil microbiome and the parallel origin of antibiotic resistance there as well. Students will learn the basics of laboratory microbiology, as well as about the practical aspects of antimicrobial discovery

and clinical antimicrobial susceptibility testing. This is a CURE (course-based undergraduate research experience) class with the goal of promoting student belonging and persistence in STEM fields and it encompasses all aspects of authentic scientific research. The course is targeted at students interested in scientific research and, specifically, those interested in microbiology techniques, antibiotics and antibiotic resistance, and those seeking careers where clinical antimicrobial susceptibility testing occurs.

Learning Outcomes

As a result of this course, students will:

- Describe the ecological pressures that lead to the evolution of antibiotics and antibiotic resistance in soil
- Describe the molecular targets and mechanisms of action of broad antibiotic classes and why they function
- Describe the mechanisms of action of antibiotic resistance enzymes and proteins
- Be able to employ aseptic technique, streaking and plating, and serial dilutions to isolate and test soil bacteria for antimicrobial production
- Be able to employ agar plates, microtiter plates, sterile disks, and antibiotic dilutions to measure antibiotic susceptibility of bacteria
- Collect, analyze, and critically interpret data from their own experiments
- Communicate in a written report the methods and results of the experiments they carried out over the course of the semester

General Education Categories

This is a laboratory course. Each class period will be divided into a ~30 minute lecture and a ~90 minute laboratory block of time.

Prerequisites

Students wishing to take the course should have introductory microbiology/molecular biology (*e.g.* MCB 100 or MCB 150) and introductory lab (*e.g.,* MCB 101 or MCB 151) or equivalent course experience. Interested students may contact Dr. Crofts to discuss exceptions to these prerequisites.

Course Materials

Learning Management System

Canvas

Required and Recommended Course Readings

We will draw readings and protocols from “Tiny Earth - A Research Guide to Studentsourcing Antibiotic Discovery”. I will assign chapters based on the 2022 edition but other editions will likely have the same material available and may be compatible with the course.

Additional materials in the form of protocols and papers will be provided over the course of the semester.

Required and Recommended Materials

Close-toed shoes and lab-appropriate clothing must be worn to each class as personal protective equipment (PPE).Nitrile gloves and glasses will be made available in-class.

Students must also bring a notebook and writing materials to class to take notes and record results.

Required Software

Students have access to the Microsoft Office suite through the U of I (Specifically, Word, Excel, and PowerPoint).

Students can download the ApE Plasmid Editor program for free for DNA sequence manipulation.

MetaGeneMark, Bakta, BLAST, and CARD are free programs accessible as online servers for annotating DNA and predicting gene function.

Course Requirements and Policies

Grading Breakdown

Instructional Activity	Occurrences	Point Value	Total Points
Class Assignments	24	5	120
Class Participation	24	5	120
Weekly Quizzes	12	5	60
Midterm Practical	1	60	60
Final Practical	1	60	60
Final Report	1	80	80

Instructional Activity	Occurrences	Point Value	Total Points
Total			500

As this is an experimental course grading breakdown may be adjusted during the semester. Any changes will be widely communicated inside and out of the classroom.

Course Components

Class Assignments

Class assignments will generally involve independent research relevant to the upcoming class (*e.g.,* before soil plating choosing a soil type, before antibiotic testing choosing and researching a tester strains, *etc*.). Assignments will be due on the day of class prior to 10:00 am and will be submitted through Canvas.

Class Participation

Class participation will be evaluated using the scale below during your time in class each lesson.

5 points – Student is present, fully prepared for the lesson (lecture and practical aspects, including wearing lab appropriate attire), interacting with their group but not dominating it, and contributing to in-class discussion, small-group discussion, or working with their lab partner(s) in an interested and respectful way.

4 Points – Student is present and largely prepared for the lesson, and interacting with their group or the general discussion.

3 Points – Student is present but poorly prepared for the lesson and is interacting with their group or the general discussion.

2 Points – Student is present but poorly prepared for the lesson, fails to interact with their group or the general discussion or does so in a disrespectful manner.

1 Points – Student is present but unprepared for the lesson, does not interact or does so in a disrespectful manner.

0 Points – Student is absent without explanation.

Weekly Quizzes

Short, low-stakes formative assessment quizzes will be taken in class once a week to gauge understanding of concepts from the pre-class assignments and in-class lessons. Quizzes will be taken on paper handouts and handed in during class.

Practical Exams

In-class practical exams will occur during class near the middle and end of the semester. Practical exams will test understanding and mastery of concepts and laboratory skills. These will include laboratory techniques such as streaking for single colonies, laboratory concepts such as serial dilution calculations. The practical exams will also include a brief hand-written, open-ended portion to allow students to demonstrate their understanding of subjects that came up during class assignments (*e.g.,* in 5 sentences or fewer explain how you chose a particular soil sample to study).

Final Report

The final report will be the students' summary of their work across the semester. It may consist of just their antibiotic producing isolate experiments or just their antibiotic resistance experiments. This report will include data acquired during class (*e.g.,* soil colony counts, growth on differential media, MICs), concepts learned from assignments, and independent research when relevant. It should be formal, organized, referenced, and consistently formatted. This component of the class will be graded with different expectations for undergraduate students and graduate students. Graduate students are expected to model their reports off scientific manuscripts, with abstract, introduction, methods, results, and discussion sections. Undergraduate students may turn in a document in line with a classic laboratory report. Examples will be provided.

Final reports will be due during finals week and will be submitted through Canvas.

Late Assignment Policy

Late class assignments will be given a 1 point penalty per day late beginning after the start of the class when they were due. Late final projects will be given a 2 point penalty per day after the last day of finals week.

Class Attendance

The Student Code states "Regular class attendance is expected of all students at the university." As this is a laboratory course, in-class attendance, beginning on time, is required.

Absence Policy

Students who have an unavoidable absence should reach out to Dr. Crofts (ahead of time if possible) to discuss options for making up the lesson and in-class participation points. Depending on the speed at which the class progresses there may be 'free days' available for students to practice techniques or make up absences (with potential deductions for class participation).

Participation

Active participation in class is expected for all students. This includes participation in the laboratory experiments, but also in small group exercises and full class discussion. To earn full credit for in-class participation students will need to voluntarily contribute to all aspects of the class above, come to class fully prepared, and participate in class in a way that is respectful to all.

Final Letter Grades/ Grading Scale

The grading scale below will be used.

Percentage	Letter Grade
98.00% - 100.00%	A+
93.00% - 97.99%	A
90.00% - 92.99%	A-
87.00% - 89.99%	B+
83.00% - 86.99%	B
80.00% - 82.99%	B-
77.00% - 79.99%	C+
73.00% - 76.99%	C
70.00% - 72.99%	C-
67.00% - 69.99%	D+
63.00% - 66.99%	D
60.00% - 62.99%	D-
59.99% and below	F

Additional Course and Campus Policies

Academic Integrity

The University of Illinois Urbana-Champaign *Student Code* should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: https://studentcode.illinois.edu/article1/part4/1-401/ . Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any

misunderstanding. **Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity**.

Copying work and presenting it as your own, especially without citation, is plagiarism and grounds for receiving 0 points on a given assignment or project.

Use of Artificial Intelligence

The use of AI to write is not allowed, but AI may be used by students to help with their research and to find sources. All AI use should be documented and reported alongside the assignment it was used on. Chat GPT and other AI resources can hallucinate facts and references that do not actually exist. Factual errors due to AI use may be graded more harshly.

Students with Disabilities

The University of Illinois Champaign-Urbana, is committed to ensuring that all students, including students with disabilities, do not experience barriers to learning and participating fully in class. Students who have a letter of accommodation from DRES are advised to share that with instructors as soon as possible to ensure accommodation needs can be discussed and met.

To obtain disability-related academic accommodations, disabled students must contact Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, please visit 1207 S. Oak Street, Champaign, call 217.333.1970, email disability@illinois.edu, or visit the DRES website.

Family Educational Rights and Privacy Act (FERPA)

See http://registrar.illinois.edu/ferpa for more information on Family Educational Rights and Privacy Act (FERPA).

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Health Service Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center

Community of Care

Reminders for Faculty: Should a student disclose information that causes concern for their well-being, or should a student exhibit concerning behaviors in the classroom, we encourage you to refer this behavior to the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students. You may do so by calling 217-333-0050 or by submitting an online referral. Based on your report, staff in the Connie Frank CARE Center will reach out to offer support and assistance. However, should you have concerns about the imminent health and safety of a student, please call 911 to request the assistance of first responders.

Syllabus Language: As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regard to their well-being or yours, we encourage you to refer this behavior to the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students. You may do so by calling 217-333-0050 or by submitting an online referral. Based on your report, staff in the Connie Frank CARE Center will reach out to offer support and assistance.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is

interfering with your coursework, you are encouraged to contact the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://go.illinois.edu/ReportMisconduct; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: https://police.illinois.edu/em/run-hide-fight/. I encourage you to review this website within the first 10 days of class.

Religious Observances

It is the policy of the University of Illinois Urbana-Champaign to reasonably accommodate its students' religious beliefs, observances, and practices that conflict with a student's class attendance or participation in a scheduled examination or work requirement, consistent with state and federal law. Students must make requests for accommodation in advance of the conflict to allow time for both consideration of the request and alternate procedures to be prepared. Requests should be directed to the instructor. The Office of the Dean of Students provides an optional resource on its website to assist students in making such requests.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including supportive measures, resources, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Veterans and Military Students

As a military-friendly institution, and per federal regulations and Illinois statutes, the University of Illinois Urbana-Champaign has established policies and procedures to accommodate military-connected students. In addition to the support available at the Chez Veterans Center (https://chezveteranscenter.ahs.illinois.edu/), members of the National Guard or Reserves and active-duty military personnel with military obligations (e.g., deployments, training, drills) are encouraged to communicate these, in advance whenever possible, to the instructor. The policy for Excused Absences and Departure from the University for U.S. Military or other U.S. National Defense Services can be found at https://studentcode.illinois.edu/article3/part3/3-313.

Course Schedule/Outline

Week	Topics	Instructional Activities
Week 1 (Jan 20, 22)	• Becoming a scientist • Ethics of research • Lab safety • Importance of coonies in microbiology	• Lab 1 Lab tour Safety in the lab Aseptic technique
		• Lab 2 Streak for single colonies Dilute cultures Pipetting Spread plates for single colonies
Week 2 (Jan 27, 29)	• Soil and antibiotics • Bacterial colonies • Media type	• Lab 3 Choose agar Prepare agar plates Plate culture serial dilutions
		• Lab 4 Record soil characteristics

Week	Topics	Instructional Activities
		Prepare agar plates Plate soil dilutions
Week 3 (Feb 3, 5)	• Colony morphology • Importance of single colonies • ESKAPE pathogens and fauxscape testers • McFarland and cell concentration	• Lab 5 Morphology observations Count colonies Patch antibiotic producer candidates
		• Lab 6 Choose fauxscape tester strain Prepare McFarland standard culture Spread plate tester and patch producers
Week 4 (Feb 10, 11)	• Zone of inhibition • Antibiotic production screening	• Lab 7 Evaluate fauxscape plates Streak candidate strains for single colonies
		• Lab 8 Repeat patch and plate screening with other media or other test strains Students attempt other screening methods
Week 5 (Feb 17, 19)	• Differential media • Characterizing bacterial metabolisms	• Lab 9 Set up biochemical tests for control strains Evaluate additional antibiotic production screens
		• Lab 10 Score control biochemical tests

Week	Topics	Instructional Activities
		Set up biochemical tests for antibiotic producing strains
Week 6 (Feb 24, 26)	• Antibiotic resistance • Plasmids and horizontal gene transfer	• Lab 11 Score antibiotic producer biochemical tests Make permanent stocks Prepare antibiotic plates Spread
		• Lab 12 Count antibiotic resistant colonies
Week 7 (Mar 3, 4)	• Antimicrobial susceptibility testing • Meuller-Hinton agar • Practice	• Lab 13 Prepare antibiotic agar plates Streak tester resistant strains
		• Lab 14 Identify resistant strains Catch-up and practice
Week 8 (Mar 10, 12)	• Mar 10 catch-up and practice day • Mar 12 First practical exam	• Catch-up and practice
		• Lab practical exam
Week 9 (Mar 17, 19)	• No class, Spring break	
Week 10 (Mar 24, 26)	• Antibiotic targets • Antibiotic resistance • Kirby-Bauer disk diffusion assay	• Lab 15 Preparing agar plates Spread tester strains Kirby Bauer disk method
		• Lab 16 Measure zones of inhibition

Week	Topics	Instructional Activities
Week 11 (Mar 31, Apr 2)	• Antibiotic dilution plates and broth • Minimal inhibitory concentration • 50% inhibitory concentration	• Lab 17 Prepare agar dilution plates Tester strain swab streaking Broth dilution testing
		• Lab 18 Find agar MIC Find broth MIC
Week 12 (Apr 7, 9)	• Microbiomes and metagenomes • Functional metagenomic selections • Plasmids and minipreps	• Lab 19 Choose antibiotics Prepare 2x MIC agar plates Choose a functional metagenomic library Plate libraries
		• Lab 20 Count resistant colonies Re-streak 8 colonies Slurry plates Miniprep
Week 13 (Apr 14, 16)	• Resistance testing • Plasmid sequencing	• Lab 21 Prepare agar dilution plates Plate 8 resistant unknowns to find MIC
		• Lab 22 Find MICs Prepare permanent stocks Submit colony for sequencing

Week	Topics	Instructional Activities
Week 14 (Apr 21, 23)	• Sequence alignments • BLAST suite • Open reading frames • Function prediction	• Lab 23 Find metagenomic DNA fragments in ApE Call open reading frames in Bakta or MetaGeneMark Search for known resistance genes with CARD Predict functions with blastx and blastp
		• Lab 24 Continue analyses
Week 15 (Apr 28, 30)	• Scientific reports • Practice	• Catch-up and practice
		• Catch-up and practice
Week 16 (May 5)	• May 5 Second practical exam	• Lab practical exam
Week 17 (May 14)	• May 14 Final report due	• No lab this week