

MCB4271: Antimicrobial Resistance

3 credits

Course Description

UF Catalog: This course covers content related to antimicrobial resistance: the origins of antimicrobial resistance, dissemination, mechanisms, therapeutics, and impact on healthcare, agriculture, and the environment. This course mainly concentrates on resistance in bacteria, but will also discuss other organisms, including viruses, parasites, fungi, and cancer.

Course Importance: Cells are living factories that are capable of adapting their production line to any changes in the environment. Hence, cells encountering a toxic environment will evolve their machinery to maintain survival and replication. Such adaptation, called Antimicrobial Resistance, is commonly observed across bacteria, viruses, parasites, and fungi. However, only recently, the overuse of antimicrobial agents created a high selection pressure to drive widespread resistance. While we are currently witnessing a constant increase in antimicrobial resistance, the development of novel treatments has almost completely ceased. This course will provide an extensive background on antimicrobial resistance, treatments, and respective mechanisms.

Time and Location

Online pre-recorded classes for the upcoming week (M-W-F lectures) will be available every Sunday. New lectures are uploaded weekly onto Canvas (see access instructions below)

Instructor

Dr. Daniel Czyz (*chysh*)

Department of Microbiology and Cell Science

1355 Museum Drive

Office: Room 1004, Building 981

Phone: 352-392-0237

Email: dczyz@ufl.edu

Twitter: @360Science

Slack: AMR-UF, the app can be downloaded on a desktop, Android, or iOS

The preferred method of communication with the instructor regarding the course is Slack

Virtual Zoom Office hours: Thursdays, 8:00-9:00 am EST <https://ufl.zoom.us/j/98148445638> or by appointment.

*To request an office hours appointment, send an e-mail directly to the instructor with three suggested dates/times. **To save time, please submit your questions in advance of the meeting.***

Instructor's Teaching Philosophy

"Your work is going to fill a large part of your life, and the only way to be truly satisfied is to do what you believe is great work" - Steve Jobs

You embrace education, devote your time to pursue your goals, strive for success, and do your best, but sometimes you are just hitting obstacles that prevent you from moving forward. That's when you wish you would have a good mentor. I've helped people who hit obstacles get right back on track, but more importantly, I help my mentees and students avoid hitting obstacles in the first place. I always make sure

I am available for my students and my colleagues, whether it's in a classroom or in a laboratory setting. As a scientist, I put a lot of time and emphasis on my trainees, providing them with the right personalized support plan to guide them toward their short and long-term goals, as their success is my success. As an educator, my primary objectives are to retain students' attention, promote creativity and teamwork, and encourage out-of-classroom learning.

I find science to be the most fascinating and exciting subject to teach, mostly because it is never fully explored, and with the ongoing new discoveries, teaching becomes learning. Science can be found in our everyday lives, and I believe that relating new information to practical application in daily life focuses students' attention and enhances learning. For that reason, I link my lecture material to everyday applications as much as possible.

I encourage and expect students to employ out-of-textbook material, including public databases, online tools, and primary literature. While independent projects are important, in science, single-person projects are nearly nonexistent. I strongly believe that assigning students to group projects strengthens their team-building core, helps to develop essential communication skills, exposes students to conflicts, and teaches them how to deal with them. Most importantly, an assignment might seem difficult for an individual student but becomes trivial when done as a team.

Finally, I put emphasis on mentorship and participation in extracurricular activities. My students are expected to mentor each other because it will help them develop essential skills in their future careers. It's never too early to become a mentor. Finally, I truly believe that building a career is not solely attained during classroom education. Participation in community outreach events, conferences, seminars, and symposia is just as important as classroom-based learning. These extracurricular activities build leadership and improve communication skills and I strongly encourage my students to participate in such activities.

Course Level & Prerequisites

The course is designed for both undergraduate and graduate students.

The course requires undergraduate students to have the following prerequisites: MCB2000, MCB3020, or MCB3023. Important concepts will be briefly reviewed to provide students with a better understanding of the subject.

Course Objectives

After completion of this course, students should be able to:

- Outline problems associated with antimicrobial resistance across healthcare, agriculture, and the environment
- Explain resistance mechanisms in viruses, fungi, parasites, and cancer
- Identify major classes of antibiotics and their respective mechanisms of action
- Describe known mechanisms of antibiotic resistance and modes of transmission
- Identify means of detection/assessment of antibiotic resistance
- Describe therapeutic approaches used to fight antibiotic resistance
- Recognize scientific terms related to antimicrobial resistance
- Assess risks associated with antibiotic-resistant infections
- Employ online databases to utilize genomic, chemical, and epidemiological data on AMR

Learning Assessment

Grades are used to assess your learning progress. The vast extent of the information covered by this course should not discourage students. This course is designed to teach you and not fail you. If you

encounter any learning difficulties that will affect your grades/learning progress, contact the professor as soon as possible.

GRADING SCALE (total: 875 pts)

Grade	Percentage
A	>93.4
A-	93.3-90.0
B+	89.9-86.6
B	86.5-83.4
B-	83.3-80.0
C+	79.9-76.5
C	76.4-73.3
C-	73.2-70.0
D+	69.9-66.6
D	66.5-63.3
D-	63.2-60.0
E	<60.0

Assessment	Undergraduate	Graduate
Exam I	100	100
Midterm	200	200
Exam III	100	100
Final Exam	300	300
Quizzes	100	100
Assignments	0	260
Discussions	75	0
Total	875	1060
Total after drop	775	960

No drop **Final grade (%) = (Total points/total possible points)*100**
 Drop **Final grade (%) = (Total points-Exam I or III/total after drop points)*100**

EXAMS (700 pts):

Exam I, February 11 – February 15, 2026: Covers lectures 1-11. (100 pts)

Exam II, March 11 – March 15, 2026: Covers lectures 1-23. (200 pts)

Exam III, April 8 – April 12, 2026: Covers lectures 26-32. (100 pts)

Exam IV, April 22 – April 29, 2026: Covers lectures 1-43. (300 pts)

Exams will assess student knowledge of the material covered in lectures, assignments, and required reading/video material. The lowest exam score (either Exam I or III only) will be dropped. All exams are mandatory and only students who take all four exams will be able to drop one. Students who fail one of the exams on purpose will not be able to drop the score of that exam. Also, students who are caught cheating on any of the exams will not be allowed to drop the lowest score. Each exam will take approximately 50 minutes (final exam will take 2x time) to complete and will consist of multiple-choice questions, true/false, fill in the blanks, sentence completion, definition matching, and short-answer questions. The exams will be proctored using Honorlock and will require an external wide-angle camera. The academic honesty will be remotely monitored in real-time by assigned course proctors. For more information about academic honesty, please see the [Student Honor Code](#).

For additional information on Grading Policies please visit <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

QUIZZES (100 pts):

There will be 11 quizzes (10 points each, 100 points total plus 10 extra credit points). See the Course Content (below) for dates. Quizzes will cover lecture material and assigned reading/video material. There will be one Extra Credit Quiz during the first week. This will be an introductory quiz that will cover students' understanding of the syllabus and course requirements.

DISCUSSIONS (75 pts):

There will be 15 graded discussions (5 points each, 75 points total). The discussions will be facilitated using Perusall – a social learning platform where you will engage in discussing reading materials, videos, and podcasts.

EXTRA CREDIT: The professor may offer an extra credit written assignment.

Online Proctoring

UF is committed to the integrity of your degree. An important part of protecting integrity is to proctor exams, whether they be in-person or online. For online exams, the Microbiology and Cell Science Department has preliminary evidence that external cameras detect and deter cheating at far higher rates than a simple webcam on a computer. We need to continue this experiment to be more confident in this result. We expect external cameras will protect your degree. We are also confident that the vast majority of our students do not cheat during online exams. Our work is intended to benefit those students who do the right thing.

Please order your 120-degree wide-angle webcam as soon as possible so it arrives before the first exam. The order can be placed via Amazon: [CLICK HERE](#). However, you can use any other wide-angle camera, and you can reuse one from other classes if you already purchased one.

Note: A 10% total score penalty will be given to students who do not use a properly positioned external wide-angle camera during exams 1-4 or if a front-facing camera is used. It is the student's responsibility to ensure the camera is properly positioned and working.

The webcam you will receive and examples of how it should be set up for an exam:



As the university continues to evaluate the use of an external wide-angled camera you will receive a survey during the term to provide feedback from your experience using the external webcam for online proctored exams with Honorlock.

Grades and Grade Points

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>.

Attendance and Make-Up Work

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>.

Website

Course material can be accessed through Canvas.
<https://ufl.instructure.com/>

*Technical issues related to the course can be addressed to UF helpdesk
<http://helpdesk.ufl.edu>, 352-393-4357, helpdesk@ufl.edu*

Canvas Technology Requirements

Computers, Internet, and Web browsers: Canvas runs on Windows, Mac, Linux, iOS, Android, or any other device with a modern web browser. It is recommended to use a computer less than five years old with at least 1GB of RAM. It is recommended to have a minimum Internet speed of 512kbps. It is **strongly recommended** to not use a wireless connection, phone, tablet, or notepad for critical course tasks such as exams and discussions.

Canvas currently supports the following browsers: Chrome, Safari, Firefox, Edge. Canvas supports the last two versions of most browsers. It is **highly recommend** updating to the **newest version** of whatever browser you are using. Note that your computer's operating system may affect browser function. Failure to use one of these browsers will cause problems.

For more information on approved computers and browsers please visit:

<https://community.canvaslms.com/t5/Canvas-Basics-Guide/What-are-the-browser-and-computer-requirements-for-Canvas/ta-p/66> On this web page there is an area titled "Is My Browser up to Date?" Use it to check each computer and browser you may use in this course. There is another important area on "Browser Privacy Settings." Read the section(s) for any browser intended for use. For example, **Note that:** In browsers such as Safari, insecure content will never be displayed in the browser. Return to the page to check for updates on technology issues in Canvas.

If you encounter technical difficulties in this course, **contact the UF Computing Help Desk** right away to troubleshoot. <https://helpdesk.ufl.edu/> or (352) 392-HELP. If the problem cannot be fixed immediately, **notify your instructor, and provide them with the Help Desk ticket number.**

Communication

For questions and issues on assignments and class organization please check first the syllabus, the announcements, calendar, and the Course Handout. To seek further help, please communicate with the

instructor via **Slack** or email. For questions regarding class and class content use the Canvas **Discussion Board**.

Discussion Board: Available through Canvas. Postings and answers are monitored by the instructor

Slack: AMR-UF, the app can be downloaded on a desktop, Android, or iOS

X (Twitter): Follow and share science news related to the course using #AMR_UF

IMPORTANT: Prior to the first lecture, please familiarize yourself with [netiquette](#) (cyber behavior guidelines). See below "Netiquette guide for online courses".

Students should expect to receive prompt responses, feedback, and grades:

- Quizzes and Exams: within three days of completion
- Assignments: within two weeks of submission
- Communication: between 0-24 h

Course Material

Required material: There is no textbook for this course. This course is based on peer-reviewed publications that will be provided by the instructor. The required reading material will be posted under "Assignments" in Canvas. Questions related to information from the required reading/video material will appear on quizzes and exams. Please refer to the "Assignment" section at the end of the syllabus for a list of Assigned Reading.

Recommended reading and other material: Additional reading material, links to videos, and other online resources will be posted under "Files" in Canvas.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor. A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session. Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording

without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, <https://disability.ufl.edu/>

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

These resources include:

Health & Wellness

- [U Matter, We Care](#): If you or a friend is in distress, please contact umatter@ufl.edu or tel. 352-392-1575 so that a team member can reach out to the student. <http://www.umatter.ufl.edu/>
- University [Counseling and Wellness Center](#): Provides counseling services to students 3190 Radio Road. Tel. 352-392-1575. <https://counseling.ufl.edu/>
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Wellness Coaching
- [Sexual Assault Recovery Services](#) (SARS): Provides services related to sexual violence. Tel. 352-392-5648. http://www.umatter.ufl.edu/sexual_violence
- [Student Health Care Center](#): Student health-related services. Tel. 352-392-1161. <https://shcc.ufl.edu/>
- [Gator Career Closet](#): Serves as a lending closet for students to borrow professional clothing and accessories free of charge. This service is available to all UF students with a valid UF ID. Tel. 352-392-1601. <https://career.ufl.edu/careercloset/>
- [Food Pantry](#): Offers non-perishable food, toiletries, and fresh vegetables. This service is provided to current students, staff, and faculty at the University of Florida. Gator 1 ID is required, but no proof of need is required.

For emergencies call the [University Police Department](#) at 352-392-1111 (or 911).

Academic Resources

E-learning technical support: Tel. 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connection Center, First Floor JWRU: Career assistance and counseling. Tel. 352-392-1601.
<https://career.ufl.edu/>.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources. Text 813-463-2283 or Tel. 866-281-6309. <http://cms.uflib.ufl.edu/ask>

Teaching Center, Broward Hall: General study skills and tutoring. Tel. 352-392-2010 or 352-392-6420.
<http://teachingcenter.ufl.edu/>

Writing Studio, 302 Tigert Hall: Help brainstorming, formatting, and writing papers. Tel. 352-846-1138.
<http://writing.ufl.edu/writing-studio/>

Online Course Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluer.com/ufl/>. Summaries of course evaluation results are available to students at: <https://gatorevals.ua.ufl.edu/public-results/>.

Setting up VPN

To access UF resources and journal articles off-campus, please set up a Virtual Private Network (VPN). VPN allows you to remotely connect to UF services (i.e. library, UF servers). For detailed instructions on how to set up VPN visit: <https://it.clas.ufl.edu/kb/category/vpn/>

Netiquette guide for online courses

It is important to recognize that the online classroom is in fact a classroom, and certain behaviors are expected when you communicate with both your peers and your instructors. These guidelines for online behavior and interaction are known as netiquette.
<http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf>

Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for

credit at the University of Florida, the following pledge is either required or implied: "*On my honor, I have neither given nor received unauthorized aid in doing this assignment.*" It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <https://policy.ufl.edu/regulation/4-040/>. If you have any questions or concerns, please consult with the instructor. Additional policies on academic integrity can be found in the [Orange Book](#).

Additional comments regarding academic integrity:

Students are encouraged to discuss the course material with each other, help each other understand concepts, study together, and even discuss assessment questions with each other once the quiz window is closed. However, the following is considered academic dishonesty, and I expect that no student will ever do any of the following:

- Have another person complete a quiz in this course
- Copy another student's quiz in this course
- Collaborate with anyone during a quiz in this course
- Discuss the questions and answers of a quiz with other students while the quiz is still open
- Manipulate and/or distribute any materials provided in this course for any purpose (including course lecture slides).
- Use any materials provided by a previous student in the course

The result of any infraction will be consistent with university policy - see "Academic Honesty".

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Microsoft Office 365 Software is free for UF students

<http://www.it.ufl.edu/gatorcloud/free-office-365-downloads/>

Other free software is available at:

<http://www.software.ufl.edu/>

To check for availability of the media and technical requirements, contact the UF Computing Help Desk at (352)392-HELP(4357).

University of Florida Complaints Policy and Student Complaint Process

The University of Florida and most instructors believe strongly in the ability of students to express concerns regarding their experiences at the University. Most problems, questions and concerns about the course will be resolved by professionally communicating with the instructor. Please try to meet your instructor in person, make an appointment to call, or try to set up a remote meeting through Skype or other media. The University encourages its students who still wish to file a written complaint to submit that complaint directly to the department that manages that policy. For more information visit:

- Residential Course: <https://sccr.dso.ufl.edu/policies/student-honor-code-studentconduct-code/>.
- Online Course: <http://www.distance.ufl.edu/student-complaint-process>

Professionalism is a two-way street. Unprofessional behavior of students includes, among other things: lack of communication, blaming other people or external factors, lying, affecting others negatively in a group or in the class, not accepting criticism and not being proactive in solving problems or seeking help. Furthermore, faculty often have family and other obligations to tend to. Over the weekend, replies to your inquiries or questions may be delayed. If a student is lacking professionalism repeatedly, the instructor has the right to file a formal complaint against the student through the Dean of Student office.

Academic Calendar

Students should familiarize themselves with important academic dates and deadlines available at <https://catalog.ufl.edu/UGRD/dates-deadlines/>

Course Content

Module	Lecture	Lecture topic	Due
1	1	Course Introduction; Antimicrobial Resistance in Healthcare	Orientation Quiz
	2	Antimicrobial Resistance in Agriculture	Discussion 1
	3	Antimicrobial Resistance in the Environment	
2	<i>Happy Martin Luther King Jr. Day!</i>		
	4	Penicillin Discovery and Mechanism of Action	Quiz 1 (1-3)
	5	Antibiotics: Cell Wall Synthesis Inhibitors, Part I	Discussion 2
3	6	Antibiotics: Cell Wall Synthesis Inhibitors, Part II	
	7	Antibiotics: Folate Synthesis Inhibitors	Quiz 2 (4-6)
	8	Antibiotics: Protein Synthesis Inhibitors, Part I	Discussion 3
4	9	Antibiotics: Protein Synthesis Inhibitors, Part II	Quiz 3 (7-9)
	10	Antibiotics: Other Mechanisms of Action	Discussion 4
	11	Antibiotics: Toxicity and Side Effects	
5	12	Lecture 1-11 Exam Review	Quiz 4 (10, 11, 14)
	13	No Lecture, Exam I covers lectures 1-11	EXAM (1-11)/Discussio 5
	14	Antibiotic Resistance: Overview	Quiz 5 (15-17)
6	15	Antibiotic Resistance: Modification/Destruction of Antibioitics	Discussion 6
	16	Antibiotic Resistance: Efflux Pumps	
	17	Antibiotic Resistance: Target Modification	
7	18	Antibiotic Resistance: Bacterial Biofilms	Quiz 6 (17-19)
	19	Multidrug Resistant Bacteria: No ESKAPE	Discussion 7
8	20	Multidrug Resistant Bacteria: MRSA/VRSA	Quiz 7 (21-23)
	21	Antibiotic Resistance Reservoirs	Discussion 8
	22	Modes of Transmission	
9	23	Antimicrobial Resistance in Sexually Transmitted Infections	
	24	Lecture 1-23 Exam Review	Survey*/Discussion 9
	25	No Lecture, Exam II covers lectures 1-23	EXAM II (1-23)
No class	<i>Have a safe spring break</i>		
No class			
No class			
10	26	Antimicrobial Resistance Assessments, Part I	Discussion 10
	27	Antimicrobial Resistance Assessments, Part II	
	28	Therapeutics: Hunt for Novel Antibiotics	Quiz 8 (26-28)
11	29	Therapeutics: Host-targeted Therapeutics, Part I	Quiz 9 (29-32)
	30	Therapeutics: Host-targeted Therapeutics, Part II	Extra Credit opens
	31	Therapeutics: Alternative Medicine	Discussion 11
12	32	Prophylactic and Control Measures	Discussion 12
	33	Lecture 26-32 Exam Review	
		No Lecture, Exam III covers lectures 26-32	EXAM III (26-32)
13	34	Antimicrobial Resistance: Viral Infections, Part I	Quiz 10 (32-37)
	35	Antimicrobial Resistance: Viral Infections, Part II	Discussion 13
	36	COVID-19 and Antiviral Drug Resistance	
14	37	COVID-19 and Antimicrobial Resistance	
	38	Antimicrobial Resistance: Fungal Infections, Part I	Discussion 14
	39	Antimicrobial Resistance: Fungal Infections, Part II	
15	40	The Effect of the COVID-19 Pandemic on Fungal Resistance	
	41	Antimicrobial Resistance: Parasitic Infections	Evaluations**
	42	Pesticide Resistance: Genetically Modified Organisms	Discussion 15
	43	Drug Resistance in Cancer	
	44	Exams I-III Review	
	45	Final Exam Review	Extra Credit due
No Class	Reading Day		Evaluations** due
No Class			
No Class	Final Exam covers lectures 1-43		FINAL EXAM (1-43)
No Class			

Have a safe summer break



*Required informal course and instructor evaluation

**Final and official course evaluation