

GENERAL MICROBIOLOGY

01:447:390

SPRING 2023

I. COURSE OVERVIEW

Microorganisms are an essential component of the biosphere and significant not only for the disease they cause, but also for their ecological, agricultural, pharmaceutical, and industrial benefits. This course will introduce students to the physiology, morphology, pathogenicity, and genetics of groups of microorganisms and their applications. In the lecture portion of this course, various aspects of the evolution, cell structure and function, metabolic pathways, information flow and genetics, systems, and impact of microorganisms will be discussed. The lab component of the course will develop key microbiology skills including how to properly isolate, aseptically transfer, and culture microorganisms. Students will study microscopy and staining techniques, the growth cycle and generation of a standard curve, environmental and nutrient requirements for growth, morphological and physiological characteristics, and bacterial transformation.

- **PREREQUISITES** General Biology 119:115/116 (or 101/102) & Organic Chemistry
- **ACADEMIC ACCOMMODATIONS**
Students with disabilities requesting accommodations must follow the procedures outlined by the Office of Disability Services. Requests for accommodations must be completed no later than Feb 2, 2023. Full disability policies and procedures can be found at <https://ods.rutgers.edu/>
- **ACADEMIC INTEGRITY POLICY**
Dishonesty in any form will not be tolerated in this course. Students must adhere to the University Policy on Academic Integrity which can be found at <http://nbacademicintegrity.rutgers.edu/home-2/academic-integrity-policy/>
- **COURSE GRADES**
To pass the course, it is necessary to pass both the lecture and laboratory portions.
Lecture = 50% of final course grade
Laboratory = 50% of final course grade
- **COURSE GRADING SCALE**

| Final course grade | Final course average |
|--------------------|----------------------|
| A | 90.00 – 100.00 |
| B+ | 85.00 – 89.99 |
| B | 80.00 – 84.99 |
| C+ | 75.00 – 79.99 |
| C | 70.00 – 74.99 |
| D | 60.00 – 69.99 |
| F | 0 – 59.99 |
- **EXTRA CREDIT**
NONE. NO EXCEPTIONS. Any requests for extra credit will be ignored.

II. LECTURE

- **INSTRUCTOR** Dr. Anne Keating
keating@biology.rutgers.edu

- **TIME AND LOCATION**

Mondays and Thursdays, 1st period (8:30 - 9:50 AM)
SEC-118, Busch Campus

- **RESOURCES**

Text *Prescott's Microbiology*, 11th ed.
Willey, J.M.
McGraw-Hill Higher Education, 2019.
Available on Canvas in the First Day Course Materials

Website <https://canvas.rutgers.edu/>
All lecture material and information including quizzes, announcements, and grades will be posted throughout the semester on the lecture Canvas website. (A separate Canvas website will be used for the lab portion of the course.)

- **OFFICE HOURS**

Office hours will be held on Zoom. Day/time are TBD. Link will be posted on Canvas.

- **LEARNING GOALS**

The objectives of this course are modeled according to the *Recommended Curriculum Guidelines for Undergraduate Microbiology Education* which was developed by the American Society for Microbiology (2014, https://asm.org/getattachment/1b074b9e-8522-4d9d-bbc3-c0ca9b9abf1a/FINAL_Curriculum_Guidelines_w_title_page.pdf).

Departmental Learning Goals: Upon successful completion of the lecture portion of the course, students will be able to understand and use standard terms in microbiology, discuss fundamental concepts, and expand on material which was introduced in General Biology at Rutgers. Students will be able to discuss microbes in the context of evolution, ecosystems, and human health.

• ASSESSMENTS

Study Quizzes

Almost every week there will be a study quiz on Canvas with questions related to material covered in two lectures. These questions will cover lecture material and any other content (videos, readings, papers, etc.) that may have been assigned. These quizzes will help you stay up-to-date with the information and allow you to gauge your mastery of the content. Generally, quizzes will be posted on Canvas on Monday afternoon and must be submitted by 9:00 PM on the next Sunday. Students are responsible for ensuring that they have a stable internet connection. Once a quiz has closed, it cannot be made up (there will be no exceptions and any requests will be ignored).

Quiz schedule

| Quiz | Lectures | Quiz opens 3:00 pm on Monday | Quiz closes 9:00 pm on Sunday |
|------|----------|------------------------------|-------------------------------|
| 1 | 1 & 2 | 1/23 | 1/29 |
| 2 | 3 & 4 | 1/30 | 2/5 |
| 3 | 5 & 6 | 2/6 | 2/12 |
| 4 | 7 & 8 | 2/13 | 2/19 |
| 5 | 10 & 11 | 2/27 | 3/5 |
| 6 | 12 & 13 | 3/6 | 3/12 |
| 7 | 14 & 15 | 3/20 | 3/26 |
| 8 | 16 & 17 | 3/27 | 4/2 |
| 9 | 19 & 20 | 4/10 | 4/16 |
| 10 | 21 & 22 | 4/17 | 4/23 |
| 11 | 23 & 24 | 4/24 | 4/30 |

Exams

There will be three non-cumulative exams which will consist of a variety of formats including multiple choice, matching, short answer, essay, and calculation questions. The exams will cover material discussed in the lectures/videos and from any figures/reading assigned in the book or from other sources.

Students who require special accommodations must make arrangements at least a week in advance. These accommodations will be given only if approved by the Office of Disability Services.

Exams cannot be rescheduled or retaken. Individual exceptions will possibly be made only in cases of documented serious, long-term illness or family emergency. Only one makeup exam may be taken during the semester.

Grade appeals

All grade appeals on study quizzes or exams must be submitted no later than 1 week after the grade has been posted. Appeals must be clearly stated and emailed to Dr. Keating. Any appeals submitted after 1 week following the posting of a grade will not be considered.

Lecture grades

| Lecture assessment | % of lecture grade |
|---------------------------|---------------------------|
| Study quizzes | 10 |
| Exam 1 | 30 |
| Exam 2 | 30 |
| Final Exam | 30 |

• **LECTURE & EXAM SCHEDULE**

| Lecture | Date | Lecture Topic | Book (selected sections) |
|---------|------------------|--|--------------------------|
| 1 | Thurs, 1/19 | Introduction to Microbiology History and importance of microbiology. Basics of microscopes and staining. | Ch. 1 & 2 |
| 2 | Mon, 1/23 | Prokaryotic Cells: Cell Wall Distinguishing bacteria by cell walls. Gram stain. | Ch. 2 & 3 |
| 3 | Thurs, 1/26 | Prokaryotic Cells: Plasma Membrane & Cytoplasm Movement across membranes. Internal structure | Ch. 3 |
| 4 | Mon, 1/30 | Prokaryotic Cells: Cell Surface Structures, Motility & Endospores Structure and function of flagella. Mechanism of chemotaxis. Endospores as a survival strategy. | Ch. 3 |
| 5 | Thurs, 2/2 | Microbial Taxonomy Methods in microbial taxonomy. Comparison of three domains. Microbial diversity. | Ch. 19 |
| 6 | Mon, 2/6 | Domain Archaea Cell structure and diversity. | Ch. 4 & 20 |
| 7 | Thurs, 2/9 | Viruses I Characteristics and classification. Replication strategies. | Ch. 6 & 26 |
| 8 | Mon, 2/13 | Viruses II & Virus-like Agents Viral diseases. Prions and other virus-like agents. | Ch. 6 & 38 |
| 9 | Thurs, 2/16 | SARS-CoV-2 Overview, transmission, diagnostic tests, vaccines. | |
| | Mon, 2/20 | Exam 1: Lectures 1 (Jan 19) – 8 (Feb 13) | |

| Lecture | Date | Lecture Topic | Book (selected sections) |
|---------|-------------|--|--------------------------|
| 10 | Thurs, 2/23 | SARS-CoV-2 Recent developments | |
| 11 | Mon, 2/27 | Microbial Growth I Cell division and population growth. Batch culture and continuous culture. | Ch. 7 & 13 |
| 12 | Thurs, 3/2 | Microbial Growth II Major requirements for all living organisms. Comparison of culture media. Environmental factors affecting bacterial growth. Measurement of microbial growth. | Ch. 7 |
| 13 | Mon, 3/6 | Control of Infectious Disease I: Prevention Mechanism of action of control methods. Evaluating effectiveness of antimicrobial agents. | Ch. 8 |
| 14 | Thurs, 3/9 | Microbial Metabolism I Principles and regulation of metabolism. | Ch. 10 & 11 |
| | | SPRING BREAK | |
| 15 | Mon, 3/20 | Microbial Metabolism II Overview of catabolism. | Ch. 11 |
| 16 | Thurs, 3/23 | Microbial Genetics I Overview of bacterial genetics | Ch. 13 |
| 17 | Mon, 3/27 | Microbial Genetics II Mutations, replica plating, and Ames test. Transformation, transduction, and conjugation. | Ch. 16 |
| 18 | Thurs, 3/30 | Immunity I Overview of innate immunity | Ch. 32 |
| | Mon, 4/3 | Exam 2: Lectures 9 (Feb 16) – 17 (Mar 27) | |

| Lecture | Date | Lecture Topic | Book (selected sections) |
|---------|-------------|--|--------------------------|
| 19 | Thurs, 4/6 | Immunity II Overview of adaptive immunity | Ch. 33 |
| 20 | Mon, 4/10 | Host-Microbe Relationship Symbioses. Microbiome. Virulence factors. Toxins. | Ch. 27 & 34 |
| 21 | Tues, 4/13 | Process of infection Transmission. Chain of infection. | Ch. 35 |
| 22 | Mon, 4/17 | Control of Infectious Disease II: Treatment Antimicrobial therapy and resistance. | Ch. 9 |
| 23 | Thurs, 4/20 | Epidemiology Overview of epidemiology. Epidemics. Emerging diseases. Vaccines | Ch. 36 |
| 24 | Mon, 4/24 | Eukaryotic Microbes Overview of eukaryotic cell structure. Protists and fungi. Compare and contrast the 3 domains. | Ch. 5 & 40 |
| 25 | Thurs, 4/27 | Food Microbiology Food spoilage. Food-borne diseases. | Ch. 41 |
| 26 | Mon, 5/1 | Environmental Microbiology Biogeochemical cycles. Water treatment. Bioremediation. Course conclusion | Ch. 28 & 43 |
| | TBD | Final Exam: Lectures 18 (Mar 30) – 26 (May 1) | |

Please note – Schedule and topics are subject to change

III. Laboratory

- **Learning Goals**

The Learning Goals for this course are adapted from the American Society of Microbiology (ASM) Guidelines on teaching undergraduate microbiology. Here we have listed the goals relevant to Laboratory Skills and Scientific thinking. After taking the course, successful students will be able to design an experiment, carry out the research using the appropriate laboratory techniques and analyze and interpret their data.

A. Scientific Thinking

28. Ability to apply the process of science
 - a. Demonstrate an ability to formulate hypotheses and design experiments based on the scientific method.
 - b. Analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations.
29. Ability to use quantitative reasoning
 - a. Use mathematical reasoning and graphing skills to solve problems in microbiology.
30. Ability to communicate and collaborate with other disciplines
 - a. Effectively communicate fundamental concepts of microbiology in written and oral format.
 - b. Identify credible scientific sources and interpret and evaluate the information therein.
31. Ability to understand the relationship between science and society
 - a. Identify and discuss ethical issues in microbiology.

B. Microbiology Laboratory Skills

32. Properly prepare and view specimens for examination using microscopy (bright field and, if possible, phase contrast).
33. Use pure culture and selective techniques to enrich for and isolate microorganisms.
34. Use appropriate methods to identify microorganisms (media-based, molecular and serological).
35. Estimate the number of microorganisms in a sample (using, for example, direct count, viable plate count, and spectrophotometric methods).
36. Use appropriate microbiological and molecular lab equipment and methods.
37. Practice safe microbiology, using appropriate protective and emergency procedures.
38. Document and report on experimental protocols, results and conclusions.

(ASM Guidelines 2012)

- **Instructors**

Sections 1 & 5: Dr. Alexandra Walczak, Bio, Walczak@dls.rutgers.edu

Section 1 (after spring break): Alanna Cohen, abc162@rutgers.edu

Sections 4, 6, and 5 (after spring break): Dr. Haiyang Lu, Hlu@dls.rutgers.edu

Sections 2 & 3: Erin Welsh, edw52@scarletmail.rutgers.edu

- **Lab Schedule**

In-person Lab meetings will start the week of January 30th. Please complete all pre-lab prep before January 23rd at 11:59pm to be prepared for your first lab meeting.

Schedule and point values may be modified during the semester if needed.

Make sure to check your email and visit the Canvas Course site regularly for updates

| Lab Day | Date | New Topics | Large Assignments/Technique Quizzes |
|------------------------------|----------------------------------|--|--|
| Pre-lab Prep | Complete by 11:59pm on Jan. 24th | Self-paced: Orientation, Lab policies, Safety, Intro to Canvas and learning tools used in class. | |
| Lab 1 Virtual | Jan. 25,26,27 | Introductions, Orientation Questions | |
| Lab 2 | Feb. 1,2,3 | Group Contract, Ubiquity of Microbes and Microscopy and Staining: Simple Stains- Basic and Acidic staining | |
| Lab 3 | Feb. 8,9,10 | Microscopy and Staining Part 2: Stains, Spore and Gram | |
| Lab 4 | Feb. 15,16,17 | Aseptic Tech, Culture Basics, and Pure Culture/Isolation of Bacteria | Technique Quiz: Gram Stain |
| Lab 5 | Feb. 22,23,24 | Growth Rate and Enumeration of Bacteria | Technique Quiz: Quadrant Streak |
| Lab 6 | Mar. 1,2,3 | Growth Conditions: Effects of Oxygen, pH, Temperature, Osmotic Pressure | Growth Curve Graphs (In Class) |
| Lab 7 | Mar. 8,9,10 | Exam 1 (Covers Lab 1-6) | |

| | | | |
|--------|---------------|---|---------------------------------------|
| Lab 8 | Mar. 15,16,17 | NO in-Person Lab/Spring Break | |
| Lab 9 | Mar. 22,23,24 | Biochemical Activities of Microorganisms, Motility of Organisms, Enteric Unknown | |
| Lab 10 | Mar. 29,30,31 | Other methods of identification: Enterotube, PCR, Enteric Unknown Identification, Wet Mount, Qualitative Analysis of Water Part 1 | |
| Lab 11 | Apr. 5,6,7 | Control of Microbial growth: UV, Kirby Bauer, Disinfectants, Qualitative Analysis of Water Part 2 | Draft Submission of Formal Lab Report |
| Lab 12 | Apr. 12,13,14 | Gram + Pathogens: Staphylococci and Streptococci | Peer Review Formal Lab Report |
| Lab 13 | Apr. 19,20,21 | Transformation/Review | Final Submission of Formal Lab Report |
| Lab 14 | Apr. 26,27,28 | Exam 2 Cumulative | |

- **Lab Grading**

Lab counts for 50% of your total Microbiology Grade. You must pass lab to pass the course. The general breakdown of the lab course grade is below. At the end of the semester, your final grade as a percent will be averaged with your lecture grade to calculate your overall grade. The lab adheres to the same grading policies as stated in the lecture syllabus meaning no curve and no bumping students to the next letter grade. If you need to appeal an individual assignment grade you have **1 week** from the date the grade was posted. Your instructor will not address appeals at the end of the semester related to material covered in the beginning or middle of the semester.

| Categories | Percentage | Due Dates |
|---|-------------------|---|
| Pre-Lab Reading/Video Quizzes | 15% | Weekly |
| Simulations | 5% | Weekly |
| Post-Lab Weekly Quizzes | 20% | Weekly |
| Exams (2) | 30% | Mar. 8,9,10 Apr. 26,27,28 |
| Unknown Identification/Formal Lab Report | 6% | Draft Apr. 5,6,7 Final Apr. 19,20,21 |
| Notebook Entries (Individual and Group Submissions) | 14% | Weekly |
| Proper Lab Technique/Group Participation/Class Conduct | 10% | Weekly |
| Total Percent | 100 | |

IV. Student-Wellness Services

Resources for Student Success (success.rutgers.edu)

The faculty and staff at Rutgers are committed to your success. Students who are successful tend to seek out resources that enable them to excel academically, maintain their health and wellness, prepare for future careers, navigate college life and finances, and connect with the RU community. Resources that can help you succeed and connect with the Rutgers community can be found at success.rutgers.edu, and nearly all services and resources that are typically provided in-person are now available remotely.

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884

rhscaps.rutgers.edu/

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181

vpva.rutgers.edu/

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling, and advocacy for victims of sexual and relationship violence and stalking to students, staff, and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 445-6800

<https://ods.rutgers.edu/>

The Office of Disability Services works with students with a documented disability to determine the eligibility of reasonable accommodations, facilitates and coordinates those accommodations when applicable, and lastly engages with the Rutgers community at large to provide and connect students to appropriate resources.

Scarlet Listeners

(732) 247-5555

<http://www.scarletlisteners.com/>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.