MICROBIOLOGY (MICROBIO)

MICROBIO 100 – THE MICROBIAL WORLD
3 credits.

Primarily for non-science majors. Roles of microorganisms and viruses in nature, health, agriculture, pollution control and ecology. Principles of disease production, epidemiology and body defense mechanisms. Biotechnology and the genetic engineering revolution.
Requisites: Not open to students with credit for MICROBIO 101 or 303.
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2025
Learning Outcomes: 1. Understand, analyze, and evaluate information effectively.
Audience: Undergraduate

2. Describe what makes up a microorganism. How is the make up different between a microorganism and a human being?
Audience: Undergraduate

3. Define a disease. Describe how your body, your doctor, and the government fight disease.
Audience: Undergraduate

4. Understand where we came from. Analyze the various theories of how life originated and express an opinion on which is most plausible.
Audience: Undergraduate

5. Articulate the positive impacts microbes have on your health, the well-being of their host organisms, the cycling of important elements, and the environment.
Audience: Undergraduate

MICROBIO 101 – GENERAL MICROBIOLOGY
3 credits.

Survey of microorganisms and their activities; emphasis on structure, function, ecology, nutrition, physiology, genetics. Survey of applied microbiology--medical, agricultural, food and industrial microbiology. Intended to satisfy any curriculum which requires introductory level microbiology.
Requisites: CHEM 103, 108, 109, or 115. Not open to students with credit for MICROBIO 303
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2025
Learning Outcomes: 1. Identify the three Domains of the phylogenetic tree of life and draw inferences about evolutionary processes based on phylogenetic trees.
Audience: Undergraduate

2. Describe the basic cell structure of cells (bacteria, archaea, eukarya) and the structure of viruses and explain how this affects microbial function.
Audience: Undergraduate

3. Understand the impact of environmental conditions on microbial growth and how this impacts the abundance and distribution of microbes on Earth.
Audience: Undergraduate

4. Describe how microbes obtain nutrients and energy from the environment and how this is important to food production, waste treatment, sustainability and global ecosystems.
Audience: Undergraduate

5. Describe the flow and exchange of information in microbial cells and populations and understand how this affects microbial diversity and evolution.
Audience: Undergraduate

6. Compare different methods of microbial growth control and their impact on microbes.
Audience: Undergraduate

7. Compare and contrast the different ways in which microbes interact with their human hosts and the impacts on global health and disease.
Audience: Undergraduate

8. Describe the human immune response to microbes.
Audience: Undergraduate

MICROBIO 102 – GENERAL MICROBIOLOGY LABORATORY
2 credits.

Covers techniques and procedures used in general microbiology, including cultivation, enumeration, aseptic techniques, physiology and selected applications.
Requisites: MICROBIO 101, 303 or concurrent enrollment. Not open to students with credit for MICROBIO 304.
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Demonstrate competencies in microbiological laboratory techniques.
Audience: Undergraduate

2. Isolate and identify bacteria.
Audience: Undergraduate

3. Keep careful records of observations.
Audience: Undergraduate

4. Develop hypotheses, and think critically and make valid conclusions about them.
Audience: Undergraduate

5. Assess the credibility of scientific sources.
Audience: Undergraduate

6. Communicate scientific findings and ideas effectively through writing.
Audience: Undergraduate

MICROBIO 150 – MICROBIOMES AND MICROBIOLOGY - FIRST-YEAR SEMINAR
1 credit.

Introduction to major questions related to the study of the microbiome. Acquire foundational research skills necessary for success as a microbiology or life sciences major. Engage with faculty and their cutting-edge research related to Microbiology. Explore department and campus resources and career options available in the field of microbiology.
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Describe the academic skills and practical steps required to succeed as a microbiology major
Audience: Undergraduate

2. Discuss the research and teaching interests of department faculty
Audience: Undergraduate

3. Describe the variety of career opportunities available to individuals with microbiology and life science backgrounds
Audience: Undergraduate

4. Identify university, college, and department resources that support success at UW-Madison
Audience: Undergraduate

5. Identify credible sources of information related to microbiome research
Audience: Undergraduate

6. Discuss the major research questions in the study of the microbiome
Audience: Undergraduate

MICROBIO 299 – INDEPENDENT STUDY
1-3 credits.

Research work for students under direct guidance of a faculty member in an area encompassing Microbiology. Students are responsible for arranging the work and credits with the supervising instructor.
Requisites: Consent of instructor
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

MICROBIO 303 – BIOLOGY OF MICROORGANISMS
3 credits.

Basic biology of microorganisms, including structure, function, physiology, genetics, ecology, diversity, and evolution.
Requisites: (ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 151, BIOCORE 383, or BIOLOGY/BOTANY 130) and (CHEM 104 or 109) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2025
Learning Outcomes: 1. Explain the historical context of microbiology from a human and evolutionary perspective.
Audience: Undergraduate

2. Compare different microbial cell structures and predict behaviors based upon those structures.
Audience: Undergraduate

3. Explain how mutations occur in cells, the mechanisms organisms have to combat these changes, and how these changes relate to the evolution of species.
Audience: Undergraduate

4. Predict the modes of growth of microbes based upon the enzymes they contain and the metabolic breakdown of substrates.
Audience: Undergraduate

5. Describe the regulatory paradigms in microbes and predict the changes in behavior that occur when these pathways are disrupted.
Audience: Undergraduate

6. Explain the symbiotic and dysbiotic state in a host-microbe interaction and list factors that can affect this relationship.
Audience: Undergraduate

7. Compare common virulence factors and explain their effect on symbiotic relationships and how these virulence factors contribute to disease.
Audience: Undergraduate

MICROBIO 304 – BIOLOGY OF MICROORGANISMS LABORATORY
2 credits.

Introduction to modern laboratory techniques used to study the distribution and properties of microorganisms.
Requisites: MICROBIO 303 or concurrent enrollment
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Summer 2025
Learning Outcomes: 1. Demonstrate proficiency in microscopy, media preparation, aseptic technique, and microbiological measurements.
Audience: Undergraduate

2. Identify representative groups of microorganisms. Those that are important in: antibiotic production, sewage treatment, disease, food manufacturing, and the local environment.
Audience: Undergraduate

3. Characterize microbial isolates from nature and describe their taxonomy.
Audience: Undergraduate

4. Create detailed lab notes that describe accurately the experiments performed.
Audience: Undergraduate

5. Develop hypotheses, design experiments, perform experiments, collect data, analyse data critically, report data to others clearly and accurately, and communicate about scientific topics in a precise manner.
Audience: Undergraduate

MICROBIO 305 – CRITICAL ANALYSES IN MICROBIOLOGY
1 credit.

Train students to become scientific problem-solvers, to critically analyze data, and to comprehend the principles of microbiological research via active discussion of a combination of scholarly papers and contemporary, hot topics in our field.
Requisites: MICROBIO 303 or concurrent enrollment
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Recognize the breadth of the field of microbiology and nature of the science.
Audience: Undergraduate

2. Describe the scientific method used in presented material.
Audience: Undergraduate

3. Demonstrate critical thinking and problem solving skills through an exploration of seminal papers and cutting-edge research in the field of microbiology.
Audience: Undergraduate

4. Critique primary scientific papers by identifying the hypothesis, analyzing the data being presented, and proposing future experiments or directions for a particular study.
Audience: Undergraduate

5. Communicate analysis of primary literature to others.
Audience: Undergraduate

MICROBIO/FOOD SCI 324 – FOOD MICROBIOLOGY LABORATORY
2 credits.

Lab exercises dealing with food preservation, spoilage, and food poisoning. Isolation, identification and quantification of specific microbes occurring in foods, and food fermentations by bacteria and yeast.
Requisites: (MICROBIO 102 or MICROBIO 304) and FOOD SCI/ MICROBIO 325 or concurrent enrollment
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Utilize laboratory techniques to identify microorganisms in food.
Audience: Undergraduate

2. Describe the principles involving food preservation via fermentation processes.
Audience: Undergraduate

3. Demonstrate understanding of the role and significance of microbial inactivation, adaptation, and environmental factors (i.e., water activity, pH, temperature) on growth and response of microorganisms in various environments.
Audience: Undergraduate

4. Identify the conditions, including sanitation practices, under which important pathogens and spoilage microorganisms are commonly inactivated, killed, or made harmless in foods.
Audience: Undergraduate

MICROBIO/FOOD SCI 325 – FOOD MICROBIOLOGY
3 credits.

Principles of food preservation, epidemiology of foodborne illness, agents of foodborne illness, food fermentations and biotechnology.
Requisites: MICROBIO 101, 303, or M M & I 301 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Identify and summarize the impacts of intrinsic and extrinsic factors on microorganisms.
Audience: Undergraduate

2. Calculate and apply thermal processing parameters to reductions in microbial numbers.
Audience: Undergraduate

3. Apply Hazard Analysis Critical Control Point (HACCP) concepts and principles to food production processes.
Audience: Undergraduate

4. Demonstrate knowledge of foodborne microbial pathogens.
Audience: Undergraduate

5. Describe methods and principles of sampling and testing food for microorganisms.
Audience: Undergraduate

6. Compare and contrast the principles, practices, and pathways of food fermentations.
Audience: Undergraduate

7. Analyze and use microbiological data sets.
Audience: Undergraduate

8. Evaluate the benefits and hazards of modern food production, organic foods, and genetically-engineered foods.
Audience: Undergraduate

MICROBIO/AN SCI/BOTANY 335 – THE MICROBIOME OF PLANTS, ANIMALS, AND HUMANS
3 credits.

Examination of the structure and function of microbial communities that live inside and on host organisms (plants, animals, and humans). Introduction to general concepts of the microbiome and microbiota, and their relationship to host nutrition, health, and disease.
Requisites: MICROBIO 101 or 303 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe how microorganisms interact with plant and animal (including human) hosts in beneficial, neutral or detrimental ways.
Audience: Undergraduate

2. Express how the environment affects these host-microbe interactions.
Audience: Undergraduate

3. Summarize new molecular and bioinformatic methods that allow for the study of microbial communities.
Audience: Undergraduate

4. Describe how microbial communities are essential for life as we know it, and the processes that support life.
Audience: Undergraduate

5. Articulate several ways in which microbial communities are essential to plant and animal (including human) health.
Audience: Undergraduate

6. Explain our current knowledge about the diversity of microbial life and why its effects and potential benefits have not been fully explored.
Audience: Undergraduate

MICROBIO 345 – INTRODUCTION TO DISEASE BIOLOGY
3 credits.

Introduces the rich biology of infectious disease and how it impacts the biology of humans and other organisms, through the lens of global health. Steps beyond a narrow focus on the biological dimensions of disease to also cover the social, political, and cultural factors that shape the spread and persistence of disease in natural populations. Includes a survey of the various types of pathogens and the science behind infection, transmission, evolution, and virulence.
Requisites: ZOOLOGY/BIOLOGY 101, BOTANY/BIOLOGY 130, ZOOLOGY/BIOLOGY/BOTANY 151, or BIOCORE 381
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe different types of parasites/pathogens and their modes of transmission
Audience: Undergraduate

2. Summarize the function of the human immune system in protecting against disease and in causing some of the damages associated with disease
Audience: Undergraduate

3. Read and analyze data on the health status of populations
Audience: Undergraduate

4. Assess environmental, medical and political strategies for controlling infectious diseases
Audience: Undergraduate

5. Identify the evolutionary processes that lead to adaptation and biological diversity
Audience: Undergraduate

6. Describe the genetic and behavioral reasons why there are increasing numbers of antibiotic resistant infections
Audience: Undergraduate

7. Evaluate global progress toward reaching MD6—to reduce the burden of HIV, TB, Malaria and other diseases
Audience: Undergraduate

8. Critically evaluate and effectively use textbooks, current research literature, online information, as well as information related to scientific and biological issues in the popular press
Audience: Undergraduate

MICROBIO 357 – GENERAL BIOINFORMATICS FOR MICROBIOLOGISTS
3 credits.

Provides foundational introduction to bioinformatics for microbiologists. Emphasis on the basic understanding of bioinformatics tools, analysis, and databases and their applications (e.g. Sequence alignment, Phylogenetic trees, Genome analyses). Topics include: command line manipulation, sequence alignment, file formats, phylogenetic trees, standard genome and protein databases, interpretation of microbial and viral genomes, and basic scientific computer programming.
Requisites: MICROBIO 303, BIOCHEM 501, 507, or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Perform basic command line operations to navigate through an operating system
Audience: Undergraduate

2. Recognize basic sequence data formats, access them through publicly available datasets, and utilize them in bioinformatics applications
Audience: Undergraduate

3. Use sequence analysis programs by downloading and installing them locally on their own computers
Audience: Undergraduate

4. Use publicly available bioinformatics databases
Audience: Undergraduate

5. Create programs in a scientific programming language to conduct basic bioinformatics analyses
Audience: Undergraduate

6. Demonstrate mastery of basic bioinformatics skills by completing a hands-on final project focused on the recovery and analyses of microbial genomes from public databases
Audience: Undergraduate

MICROBIO 375 – SPECIAL TOPICS
1-4 credits.

Specialized subject matter of current interest to undergraduate students.
Requisites: None
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2020

MICROBIO 399 – COORDINATIVE INTERNSHIP/COOPERATIVE EDUCATION
1-8 credits.

An internship under guidance of a faculty or instructional academic staff member in the Bacteriology department and a internship site supervisor. Students are responsible for arranging the work and credits with the faculty or instructional academic staff member and the internship site supervisor.
Requisites: Consent of instructor
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2013
Learning Outcomes: 1. Perform assigned responsibilities in a professional setting for 80 hrs/credit/semester.
Audience: Undergraduate

2. Identify and employ standards of professionalism at work site.
Audience: Undergraduate

3. Articulate through discussion with faculty mentor how concepts learned in microbiology relate to real work situations.
Audience: Undergraduate

4. Synthesize and apply knowledge from the microbiology curriculum and broader coursework to solve problems on the worksite.
Audience: Undergraduate

5. Create and submit a progress report to a faculty mentor, twice during the semester, one at mid-semester and one at the end of the semester.
Audience: Undergraduate

MICROBIO 400 – STUDY ABROAD IN MICROBIOLOGY
1-6 credits.

Provides an area equivalency for courses taken on Madison Study Abroad Programs that do not equate to existing UW courses.
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions

MICROBIO/SOIL SCI 425 – ENVIRONMENTAL MICROBIOLOGY
3 credits.

Microbial interactions in soils, water, extreme environments and biofilms. Modern methods for studying microbial ecology. role of microbes in nutrient cycles and biogeochemistry. Use of microbes for mitigating manmade environmental problems of industrial, agricultural, and domestic origin.
Requisites: MICROBIO 303 and (CHEM 341 or 343), or graduate/professional standing
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Build intuition and an ability to predict which kinds of organisms will be found in different ecosystems using quantitative reasoning when possible.
Audience: Undergraduate

2. Gain familiarity with research tools and applications in environmental microbiology, along with an appreciation for their limitations.
Audience: Undergraduate

3. Critically evaluate published research carried out in the field and think creatively about new potential research questions and applications.
Audience: Undergraduate

4. Work collaboratively in a team to enhance learning and solve complex problems.
Audience: Undergraduate

MICROBIO 450 – DIVERSITY, ECOLOGY AND EVOLUTION OF MICROORGANISMS
3 credits.

Fundamental concepts relating to the phylogenetic diversity, ecology and evolution of microbes. Active learning methods applying these concepts will promote a deeper understanding of microbiology.
Requisites: MICROBIO 303 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Define the foundational principles of phylogenetics.
Audience: Undergraduate

2. Compare the major phyla within bacteria, archaea and eukaryotic microbes.
Audience: Undergraduate

3. Recognize general properties of viruses and the issues with their phylogenetic classification.
Audience: Undergraduate

4. Define ecology, its domains and distinguish it from other closely related fields.
Audience: Undergraduate

5. Develop a deeper understanding of methods available to characterize microbial communities.
Audience: Undergraduate

6. Explain Darwin's Theory of Natural Selection and the four postulates of natural selection.
Audience: Undergraduate

7. Describe the concept of adaptation and how over the history of science this concept has changed.
Audience: Undergraduate

8. Identify the major events in the history of microbial life.
Audience: Undergraduate

9. Develop an evolutionary understanding of the 3 domains of life.
Audience: Undergraduate

MICROBIO 470 – MICROBIAL GENETICS & MOLECULAR MACHINES
3 credits.

Examines modern microbial genetics and molecular processes. Emphasis on the use of eubacterial and eukaryotic microbes to elucidate cellular function. Discussion of experimental approaches to study microbes and their use in biotechnology, bioremediation, and medicine.
Requisites: MICROBIO 303 or concurrent enrollment or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Use correct nomenclature to describe microbial genetic and molecular processes and experimental approaches.
Audience: Undergraduate

2. Recognize and apply concepts of genetics.
Audience: Undergraduate

3. Describe how the molecular machines in bacterial gene expression function and, how they contribute to final gene-encoded activities.
Audience: Undergraduate

4. Explain the mechanisms by which these molecular machines are regulated.
Audience: Undergraduate

5. Interpret molecular and genetic data in regard to specific experimental questions.
Audience: Undergraduate

6. Apply understanding of microbial genetics and molecular machines to design experimental approaches test research hypotheses.
Audience: Undergraduate

MICROBIO 520 – PLANETARY MICROBIOLOGY: WHAT LIFE HERE TELLS US ABOUT LIFE OUT THERE
3 credits.

Connects the molecular underpinnings of life with corresponding planetary scale changes in geochemistry. Focuses on the dynamics between life and environment over planet Earth's history from a microbial and molecular perspective, including the origins of life, and emergence of essential metabolisms and their evolution across billions of years of planetary evolution. Discusses how innovations such as translation machinery and carbon and nitrogen fixation were impacted by significant changes in the environment. Examines how understanding the origins of life on Earth may allow for the recognition of life elsewhere in the universe by exploring, assessing, and discussing various signs of life and the processes that expands life to planetary scale.
Requisites: MICROBIO 101 or 303 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Evaluate the reliability of sources of information about biology
Audience: Both Grad & Undergrad

2. Synthesize key topics/concepts of planetary microbiology, astrobiology, and the molecular history of life
Audience: Both Grad & Undergrad

3. Describe the environments in which life on Earth might have originated, emerged, and persisted over billions of years
Audience: Both Grad & Undergrad

4. Analyze and describe the significant molecular innovations that impacted life on Earth
Audience: Both Grad & Undergrad

5. Describe the current origins of life scenarios on Earth and planetary conditions that may give rise to life elsewhere in the universe
Audience: Both Grad & Undergrad

6. Formulate an original hypothesis to guide future research based on a synthesis of current research into the connections between the origins, evolution, and molecular underpinnings of life and corresponding planetary scale changed
Audience: Graduate

MICROBIO/SOIL SCI 523 – SOIL MICROBIOLOGY AND BIOCHEMISTRY
3 credits.

Transformations of nutrients and contaminants in soils and groundwater by microorganisms: emphasis on enzymatic mechanisms and metabolic pathways. Approaches for analyzing microbial populations and activities including molecular techniques. Applications of microbial activities for bioremediation of contaminated soils and groundwater. Students should have completed one course in either Soil Science or Microbiology to feel comfortable with the course content.
Requisites: Senior standing, (CHEM 104, 109, or 116) and (ZOOLOGY/BIOLOGY 102, BOTANY/BIOLOGY 130, or ZOOLOGY/BIOLOGY/BOTANY 151), or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe the soil environment from the perspective of a microbe
Audience: Both Grad & Undergrad

2. Explain the importance of soil microbes for globally important issues such as climate change, nutrient cycling, and biodiversity
Audience: Both Grad & Undergrad

3. Describe key methods used to study soil microbes and explain their limitations
Audience: Both Grad & Undergrad

4. Analyze microbial community data to answer the question, are the organisms in these communities different, and how
Audience: Both Grad & Undergrad

5. Discuss and critically evaluate scientific papers in soil microbiology at an advanced undergraduate level
Audience: Undergraduate

6. Conduct, analyze, and interpret a research project
Audience: Undergraduate

7. Discuss and critically evaluate scientific papers in soil microbiology at a graduate level
Audience: Graduate

8. Design, conduct, analyze, and interpret a research project, drawing on the broader literature
Audience: Graduate

MICROBIO 525 – FIELD STUDIES OF PLANETARY MICROBIOLOGY AND LIFE IN THE UNIVERSE
3 credits.

Explores the origins, early evolution, and most common traces left by our planet's form of microbial life. Discovery and interpretation of microbial biosignatures in the context of a simulated surface lander mission through travel to field sites. Introduction to microbial biosignatures as inferred through satellite and drone imagery interpretation, portable XRF elemental analysis, UV-VIS-IR spectrophotometry, body and trace fossil analysis and interpretation, and metagenome sequencing. Explore evidence and methods of detection of life on other planets.
Requisites: MICROBIO 520 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Learning Outcomes: 1. Define basic categories and modes of biosignature production and preservation.
Audience: Both Grad & Undergrad

2. Describe the environmental and ecological attributes that enable biosignature preservation.
Audience: Both Grad & Undergrad

3. Articulate how different microenvironments can be present in an extreme environment (i.e., a salt flat), and how different instruments are required to explore these microenvironments at different scales of observation.
Audience: Both Grad & Undergrad

4. Explain the basic chemical drivers of life that exist in different microenvironments.
Audience: Both Grad & Undergrad

5. Hypothesize planetary and stellar conditions likely to lead to the long-term persistence of life on a planet.
Audience: Both Grad & Undergrad

6. Operate each of the main instruments that compose the payload package of the simulated spacecraft, organized in order of scale: Drone/imaging data (km-m); Outcrop scale detection/field microscope and hand lens (m-dm); Molecular characterization/spectrophotometer (mm-nm); Atomic characterization/XRD (nm-fm).
Audience: Both Grad & Undergrad

7. Formulate an original hypothesis to guide future research based on a synthesis of findings from the field experience with current understandings of the origins, evolution and molecular underpinnings of life and corresponding planetary scale changes.
Audience: Graduate

MICROBIO 526 – PHYSIOLOGY OF MICROORGANISMS
3 credits.

Biochemistry of microbial processes.
Requisites: (BIOCHEM 501 or 507 or concurrent enrollment) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Recognize the chemical logic and fundamental regulatory principles of central metabolism.
Audience: Undergraduate

2. Describe how the fundamental concepts in metabolism relate to real-world problems in areas such as microbiology, biotechnology, and human health.
Audience: Undergraduate

3. Recognize that the same fundamental principles that help us understand microbial metabolism also apply to higher organisms.
Audience: Undergraduate

4. Describe the interconnected nature of metabolism, where pathways work in concert by feeding, draining, and regulating each other.
Audience: Undergraduate

5. Describe the core mechanisms of energy generation in biology and how they impact the diversity of microbial life.
Audience: Undergraduate

MICROBIO 527 – ADVANCED LABORATORY TECHNIQUES IN MICROBIOLOGY
2 credits.

Provides a foundation in modern methods of research in the biomedical sciences. Coaching and practice in hypothesis-driven scientific questions, critical data analysis, and scientific writing.
Requisites: Declared in Microbiology and MICROBIO 304
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Explain the conceptual design of an experiment.
Audience: Undergraduate

2. Given an experimental question, design and effectively execute an experiment that answers a scientific question.
Audience: Undergraduate

3. Find, and use correctly, information in the primary literature relevant to experiments being carried out.
Audience: Undergraduate

4. Properly and critically interpret data including understanding experimental limitations and controls.
Audience: Undergraduate

5. Effectively communicate their scientific findings through writing as well as present data/results clearly and effectively in a professional manner.
Audience: Undergraduate

6. Take complete, effective and detailed lab notes.
Audience: Undergraduate

MICROBIO/ONCOLOGY 545 – TOPICS IN BIOTECHNOLOGY
1 credit.

Seminars on current topics in agricultural, medical, and industrial biotechnology such as: microbiological production of food, drink, biopharmaceuticals; production methods, genetic engineering (vectors, recombination cloning), continuous fermentation; bioconversion processes and production of chemicals from biomass; plant biotechnology; transgenic animals.
Requisites: (ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 151, BIOCORE 383, or BIOLOGY/BOTANY 130) and (CHEM 104 or 109) or graduate/professional standing
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025
Learning Outcomes: 1. Attend all lectures on a diverse range of speakers from the Biotechnology sector and related topics.
Audience: Undergraduate

2. Demonstrate an understanding of lectures though lecture evaluation sheets.
Audience: Undergraduate

3. Choose a current topic in Biotechnology and formulate an opinion paper on the challenges and potential utility.
Audience: Undergraduate

MICROBIO 551 – CAPSTONE RESEARCH PROJECT IN MICROBIOLOGY
2 credits.

Conduct independent research in either a PI's laboratory or in small groups in microbiology teaching laboratories. Discuss progress of projects and research ethics, write a research proposal, and prepare and present a poster with final results for the department Poster Session. The in-class students use microbiological, molecular, and bioinformatic approaches to investigate the microbial ecology of environmental microbial communities. Research-lab students will progress toward goals established by the research mentor / PI.
Requisites: MICROBIO 527
Course Designation: Gen Ed - Communication Part B
Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Demonstrate proficiency in bacterial culturing, PCR, gel electrophoresis, Sanger sequencing, DNA quantitation, analytical micropipetting, and BLAST analysis.
Audience: Undergraduate

2. Complete a next-generation or genomics sequencing project on an under-study microbial environment and use bioinformatics tools to analyze large datasets of DNA and/or RNA sequences.
Audience: Undergraduate

3. Design and troubleshoot experiments, isolate targeted microbes, or microbial groups, from a given environment.
Audience: Undergraduate

4. Cultivate the ability to work in teams by designing and troubleshooting a team experiment and presenting their progress and findings throughout the semester.
Audience: Undergraduate

5. Improve scientific writing by preparing and revising drafts of a research proposal.
Audience: Undergraduate

6. Improve oral scientific communication by presenting powerpoint and poster presentations on scientific research.
Audience: Undergraduate

7. Explore ethical dilemmas in science through writing, discussion, and case studies.
Audience: Undergraduate

MICROBIO/BIOCHEM/GENETICS 612 – PROKARYOTIC MOLECULAR BIOLOGY
3 credits.

Molecular basis of bacterial physiology and genetics with emphasis on molecular mechanisms; topics include nucleic acid-protein interactions, transcription, translation, replication, recombination, regulation of gene expression.
Requisites: (BIOCHEM 501 or 507) and (MICROBIO 470, GENETICS 466 or 468) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Access and evaluate original research literature.
Audience: Undergraduate

2. Demonstrate problem solving practices.
Audience: Undergraduate

3. Identify enzyme mechanisms responsible for transcription, translation, gene regulation, and replication in bacteria.
Audience: Graduate

4. Compare the structural bases for the mechanisms.
Audience: Graduate

5. Evaluate the experiments that led to our understanding of theses mechanisms.
Audience: Graduate

6. Deconstruct how these enzymes respond to nutritional and environmental signals in cells.
Audience: Graduate

7. Outline the evolutionary basis and selection pressure for these mechanisms in vivo.
Audience: Graduate

MICROBIO 626 – MICROBIAL AND CELLULAR METABOLOMICS
3 credits.

Provides an in-depth exploration of the use of mass spectrometry-based metabolomic approaches for the quantitative investigation of microbial and mammalian cellular metabolic processes. Using recent examples from primary literature, highlights the application of metabolomics, lipidomics, and metabolic flux analysis to diverse areas, including rational engineering of metabolic pathways, microbial biofuel production, discovery and characterization of new biochemical pathways, metabolic interactions within microbial communities, biochemical capabilities of the human gut microbiome, and mammalian cell metabolism.
Requisites: (BIOLOGY/ZOOLOGY 101, BOTANY/BIOLOGY/ZOOLOGY 151, BIOCORE 383, or BOTANY/BIOLOGY 130), (CHEM 341 or 343), and (BIOCHEM 301, 501, or 507), or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Describe the instrumentation and analytical approaches commonly used in mass spectrometry-based metabolomics, lipidomics, and metabolic flux analysis studies.
Audience: Both Grad & Undergrad

2. Explain how isotope tracers are used to measure metabolic flux, elucidate metabolic network structure, and investigate pathway thermodynamics.
Audience: Both Grad & Undergrad

3. Critically evaluate primary scientific literature that utilizes metabolomics, lipidomics, or isotope tracer studies as a key research component.
Audience: Both Grad & Undergrad

4. Argue how fundamental concepts in cellular metabolism relate to real-world problems in areas such as microbiology, biotechnology, and human health.
Audience: Both Grad & Undergrad

5. Analyze and interpret published or unpublished metabolomics and lipidomics data to generate biological insights on microbial and/or cellular metabolism.
Audience: Both Grad & Undergrad

6. Analyze and interpret published or unpublished data from isotope-tracer studies to make inferences on pathway activity and metabolic network structure in microbial and/or mammalian cellular systems.
Audience: Both Grad & Undergrad

7. Formulate experimental designs that incorporate metabolomics and isotope tracers to test specific hypothesis related to cellular metabolism.
Audience: Graduate

MICROBIO 657 – BIOINFORMATICS FOR MICROBIOLOGISTS
3 credits.

Provides a practical and fundamental introduction to sequence-based analysis focused on microbial systems. Emphasis on gaining a basic understanding of the principles of both classical and newer algorithms useful for bioinformatic analysis. Topics include: BLAST; RNA-seq analysis; transcriptional binding prediction; genome sequence assembly, analysis and annotation; and comparative genomics. Note that this course requires that each student have access to a laptop that runs a linux/unix Operating System such as a Mac or a ChromeBook. PC Laptops running a VM are also acceptable. No prior knowledge of computational biology is required.
Requisites: MICROBIO 303, BIOCHEM 501, GENETICS 466, or 467 or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Demonstrate use of the Unix/Linux-based operating system using command line.
Audience: Both Grad & Undergrad

2. Download and install sequence analysis programs locally on a computer.

Audience: Both Grad & Undergrad

3. Evaluate the outcomes of sequence data analysis and determine if an analysis is statistically relevant and robust.
Audience: Both Grad & Undergrad

4. Code complex and advanced programs in python that not only facilitate pipeline construction, but also more in-depth parsing of tool output.
Audience: Both Grad & Undergrad

5. Utilize bioinformatics tools to enable comparative genomics analysis that extend the standard use of those tools.
Audience: Both Grad & Undergrad

6. Evaluate primary literature and determine what available tools are most appropriate for solving a specific analysis problem.
Audience: Both Grad & Undergrad

7. Utilize advanced parameters in BLAST to facilitate complex comparisons across sequence data types.
Audience: Graduate

8. Demonstrate the ability to compile a program from source code so as to leverage local environmental variables for installation.
Audience: Graduate

MICROBIO/BMOLCHEM 668 – MICROBIOLOGY AT ATOMIC RESOLUTION
3 credits.

Three-dimensional protein structures form the basis for discussions of high resolution microbiology; how particular problems are solved with given protein architectures and chemistries and how themes of protein structure are modified and recycled.
Requisites: (BIOCHEM 501 or 507) and (MICROBIO 470 or 612) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Demonstrate proficient use of PyMol software for visualizing 3D structures.
Audience: Both Grad & Undergrad

2. Evaluate the quality of published structural models for biological macromolecules.
Audience: Both Grad & Undergrad

3. Identify common themes in structural biology which are used when addressing structural biology research questions.
Audience: Both Grad & Undergrad

4. Design and deliver a presentation to communicate scientific results to an audience of their peers.
Audience: Graduate

MICROBIO 681 – SENIOR HONORS THESIS
2-3 credits.

Individual study for majors completing theses for Honors degrees as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

6. Write an honors thesis that contains an abstract, background, a demonstration of research skills, analysis of the research question, and a summary of the impact of the work.
Audience: Undergraduate

MICROBIO 682 – SENIOR HONORS THESIS
2-4 credits.

Second semester of individual study for majors completing theses for Honors degrees as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

6. Write an honors thesis that contains an abstract, background, a demonstration of research skills, analysis of the research question, and a summary of the impact of the work.
Audience: Undergraduate

MICROBIO 691 – SENIOR THESIS
2 credits.

Individual study for majors completing theses as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2024
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

6. Write a thesis that contextualizes the work, presents the research question, describes the experiments performed to answer the question, and analyzes the results.
Audience: Undergraduate

MICROBIO 692 – SENIOR THESIS
2 credits.

Second semester of individual study for majors completing theses as arranged with a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

6. Write a thesis that contextualizes the work, presents the research question, describes the experiments performed to answer the question, and analyzes the results.
Audience: Undergraduate

MICROBIO 699 – SPECIAL PROBLEMS
1-4 credits.

Individual advanced work in an area of Microbiology under the direct guidance of a faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2025
Learning Outcomes: 1. Investigate a science topic in conjunction with other investigators to develop a deep understanding of a research problem.
Audience: Undergraduate

2. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Undergraduate

3. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Undergraduate

4. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Undergraduate

5. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Undergraduate

MICROBIO 710 – MICROBIAL SYMBIOSIS
3 credits.

Covers the themes and diversity of plant and animal associations with microbes with an emphasis on beneficial relationships. Examples will be drawn from recent literature.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025

MICROBIO 731 – SEMINAR
1 credit.

Reviews of microbiological subjects, and reports on research work.
Requisites: Declared in Microbiology doctoral program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025

MICROBIO 810 – CURRENT ISSUES IN MICROBIOLOGY
1 credit.

Explores the diversity of scientific topics comprising the field of contemporary microbiology.
Requisites: Declared in Microbiology doctoral program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2024

MICROBIO 811 – ADVANCED PROBLEMS IN MICROBIOLOGY
1 credit.

Explores the diversity of scientific topics comprising the field of contemporary microbiology.
Requisites: Declared in Microbiology doctoral program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025

MICROBIO 875 – SPECIAL TOPICS
1-4 credits.

Specialized subject matter of current interest to graduate students.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2025

MICROBIO 899 – INDEPENDENT STUDY
1-9 credits.

Independent study or research under the direction of a faculty member in the area of biological science.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2025
Learning Outcomes: 1. Identify a research problem and develop a series of experiments to test a hypothesis related to the problem under investigation.
Audience: Graduate

2. Carry out designed experiments and collect data related to the research problem under investigation.
Audience: Graduate

3. Analyze the results of experiments and use them to test the validity of the developed hypothesis.
Audience: Graduate

4. Communicate the results of investigations via written and/or oral means to an appropriate audience.
Audience: Graduate

MICROBIO/BIOCHEM 917 – REGULATION OF GENE EXPRESSION (ADVANCED SEMINAR)
1 credit.

Analysis of recent literature in topics related to prokaryotic and eukaryotic gene regulation, including regulation of transcription, translation, and genome organization.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Discuss state-of-the-art research in gene expression and regulation
Audience: Graduate

2. Communicate and critically evaluate experimental results
Audience: Graduate

MICROBIO 990 – RESEARCH
1-9 credits.

Full lab and literature review of a problem in microbiology. Leads to preparation of thesis and publication.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2025