

# MICROBIOLOGY

Microbiology is the study of organisms that usually require the aid of a microscope in order to be seen.

Micro-organisms include viruses, bacteria, archaea bacteria, algae, fungi, and protozoa. Microbiologists seek to understand the interactions between these organisms and components of our biosphere. Many micro-organisms are essential for life, as we know it, to exist on earth. Many of these organisms produce useful biologically active products, such as enzymes and antibiotics. A small number of them cause diseases in plants and animals, including humans.

The study of micro-organisms has led to many important discoveries concerning:

- the complexities, universality and mechanism of expression of the genetic code;
- the transfer of genetic information between species and modulation of the gene pool;
- the mechanism of antigen-antibody reactions and cellular immunity;
- the synthesis of proteins, nucleic acids and other cellular constituents;
- the structure, function and biogenesis of membranes; and,
- the process of molecular and cellular differentiation.

Students majoring in Microbiology will understand basic principles relating to molecular, cellular and organismal biology. In addition to these, students will exhibit proficiency in selected empirical laboratory skills, develop knowledge of contemporary research using the scientific method and demonstrate competence in oral and written communication. This background of knowledge and experience will prepare the students for entry into professional/graduate school or for employment in government, academic or industrial positions. The learning goals are divided into five parts including (1) Conceptual knowledge; (2) Critical and independent thinking skills; (3) Communication skills; (4) Collaborative skills; and (5) Societal impact.

## Dearborn Discovery Core (General Education)

All students must satisfy the University's Dearborn Discovery Core requirements ([http://catalog.umd.umich.edu/undergraduate/gen\\_ed\\_ddc/](http://catalog.umd.umich.edu/undergraduate/gen_ed_ddc/)), in addition to the requirements for the major. Students must also complete all CASL Degree Requirements. (<http://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/>)

## Pre-Major Requirements

A solid background in mathematics is essential to success in any of the scientific disciplines. Incoming students who intend to choose a major in Microbiology should have completed at least three years of high school mathematics. First year students should plan to enroll in MATH 104 or MATH 105; MATH 113 or MATH 115; or MATH 114 or MATH 116 based on the results of their math placement tests. CHEM 134 and CHEM 136 are prerequisites to many other courses in the Natural Sciences Department; students majoring in any of the sciences should complete this sequence as soon as possible.

Code	Title	Credit Hours
BIOL 140	Intro Molec & Cellular Biology	4
BIOL/MICR 285	Microbiology	4
CHEM 134	General Chemistry IA	4
CHEM 136	General Chemistry IIA	4
CHEM 225 & CHEM 226 & CHEM 227	Organic Chemistry I and Organic Chemistry II and Organic Chemistry Laboratory	10
MATH 113 or MATH 115	Calc I for Biology & Life Sci Calculus I	4
Select one of the following:		3-4
MATH 114	Calc II for Biology & Life Sci	
MATH 116	Calculus II	
STAT 301	Biostatistics I	
STAT 327	Statistical Computing	
Select one of the following:		8
PHYS 125 & PHYS 126	Introductory Physics I and Introductory Physics II (preferred sequence)	
PHYS 150 & PHYS 151	General Physics I and General Physics II	
<b>Total Credit Hours</b>		<b>41-42</b>

## Major Requirements

A minimum of 31 upper level credit hours in Microbiology (MICR) or Biological Sciences (BIOL) must be completed as outlined below:

*Note: Students should begin the chemistry sequence before electing any MICR/BIOL course.*

## Required Courses

Code	Title	Credit Hours
<b>Core Courses</b>		
All of the following courses are required:		
BIOL 306	General Genetics	4
MICR/BIOL 405	Environmental and Public Health Microbiology	4
MICR 407	Environmental and Public Health Microbiology Laboratory	2
MICR/BIOL 440	Microbial Genetics & Physiology Laboratory	2
MICR/BIOL 459	Pathogenic Microbiology	4
MICR/BIOL 485	Phys & Bchm of Microorg (MICR)	4
Select at least one credit hour from the following: <sup>1</sup>		1
MICR 495	Off-Campus Research	
MICR 497	Seminar in Microbiology	
MICR 498	Ind Study in Microbiology	
MICR 499	Lab in Micro Research	
Complete an additional 10 credit hours (to reach minimum 31 hours required for the major) from the following list, of which at least four credit hours must be from microbiology courses (MICR).		
<b>Microbiology (MICR) Courses- A minimum of 4 credit hours from: <sup>2</sup></b>		<b>4</b>
MICR/BIOL 380	Epidemiology	
MICR 390	Topics in Microbiology <sup>3</sup>	

MICR/BIOL 450	Virology
MICR 451	Virology Laboratory
MICR/BIOL 455	Immunology
MICR 458	Pathogenic Microbiology and Immunology Laboratory
MICR 495	Off-Campus Research
MICR 497	Seminar in Microbiology
MICR 498	Ind Study in Microbiology
MICR 499	Lab in Micro Research
Electives - select a minimum of 6 credits from:	6
BIOL 310	Histology
BIOL 302	Cell Biology and Cellular Physiology laboratory
BIOL/BCHM/CHEM 370	Principles of Biochemistry
BIOL/MICR 380	Epidemiology
BIOL 390	Topics in Biology <sup>3</sup>
BIOL/MICR 450	Virology
BIOL/MICR 455	Immunology
BIOL/BCHM/CHEM 470	Biochemistry I
BIOL/BCHM/CHEM 471	Biochemistry II
BIOL/BCHM/CHEM 472	Biochemistry Lab I
BIOL/BCHM/CHEM 473	Biochemistry Laboratory II
BIOL/BCHM 474	Molecular Biology
BIOL 475	Molecular Biology Laboratory
BIOL 497	Seminar in Biology
BIOL 498	Independent Study in Biology
BIOL 499	Laboratory in Biological Resrh

**Total Credit Hours** **31**

<sup>1</sup> No more than a total of six credit hours combined in MICR 495, MICR 498, and MICR 499 may be applied toward the 120 credit hours required for graduation. Both MICR 498 and MICR 499 require independent study contracts agreed upon by a faculty member.

<sup>2</sup> All MICR courses (200-400 level) have BIOL 140 as a prerequisite.

<sup>3</sup> When topic is appropriate – must Petition.

#### Notes:

1. A maximum of 44 credit hours of MICR or BIOL may count in the 120 hours required for graduation.
2. At least 15 of the 31 credit hours of upper level MICR/BIOL used toward the major must be elected at UM-Dearborn.
3. A maximum of 6 credit hours of Independent Study (courses numbered 495, 498, 499) in any science discipline may count in the 120 hours to graduate.

4. A maximum of 6 credit hours combined in MICR 495/BIOL 495, MICR 498/BIOL 498, MICR 499/BIOL 499 may be applied toward the 30 credit hours required in the major.
5. Any one course may be used to satisfy only one requirement within the major.

## Minor or Integrative Studies Concentration Requirements

A minor or concentration consists of 12 credit hours of upper-level courses in microbiology (MICR).

- A minimum GPA of 2.0 is required for the minor/concentration. The GPA is based on all coursework required within the minor (excluding prerequisites).
- The use of transfer credit, field placements, internships, seminars, S/E graded courses, and independent study/research courses is limited to 3 credits in a 12 credit hour minor/concentration and 6 credits in a 15 credit hour and above minor/concentration.
- Courses within a minor/concentration cannot be taken as Pass/Fail (P/F).
- Minors requiring 12 credits may share one course with a major. Minors requiring 15 credits or more may share two courses with a major. This does not apply to concentrations for the Integrative Studies major.

## Learning Goals

Students majoring in Microbiology will understand basic principles relating to molecular, cellular and organismal biology. In addition, these students will exhibit proficiency in selected empirical laboratory skills, develop knowledge of contemporary research using the scientific method and demonstrate competence in oral and written communication. This background of knowledge and experience will prepare the students for entry into professional/graduate school or for employment in government, academic or industrial positions. The learning goals are divided in to five parts including (1) Conceptual knowledge; (2) Critical and independent thinking skills; (3) Communication skills; (4) Collaborative skills; and (5) Societal impact.

### 1. Conceptual knowledge:

- Proficiency in basic principles of biology of microorganisms including:
  - Microbial cell biology
  - Microbial genetics
  - Microbial physiology
  - Microbial diversity and ecology
  - Medical microbiology
  - Microbial biotechnology

### 2. Critical and independent thinking skills:

- Ability to acquire, present, and develop scientific ideas
- Proficiency in scientific method and hypothesis testing
- Ability to develop theoretical and practical skills in the design of experiment
- Ability to assess the validity of data or scientific information
- Ability to draw conclusions based on results or findings
- Ability to perform statistical and quantitative analyses

### 3. Communication skills

- Ability to search literature for pertinent information
- Ability to discuss and present scientific information (i.e. laboratory results, scientific articles, etc.)
- Ability to communicate scientific information in writing (includes scientific format, appropriate citations, etc.)

### 4. Collaborative skills

- Ability to work effectively in groups or teams
- Ability to manage time and tasks to be done simultaneously by individuals and within group

### 5. Societal impact

- Ability to describe the societal place of microbiology as a science
- Ability to integrate knowledge and make informed judgments about microbiology in everyday life

#### **MICR 285 Microbiology 4 Credit Hours**

The biology of microorganisms is considered through study of the properties of bacteria, fungi, algae, protozoa, and viruses. Microbial structures are discussed and correlated with their function. Aspects of cellular metabolism pertinent to microorganisms are emphasized. The interaction of microorganisms and their environment, animate and inanimate, is discussed with respect to the beneficial or harmful effects of the different microbial groups. Laboratory exercises introduce the student to basic, practical microbiological techniques and illustrate various principles of microbial life. Three hours lecture, three hours laboratory. (F, W, S).

**Prerequisite(s):** BIOL 140 and (CHEM 134\* or CHEM 144\*)

**Corequisite(s):** MICR 285L

#### **MICR 380 Epidemiology 3 Credit Hours**

Introduces the methods for infectious disease epidemiology (occurrence and spread in population) and case studies of important disease syndromes and entities. Methods include definitions and nomenclature, outbreak investigations, disease surveillance, case-control studies, cohort studies, laboratory diagnosis, molecular epidemiology, dynamics of transmission, and assessment of vaccine field effectiveness. Case-studies focus on acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases. This course emphasizes methods of study that would contribute to understanding diseases etiology. This course will also cover important concepts in social epidemiology, including social inequalities and social capital in health, clinical studies and treatment of diseases. (S).

**Prerequisite(s):** BIOL 140

#### **MICR 385 Microbiology 4 Credit Hours**

The biology of microorganisms is considered through study of the properties of bacteria, fungi, algae, protozoa, and viruses. Microbial structures are discussed and correlated with their function. Aspects of cellular metabolism pertinent to microorganisms are emphasized. The interaction of microorganisms and their environment, animate and inanimate, is discussed with respect to the beneficial or harmful effects of the different microbial groups. Laboratory exercises introduce the student to basic, practical microbiological techniques and illustrate various principles of microbial life. Three hours lecture, four hours laboratory. (F,S).

**Prerequisite(s):** BIOL 140 and (CHEM 134\* or CHEM 144\*)

**Corequisite(s):** MICR 385L

#### **MICR 390 Topics in Microbiology 1 to 6 Credit Hours**

Current topics in microbiology will be presented through a lecture, discussion and/or laboratory format. Topics will vary, as appropriate, and may cover any area of microbiology including studies on bacteria, algae, fungi, protozoa, viruses, biotechnology, mechanisms of pathogenesis and immunology. (OC).

**Prerequisite(s):** BIOL 385 or MICR 385

#### **MICR 405 Environmental and Public Health Microbiology 4 Credit Hours**

The study of the diversity, structure and function of microorganisms as they interact with their environment. Emphasis will be placed on soil microbiology (fungi, bacteria, microalgae) and plant-microbe interactions (pathogens, symbioses). Ecological topics include decomposition, nutrient cycling, bioremediation and agroecosystems. Three hours lecture, four hours laboratory. (W).

**Prerequisite(s):** BIOL 140

**Restriction(s):**

Can enroll if Class is Senior

#### **MICR 407 Environmental and Public Health Microbiology Laboratory 2 Credit Hours**

The Environmental and Public Health Microbiology Laboratory course provides students with hands-on experience in exploring the intricate relationships between microorganisms, the environment, and human health. Through a combination of experiments, analyses, and critical thinking, students will delve into the detection, identification, quantification, and assessment of health-related microorganisms within environmental samples. This immersive laboratory experience spans a broad spectrum of topics, encompassing the assessment of microbial diversity, water quality analysis, airborne microorganism monitoring, and bioremediation studies. Students will detect, identify, and quantify microorganisms within various environmental niches. (F).

**Prerequisite(s):** BIOL 140

#### **MICR 440 Microbial Genetics & Physiology Laboratory 2 Credit Hours**

Microbial Genetics and Physiology Laboratory emphasizes the use of advanced microbiological techniques for understanding the genetics and physiology of microorganisms. Experiments focus on the understanding of general microbial phenomena, such as nutrition, metabolism, and biochemistry; protein and nucleic acid synthesis; energy generation, enzyme regulation, membrane transport, motility, differentiation, cellular communication, and the behavior of populations. The course involves laboratory work, data analysis of molecular data using bioinformatic tools, abstract writing, and poster presentation. (W).

**Prerequisite(s):** BIOL 140\*

**Restriction(s):**

Cannot enroll if Class is Freshman

Can enroll if Level is Undergraduate

#### **MICR 450 Virology (MICR) 4 Credit Hours**

The first half of this course deals with bacterial viruses, with emphasis on classical events in this field. The second half surveys the field of animal viruses, with emphasis on recent discoveries, including replication, pathogenesis, and viral association with cancers. Three hours lecture, four hours laboratory. (AY,W).

**Prerequisite(s):** BIOL 140 and CHEM 226\*

**Corequisite(s):** MICR 450L

**MICR 451 Virology Laboratory 2 Credit Hours**

This course is a stand-alone laboratory experience designed to enhance the detailed study of virology. Hands-on lab exercises will include common methods used to study viruses including diagnostic techniques. Experiments will include a variety of modern antibody-based clinical approaches. This course is complementary to BIOL/MICR 450 but can be taken without BIOL/MICR 450 for students seeking a molecular and cellular biology laboratory course. (W, AY).

**Prerequisite(s):** BIOL 140

**MICR 455 Immunology 4 Credit Hours**

A detailed study of the field of immunology. Among the topics covered are various aspects of the immunological response, such as humoral or cell-mediated immunity, cell-cell interactions, and immunology as related to the cause and prevention of disease. Three hours lecture, four hours laboratory. (AY,F).

**Prerequisite(s):** BIOL 385 or BIOL 301 or MICR 385

**Corequisite(s):** MICR 455L

**MICR 458 Pathogenic Microbiology and Immunology Laboratory 2 Credit Hours**

This course is a stand-alone laboratory experience designed to enhance the detailed study of pathogenic microbiology and immunology. Hands-on lab exercises will include common techniques used to study bacterial pathogens, infectious diseases, and measuring immune responses.

Experiments will include gene editing using CRISPR, quantifying pathogen sensitivity to antibiotics and immune defense mechanisms, and a variety of modern antibody-based clinical approaches. (F).

**Prerequisite(s):** BIOL 140

**MICR 459 Pathogenic Microbiology (MICR) 4 Credit Hours**

An introduction to pathogenic microorganisms and mechanisms of microbial pathogenicity. Disease-causing bacteria, fungi, viruses, and protozoa are studied. Laboratories emphasize clinical approaches to isolation, identification, and treatment. Three hours lecture, four hours laboratory. (AY,F).

**Prerequisite(s):** BIOL 140

**MICR 485 Phys & Bchm of Microorg (MICR) 4 Credit Hours**

Physiology of Microorganisms (BIOL/MICR 485) is a lecture-based course that delves deeply into the intricacies of microbial physiology and biochemistry. This intensive course is specifically designed to foster an integrated understanding of the cellular functions of microorganisms, underpinned by the synergistic interaction of biochemistry and genetics. The course takes a holistic approach to unravel the diverse and robust nature of microbial life. The focal points covered within this course encompass various aspects, such as microorganism growth and nutritional patterns, the microbial breakdown of organic compounds, the control of degradation reactions, the production of distinct microbial compounds and secondary metabolites (including antibiotics and toxins), responses to microbial stress, and the phenomenon of bacterial differentiation. (W, YR).

**Prerequisite(s):** BIOL 140 and CHEM 225\*

**MICR 495 Off-Campus Research 1 to 3 Credit Hours**

Participation in ongoing experimental research at an off-campus laboratory (or in the field). Arrangements made between the research laboratory, (director of field study), the student, and the microbiology concentration advisor. No more than 6 hours combined from MICR 495, 498, and 499 may be credited toward the 120 hours required for a degree. Four to twelve hours laboratory. Permission of concentration advisor. (F,W,S).

**MICR 497 Seminar in Microbiology 1 Credit Hour**

Topics of current interest in microbiology will be presented by guest lecturers, faculty members or students. Topics chosen will vary from term to term. Can be elected up to three times. One hour seminar. Permission of instructor. (W).

**MICR 498 Ind Study in Microbiology 1 to 3 Credit Hours**

Library research and independent study performed under the guidance of a faculty member. Four to twelve hours readings. (F,W,S).

**MICR 499 Lab in Micro Research 1 to 3 Credit Hours**

Directed laboratory research performed under the guidance of a faculty member. Four to twelve hours laboratory. Permission of instructor. (F,W,S).

\*An asterisk denotes that a course may be taken concurrently.

## Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally