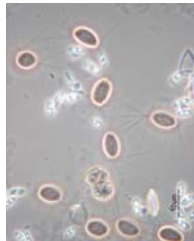




# MICROBIOLOGY MAJOR

[WWW.COOK.RUTGERS.EDU/~DBM/MICRO.HTM](http://WWW.COOK.RUTGERS.EDU/~DBM/MICRO.HTM)

## A Student's Guide



*The primary objectives of the program are to broadly educate students on the biology of microorganisms and prepare them for positions in the microbial industries and graduate/professional study in life sciences through extensive laboratory and course work and research experience.*

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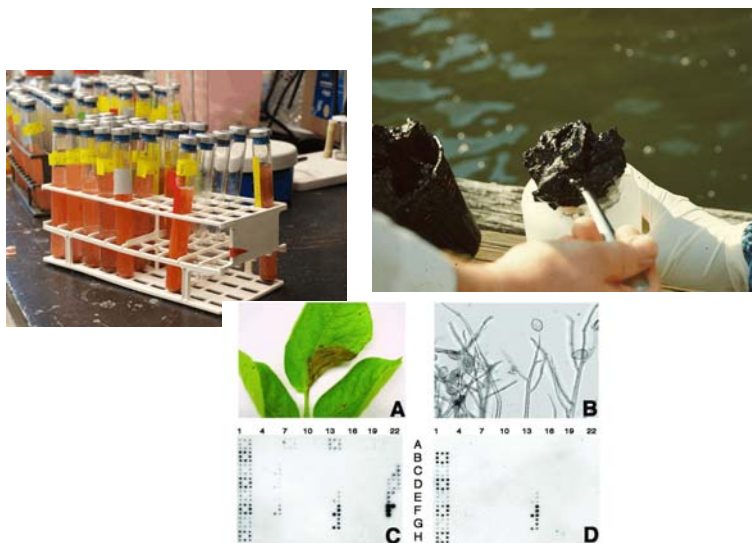
# MICROBIOLOGY 680

**Degree: B.S.**

Microorganisms are the smallest living things, the oldest form of life on earth, ubiquitous in the biosphere and central to the essential life processes on earth. The microbiology curriculum emphasizes the uniqueness of microbial biology, its enormous diversity, and the biochemical basis of microbial life.

The curriculum examines the diverse roles of microorganisms and covers the fundamentals of microbial diversity, physiology and genetics. The focus is on the examination of microorganisms, microbial processes in natural and managed environments and their effects on human, animal, plant and environmental health. The nature and activity of microbial populations in aquatic and terrestrial ecosystems, the interactions within microbial communities, and biogeochemical cycles and energy flows are explored. The curriculum provides students with a fundamental understanding of the applications of microbes in biotechnology, the food industry, agriculture, and medicine. Recent advances in microbial molecular biology and biotechnology have led to an in-depth understanding of the physiology, genetics and taxonomy of microbes. Microbes are central to the food, biotechnology and pharmaceutical industries and are broadly utilized ranging from food fermentations and biosynthetic processes to waste treatment and biodegradation of toxic chemicals. The field of microbiology is a major contributor toward industrial development, human, animal and plant health, environmental integrity and agricultural productivity.

The primary objectives of the curriculum are to broadly educate students regarding the biology of microorganisms. The curriculum prepares students for positions in industry, government and graduate/professional study in life sciences through extensive course work combined with laboratory and research experience.



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# Graduation Requirements for the Major

Degree: Bachelor of Science

To enter upper-level microbiology (11:680) courses, students must have completed 01:119:101-102 General Biology and 01:160:161-162 General Chemistry with grades of C or better.

## **I. College Mission: Interdisciplinary Critical Analysis (3 credits)**

11:015:400 Junior/Senior Colloquium (3)

## **II. Introductory Life and Physical Sciences**

### **A. Life Sciences (8 credits)**

01:119:101-102 General Biology (4,4)

### **B. Physical Science (9 credits)**

01:160:161-162 General Chemistry (4,4)

01:160:171 Introduction to Experimentation (1)

## **III. Humanities and Arts (6 credits)**

See suggested courses in the Degree Requirements chapter.

## **IV. Multicultural and International Studies (6 credits)**

See suggested courses in the Degree Requirements chapter.

## **V. Human Behavior, Economic Systems, and Political Processes (9 credits)**

See suggested courses in the Degree Requirements chapter.

## **VI. Oral and Written Communication (6 credits)**

See suggested courses in the Degree Requirements chapter.

01:355:302 Scientific and Technical Writing (3) is strongly recommended.

## **VII. Experience-Based Education (0-3 credits)**

11:680:497,498 Research in Microbiology (BA, BA) *or* equivalent independent research project *or* appropriate cooperative education placement of at least 3 credits *or* appropriate non-credit bearing internship approved by the curriculum coordinator

## **VIII. Proficiency in Microbiology (72-73 credits)**

### **A. REQUIRED COURSES (52-53)**

#### ***Quantitative skills (8)***

01:640:1\_\_1\_\_ CALC1-CALC2 (4,4) [01:640:151-152 Calculus for Mathematics and Physical Sciences (4,4) is preferred]

#### ***Professional Ethics (1)***

11:680:401 Ethics and Issues in Microbiology (1) or other bioethics course approved by the curriculum coordinator.

**Additional requirements (43-44)**

- 11:115:403-404 General Biochemistry (4,3) or 01:694:407-408 Molecular Biology and Biochemistry (3,3)  
11:115:413 Experimental Biochemistry (3)  
01:160:307-308 Organic Chemistry (4,4) or 01:160:315-316 Principles of Organic Chemistry (4,4) \*  
01:447:380 Genetics (4)  
01:447:498 Bacterial Physiology (3)  
11:680:390 General Microbiology (4) or 01:447:390 General Microbiology (4)  
11:680:480 Microbial Genetics and Genomics (3) or 11:126:481 Molecular Genetics (3)  
11:680:491 Microbial Ecology and Diversity (3)  
11:680:495 Seminar in Microbiology (1)  
01:750:193-194 Physics for the Sciences (4,4) or equivalent \*

\*Students intending to apply to medical school should be aware that many schools require laboratories in organic chemistry and physics.

**B. ELECTIVES (20)**

A minimum of 20 credits of elective courses from the two groups below, with at least 11 credits and at least two laboratories from Group A.

**Group A**

- 11:126:407 Comparative Virology (3)  
01:146:474 Immunology (3)  
01:146:475 Laboratory in Immunology (1)  
11:375:411 Environmental Microbiology (3)  
11:400:423 Food Microbiology (3)  
11:400:424 Food Microbiology Laboratory (1)  
01:447:392 Pathogenic Microbiology (3)  
11:628:404 Fungi and Ecosystems (3) *or* 11:770:403 Fungi in the Environment (3)  
11:680:394 Applied Microbiology (4) (includes laboratory)  
11:680:492 Microbial Ecology Laboratory (2)

**Group B**

- 11:115:412 Protein and Enzyme Chemistry (3)  
11:115:428 Homology Modeling of Proteins (3)  
11:126:405 Microbial Technology (3)  
11:126:412 Process Biotechnology (3)  
11:126:427 Methods in Recombinant DNA Technology (4)  
11:126:482 Molecular Genetics Laboratory (3)  
11:126:483 Nucleotide Sequence Analysis (3)  
11:126:484 Biotechnology Robotics (3)  
11:126:486 Analytical Methods in Microbiology (3)  
11:127:414 Unit Processes in Bioenvironmental Engineering II (3)  
01:146:328 Human Parasitology (3)  
11:375:453 Soil Ecology (3)  
11:375:312 Environmental Microbiology Laboratory (2)  
01:447:398 Electron Microscopy (3)  
01:447:480 Topics in Molecular Genetics (3)  
11:628:418 Marine Microbiology (4)  
11:680:497,498 Research in Microbiology (BA): One to three credits of research may be substituted for an equal number of credits of elective courses, with the approval of the curriculum coordinator.  
11:770:301 General Plant Pathology (3)

**IX. Unspecified Electives (3-7 credits)**

## Suggested Course Sequence

### First Year, Fall Term

01:355:101 Expository Writing (3)  
01:119:101 General Biology (4)  
01:160:161 General Chemistry (4)  
01:640:135 Calculus I (4)\*  
\* Can be delayed to subsequent year

Total Semester Credits: 15  
Cumulative Total Credits: 15

### First Year, Spring Term

01:119:102 General Biology (4)  
01:160:162 General Chemistry (4)  
01:160:171 Introduction to Experimentation (1)  
01:640:138 Calculus II (4)\*  
\* Can be delayed to subsequent year  
Course fulfilling Areas III, IV or V (3)

Total Semester Credits: 16  
Cumulative Total Credits: 31

### Second Year, Fall Term

11:680:390 General Microbiology (4)  
01:160:307 Organic Chemistry (4)  
01:750:193 Physics for the Sciences (4)  
Courses fulfilling Areas III, IV or V (6)

Total Semester Credits: 18  
Cumulative Total Credits: 49

### Second Year, Spring Term

01:160:308 Organic Chemistry (4) \*  
01:447:380 Genetics (4)  
01:750:194 Physics for the Sciences (4)  
Microbiology Elective and lab (4)

\* 01:160:311 Organic Chemistry Laboratory (2)  
recommended

Total Semester Credits: 16  
Cumulative Total Credits: 65

### Third Year, Fall Term

11:115:403 Biochemistry (4)  
11:115:413 Experimental Biochemistry (3)  
Microbiology elective (3)  
01:355:302 Scientific and Technical Writing (3) or  
equivalent  
Course fulfilling Areas III, IV or V (3)

Total Semester Credits: 16  
Cumulative Total Credits: 81

### Third Year, Spring Term

11:680:491 Microbial Ecology and Diversity (3)  
11:115:404 Biochemistry (3)  
11:680:480 Microbial Genetics and Genomics (3)  
Microbiology electives (3-6) and/or Research in  
Microbiology (3)  
11:680:401 Ethics and Issues in Microbiology (1)

Total Semester Credits: 16  
Cumulative Total Credits: 97

### Fourth Year, Fall Term

11:680:495 Seminar in Microbiology (1)  
Microbiology Electives (6-9) and/or Research in  
Microbiology (3)\*  
Courses fulfilling Areas III, IV or V (3)  
Free elective courses (0-5)

Total Semester Credits: 15-18  
Cumulative Total Credits: 112-115

### Fourth Year, Spring Term

Junior/Senior Colloquium (3)  
01:447:498 Microbial Physiology (3)  
Microbiology Electives (3-6) and/or Research in  
Microbiology (3)\*  
Courses fulfilling Areas III, IV or V (3)  
Free elective courses (3)

Total Semester Credits: 14-17  
Cumulative Total Credits: 128

\*An appropriate cooperative education placement, approved by the Curriculum Coordinator, or a George H. Cook Scholars project can substitute for Research in Microbiology.

## Schedule for Key Courses in Microbiology

### Fall Semesters

11:680:390 / 11:447:390 General Microbiology  
11:680:495 Seminar in Microbiology  
11:680:492 Microbial Ecology Laboratory (taught every other year)  
11:680:497 Research in Microbiology  
11:115:403 General Biochemistry  
11:115:413 Experimental Biochemistry  
11:126:405 Microbial Technology  
11:126:407 Comparative Virology (taught every other year)  
11:126:481 Molecular Genetics  
11:126:483 Nucleotide Sequence Analysis  
11:126:484 Biotechnology Robotics  
11:126:486 Analytical Methods in Microbiology (taught every other year)  
11:127:414 Unit Processes in Bioenvironmental Engineering II  
01:146:328 Human Parasitology  
11:375:411 Environmental Microbiology  
11:375:312 Environmental Microbiology Laboratory  
11:375:453 Soil Ecology  
01:447:380 Genetics  
11:628:404 Fungi and Ecosystems (3) or 11:770:403 Fungi in the Environment  
11:770:301 General Plant Pathology

### Spring Semester

11:680:390 / 11:447:390 General Microbiology  
11:680:394 Applied Microbiology  
11:680:401 Ethics and Issues in Microbiology  
11:680:480 Microbial Genetics and Genomics  
11:680:491 Microbial Ecology and Diversity  
11:680:498 Research in Microbiology  
11:115:403 General Biochemistry  
11:126:412 Process Biotechnology (taught every other year)  
11:126:427 Methods in Recombinant DNA Technology  
11:126:482 Molecular Genetics Laboratory  
11:126:483 Nucleotide Sequence Analysis  
01:146:328 Human Parasitology  
01:146:474 Immunology  
01:146:475 Laboratory in Immunology  
11:400:423 Food Microbiology  
11:400:424 Food Microbiology Laboratory  
01:447:380 Genetics  
01:447:392 Pathogenic Microbiology  
01:447:398 Electron Microscopy  
01:447:498 Bacterial Physiology  
01:447:480 Topics in Molecular Genetics

### Summer Session

01:146:474 Immunology  
01:146:475 Laboratory in Immunology  
01:447:392 Pathogenic Microbiology  
01:447:380 Genetics  
11:447:390 General Microbiology