

BIOTECHNOLOGY, MS

Degree: Master of Science (MS)

Field of Study: Biotechnology

MS-Biotech@case.edu

The Departments of Biochemistry, Neurosciences, and Pharmacology provide an interdisciplinary home for the Master of Science in Biotechnology program. This 30 credit hour program provides classroom and research experiences that will help prepare students for various career fields across the biotech industry, from vaccine and drug development to forensics, toxicology and quality control. A key component of the program is an internship at a biotech company or a research laboratory at CWRU or an affiliated hospital. Students will select one of three specialization tracks by the end of the first semester: biochemistry, neuroscience, or pharmacology.

The Biochemistry Track gives students the broadest exposure to cutting edge experimental techniques used in the biotechnology industry and biomedical research. The track includes hands-on labs with a focus on molecular and biochemical approaches, as well as courses relevant to human health, diseases such as cancer, metabolic disorders and infectious diseases, and therapeutic development.

The Neurosciences Track is designed to introduce students to the principles of Neuroscience, including electrical and chemical communication within and between neurons, neural development, neurological diseases/disorders, as well as experimental methods commonly used in contemporary neuroscience research, including approaches to drug discovery and development.

The Pharmacology Track is designed to introduce students to the principles of pharmacology, including drug absorption, distribution, elimination, metabolism (pharmacokinetics), and drug-receptor theory and mechanism of action (pharmacodynamics), as well as contemporary approaches to drug discovery.

Applicants must have a BA, BS, or equivalent undergraduate degree in chemistry or the biological sciences. Please visit the program's website for details about the application process.

Graduate Policies

For graduate policies and procedures, please review the School of Graduate Studies section of the General Bulletin.

Program Requirements

The Master of Science in Biotechnology prepares students for entry into the biotechnology and pharmaceutical industries. This program provides fundamental laboratory experience and builds a knowledge base that students can use to acquire advanced skills. Students can choose a track in Biochemistry, Neurosciences, or Pharmacology that offer specialized coursework and experiences. The program provides students with laboratory experience through hands-on laboratory coursework and a culminating semester-long internship in a biotech company or an academic laboratory. The MS in Biotechnology requires 30 credit hours of work and can be completed in 1.5-2 years of full-time study. It can also be completed by part-time study.

The program consists of the following elements:

- **Biotechnology Core Curriculum.** These courses give students a solid foundation in laboratory skills, the design and interpretation of experiments, and the practice of science.
- **Tracks in Biochemistry, Neurosciences, and Pharmacology.** Didactic courses in these tracks give students a solid foundation in one of these areas of biomedical science.
- **Internship.** Hands-on laboratory experiences in labs at CWRU or in internships at biotechnology companies will give students real-world experiences that will be valuable assets as they move into the real world after graduation.

Biotechnology Core Curriculum

Students complete the biotechnology core curriculum (7-10 credit hours) in their first year. It includes:

- BIOC 500 establishes the foundation for hands-on experience with basic laboratory skills.
- Advanced laboratory skills: BIOC 502A, BIOC 502B and BIOC 502C are in-depth lab courses in biochemistry and molecular biology. These cover techniques for the engineering, preparation, and study of proteins and nucleic acids. Techniques focusing upon eukaryotic and prokaryotic cells, and mass spectrometry are also presented. Students will take some or all these courses, depending on which track they choose.
- Experimental design: BIOC 501 introduces key techniques and how these techniques are used to answer experimental questions.
- Biotechnology practice: BIOC 511 introduces the business and practical aspects of biotechnology.

Tracks in Biochemistry, Neurosciences, and Pharmacology

The Biochemistry Track emphasizes engineering, expressing, purifying and working with proteins. The Neurosciences Track focuses on the application of biotechnology to the nervous system. The Pharmacology Track prepares students for work in the pharmaceutical industry. Finally the Research-Intensive Pharmacology Track is for students who wish to pursue a PhD in pharmacology.

The tracks offer specialized courses that give students a core of knowledge. Students also take some or all of the Biotechnology Core Curriculum, with topics selected to reflect the skills needed for research in that track. Finally, students select internships to fit their interests and areas of specialization.

Internship

The program requires an internship at a biotechnology company or in a faculty research lab at CWRU. This internship BIOC 610/NEUR 610/PHRM 610 allows students to enhance their resumés and future employment prospects with real-world experience. The internship must be completed in a laboratory and involve some benchwork. Students are expected to work at least 150 hours to accumulate 3 credit hours. Our program works with students to arrange internships.

Sample Plans of Study

Biochemistry Track Plan of Study

First Year

		Credit Hours
Fall		
BIOC 407	Introduction to Biochemistry: From Molecules To Medical Science	4
BIOC 500	Biotechnology Laboratory: Molecular Biology Basics	1
BIOC 501	Biochemical and Cellular Techniques for Biotechnology	3
BIOC 511	Practice and Professionalism in Biotechnology	1
Credit Hours		9

Spring

BIOC 408	Molecular Biology	4
BIOC 502A	Biotechnology Laboratory: Molecular Biology and Biochemical Techniques	2
BIOC 502B	Biotechnology Laboratory: Eukaryotic Molecular and Cellular Biology	2
BIOC 502C	Biotechnology Laboratory: Mass Spectrometry Techniques	1
Credit Hours		9

Second Year

Fall		
Approved Electives		9
Credit Hours		9
Spring		
BIOC 610	Internship in Experimental Biotechnology	3
Credit Hours		3
Total Credit Hours		30

Neurosciences Track Plan of Study

First Year

		Credit Hours
Fall		
BIOC 500	Biotechnology Laboratory: Molecular Biology Basics	1
BIOC 501	Biochemical and Cellular Techniques for Biotechnology	3
BIOC 511	Practice and Professionalism in Biotechnology	1
NEUR 401	Biological Mechanisms of Brain Disorders	3
NEUR 415	Neuroscience Seminars	1
Credit Hours		9

Spring

BIOC 502B	Biotechnology Laboratory: Eukaryotic Molecular and Cellular Biology	2
NEUR 402	Principles of Neural Science	3
NEUR 403	Methods Neuroscience Research	4

NEUR 415	Neuroscience Seminars	1
Credit Hours		10

Second Year

Fall

PHRM 528	Contemporary Approaches to Drug Discovery	3
Approved Electives		6
Credit Hours		9

Spring

NEUR 610	Internship in Experimental Biotechnology	3
Credit Hours		3
Total Credit Hours		31

Pharmacology Track Plan of Study

First Year

		Credit Hours
Fall		
BIOC 500	Biotechnology Laboratory: Molecular Biology Basics	1
BIOC 501	Biochemical and Cellular Techniques for Biotechnology	3
BIOC 511	Practice and Professionalism in Biotechnology	1
PHRM 511	Frontiers in Pharmacology	1
PQHS 431	Statistical Methods I	3
Credit Hours		9

Spring

BIOC 502A	Biotechnology Laboratory: Molecular Biology and Biochemical Techniques	2
PHRM 511	Frontiers in Pharmacology	1
Approved Electives		6
Credit Hours		9

Second Year

Fall

PHRM 409	Principles of Pharmacology	3
PHRM 528	Contemporary Approaches to Drug Discovery	3
PHRM 525	Topics in Cell and Molecular Pharmacology	3
Credit Hours		9

Spring

PHRM 610	Internship in Experimental Biotechnology	3
Credit Hours		3
Total Credit Hours		30

Research-Intensive Pharmacology Track Plan of Study

First Year

Fall		Credit Hours
BIOC 500	Biotechnology Laboratory: Molecular Biology Basics	1
BIOC 501	Biochemical and Cellular Techniques for Biotechnology	3
BIOC 511	Practice and Professionalism in Biotechnology	1
PHRM 511	Frontiers in Pharmacology	1
PQHS 431	Statistical Methods I	3
Credit Hours		9

Spring

BIOC 502A	Biotechnology Laboratory: Molecular Biology and Biochemical Techniques	2
PHRM 401	Principles of Pharmacology I: The Molecular Basis of Therapeutics	3
PHRM 511	Frontiers in Pharmacology	1
Approved Electives		3
Credit Hours		9

Second Year

Fall		Credit Hours
PHRM 402	Principles of Pharmacology II: The Physiological Basis of Therapeutics	3
PHRM 528	Contemporary Approaches to Drug Discovery	3
PHRM 525	Topics in Cell and Molecular Pharmacology	3
Credit Hours		9
Spring		Credit Hours
PHRM 610	Internship in Experimental Biotechnology	3
Credit Hours		3
Total Credit Hours		30