

Biochemistry and Biotechnology BS

The mission of the Biochemistry and Biotechnology Program is to provide students with a solid foundation in both chemistry and biology, as well as specialized training in the rapidly growing fields of biochemistry and biotechnology. Faculty members in this program are engaged in teaching and research in a broad range of areas, including genetics and molecular biology, microbiology and immunology, and protein biochemistry and biophysics. Students have the opportunity through coursework, laboratories, seminars, and research experience to develop the knowledge and skills necessary to enter the workforce or to continue with further graduate education.

Degree Requirements

General Education Requirements

Students must satisfy the university and college general education requirements. Some math or science courses required for the major may be used to meet the science and mathematics requirement of the university. There is no foreign language requirement for the degree.

All Biochemistry & Biotechnology majors are required to take a capstone seminar (either CHEM 4797 or BIOL 4797) during the semester in which they plan to graduate (the winter semester for students graduating in the summer). Students may not receive credit for both CHEM 4797 and BIOL 4797.

Satisfactory/Unsatisfactory Option

Up to 18 credit hours may be taken on a satisfactory /unsatisfactory (s/u). Excluded from this option are required courses in biology, chemistry, physics, and mathematics.

Non-major Biology or Chemistry courses

Courses in Biology with a number less than 1800 and courses in Chemistry with a number less than 1100 do not count toward the credit hours required for a major in biochemistry and biotechnology.

Research for Credit

A maximum of 3 credit hours from any combination of BIOL 4905 and CHEM 3905 may be applied toward the Biochemistry & Biotechnology program. This provides an opportunity to gain research experience under the supervision of a faculty member. The project will normally include a review of the literature, laboratory experience and a final research report.

Transfer of Credit from Saint Louis Community Colleges

Students transferring BIO 219 and BIO 220 from Saint Louis Community Colleges will not have to complete BIOL 4614. However, they will have to take an additional 3 credit hours of Biochemistry and Biotechnology Elective coursework.

Course Requirements

Biology Core Courses

| | | |
|-----------|--|---|
| BIOL 1831 | Introductory Biology: From Molecules to Organisms (MOTR BIOL 150L) | 5 |
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|-----------|-------------------------|---|
| BIOL 2012 | Genetics | 3 |
| BIOL 2013 | Genetics Laboratory | 2 |
| BIOL 2482 | Microbiology | 3 |
| BIOL 2483 | Microbiology Laboratory | 2 |
| BIOL 3622 | Cell Biology | 3 |

Chemistry Core Courses

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|-----------|---|---|
| CHEM 1111 | Introductory Chemistry I (MOTR CHEM 150L) | 5 |
| CHEM 1121 | Introductory Chemistry II | 5 |
| CHEM 2223 | Quantitative Analysis in Chemistry | 4 |
| CHEM 2612 | Organic Chemistry I | 3 |
| CHEM 2622 | Organic Chemistry II | 3 |
| CHEM 2633 | Organic Chemistry Laboratory | 2 |
| CHEM 3302 | Physical Chemistry for The Life Sciences | 3 |

Math and Physics Core Courses

| | | |
|--------------|----------------------------------|---|
| MATH 1030 | College Algebra (MOTR MATH 130) | 3 |
| MATH 1035 | Trigonometry | 2 |
| MATH 1100 | Basic Calculus | 3 |
| or MATH 1800 | Analytic Geometry and Calculus I | |
| PHYSICS 1011 | Basic Physics I | 3 |
| PHYSICS 1012 | Basic Physics II | 3 |

Biochemistry and Biotechnology Core Courses

| | | |
|--------------|---|---|
| BIOL 4602 | Molecular Biology (Courses not taken to fulfill the requirement, may be used as an elective) | 3 |
| or BIOL 4608 | Synthetic Biology | |
| or BIOL 4632 | Nucleic Acid Structure and Function | |
| or BIOL 4642 | Plant Molecular Biology and Biotechnology | |
| BIOL 4614 | Biotechnology Laboratory I | 4 |
| CHEM 4712 | Biochemistry | 3 |
| CHEM 4733 | Biochemistry Laboratory | 2 |
| CHEM 4722 | Advanced Biochemistry | 3 |
| BIOL 4797 | Biochemistry and Biotechnology Seminar (Students may not receive credit for both BIOL 4797 and CHEM 4797) | 1 |
| or CHEM 4797 | Biochemistry and Biotechnology Seminar | |

Biochemistry and Biotechnology Elective Courses

| | | |
|------------------------------|---|---|
| Select two of the following: | | 6 |
| BIOL 3699 | Undergraduate Internship in Biotechnology | |
| BIOL 4442 | Developmental Biology | |
| BIOL 4550 | Bacterial Pathogenesis | |
| BIOL 4602 | Molecular Biology | |
| BIOL 4608 | Synthetic Biology | |
| BIOL 4615 | Biotechnology Laboratory II | |
| BIOL 4622 | Cellular Basis of Disease | |
| BIOL 4632 | Nucleic Acid Structure and Function | |
| BIOL 4642 | Plant Molecular Biology and Biotechnology | |
| BIOL 4652 | Virology | |
| BIOL 4842 | Immunobiology | |

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|--------------------|--|-----------|
| BIOL 4905 | Research (must be supervised by Biochemistry and Biotechnology faculty) | |
| BIOL 4920 | Selected Topics in Biology (when relevant) | |
| CHEM 3643 | Advanced Organic Chemistry Laboratory | |
| CHEM 3905 | Chemical Research (must be supervised by Biochemistry and Biotechnology faculty) | |
| CHEM 4772 | Physical Biochemistry | |
| CHEM 4774 | Introduction to Bioinformatics | |
| Total Hours | | 79 |

Electives

Recommendations include basic statistics (MATH 1320), computer science, public speaking (COMM 1040), foreign language, ethics, and undergraduate research.

Minor in Biology

Students who complete the B.S. degree in Biochemistry and Biotechnology may also obtain a minor in biology by completing BIOL 1821, Introductory Biology : Organisms and the Environment. The minor must be approved by the chair of the Department of Biology. At least 9 hours of the biology course credits must be taken in residence at UMSL. Candidates must have a cumulative grade point average of 2.0 or better in the minor, and none of the courses may be taken on a satisfactory/unsatisfactory (S/U) basis.

Minor in Chemistry

Students who complete the B.S. degree in Biochemistry and Biotechnology will also fulfill the course requirements for a minor in Chemistry. A GPA of at least 2.0 is required for the courses presented for the minor. At least three courses toward the Chemistry minor must be completed at UMSL.

Learning Outcomes

Students often think of the physical and life sciences as areas in which one masters a collection of "scientific facts". However, an education in Biochemistry & Biotechnology involves much more than memorizing facts. Students in this program will develop a well-rounded set of competencies in several critical areas. These include:

- **Discipline-Specific Knowledge.** Graduates will demonstrate a clear understanding of the overriding principles and theorems within and between the primary content areas of chemistry, biology, and biochemistry, including the
 - Structure and function of the basic biological units of living organisms and their role in life and disease.
 - Information flow, exchange, and storage from parent to offspring or from parent cells to progeny cells.
 - Organic reactions and physical chemical principles underlying metabolic reactions.
 - Molecular mechanisms commonly used to regulate metabolic and cellular pathways.
- **Laboratory Skills.** Scientists not only learn the results of others, they work in the lab to generate new knowledge. Graduates will develop basic skills associated with performing laboratory

experiments in chemistry, biology, and biochemistry following a broad introduction of commonly used equipment and procedures.

- **Critical thinking Skills.** Graduates will be able to formulate meaningful hypotheses and evaluate data critically, including an appreciation of the potential sources of error associated with laboratory measurements and an ability to troubleshoot technical issues.
- **Problem Solving Skills.** Graduates will be able to define and solve scientific problems. In part, this expands on laboratory skills, as students learn how to interpret and evaluate their data.
- **Translational Skills.** Graduates will be able to take general principles from various areas of chemistry, biochemistry, and biology and apply them towards solutions for novel and emerging biotechnology problems.
- **Communication Skills.** Scientists not only must be able to solve problems, they must also be able to communicate those solutions to others. Graduates of this program can present data in a clear and accurate manner. Graduates will be able to write scientific reports and make effective oral presentations of their results and ideas.
- **Scientific Literacy.** Scientists must be able to build on the previous work of others and to put their new results into the larger context of the field. Graduates will be able to find and retrieve information within the vast scientific literature in chemistry, biology, and biochemistry. Graduates will have the background knowledge necessary to read the literature and scientific information presented to the public with good comprehension and be able to critically evaluate reliability, accuracy, authority, and point of view or bias.
- **Professional Ethics.** Graduates will follow standard scientific practices, including honestly and objectively evaluating and reporting data and acknowledging the ideas and published work of others. In doing so, graduates will demonstrate an understanding and respect for the accepted standards of conduct associated with the profession.

Sample Four Year Plan

| First Year | | | |
|----------------------------------|-------|--------------------------------------|-------|
| Fall | Hours | Spring | Hours |
| INTDSC 1003 | | 1 CHEM 1111 | 5 |
| ENGL 1100 | | 3 COMM 1040 | 3 |
| MATH 1030 | | 3 CORE - Communication Proficiency | 3 |
| MATH 1035 | | 2 EXPLORE - Humanities and Fine Arts | 3 |
| CORE - US History and Government | | 3 EXPLORE - Social Sciences | 3 |
| EXPLORE - Social Sciences | | 3 | |
| | 15 | | 17 |
| Second Year | | | |
| Fall | Hours | Spring | Hours |
| BIOL 1831 | | 5 BIOL 2012 | 3 |
| CHEM 1121 | | 5 BIOL 2013 | 2 |
| MATH 1100 | | 3 CHEM 2612 | 3 |
| Global Perspectives Requirement | | 3 EXPLORE - Social Sciences | 3 |
| | | EXPLORE - Humanities and Fine Arts | 3 |
| | 16 | | 14 |
| Third Year | | | |
| Fall | Hours | Spring | Hours |
| BIOL 3622 | | 3 BIOL 2482 | 3 |
| BIOL 4614 | | 4 BIOL 2483 | 2 |
| ENGL 3160 | | 3 BIOL 4602 | 3 |

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|---------------|-----------------|-----------|
| CHEM 2622 | 3 CHEM 2223 | 4 |
| PHYSICS 1011 | 3 PHYSICS 1012 | 3 |
| PHYSICS 1011L | 1 PHYSICS 1012L | 1 |
| | 17 | 16 |

Fourth Year

| Fall | Hours | Spring | Hours |
|------------------------------------|--------------|----------------------------|--------------|
| CHEM 4712 | | 3 CHEM 3302 | 3 |
| CHEM 2633 | | 2 CHEM 4722 | 3 |
| CHEM 4733 | | 2 CHEM 4797 or BIOL 4797 | 1 |
| Biochem/Biotech Elective | | 3 Biochem/Biotech Elective | 3 |
| EXPLORE - Humanities and Fine Arts | | 3 Elective or minor | 3 |
| Elective or minor | | 3 | |
| | 16 | | 13 |

Total Hours: 124

¹ INTDSC 1003 is required only for first-time freshmen and transfer students with less than 24 college credits.

Please Note: This plan is an example of what a four year plan could look like for a typical student. Placement exam scores in math as well as the completion of coursework may change the plan. It should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor each semester. All requirements are subject to change