

Biological Sciences

Chairperson: Michelle Mynlieff, Ph.D.

Department of Biological Sciences website (<http://www.marquette.edu/biology>)

The Department of Biological Sciences offers or participates in six different majors, five which lead to a B.S. degree and one which leads to a B.A. degree. The purpose of all of these degree programs is to provide instruction in the diverse disciplines that make up modern biology. A major emphasis of these degree programs is to familiarize students with the practice of designing, performing and analyzing biological experiments; toward this goal, stand-alone laboratory courses taught by faculty are a central component of the curriculum for each major. The degree programs teach students critical thinking skills and prepare them for a wide variety of careers including medicine, dentistry, research, biotechnology, pharmacy/pharmacology, public health, and environmental and sustainability studies.

The major in Biological Sciences (BSCI) provides a comprehensive education in biology, including courses in cell biology, genetics, evolutionary biology, physiology, neurobiology, biochemistry, molecular biology, immunobiology, ecology, microbiology and plant biology. Students majoring in Biological Sciences can apply for the Disciplinary Honors Program in Biological Sciences, which provides experiential learning opportunities such as independent research, internships, research-based laboratory courses and accompanying seminars.

The Physiological Sciences major (PHSC) offers students a course of study that is more focused on human and animal structure and function. After introductory courses in cell biology and genetics, students in this major concentrate on physiology, neurobiology, and anatomy. Concentrations within this major are specifically designed for Direct-admit Physical Therapy (D.P.T.) students and for students in the Pre dental Scholars program. Students majoring in Physiological Sciences can apply for the Disciplinary Honors Program in Biological Sciences which provides experiential learning opportunities such as independent research, internships, research-based laboratory courses and accompanying seminars.

The major in Biochemistry and Molecular Biology (BIMB) is offered jointly with the Department of Chemistry. Courses in biochemistry, cell biology, genetics, physical chemistry, and quantitative analysis allow students to understand both complex biological phenomena and the underlying chemical mechanisms. Students majoring in Biochemistry and Molecular Biology can apply for the Disciplinary Honors Programs in either Biological Sciences or Chemistry; both provide experiential learning opportunities such as independent research, internships, research-based laboratory courses and accompanying seminars.

Students in the College of Education with a desire to teach high school biology can earn a B.S. degree with a second major, Biological Sciences for Education.

Bioinformatics is a field that lies at the intersection of biology, statistics, and computer science and focuses on the generation and analysis of large biological data sets. The interdisciplinary Bioinformatics major (INBI), offered jointly with the Department of Mathematics, Statistics & Computer Science, provides sufficient depth in both biology and computer science to approach problems in bioinformatics from the perspective of both parent fields, Biology and Computer Science. The program is designed to prepare individuals to use the computational tools of bioinformatics to solve problems or analyze data sets in biological sciences. For more information about the interdisciplinary Bioinformatics major (INBI), visit the College of Arts and Sciences Interdisciplinary Majors and Minors section of the Undergraduate Bulletin.

The interdisciplinary major in Environmental Studies (INES) leads to a B.A. degree and prepares students to address pressing environmental issues using an interdisciplinary approach. The curriculum of this major allows students to understand the science of the environment and the political, social, economic, philosophical and ethical issues related to restoring and protecting the environment. This is an ideal major for students who intend to pursue a career that focuses on the environment (e.g., environmental management, restoration, mitigation, consulting, policy, economics), or who intend to pursue graduate or professional school in environmental science, law, business, policy, economics, philosophy, theology or ethics. For more information about the interdisciplinary Environmental Studies major (INES), visit the College of Arts and Sciences Interdisciplinary Majors and Minors section of the Undergraduate Bulletin.

In addition, together with the Graduate School of Management, the Department of Biological Science offers a five-year B.S./M.B.A. accelerated degree program.

Notes:

- The Department of Biological Sciences offers two freshman-level survey courses that introduce students to diverse career options in the area of Biological Sciences: BIOL 1004 Biology and the Health Professions is recommended for students considering a career in the health professions, while BIOL 1003 Biology Matters is recommended for students interested in exploring other career opportunities.
- With recent changes to the MCAT exam, pre-health majors are advised to take the following courses as part of their undergraduate program: BIOL 4101 Biochemistry and the Molecular Basis of Biology, MATH 4740 Biostatistical Methods and Models, PSYC 1001 General Psychology and SOCI 1001 Principles of Sociology.

Major in Biological Sciences

The major in Biological Sciences consists of four required courses (12 credits), three lab courses (8-9 credits) and five elective courses (15-16 credits) for a total of 35-37 credit hours as well as the cognate course requirements (30-32 credits) in chemistry, physics, and mathematics or computer science chosen from the lists below.

Notes:

- Majors are encouraged to take upper-division lab courses, although one lower-division lab course may be used to satisfy this requirement.

For elective courses

- Selection can also be from any laboratory courses not previously taken, including BIOL 4987 Applying the Internship Experience or a second BIOL 4956 Laboratory Research Project in Biological Sciences.
- A maximum of one course from the Department of Biomedical Sciences in a subject that is not offered by the Department of Biological Sciences.
- By consent of instructor and departmental chairperson, any biological sciences graduate course.

Required:

12

BIOL 1001	General Biology 1
BIOL 1002	General Biology 2
BIOL 2201	Genetics
BIOL 2301	Cell Biology

Lab Courses - Choose three of the following:

8-9

BIOL 1101	Foundations in Biological Inquiry
or BIOL 2001	Principles of Biological Investigation
BIOL 3202	Experimental Genetics
BIOL 3302	Experimental Cell Biology
BIOL 3402	Experimental Ecology and Field Biology
BIOL 3502	Experimental Neurobiology
BIOL 3602	Experimental Vertebrate Anatomy and Development
BIOL 3702	Experimental Physiology
BIOL 3802	Experimental Microbiology
BIOL 4102	Experimental Molecular Biology
BIOL 4403	Tropical Ecology in Panama
BIOL 4956	Laboratory Research Project in Biological Sciences
or BIOL 4987	Applying the Internship Experience

Electives - Choose five of the following:

15-16

BIOL 2401	Ecology
BIOL 3404	Evolutionary Biology
BIOL 3406	Plant Biology
BIOL 3501	Cellular Neurobiology
BIOL 3601	Animal Development
BIOL 3701	Human Physiology
BIOL 3801	Microbiology
BIOL 4101	Biochemistry and the Molecular Basis of Biology ¹
BIOL 4201	Genomics and Bioinformatics
BIOL 4401	Advanced Ecology
BIOL 4703	Exercise Physiology
BIOL 4806	Immunobiology
BIOL 4995	Independent Study in Biology
PHYS 4046	The Physical Basis of Biological Structure and Function
PHYS 4065	Experimental Methods in Molecular Biophysics

 Total Credit Hours

35-37

Cognate Course Requirements:

Chemistry courses:

CHEM 1001 or CHEM 1013	General Chemistry 1 General Chemistry 1 for Majors	4
CHEM 1002 or CHEM 1014	General Chemistry 2 General Chemistry 2 for Majors	4
CHEM 2111 or CHEM 2113	Organic Chemistry 1 Organic Chemistry for Majors 1	4
CHEM 2112 or CHEM 2114	Organic Chemistry 2 Organic Chemistry for Majors 2	4
Physics courses:		
PHYS 1001 or PHYS 1003	General Physics 1 General Physics with Introductory Calculus 1	4
PHYS 1002 or PHYS 1004	General Physics 2 General Physics with Introductory Calculus 2	4
Mathematics and Computer Science:		
MATH 1410 or MATH 1450	Calculus for the Biological Sciences Calculus 1	3-4
MATH or COSC Course - Choose one additional course ²		3-4
Total Credit Hours		30-32

¹ For students applying to medical school, BIOL 4101 Biochemistry and the Molecular Basis of Biology is recommended as a Biological Sciences elective, MATH 4740 Biostatistical Methods and Models is recommended as a math elective, PSYC 1001 General Psychology is recommended as a general elective, and SOCI 1001 Principles of Sociology is recommended as a MCC ESSV1 course.

² If choosing statistics as a MATH course, MATH 4740 Biostatistical Methods and Models is strongly recommended. PSYC 2001 Psychological Measurements and Statistics or SOCI 2060 Social Statistics may also fulfill this requirement.

Typical Program for Biological Science Majors

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
BIOL 1004 ¹	1	BIOL 1003 ¹	1
CHEM 1001 or 1013	4	BIOL 1101 (Optional) ³	2
ENGL 1001 or ESSV1 (MCC)	3	CHEM 1002 or 1014	4
PHIL 1001 or THEO 1001 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
		MATH 1410 ⁴	3
	14		16

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2001 or elective ³	3	BIOL 2201	3
BIOL 2301	3	CHEM 2112 or 2114	4
CHEM 2111 or 2113	4	PHIL 1001 or THEO 1001 (MCC)	3
MATH or COSC elective ⁵	3	DSCV (MCC) ^{6,7}	3
CORE 1929 (MCC)	3	Elective ⁸	3
	16		16

Junior

First Term	Hours	Second Term	Hours
BIOL elective ⁹	3	BIOL elective	3

PHYS 1001 or 1003	4	BIOL lab	3
DSCV (MCC) ^{6,7}	3	PHYS 1002 or 1004	4
Electives	6	DSCV (MCC) ^{6,7}	3
		Elective	3
		16	16
Senior			
First Term	Hours	Second Term	Hours
BIOL elective	3	BIOL elective	3
BIOL elective or BIOL lab	3	BIOL lab or BIOL elective	3
CORE 4929 (MCC) or elective	3	CORE 4929 (MCC) or elective	3
DSCV (MCC) ^{6,7}	3	Elective	3
Elective	3		
		15	12

Total credit hours: 121

Note: A minimum of 120 credits is required for the degree.

- 1 BIOL 1004 Biology and the Health Professions is recommended for students considering a career in the health professions, while BIOL 1003 Biology Matters is recommended for students exploring other career opportunities in Biological Sciences.
- 2 SOCI 1001 Principles of Sociology satisfies the MCC ESSV1 requirement and is recommended for students considering medical school.
- 3 Students who take BIOL 1101 Foundations in Biological Inquiry cannot take BIOL 2001 Principles of Biological Investigation.
- 4 Students wishing to take MATH 1450 instead of MATH 1410 are recommended to take Math in the fall term and THEO 1001 in the spring term.
- 5 For students intending to apply to medical school, MATH 4740 Biostatistical Methods and Models is strongly recommended. PSYC 2001 Psychological Measurements and Statistics and SOCI 2060 Social Statistics are also accepted.
- 6 The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.
- 7 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- 8 PSYC 1001 General Psychology is recommended for students considering medical school.
- 9 For students intending to apply to medical school, BIOL 4101 Biochemistry and the Molecular Basis of Biology is recommended as a Biological Sciences Elective.

Major in Biological Sciences: Pre-dental Scholars

This major in biological sciences is open to students who were directly admitted to the Pre-dental Scholars Program or students who were accepted into the program after their freshman year. In this program, students complete three years of courses in the College of Arts and Sciences for a minimum of 96-97 credits (depending on courses) by the end of the third year. The fourth year of the program consists of Dental School course requirements, which typically consist of approximately 44 credit hours.

The major consists of six required biology courses (17-18 credit hours), one laboratory course (3 credit hours) and the first year Dental School course requirements, as well as eight cognate course requirements (30-31 credit hours) in chemistry, mathematics and physics chosen from the lists below. Certain courses in the first year dental curriculum are counted toward completion of the major in Biological Sciences (BISC 7410 Microbiology, BISC 7514 Human Microanatomy, BISC 7515 Biomedical Systems 1, BISC 7516 Biomedical Systems 2 and DEIN 7121 Oral Biology); in addition, other courses (i.e. DEIN 7114 Introduction to Clinical Practice 1, DEIN 7118 Dental Rounds 1, DEIN 7124 Introduction to Clinical Practice 2, DEIN 7128 Dental Rounds 2, DEGD 7113 Dental Anatomy and Occlusion 1, DEGD 7123 Dental Anatomy and Occlusion 2) count toward the total credit hour requirement for the Bachelor of Science degree as well as for dental school requirements. After successful completion of these dental courses a B.S. degree is conferred.

Note:

- Dental curriculum for all dental students is determined by the Dental School and is subject to change.
- Students must achieve a grade of C or better in those courses in order to count them toward the B.S. completion.

Required Courses:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2001 or BIOL 1101	Principles of Biological Investigation Foundations in Biological Inquiry	2-3
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
BIOL 4101	Biochemistry and the Molecular Basis of Biology	3
Laboratory Courses - Choose one of the following:		3
BIOL 3202	Experimental Genetics	
BIOL 3302	Experimental Cell Biology	
BIOL 3402	Experimental Ecology and Field Biology	
BIOL 3502	Experimental Neurobiology	
BIOL 3602	Experimental Vertebrate Anatomy and Development	
BIOL 3702	Experimental Physiology	
BIOL 3802	Experimental Microbiology	
BIOL 4102	Experimental Molecular Biology	
BIOL 4956	Laboratory Research Project in Biological Sciences	
Total Credit Hours		20-21

Cognate Course Requirements:

Chemistry Courses:

CHEM 1001 or CHEM 1013	General Chemistry 1 General Chemistry 1 for Majors	4
CHEM 1002 or CHEM 1014	General Chemistry 2 General Chemistry 2 for Majors	4
CHEM 2111 or CHEM 2113	Organic Chemistry 1 Organic Chemistry for Majors 1	4
CHEM 2112 or CHEM 2114	Organic Chemistry 2 Organic Chemistry for Majors 2	4

Mathematics Courses:

MATH 1410 or MATH 1450	Calculus for the Biological Sciences Calculus 1	3-4
MATH 4740 or MATH 1700	Biostatistical Methods and Models ¹ Modern Elementary Statistics	3

Physics Courses:

PHYS 1001 or PHYS 1003	General Physics 1 General Physics with Introductory Calculus 1	4
PHYS 1002 or PHYS 1004	General Physics 2 General Physics with Introductory Calculus 2	4
Total Credit Hours		30-31

¹ MATH 4740 Biostatistical Methods and Models is strongly recommended. PSYC 2001 Psychological Measurements and Statistics or SOCI 2060 Social Statistics are accepted.

Typical Program for Biological Sciences Major - Pre-dental Scholars Curriculum

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
ENGL 1001 or ESSV1 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
PHIL 1001 or THEO 1001 (MCC)	3	MATH 1410 ¹	3
Elective	3	BIOL 1101 (Optional) or elective ²	2-3
		BISC 1030 (Recommended)	1
	16		16-17

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2001 or elective ²	3	BIOL 2201	3
BIOL 2301	3	CHEM 2112 or 2114	4
CHEM 2111 or 2113	4	PHIL 1001 or THEO 1001 (MCC)	3
MATH 4740 ³	3	DSCV (MCC) ^{4,5}	3
CORE 1929 (MCC)	3	DSCV (MCC) or elective ^{4,5}	3
	16		16

Junior

First Term	Hours	Second Term	Hours
BIOL 4101	3	Biology lab (upper division)	3
PHYS 1001 or 1003	4	PHYS 1002 or 1004	4
DSCV (MCC) ^{4,5}	3	CORE 4929 (MCC)	3
DSCV (MCC) or elective ^{4,5}	3	DSCV (MCC) ^{4,5}	3
Elective	3	Elective	3
	16		16

Total credit hours: 96-97

- Must complete a minimum of 96 or 97 credits, depending on number of electives.

¹ Students wishing to take MATH 1450 instead of MATH 1410 are recommended to take Math in the fall term and THEO 1001 in the spring term.

² Students who take BIOL 1101 Foundations in Biological Inquiry cannot also take BIOL 2001 Principles of Biological Investigation.

³ For the required statistics course, MATH 4740 Biostatistical Methods and Models is strongly recommended, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, and SOCI 2060 Social Statistics are accepted.

⁴ The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

⁵ Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.

Year One - Dental Curriculum

First Year			
First Term	Hours	Second Term	Hours
BISC 7410	4	BISC 7516	4
BISC 7514	4	BISC 7517	4
BISC 7515	3	BISC 7518	4
DEGD 7112	3	DEGD 7122	3
DEGD 7113	2	DEGD 7123	2
DEIN 7110	3	DEIN 7120	3
DEIN 7114	3	DEIN 7121	4
DEIN 7118	1	DEIN 7124	2
		DEIN 7128	1
		23	27

Total credit hours: 50

Note: Dental curriculum for all dental students is determined by the Dental School. This represents a sample year one schedule and is subject to change. The curriculum for years two through four are also the same as other dental students. Certain courses in the first year dental curriculum are counted toward completion of the bachelor of science degree as well as for dental school requirements. Students must achieve a grade of C or better in those courses in order to count them toward the B.S. completion.

Biological Sciences B.S. / M.B.A. Accelerated Degree Programs

The Department of Biological Sciences together with the Graduate School of Management offers an accelerated degree program which allow students to earn their B.S. in Biological Sciences, and a master of business administration (M.B.A.), all within a five-year time period.

During the first four years of the program, students complete both their coursework requirements for their B.S. degree and the necessary prerequisite courses for the M.B.A. degree in the College of Business Administration. In addition, undergraduate students begin their M.B.A. graduate work in their senior year by taking two graduate level courses.

To be considered for admission to the B.S./M.B.A. five-year program, applicants must formally apply to the Graduate School of Management during their junior year at Marquette University. For more detailed information and details of a typical five-year coursework plan, please refer to the Graduate School of Management Bulletin and contact the Department of Biological Sciences or the Graduate School of Management.

Major in Biological Sciences for Education

Biological Sciences for Education is a second major for students in the College of Education who wish to teach biology at the high school level. The major consists of five required courses (14-15 credit hours), one additional biology course (3-4 credit hours), one lab course (3 credit hours) and three elective courses (9 credit hours) for a total of 29-31 credit hours as well as the cognate course requirements in chemistry, physics, mathematics or computer science (22 credit hours) chosen from the lists below.

Required:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2001	Principles of Biological Investigation	2-3
or BIOL 1101	Foundations in Biological Inquiry	
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
Choose one additional course from the following:		3-4
BIOL 3406	Plant Biology	
BIOL 3701	Human Physiology	
BIOL 3801	Microbiology	
Lab Courses - Choose one of the following:		3
BIOL 3202	Experimental Genetics	

BIOL 3302	Experimental Cell Biology	
BIOL 3402	Experimental Ecology and Field Biology	
BIOL 3502	Experimental Neurobiology	
BIOL 3602	Experimental Vertebrate Anatomy and Development	
BIOL 3702	Experimental Physiology	
BIOL 3802	Experimental Microbiology	
BIOL 4102	Experimental Molecular Biology	
BIOL 4403	Tropical Ecology in Panama	
Electives - Choose three of the following:		9
BIOL 1406	Plants, Pathogens and People	
BIOL 1410	Biology of Human Disease	
BIOL 2401	Ecology	
BIOL 3404	Evolutionary Biology	
BIOL 3406	Plant Biology	
BIOL 3501	Cellular Neurobiology	
BIOL 3601	Animal Development	
BIOL 3701	Human Physiology	
BIOL 3801	Microbiology	
BIOL 4101 & CHEM 2112	Biochemistry and the Molecular Basis of Biology and Organic Chemistry 2 (CHEM 2112 prerequisite taken concurrently)	
BIOL 4201	Genomics and Bioinformatics	
BIOL 4401	Advanced Ecology	
BIOL 4806	Immunobiology	
Total Credit Hours		29-31

Notes: Electives

- Any lab course from the lab course listing above not previously taken.
- With consent of instructor and department chairperson any Biological Sciences graduate course.
- One Biomedical Sciences course not offered by Biological Sciences.
- Courses offered by other departments with consent of department chairperson.

Cognate courses: six courses required:

Chemistry: three courses required

CHEM 1001 or CHEM 1013	General Chemistry 1 General Chemistry 1 for Majors	4
CHEM 1002 or CHEM 1014	General Chemistry 2 General Chemistry 2 for Majors	4
CHEM 2111 or CHEM 2113	Organic Chemistry 1 Organic Chemistry for Majors 1	4

Mathematics: two courses required

MATH 4740	Biostatistical Methods and Models ¹	3
MATH 1410 or MATH 1450	Calculus for the Biological Sciences (highly recommended) Calculus 1	3-4

Physics: one course required

PHYS 1001 or PHYS 1008 or PHYS 1009 or ARSC 1020	General Physics 1 Astronomy and Space Physics Earth and Environmental Physics Major Concepts in Modern Science 1	3-4
---	---	-----

Total Credit Hours

21-23

¹ For MATH cognate course, MATH 4740 is strongly recommended, however MATH 1700, PSYC 2001, SOCI 2060, or equivalent are accepted.

Typical Program for Biological sciences for Education Majors

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
EDUC 1210	3	EDUC 1220 (ESSV1 (MCC))	3
ENGL 1001 or PHIL 1001 (MCC)	3	PHIL 1001 or ENGL 1001 (MCC)	3
Second Language 1003	4	HIST 1301, 1401, or 1501 (or THEO 1001 (MCC))	3
	17		16

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2301	3	Biology elective	3
CHEM 2111	4	BIOL 2201	3
EDUC 2227	3	HIST 1001 or 1002	3
CORE 1929	3	PHYS 1009	3
HIST 1301, 1401, or 1501 (or THEO 1001 (MCC))	3	DSCV (MCC) ^{1,2}	3
		DSCV (MCC) ^{1,2}	3
	16		18

Junior

First Term	Hours	Second Term	Hours
BIOL 2001	3	Biology lab	3
Biology elective	3	Biology elective	3
EDUC 4037	3	EDUC 4297	4
EDUC 4217	3	EDUC 4240	3
MATH 4740 ³	3	DSCV (MCC) ^{1,2}	3
DSCV (MCC) ^{1,2}	3		
	18		16

Senior

First Term	Hours	Second Term	Hours
BIOL 3406, 3701, or 3801	3-4	EDUC 4965	15
EDUC 4540	3		
Advanced Methods	3		
Fine Arts	3		
CORE 4929 (MCC)	3		
	15-16		15

Total credit hours: 131-132

¹ The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

- 2 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- 3 For MATH cognate course, MATH 4740 is strongly recommended, however MATH 1700, PSYC 2001, SOCI 2060 or equivalent are accepted.

Major in Physiological Sciences

Provides students interested in physiology and neurobiology a strong foundation in biological sciences, cell biology and biochemistry and further studies in neurobiology, human physiology and anatomy, muscle and exercise physiology. The major consists of eight required courses (25 credit hours), one anatomy course (3-4 credit hours) and three elective courses (8-9 credit hours) for a total of 36-38 credit hours as well as the cognate course requirements (33-34 credit hours) in chemistry, physics, mathematics, and philosophy or theology chosen from the lists below.

Required:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
BIOL 3501	Cellular Neurobiology	3
BIOL 3502	Experimental Neurobiology	3
BIOL 3701	Human Physiology	4
BIOL 3702	Experimental Physiology	3

One of these anatomy courses: 3-4

BIOL 3602	Experimental Vertebrate Anatomy and Development
BISC 2135	Clinical Human Anatomy

Electives - Choose three courses from the following: 8-9

BIOL 1101	Foundations in Biological Inquiry
or BIOL 2001	Principles of Biological Investigation
BIOL 3202	Experimental Genetics
BIOL 3302	Experimental Cell Biology
BIOL 3402	Experimental Ecology and Field Biology
BIOL 3404	Evolutionary Biology
BIOL 3406	Plant Biology
BIOL 3601	Animal Development
BIOL 3602	Experimental Vertebrate Anatomy and Development
BIOL 3801	Microbiology
BIOL 3802	Experimental Microbiology
BIOL 4101	Biochemistry and the Molecular Basis of Biology ¹
BIOL 4102	Experimental Molecular Biology
BIOL 4201	Genomics and Bioinformatics
BIOL 4401	Advanced Ecology
BIOL 4703	Exercise Physiology
BIOL 4403	Tropical Ecology in Panama
BIOL 4806	Immunobiology
BIOL 4956	Laboratory Research Project in Biological Sciences
BIOL 4987	Applying the Internship Experience
BIOL 4995	Independent Study in Biology
PHYS 4046	The Physical Basis of Biological Structure and Function
PHYS 4065	Experimental Methods in Molecular Biophysics

Total Credit Hours 36-38

Cognate Course Requirements:

Chemistry Courses:

CHEM 1001	General Chemistry 1	4
or CHEM 1013	General Chemistry 1 for Majors	
CHEM 1002	General Chemistry 2	4

or CHEM 1014	General Chemistry 2 for Majors	
CHEM 2111	Organic Chemistry 1	4
or CHEM 2113	Organic Chemistry for Majors 1	
CHEM 2112	Organic Chemistry 2	4
or CHEM 2114	Organic Chemistry for Majors 2	
Mathematics Courses:		
MATH 1410	Calculus for the Biological Sciences	3-4
or MATH 1450	Calculus 1	
MATH 4740	Biostatistical Methods and Models ²	3
Philosophy or Theology courses:		
PHIL 4335	Biomedical Ethics	3
or THEO 4450	Medical Ethics	
Physics Courses:		
PHYS 1001	General Physics 1	4
or PHYS 1003	General Physics with Introductory Calculus 1	
PHYS 1002	General Physics 2	4
or PHYS 1004	General Physics with Introductory Calculus 2	
Total Credit Hours		33-34

¹ For students intending to apply to medical school: BIOL 4101 Biochemistry and the Molecular Basis of Biology is recommended as a Biological Sciences elective, MATH 4740 Biostatistical Methods and Models is recommended as a math elective, PSYC 1001 General Psychology is recommended as a general elective, and SOCI 1001 Principles of Sociology is recommended as a MCC ESSV1 course.

² For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is the preferred statistics course, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, SOCI 2060 Social Statistics, or equivalent are accepted.

Typical Program for Physiological Sciences Majors

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
ENGL 1001 or ESSV 1 (MCC) ¹	3	ENGL 1001 or ESSV1 (MCC) ¹	3
PHIL 1001 or THEO 1001 (MCC)	3	MATH 1410 ³	3
BIOL 1004 ²	1	BIOL 1101 (optional) ⁴	2
		BIOL 1003 (Recommended) ²	1
	14		16

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2301	3	BIOL 2201	3
CHEM 2111 or 2113	4	CHEM 2112 or 2114	4
MATH 4740 ⁵	3	PHIL 1001 or THEO 1001 (MCC)	3
CORE 1929 (MCC)	3	DSCV (MCC) ^{7,8}	3
Elective ⁶	3	Elective ⁶	3
	16		16

Junior

First Term	Hours	Second Term	Hours
BIOL 3701	4	BIOL 3501	3

BIOL 3702	3	BIOL 3502	3
PHYS 1001 or 1003	4	PHYS 1002 or 1004	4
DSCV (MCC) ^{7, 8}	3	PHIL 4335	3
		DSCV (MCC) ^{7, 8}	3
	14		16
Senior			
First Term	Hours	Second Term	Hours
Biology elective ⁹	3	Biology electives	6
BISC 2135	4	CORE 4929 (MCC) or elective	3
CORE 4929 (MCC) or elective	3	Elective	3
DSCV (MCC) ^{7, 8}	3		
Elective	3		
	16		12

Total credit hours: 120

- 1 SOCI 1001 Principles of Sociology satisfies the MCC ESSV1 requirement and is recommended for students considering medical school.
- 2 BIOL 1004 Biology and the Health Professions is recommended for students considering a career in the health professions, while BIOL 1003 Biology Matters is recommended for students exploring other career opportunities in Biological Sciences.
- 3 Students wishing to take MATH 1450 instead of MATH 1410 are recommended to take Math in the fall term and THEO 1001 in the spring term.
- 4 Students who take BIOL 1101 Foundations in Biological Inquiry cannot also take BIOL 2001 Principles of Biological Investigation.
- 5 For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is strongly recommended, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, and SOCI 2060 Social Statistics are accepted.
- 6 PSYC 1001 General Psychology is recommended as a general elective for students considering medical school.
- 7 The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.
- 8 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- 9 For students intending to apply to medical school, BIOL 4101 Biochemistry and the Molecular Basis of Biology is recommended as a science elective.

Major in Physiological Sciences: Pre-dental Scholars

This major in physiological sciences is open to students who were directly admitted to the Pre-dental Scholars Program or students who were accepted into the program after their freshman year. In this program, students complete three years of courses in the College of Arts and Sciences for a minimum of 98 credits by end of third year. The fourth year of the program consists of Dental School course requirements, which typically consist of approximately 44 credit hours.

The major consists of seven required biology courses, including one laboratory course, and the first year Dental School course requirements, as well as nine cognate course requirements in chemistry, mathematics, philosophy or theology, and physics chosen from the lists below. Certain courses in the first year dental curriculum are counted toward completion of the Major in Physiological Sciences (BISC 7410 Microbiology, BISC 7514 Human Microanatomy, BISC 7515 Biomedical Systems 1, BISC 7516 Biomedical Systems 2 and DEIN 7121 Oral Biology); in addition, other courses (i.e., DEIN 7114 Introduction to Clinical Practice 1, DEIN 7118 Dental Rounds 1, DEIN 7124 Introduction to Clinical Practice 2, DEIN 7128 Dental Rounds 2; DEGD 7113 Dental Anatomy and Occlusion 1, DEGD 7123 Dental Anatomy and Occlusion 2) count toward the total credit hour requirement for the Bachelor of Science degree as well as for dental school requirements. After successful completion of these dental courses a B.S. degree is conferred.

Notes:

- Dental curriculum for all dental students is determined by the Dental School and is subject to change.
- Students must achieve a grade of C or better in those courses in order to count them toward the B.S. completion.

Required Courses:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2301	Cell Biology	3
BIOL 3501	Cellular Neurobiology	3
BIOL 3701	Human Physiology	4
BIOL 4101	Biochemistry and the Molecular Basis of Biology	3

Laboratory Course Requirement:

BIOL 3502	Experimental Neurobiology	3
or BIOL 3702	Experimental Physiology	

First Year Dental School Requirements for BS Completion:

BISC 7410	Microbiology	4
BISC 7514	Human Microanatomy	4
BISC 7515	Biomedical Systems 1	3
BISC 7516	Biomedical Systems 2	4
DEIN 7121	Oral Biology	4
DEIN 7114	Introduction to Clinical Practice 1	3
DEIN 7124	Introduction to Clinical Practice 2	2
DEGD 7113	Dental Anatomy and Occlusion 1	2
DEGD 7123	Dental Anatomy and Occlusion 2	2
DEIN 7118	Dental Rounds 1	1
DEIN 7128	Dental Rounds 2	1

Total Credit Hours 52

Cognate Course Requirements:

Chemistry Courses:

CHEM 1001	General Chemistry 1	4
or CHEM 1013	General Chemistry 1 for Majors	
CHEM 1002	General Chemistry 2	4
or CHEM 1014	General Chemistry 2 for Majors	
CHEM 2111	Organic Chemistry 1	4
or CHEM 2113	Organic Chemistry for Majors 1	
CHEM 2112	Organic Chemistry 2	4
or CHEM 2114	Organic Chemistry for Majors 2	

Mathematics Courses:

MATH 1410	Calculus for the Biological Sciences	3-4
or MATH 1450	Calculus 1	
MATH 4740	Biostatistical Methods and Models ¹	3

Ethics Course - Choose one of the following:

PHIL 4335	Biomedical Ethics	3
or THEO 4450	Medical Ethics	

Physics Courses:

PHYS 1001	General Physics 1	4
or PHYS 1003	General Physics with Introductory Calculus 1	
PHYS 1002	General Physics 2	4
or PHYS 1004	General Physics with Introductory Calculus 2	

Total Credit Hours 33-34

¹ For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is the preferred statistics course, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, SOCI 2060 Social Statistics, or equivalent are accepted.

Typical Program for Physiological Sciences Majors - Pre-dental Scholars

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
ENGL 1001 or ESSV1 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
PHIL 1001 or THEO 1001 (MCC)	3	MATH 1410 ¹	3
Elective	3	BISC 1030 (recommended)	1
		Elective	3
	16		17

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2301	3	CHEM 2112 or 2114	4
CHEM 2111 or 2113	4	PHIL 1001 or THEO 1001 (MCC)	3
MATH 4740 ²	3	DSCV (MCC) ^{3,4}	3
CORE 1929 (MCC)	3	Electives	6
DSCV (MCC) ^{3,4}	3		
	16		16

Junior

First Term	Hours	Second Term	Hours
BIOL 3701	4	BIOL 3501	3
BIOL 3702 or DSCV (MCC) ^{3,4}	3	BIOL 3502 or DSCV (MCC) ^{3,4}	3
BIOL 4101	3	PHYS 1002 or 1004	4
PHYS 1001 or 1003	4	PHIL 4335 ⁵	3
DSCV (MCC) ^{3,4}	3	CORE 4929 (MCC)	3
	17		16

Total credit hours: 98

- Must complete a minimum of 98 credits, depending on courses.

- ¹ Students wishing to take MATH 1450 instead of MATH 1410 are recommended to take Math in the fall term and THEO 1001 in the spring term.
- ² For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is the preferred statistics course, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, SOCI 2060 Social Statistics, or equivalent are accepted.
- ³ The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.
- ⁴ Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- ⁵ If PHIL 4335 Biomedical Ethics or THEO 4450 Medical Ethics cannot be scheduled due to conflicts with other required courses, students are required to take a one credit medical ethics course (PHIL 4336 Applied Ethics for the Health Sciences).

Year One - Dental Curriculum

First Year

First Term	Hours	Second Term	Hours
BISC 7410	4	BISC 7516	4
BISC 7514	4	BISC 7517	4
BISC 7515	3	BISC 7518	4
DEGD 7112	3	DEGD 7122	3
DEGD 7113	2	DEGD 7123	2
DEIN 7110	3	DEIN 7120	3
DEIN 7114	3	DEIN 7121	4
DEIN 7118	1	DEIN 7124	2
		DEIN 7128	1
		23	27

Total credit hours: 50

Note: Dental curriculum for all dental students is determined by the Dental School. This represents a sample year one schedule and is subject to change. The curriculum for years two through four are also the same as other dental students. Certain courses in the first year dental curriculum are counted toward completion of the Bachelor of Science degree as well as for dental school requirements. Students must achieve a grade of C or better in those courses in order to count them toward the B.S. completion.

Major in Physiological Sciences: Physical Therapy

Open only to undergraduate students who have been admitted directly into the six year doctor of physical therapy degree program, are in good academic standing prior to the beginning of the professional phase of the program and want to earn a bachelor of science degree from the Klingler College of Arts and Sciences after four years of study. The major consists of 20 required courses (60 credit hours) as well as 11 cognate course requirements (39-40 credit hours) in chemistry, physics, mathematics, philosophy and psychology chosen from the lists below.

Note:

- For information on the physical therapy program, please see the College of Health Sciences section in this bulletin. Students admitted directly to the doctoral PT program who are interested in the Physiological Sciences major should contact the Department of Biological Sciences as soon as possible, and then consult with an adviser in the Department of Physical Therapy.

Required:

Biology Courses:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
BIOL 3501	Cellular Neurobiology	3
BIOL 3502	Experimental Neurobiology	3
BIOL 3701	Human Physiology	4
BIOL 3702	Experimental Physiology	3

Biomedical Sciences Courses:

BISC 2135	Clinical Human Anatomy	4
BISC 7130	Human Gross Anatomy	5

Physical Therapy Courses:

PHTH 1001	Introduction to Physical Therapy and Medical Terminology	1
PHTH 4512	Culture and Disability	3
PHTH 7120	Pharmacology in Physical Therapy	3
PHTH 7503	Patient Management 1	3
PHTH 7504	Patient Management 2	2

PHTH 7513	Health Care Policy/Management	3
PHTH 7515	Clinical Pathology and Pathophysiology	4
PHTH 7516	Geriatric Rehabilitation	2
PHTH 7525	Kinesiology 1: The Upper Extremity	3
PHTH 7528	Physical Therapy Evaluation, Tests and Measures	2
Total Credit Hours		60

Cognate Course Requirements: 11 courses:

Chemistry courses:

CHEM 1001	General Chemistry 1	4
or CHEM 1013	General Chemistry 1 for Majors	
CHEM 1002	General Chemistry 2	4
or CHEM 1014	General Chemistry 2 for Majors	
CHEM 2111	Organic Chemistry 1	4
or CHEM 2113	Organic Chemistry for Majors 1	
CHEM 2112	Organic Chemistry 2	4
or CHEM 2114	Organic Chemistry for Majors 2	

Mathematics:

MATH 1410	Calculus for the Biological Sciences	3-4
or MATH 1450	Calculus 1	
MATH 4740	Biostatistical Methods and Models ¹	3

Ethics Course:

PHIL 4335	Biomedical Ethics	3
or THEO 4450	Medical Ethics	

Physics Courses:

PHYS 1001	General Physics 1	4
or PHYS 1003	General Physics with Introductory Calculus 1	
PHYS 1002	General Physics 2	4
or PHYS 1004	General Physics with Introductory Calculus 2	

Psychology Courses:

PSYC 1001	General Psychology	3
PSYC 3101	Developmental Psychology: Conception Through Adolescence	3
or		
PSYC 3120	Developmental Psychology: Adulthood and Aging	
or		
PSYC 3401	Abnormal Psychology	

Total Credit Hours		39-40
--------------------	--	-------

¹ For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is the preferred statistics course, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, SOCI 2060 Social Statistics, or equivalent are accepted.

Typical Program for Physiological Sciences Major - Physical Therapy Concentration

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
ENGL 1001 or ESSV1 (MCC)	3	ENGL 1001 or ESSV1 (MCC)	3
PSYC 1001	3	MATH 1410 ¹	3
PHIL 1001 or THEO 1001 (MCC)	3	PHIL 1001 or THEO 1001 (MCC)	3

Sophomore

First Term	Hours	Second Term	Hours
BIOL 2301	3	BIOL 2201	3
BISC 2135	4	CHEM 2112 or 2114	4
CHEM 2111 or 2113	4	CORE 1929 (MCC)	3
MATH 4740 ²	3	DSCV (MCC) ^{3,4}	3
DSCV (MCC) ^{3,4}	3	DSCV (MCC) ^{3,4}	3
	17		16

Junior

First Term	Hours	Second Term	Hours
BIOL 3701	4	BIOL 3501	3
BIOL 3702	3	BIOL 3502	3
PHYS 1001 or 1003	4	PHYS 1002 or 1004	4
PSYC 3101, 3120, or 3401	3	PHIL 4335 ⁵	3
DSCV (MCC) ^{3,4}	3	CORE 4929 (MCC)	3
		PHTH 1001	1
	17		17

Senior

First Term	Hours	Second Term	Hours
BISC 7130	5	PHTH 7120	3
PHTH 4512	3	PHTH 7504	2
PHTH 7503	3	PHTH 7515	4
PHTH 7513	3	PHTH 7516	2
		PHTH 7525	3
		PHTH 7528	2
	14		16

Total credit hours: 129

- ¹ Students wishing to take MATH 1450 instead of MATH 1410 are recommended to take Math in the fall term and PSYC 1001 in the second term.
- ² For MATH cognate courses, MATH 4740 Biostatistical Methods and Models is strongly recommended, however MATH 1700 Modern Elementary Statistics, PSYC 2001 Psychological Measurements and Statistics, SOCI 2060 Social Statistics, or equivalent are accepted.
- ³ The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major. It is recommended that students in this program choose a Discovery Tier theme that allows them to count at least one major requirement toward the Discovery Tier.
- ⁴ Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- ⁵ If PHIL 4335 Biomedical Ethics or THEO 4450 Medical Ethics cannot be scheduled due to conflicts with other required courses, students are required to take a one credit medical ethics course (PHIL 4336 Applied Ethics for the Health Sciences).

Physiological Sciences B.S./M.B.A. Accelerated Degree Programs

The Department of Biological Sciences together with the Graduate School of Management offers accelerated degree programs which allow students to earn their B.S. in Physiological Sciences and a master of business administration (M.B.A.), all within in a five-year time period.

During the first four years of the program, students complete both their coursework requirements for their B.S. degree and the necessary prerequisite courses for the M.B.A. degree in the College of Business Administration. In addition, undergraduate students begin their M.B.A. graduate work in their senior year by taking two graduate level courses.

To be considered for admission to the B.S./M.B.A. five-year program, applicants must formally apply to the Graduate School of Management during their junior year at Marquette University. For more detailed information and details of a typical five-year coursework plan, please refer to the Graduate School of Management Bulletin and contact the Department of Biological Sciences or the Graduate School of Management.

Biochemistry and Molecular Biology

The major in biochemistry and molecular biology consists of 53-59 credit hours in biology, chemistry, mathematics and physics courses as listed below. Additional cognate courses in mathematics and physics are required.

Required Biological Sciences courses (18 cr. hrs.):

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
BIOL 4101	Biochemistry and the Molecular Basis of Biology	3
BIOL 4102	Experimental Molecular Biology	3

Required Chemistry Courses (23-26 cr. hrs.)

CHEM 1001	General Chemistry 1	4
or CHEM 1013	General Chemistry 1 for Majors	
CHEM 1002	General Chemistry 2	4
or CHEM 1014	General Chemistry 2 for Majors	
CHEM 3201	Quantitative Analysis	4

Organic Chemistry Sequence - Choose one of the following:

CHEM 2111	Organic Chemistry 1	8
& CHEM 2112	and Organic Chemistry 2	
CHEM 2113	Organic Chemistry for Majors 1	8
& CHEM 2114	and Organic Chemistry for Majors 2	

Physical Chemistry - Choose one of the following:

CHEM 4431	Physical Chemistry: Fundamentals with Applications in Biological Sciences	3-6
CHEM 4433	Physical Chemistry 1	3-6
& CHEM 4434	and Physical Chemistry 2	

Additional Laboratory Course Requirement - Choose option one or option two:

		3
Option 1:		
BIOL 4956	Laboratory Research Project in Biological Sciences	3
or CHEM 4956	Undergraduate Research in Chemistry	

Option 2 (choose one of the following):

BIOL 3202	Experimental Genetics	9-12
BIOL 3302	Experimental Cell Biology	
BIOL 3402	Experimental Ecology and Field Biology	
BIOL 3502	Experimental Neurobiology	
BIOL 3602	Experimental Vertebrate Anatomy and Development	
BIOL 3702	Experimental Physiology	
BIOL 3802	Experimental Microbiology	
BIOL 4403	Tropical Ecology in Panama	

Elective Courses - Choose any three of the following not previously taken:

Biology Courses:		9-12
BIOL 3202	Experimental Genetics	9-12
BIOL 3302	Experimental Cell Biology	
BIOL 3402	Experimental Ecology and Field Biology	
BIOL 3404	Evolutionary Biology	
BIOL 3406	Plant Biology	

BIOL 3501	Cellular Neurobiology
BIOL 3502	Experimental Neurobiology
BIOL 3601	Animal Development
BIOL 3602	Experimental Vertebrate Anatomy and Development
BIOL 3701	Human Physiology
BIOL 3702	Experimental Physiology
BIOL 3801	Microbiology
BIOL 3802	Experimental Microbiology
BIOL 4201	Genomics and Bioinformatics
BIOL 4401	Advanced Ecology
BIOL 4403	Tropical Ecology in Panama
BIOL 4703	Exercise Physiology
BIOL 4806	Immunobiology
BIOL 4956	Laboratory Research Project in Biological Sciences
BIOL 4987	Applying the Internship Experience
BIOL 4995	Independent Study in Biology
BISC 4995	Independent Study in Biomedical Sciences
Chemistry Courses:	
CHEM 3210	Instrumental Analysis
CHEM 4130	Characterization of Organic Compounds
CHEM 4330	Inorganic Chemistry
CHEM 4430	Introduction to Quantum Chemistry
CHEM 4530	Introduction to Biochemistry
CHEM 4956	Undergraduate Research in Chemistry
Mathematics Courses:	
MATH 2450	Calculus 3
MATH 2451	Differential Equations
MATH 4740	Biostatistical Methods and Models
or MATH 4720	Statistical Methods
or PSYC 2001	Psychological Measurements and Statistics
Physics Courses:	
PHYS 4046	The Physical Basis of Biological Structure and Function
PHYS 4065	Experimental Methods in Molecular Biophysics

Total Credit Hours

53-59

Notes:

- Students who take CHEM 4433 Physical Chemistry 1, CHEM 4434 Physical Chemistry 2 and MATH 2450 Calculus 3 are required to take only one additional elective in biological sciences, chemistry or mathematics.
- A second BIOL 4956 Laboratory Research Project in Biological Sciences course may be taken as an elective if previously taken as a laboratory course.
- Honors courses are available from both departments by contract with the instructors. Courses available for honors credit are identified.

Cognate Course Requirements:**Mathematics Courses:**

MATH 1450	Calculus 1	4
MATH 1451	Calculus 2	4
Physics Sequence - Choose one of the following:		8
PHYS 1001 & PHYS 1002	General Physics 1 and General Physics 2	
PHYS 1003 & PHYS 1004	General Physics with Introductory Calculus 1 and General Physics with Introductory Calculus 2	

Total Credit Hours

16

Typical Program for Biochemistry/Molecular Biology Majors

Freshman

First Term	Hours	Second Term	Hours
BIOL 1001	3	BIOL 1002	3
CHEM 1001 or 1013	4	CHEM 1002 or 1014	4
MATH 1450	4	MATH 1451	4
ENGL 1001 or PHIL 1001 (MCC)	3	PHIL 1001 or ENGL 1001 (MCC)	3
BIOL 1004 ¹	1	BIOL 1003 ¹	1
15		15	

Sophomore

First Term	Hours	Second Term	Hours
CHEM 2111 or 2113	4	CHEM 2112 or 2114	4
BIOL 2301	3	BIOL 2201	3
PHYS 1001 or 1003	4	PHYS 1002 or 1004	4
CORE 1929 (MCC)	3	DSCV (MCC) ^{3,4}	3
THEO 1001 or ESSV1 (MCC) ²	3	THEO 1001 or ESSV1 (MCC) ²	3
17		17	

Junior

First Term	Hours	Second Term	Hours
BIOL 4101	3	Biology lab (upper division) ⁶	3
CHEM 4431 ⁵	3	CHEM 3201	4
DSCV (MCC) ^{3,4}	3	DSCV (MCC) ^{3,4}	3
Electives	6	Elective	3
15		13	

Senior

First Term	Hours	Second Term	Hours
BIOL 4102	3	Biochemistry/Molecular Biology electives	6
Biochemistry/Molecular Biology elective	3-4	CORE 4929 or elective	3
DSCV (MCC) ^{3,4}	3	Electives	6
CORE 4929 or elective	3		
Elective	3		
15-16		15	

Total credit hours: 122-123

¹ BIOL 1004 Biology and the Health Professions is recommended for students considering a career in the health sciences, while BIOL 1003 Biology Matters is recommended for students exploring other career opportunities in Biological Sciences.

² For students intending to apply to medical school: MATH 4740 Biostatistical Methods and Models is recommended as a math elective, PSYC 1001 General Psychology is recommended as a general elective, and SOCI 1001 Principles of Sociology is recommended as the ESSV1 course.

³ The four courses in the Discovery Tier (DSCV) of the MCC must be completed in the same theme and include the following content areas: Humanities (HUM), Social Science (SSC), Natural Science and Mathematics (NSM) and one elective (ELE), which is an additional course from any of the three content areas. A maximum of two courses in the Discovery Tier can apply towards a primary major.

- 4 Students must also complete the Writing Intensive (WRIT) and Engaging Social System and Values 2 (ESSV2) requirements of the MCC. These requirements can be fulfilled through designated courses in the Discovery Tier or other degree requirements.
- 5 Many students, including those continuing on to graduate school, should consider the option of two terms of physical chemistry CHEM 4433 Physical Chemistry 1 and CHEM 4434 Physical Chemistry 2 which require an additional term of calculus MATH 2450 Calculus 3. Students who take CHEM 4433 Physical Chemistry 1, CHEM 4434 Physical Chemistry 2, and MATH 2450 Calculus 3 are required to take only one additional elective in biological sciences, chemistry or mathematics.
- 6 BIOL 4956 Laboratory Research Project in Biological Sciences or CHEM 4956 Undergraduate Research in Chemistry may be substituted.

Biochemistry and Molecular Biology B.S./M.B.A. Accelerated Degree Programs

The Departments of Biological Sciences and Chemistry together with the Graduate School of Management offer an accelerated degree programs which allow students to earn their B.S. in Biochemistry & Molecular Biology and a master of business administration (M.B.A.), all within in a five-year time period.

During the first four years of the program, students complete both their coursework requirements for their B.S. degree and the necessary prerequisite courses for the M.B.A. degree in the College of Business Administration. In addition, undergraduate students begin their M.B.A. graduate work in their senior year by taking two graduate level courses.

To be considered for admission to the B.S./M.B.A. five-year program, applicants must formally apply to the Graduate School of Management during their junior year at Marquette University. For more detailed information and details of a typical five-year coursework plan, please refer to the Graduate School of Management Bulletin and contact the Departments of Biological Sciences and/or Chemistry or the Graduate School of Management.

Minor in Biological Sciences

The minor in Biological Sciences consists of four required courses listed below (13 credit hours) and two electives chosen from Biological Sciences or one Biological Sciences elective and ANTH 2201 Human Evolutionary Process (6-7 credit hours) for a total of 19-20 credit hours.

Note:

- BIOL 1009 Biology for Non-Science Majors, BIOL 1406 Plants, Pathogens and People, BIOL 1410 Biology of Human Disease, and BIOL 4956 Laboratory Research Project in Biological Sciences cannot be taken except with consent of department chair.

Required:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2001	Principles of Biological Investigation	3
CHEM 1001	General Chemistry 1	4
Electives - Choose two of the following:		6-7
ANTH 2201	Human Evolutionary Process	
BIOL 2201	Genetics	
BIOL 2301	Cell Biology	
BIOL 2401	Ecology	
BIOL 3404	Evolutionary Biology	
BIOL 3406	Plant Biology	
BIOL 3501	Cellular Neurobiology	
BIOL 3601	Animal Development	
BIOL 3701	Human Physiology	
BIOL 3801	Microbiology	
BIOL 4101	Biochemistry and the Molecular Basis of Biology	
BIOL 4201	Genomics and Bioinformatics	
BIOL 4401	Advanced Ecology	
BIOL 4703	Exercise Physiology	
BIOL 4806	Immunobiology	

Total Credit Hours

19-20

Department of Public Instruction Certification

College of Education students wishing to pursue Department of Public Instruction Certification should follow the biological sciences minor. The minor consists of five required courses (15 credit hours) and one additional upper division elective course in Biological Sciences (3-4 credit hours) for a total of 18-19 credit hours as follows:

Required:

BIOL 1001	General Biology 1	3
BIOL 1002	General Biology 2	3
BIOL 2001	Principles of Biological Investigation	3
BIOL 2201	Genetics	3
BIOL 2301	Cell Biology	3
Elective - Choose one additional upper-division BIOL course.		3-4
Total Credit Hours		18-19

Program Director: Dr. Krassimira Hristova, Ph.D.

The Disciplinary Honors Program in Biological Sciences focuses on experiential learning, either as independent laboratory research or an internship, and science communication. The program is open to students majoring in any of the majors offered by the Department of Biological Sciences. Students majoring in Biochemistry and Molecular Biology may choose to follow either the Biological Sciences or Chemistry Disciplinary Honors Program in consultation with their advisors.

Curriculum Requirements

Recommended prerequisite course work:

BIOL 1001H	Honors General Biology 1 (or BIOL 1001)	3
BIOL 1002H	Honors General Biology 2 (or BIOL 1002)	3
BIOL 1101	Foundations in Biological Inquiry	2
BIOL 2953	Entering Research 1	1
BIOL 2954	Entering Research 2	1
Total Credit Hours		10

Requirements for Biological Sciences Disciplinary Honors:

Students must complete two research experiences from the four options listed below and one of the listed seminars or graduate-level courses. Students may only do one honors internship for the disciplinary honors major, but the research requirement could be fulfilled by two terms of laboratory research in BIOL or another approved department.

At least one of the following three courses:

BIOL 4956H	Honors Laboratory Research Project in Biological Sciences	3
BIOL 3986H or BIOL 3987H	Honors Internship in Biological Sciences - Part-time Honors Internship in Biological Sciences - Full-time	0
BIOL 9002H	Honors Student Study/Research Placeholder in Biology	0
Additional research experience can be taken from the following (Requires department approval from BSCI Disciplinary Honors director):		3
BIOL 3802	Experimental Microbiology	
BIOL 4102	Experimental Molecular Biology	
BIOL 4403	Tropical Ecology in Panama	
BIOL 4995	Independent Study in Biology	

And

One of the following seminar or graduate-level courses: (Similar seminar courses in MSCS, Physics, or other Arts and Sciences departments with prior approval)

BIOL 4931	Topics in Biology	1
BIOL 4953	Seminar in Undergraduate Research	1
BIOL 6011	Advanced Concepts in Genetics and Cell Biology	3
BIOL 6012	Advanced Concepts in Cell Biology and Biochemistry	3
BISC 4146H	Honors Physiology In Depth: Contemporary Issues	1
BISC 4151H	Honors Advanced Pathology	1
BISC 4214H	Honors Advanced Biochemistry	1

BISC 4341H	Honors Advanced Cellular Genetics and Cancer	1
BISC 4851H	Honors Advanced Systems Neuroscience	1

Additional Requirements

- Public presentation (talk/poster) describing results/outcomes of research/internship. Can be fulfilled by giving a public presentation based on work done in BIOL 4956H Honors Laboratory Research Project in Biological Sciences, BIOL 4987 Applying the Internship Experience, BIOL 9002H Honors Student Study/Research Placeholder in Biology, BIOL 4102 Experimental Molecular Biology, BIOL 4403 Tropical Ecology in Panama, BIOL 3802 Experimental Microbiology, BIOL 4995 Independent Study in Biology. The director will inform students of presentation opportunities and determine which presentations fulfill the requirements of the program.
- A minimum 3.200 cumulative GPA in the major at graduation is required to graduate with disciplinary honors.

Eligibility

1. Overall cumulative GPA of 3.200 or higher.
2. Identified faculty mentor/intern sponsor for disciplinary honors work.
3. Written proposal – A written proposal is required for students applying for the BSCI disciplinary honors program. The proposal should identify the honors courses for which the student is planning to enroll and explain how these courses correspond to and will benefit them in their anticipated career. The program director evaluates applications and makes decisions regarding admission to the program. Information is available on the department website to facilitate the application process in the spring of the sophomore year or fall of the junior year.

Application

Students are encouraged to apply in the spring term of the sophomore year, but applications are also be accepted in the fall term of the junior year. Applications can be made directly to the Biological Sciences department. Questions can be directed to the disciplinary honors director, Dr. Krassimira Hristova.

Courses

BIOL 1001. General Biology 1. 3 cr. hrs.

Covers the molecular basis of life, biology of the cell, genetics and evolution in a genetic context. 3 hrs. lec., disc.

BIOL 1001H. Honors General Biology 1. 3 cr. hrs.

Covers the molecular basis of life, biology of the cell, genetics and evolution in a genetic context. As an Honors Program course, includes a more intensive research or project component. 3 hrs. lec., disc. Prereq: Admission to Marquette University Honors Program.

BIOL 1002. General Biology 2. 3 cr. hrs.

Covers the diversity of Life, plant form and function, animal form and function, ecology and evolution in context of diversity. 3 hrs. lec., disc. Prereq: BIOL 1001 or cons. of instr.

BIOL 1002H. Honors General Biology 2. 3 cr. hrs.

Covers the diversity of Life, plant form and function, animal form and function, ecology and evolution in context of diversity. As an Honors Program course, includes a more intensive research or project component. 3 hrs. lec., disc. Prereq: BIOL 1001 or BIOL 1001H; or cons. of instr.; and admission to Marquette University Honors Program.

BIOL 1003. Biology Matters. 1 cr. hr.

A seminar to introduce students early in their academic careers to modern biological and biomedical research. Students learn about various career paths biological science graduates can take. Medical school, dental school, and graduate school will be discussed, along with the possibility of combining biology with disciplines such as law, finance and computer science. Primarily for freshmen and sophomores. S/U grade assessment.

BIOL 1004. Biology and the Health Professions. 1 cr. hr.

A seminar to introduce students to health-related career paths available to Arts & Sciences students. Primarily for freshmen. S/U grade assessment. Prereq: Enrolled in the College of Arts and Sciences.

BIOL 1009. Biology for Non-Science Majors. 3 cr. hrs.

Designed for non-science students, the course introduces biological concepts and will focus on how scientific knowledge is created. Special emphasis on cell function, evolutionary biology, genetics, and modern genetic methods. Topics covered will include inheritance of genetic traits, cloning, and biotechnology, nervous system evolution, speciation, and extinction. 3 hrs. lec., disc. May be counted toward the Natural Science requirement of the College Curriculum.

BIOL 1101. Foundations in Biological Inquiry. 2 cr. hrs.

Develop research questions based on hypothesis, design and conduct experiments, analyze data, and draw conclusions using basic biology research techniques and laboratory practices (pipetting, microscopy, solution preparation, sterile technique, spectrophotometry, PCR/DNA electrophoresis, data analysis and basic statistics etc.). 2 hrs. lab. Prereq: BIOL 1001 or BIOL 1001H, and cons. of instr.

BIOL 1406. Plants, Pathogens and People. 3 cr. hrs.

Plant diseases and their effects on food supplies and human history. Biology of plants and the pathogens that cause plant diseases. Controversies related to pesticide use, biological control, genetic engineering, biodiversity. Covers the major biology concepts. Hands-on activities and class discussions. Designed for nonscience students and Biological Science for Education majors. Does not fulfill major requirements for other biological science majors.

BIOL 1410. Biology of Human Disease. 3 cr. hrs.

Explores human physiology in relationship to health and disease. Topics include the cardiovascular system, heart disease, the immune system, infectious diseases, cancer, drug addiction, the brain and neurodegenerative disorders such as Alzheimer's disease. Emphasis on understanding scientific reporting and critically assessing the value and importance of published findings. Students are required to research, analyze and critique an independent topic based on science in the news. Designed for nonscience students and Biological Science for Education majors. Does not fulfill major requirements for other biological science majors.

BIOL 1420. Environmental Biology: From Macro to Micro Through the Lens of the Environment. 3 cr. hrs.

Intended for non-science majors and covers topics in global ecology and sustainability, from fossil fuels, greenhouse gasses, housing, food production and water. Challenges students to draw on their introspective skills to form positions for use in class discussions and debates. Explorations of ethical and spiritual issues surrounding topics provide a framework for deeper discussions in the tradition of Jesuit education.

BIOL 2001. Principles of Biological Investigation. 3 cr. hrs.

Introduction to selected instrumentation and techniques, including light microscopy, staining, aseptic procedures, spectrophotometry, gel electrophoresis, and immunoassays. Topics may include: photosynthesis, protein quantification, bacteria, fungi, nematodes, histology, evolution, embryo development, and physiology of the nervous system. Recommended for freshman and sophomores who have completed BIOL 1002 but may be taken concurrently. 1 hr. lec., 3 hrs. lab. Prereq: BIOL 1001.

BIOL 2201. Genetics. 3 cr. hrs.

Analysis of mechanisms of inheritance with emphasis on the nature of the gene, inheritance of genetic traits, and organisms with special advantages as model genetic systems. 3 hrs. lec., disc. Prereq: BIOL 1001 or BIOL 1001H.

BIOL 2301. Cell Biology. 3 cr. hrs.

The cell is the basic unit of life; it is the fundamental unit from which all organisms are built. The concepts as well as the scientific evidence that underlie our current understanding of cellular organization and function are emphasized. Key cellular processes including membrane function, signaling, transcriptional regulation, protein targeting, vesicular trafficking, cytoskeleton, cell cycle regulation, and cell death are discussed. These processes are related to our understanding of human disease. 3 hrs. lec., disc. Prereq: BIOL 1001 or BIOL 1001H.

BIOL 2401. Ecology. 3 cr. hrs.

Introductory study of the complex interactions of living organisms, including both micro- and macro-organisms, with each other and with their chemical and physical environments. Emphasis on the scientific principles involved in these interactions. 3 hrs. lec., disc. Prereq: BIOL 1002 or BIOL 1002H; or cons. of instr.

BIOL 2953. Entering Research 1. 1 cr. hr.

A one-credit seminar for undergraduate students that is the first in a two-course series, designed to complement the independent research experience. Students meet weekly to share their research experiences and to get feedback on the progress of their research projects.

BIOL 2953H. Honors Entering Research 1. 1 cr. hr.

A one-credit seminar for undergraduate students that is the first in a two-course series, designed to complement the independent research experience. Students meet weekly to share their research experiences and to get feedback on the progress of their research projects. As a Honors Program course, includes a more intensive research or project component. Prereq: Admission to the BSCI Disciplinary Honors Program.

BIOL 2954. Entering Research 2. 1 cr. hr.

A one-credit seminar for undergraduate students that is the second in a two course series, designed to complement the independent research experience. Students meet weekly to share their research experiences and to get feedback on the progress of their research projects.

BIOL 2954H. Honors Entering Research 2. 1 cr. hr.

A one-credit seminar for undergraduate students that is the second in a two course series, designed to complement the independent research experience. Students meet weekly to share their research experiences and to get feedback on the progress of their research projects. As a Honors Program course, includes a more intensive research or project component. Prereq: Admission to the BSCI Disciplinary Honors Program.

BIOL 3202. Experimental Genetics. 3 cr. hrs.

Genetic organization, function, engineering, and inheritance in procaryotic and eucaryotic organisms. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 2201, which may be taken concurrently; and cons. of dept. ch.

BIOL 3302. Experimental Cell Biology. 3 cr. hrs.

Molecular and biochemical studies of cellular structure and organization in relation to integrated cellular function. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 2301 and cons. of dept. ch.

BIOL 3402. Experimental Ecology and Field Biology. 3 cr. hrs.

Experimental approach of both laboratory and field exercises designed to emphasize experimental design, ecological measurement, observation, modeling and statistical analyses of fundamental concepts in ecology. 1 hr. lec., 4 hr. lab. Prereq: BIOL 2401 or equiv.

BIOL 3404. Evolutionary Biology. 3 cr. hrs.

Evolution is integral to understanding all facets of the life sciences with scientist Theodosius Dobzhansky famously stating, "nothing in biology makes sense except in the light of evolution." Covers core topics in evolution including: the history of evolutionary thought in biology, genetic variation, development, population genetics, classification and phylogeny; the fossil record; biogeography, natural selection and adaptation, genetic drift, speciation and sexual selection. Prereq: BIOL 1001 or BIOL 1001H; and BIOL 1002 or BIOL 1002H; or cons. of instr.

BIOL 3406. Plant Biology. 3 cr. hrs.

Despite their tremendous diversity in form, seed plants share many similarities in their cellular organization, metabolism, and core development paradigms. Primary course objectives include student familiarity with organization, growth and development of vascular plants; application of genetic engineering to plants; and concepts of plant evolution and reproduction from algae to flowering plants. 3 hrs. lec. Prereq: BIOL 1002 or cons. of instr.

BIOL 3501. Cellular Neurobiology. 3 cr. hrs.

General principles of the organization and function of the vertebrate nervous system. Topics include the cellular and molecular mechanisms of cell excitability, synaptic transmission, and how neuromodulators regulate these functions in neuronal networks; mechanisms of learning and memory at the synaptic level; sensory systems from transduction to higher-order processing; and motor systems from the neuromuscular junction to voluntary movement to provide an integrative understanding of the nervous system. A functional approach to neuroanatomy are integrated throughout the course. 3 hrs. lec., disc. Prereq: BIOL 1002 or BIOL 1002H.

BIOL 3502. Experimental Neurobiology. 3 cr. hrs.

Experimental analysis of synapses and neuronal circuitry using a variety of preparations and electrophysiological techniques. The basic electrical properties of excitable cells and chemical communication between cells are investigated. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 3501, which may be taken concurrently, and cons. of dept. ch.; or BIOL 3701 and cons. of dept. ch.

BIOL 3601. Animal Development. 3 cr. hrs.

The study of the ordered formation of complex, multi-cellular organisms from a single cell. A multidisciplinary exploration of the integrative processes underlying animal development, incorporating techniques of cellular and molecular biology for the study of development. 3 hrs. lec. Prereq: BIOL 2301 or cons. of instr.

BIOL 3602. Experimental Vertebrate Anatomy and Development. 3 cr. hrs.

Study of vertebrate anatomy at both gross and microscopic levels, facilitated by dissection of representative mammals and examination of microscope slides. Includes a developmental component supported by a study of early chick embryos. Prereq: BIOL 1001 and BIOL 1002, or equiv. and cons. of dept. ch.

BIOL 3701. Human Physiology. 4 cr. hrs.

Designed to explain to students in Biological Sciences, Physiological Sciences and Physical Therapy curricula the systemic and cellular mechanisms responsible for cellular, organ, and system functions in the human organism. 4 hrs. lec., disc. Prereq: BIOL 1002; or cons. of instr. BIOL 2301 recommended.

BIOL 3702. Experimental Physiology. 3 cr. hrs.

Investigation of selected topics relating to the regulation of physiological activity in vertebrate organisms. Emphasis on use of modern recording systems and experimental preparation of the vertebrate for the study of integrated systemic functions. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 3701, which may be taken concurrently, and cons. of dept. ch.

BIOL 3801. Microbiology. 3 cr. hrs.

Study of selected groups of microorganisms (algae, bacteria, and fungi). Topics include microbial morphology, taxonomy and metabolic activities, and the effect of microorganisms on man and on the earth. 3 hrs. lec., disc. Prereq: BIOL 1002.

BIOL 3802. Experimental Microbiology. 3 cr. hrs.

Basic modern approaches to the laboratory investigation of microorganisms. A major part of the course is in-depth analysis of unknown microorganisms that students isolate from the environment. Prereq: BIOL 1002 and cons. of dept. ch.

BIOL 3802H. Honors Experimental Microbiology. 3 cr. hrs.

Basic modern approaches to the laboratory investigation of microorganisms. A major part of the course is in-depth analysis of unknown microorganisms that students isolate from the environment. As a Honors Program course, includes a more intensive research or project component. Prereq: BIOL 1002 or BIOL 1002H and cons. of dept. ch.; admission to the BSCI Disciplinary Honors Program.

BIOL 3986. Internship in Biological Sciences - Part-time. 0 cr. hrs.

Experience with a business or not-for-profit organization that affords students an opportunity to apply and integrate the knowledge and skills they have gained in the classroom to the "real world". Placement is for a minimum of 160 hours per term under the supervision of an internship mentor/supervisor. Prereq: Cons. of internship coordinator.

BIOL 3986H. Honors Internship in Biological Sciences - Part-time. 0 cr. hrs.

Experience with a business or not-for-profit organization that affords students an opportunity to apply and integrate the knowledge and skills they have gained in the classroom to the "real world". Placement is for a minimum of 160 hours per term under the supervision of an internship mentor/supervisor. As a Honors Program course, includes a more intensive research or project component. Prereq: Cons. of internship coordinator; admission to the BSCI Disciplinary Honors Program.

BIOL 3987. Internship in Biological Sciences - Full-time. 0 cr. hrs.

Experience with a business or not-for-profit organization that affords students an opportunity to apply and integrate the knowledge and skills they have gained in the classroom to the "real world". Placement is for a minimum of 450 hours per term under the supervision of an internship mentor/supervisor. Prereq: Cons. of internship coordinator.

BIOL 3987H. Honors Internship in Biological Sciences - Full-time. 0 cr. hrs.

Experience with a business or not-for-profit organization that affords students an opportunity to apply and integrate the knowledge and skills they have gained in the classroom to the "real world". Placement is for a minimum of 450 hours per term under the supervision of an internship mentor/supervisor. As a Honors Program course, includes a more intensive research or project component. Prereq: Cons. of internship coordinator; admission to the BSCI Disciplinary Honors Program.

BIOL 4101. Biochemistry and the Molecular Basis of Biology. 3 cr. hrs.

Major themes in biochemistry are examined in the context of mammalian physiology. Topics include: protein structure and enzyme catalysis, carbohydrate and lipid metabolism in relation to energy production, protein and nucleic acid synthesis, and the nature of the genetic code. 3 hrs. lec., disc. Prereq: BIOL 1002 and CHEM 2111 or CHEM 2113 (can be taken concurrently). CHEM 2112 or CHEM 2114 are highly recommended; or cons. of instr.

BIOL 4102. Experimental Molecular Biology. 3 cr. hrs.

Purification, characterization and molecular analysis of proteins, nucleic acids, lipids and other biomolecules with emphasis on standard techniques widely used in research laboratories. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 4101 which may be taken concurrently with cons. of instr.

BIOL 4102H. Honors Experimental Molecular Biology. 3 cr. hrs.

Purification, characterization and molecular analysis of proteins, nucleic acids, lipids and other biomolecules with emphasis on standard techniques widely used in research laboratories. 1 hr. lec., 4 hrs. lab. As a Honors Program course, includes a more intensive research or project component. Prereq: BIOL 4101 which may be taken concurrently with cons. of instr.; admission to the BSCI Disciplinary Honors Program.

BIOL 4201. Genomics and Bioinformatics. 3 cr. hrs.

The analysis of gene structure and genetic regulation in selected prokaryotes and plant and animal systems, as well as transgenic organisms. Introduction to the principles of bioinformatics and proteomics as applied to genome comparisons and protein structure and function. Models and algorithms for predictions of the biological properties of genetically modified nucleotide sequences and proteins. Prereq: BIOL 2201 or cons. of instr.

BIOL 4401. Advanced Ecology. 3 cr. hrs.

Studies the interactions of organisms with each other and their abiotic environments beyond the introductory level. Both mathematical models and the evolutionary genetics involved in ecologically important traits are emphasized. Ecological concepts in current and classical scientific literature are explored. Mathematical and computer models are used to analyze and understand ecological interactions and processes in population, community, ecosystem and evolutionary ecology. These are combined with advanced concepts in population and ecological genetics. 3 hrs. lec, disc. Prereq: BIOL 2401 or equiv.; or cons. of instr.

BIOL 4403. Tropical Ecology in Panama. 3 cr. hrs.

Tropical Ecology is the study of the biotic and abiotic interactions that shape the origin, maintenance and consequences of species diversity in the tropics. The incredibly high species diversity found in tropical forests has intrigued biologists for centuries, including such luminaries as Darwin and Wallace and continues to engage biologists today. Explores a variety of different forest types within the Republic of Panama to gain an appreciation for the basic patterns and processes of tropical forests and the mechanisms believed to be responsible for them. Modeled after the Organization for Tropical Biology's Tropical Ecology Field Course. Prereq: BIOL 2401 or cons. of instr.

BIOL 4403H. Honors Tropical Ecology in Panama. 3 cr. hrs.

Tropical Ecology is the study of the biotic and abiotic interactions that shape the origin, maintenance and consequences of species diversity in the tropics. The incredibly high species diversity found in tropical forests has intrigued biologists for centuries, including such luminaries as Darwin and Wallace and continues to engage biologists today. Explores a variety of different forest types within the Republic of Panama to gain an appreciation for the basic patterns and processes of tropical forests and the mechanisms believed to be responsible for them. Modeled after the Organization for Tropical Biology's Tropical Ecology Field Course. As an Honors Program course, includes a more intensive research or project component. Prereq: BIOL 2401 or cons. of instr.; admission to the BSCI Disciplinary Honors Program.

BIOL 4703. Exercise Physiology. 3 cr. hrs.

Study of the effects of acute and chronic exercise on selected organ systems. Particular emphasis will be placed on muscle, cardiovascular, respiratory, and environmental physiology. Prereq: BIOL 3701 or equiv., or cons. of instr.

BIOL 4806. Immunobiology. 3 cr. hrs.

Cellular and molecular mechanisms of the immune response. Nature of antigens and antibodies and their interactions. Topics include: complement, immediate and delayed hypersensitivity, transplantation and tumor immunobiology, immunosuppression and immunological tolerance. 3 hrs. lec., disc.

BIOL 4931. Topics in Biology. 1 cr. hr.

Analysis of selected topics under faculty supervision. S/U grade assessment. A maximum of 3 cr. hrs. of BIOL 4931 will be counted towards major. Prereq: Cons. of instr.

BIOL 4931H. Honors Topics in Biology. 1 cr. hr.

Analysis of selected topics under faculty supervision. S/U grade assessment. A maximum of 3 cr. hrs. of BIOL 4931 can be counted towards major. As a Honors Program course, includes a more intensive research or project component. Prereq: Cons. of instr.; admission to the BSCI Disciplinary Honors Program.

BIOL 4951. MU Led Travel/Study Abroad. 3 cr. hrs.

Course taught in an international setting by Marquette professors and where students earn Marquette credit. Study Abroad expenses apply. Prereq: Cons. of the Office of International Education.

BIOL 4953. Seminar in Undergraduate Research. 1 cr. hr.

Designed to enhance the undergraduate research experience. Emphasis is on critical reading of the literature, presentation skills and research ethics. Prereq: Concurrent enrollment in BIOL 4956 or BIOL 4956H.

BIOL 4953H. Honors Seminar in Undergraduate Research. 1 cr. hr.

Designed to enhance the undergraduate research experience. Emphasis is on critical reading of the literature, presentation skills and research ethics. As a Honors Program course, includes a more intensive research or project component. Prereq: Concurrent enrollment in BIOL 4956 or BIOL 4956H; admission to the BSCI Disciplinary Honors Program.

BIOL 4956. Laboratory Research Project in Biological Sciences. 1-3 cr. hrs.

Laboratory experience in experimental design and analysis of a selected research project with faculty guidance and supervision. A maximum of six cr. hrs. of BIOL 4995 and BIOL 4956 combined will be counted toward the major. Prereq: cons. of dept. ch.

BIOL 4956H. Honors Laboratory Research Project in Biological Sciences. 1-3 cr. hrs.

Laboratory experience in experimental design and analysis of a selected research project with faculty guidance and supervision. A maximum of six cr. hrs. of BIOL 4995 and BIOL 4956 combined can be counted toward the major. As a Honors Program course, includes a more intensive research or project component. Prereq: Cons. of dept. ch.; admission to the BSCI Disciplinary Honors Program.

BIOL 4987. Applying the Internship Experience. 3 cr. hrs.

A weekly seminar that follows the completion of a full-time or part-time internship experience. Students reflect on and share the skills and knowledge that they have gained during their internship experience through presentations, case studies and mentoring. In addition, students present their internship projects to a broader audience of students and faculty in the format of a scientific poster and hone their scientific and technical writing skills through collaborative revision of their final work reports. Prereq: BIOL 3986 or BIOL 3987, and cons. of internship coordinator.

BIOL 4987H. Honors Applying the Internship Experience. 3 cr. hrs.

A weekly seminar that follows the completion of a full-time or part-time internship experience. Students reflect on and share the skills and knowledge that they have gained during their internship experience through presentations, case studies and mentoring. In addition, students present their internship projects to a broader audience of students and faculty in the format of a scientific poster and hone their scientific and technical writing skills through collaborative revision of their final work reports. As a Honors Program course, includes a more intensive research or project component. Prereq: BIOL 3986 or BIOL 3987 or BIOL 3987H, and cons. of internship coordinator; admission to the BSCI Disciplinary Honors Program.

BIOL 4995. Independent Study in Biology. 1-3 cr. hrs.

Readings and analyses of published papers on selected topics in biology. Prereq: Jr. or Sr. stndg., cons. of instr., and cons. of dept ch. A maximum of six (6) cr. hrs. of BIOL 4995 and BIOL 4956 combined will be counted toward the major.

BIOL 4995H. Honors Independent Study in Biology. 1-3 cr. hrs.

Readings and analyses of published papers on selected topics in biology. As a Honors Program course, includes a more intensive research or project component. A maximum of six (6) cr. hrs. of BIOL 4995H and BIOL 4956H combined can be counted toward the major. Prereq: Jr. or Sr. stndg., cons. of instr., and cons. of dept ch.; admission to the BSCI Disciplinary Honors Program.

BIOL 9002H. Honors Student Study/Research Placeholder in Biology. 0 cr. hrs.

Used to enroll a honors student who is not enrolled in the term, but is on campus for an educational experience other than academic credit, such as work in a lab or clinic. Used for tracking purposes only. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.