BIOINFORMATICS (BS/MS)

This accelerated program facilitates the completion of both the BS in Biology and MS in Bioinformatics in just 5 years (in comparison to the 6 years required to pursue the BS and MS separately). Students apply during the spring of their Junior year. The MS component of this program includes two tracks: Non-thesis (internship-based) and Thesis (research based).

CURRICULUM

The following courses are required as part of the BS Biology and MS Bioinformatics degrees.

Code	Title	Hours
Bioinformatics Electives		
Select one of the following: (**Required** BS+MS credit)		3
BIOI 565	Exploring Proteins	
CHEM 465	Special Topics in Biochemistry	
BIOL 390	Molecular Biology Laboratory	4
COMP 353	Database Programming	3
or COMP 379	Machine Learning	
Bioinformatics Fundamental Courses		
BIOL 388	Bioinformatics	3
BIOL 387	Genomics	3
or BIOL 392	Metagenomics	
COMP 483	Computational Biology (BS+MS credit)	4
STAT 437	Quantitative Bioinformatics (BS+MS credit)	3
Select one of the following:		1-4
BIOI 397	Bioinformatics Survey	
BIOI 398	Bioinformatics Internship	
BIOI 399	Bioinformatics Research	
Biology Fundamental Courses		
BIOL 101	General Biology I	3
BIOL 282	Genetics	3
BIOL 283	Genetics Laboratory	1
Chemistry Fundamental Courses		
CHEM 101	General Chemistry A Lecture/Discussion	3
CHEM 102	General Chemistry B Lecture/Discussion	3
CHEM 223	Organic Chemistry A Lec/Disc	3
CHEM 224	Organic Chemistry B Lec/Disc	3
CHEM 361	Principles of Biochemistry	3
Computer Science Fundamental Courses		
COMP 141	Introduction to Computing Tools and Techniques	3
MATH 215	Object-Oriented Programming with Mathematics	3
COMP 231	Data Structures & Algorithms for Informatics	3
Math/Stats Fundamental Courses		
MATH 131	Applied Calculus I	3
MATH 132	Applied Calculus II	3
STAT 335	Introduction to Biostatistics	3
MS Bioinformatics Fundamental Courses		
BIOI 500	Advanced Bioinformatics	3
BIOI 501	Bioinformatics Seminar	1

2 BIOI Electives		6
Total Hours		**74-77**

 Required courses within the major also satisfy the following university Core Curriculum (https://catalog.luc.edu/undergraduate/university-requirements/university-core/) requirements: scientific literacy (6 credits) and quantitative analysis (3 credits)

Sample Course Schedules

The below sequence of courses is meant to be used as a suggested path for completing coursework. An individual student's completion of requirements depends on course offerings in a given term as well as the start term for a major or graduate study. Students should consult their advisor for assistance with course selection. These course schedules display how students may complete the bioinformatics major in addition to their university Core requirements in four years of study:

Sample Schedule B.S. Bioinformatics/ M.S. Bioinformatics Non-thesis Track

Course	Title	Hours
Year 1		
Fall		
BIOL 101	General Biology I	3
CHEM 101	General Chemistry A Lecture/Discussion	3
MATH 131	Applied Calculus I	3
CORE: College Writing Seminar		3
CORE: Theology and Religious Studies Tier 1		3
	Hours	**15**
Spring		
CHEM 102	General Chemistry B Lecture/Discussion	3
COMP 141	Introduction to Computing Tools and Techniques	3
MATH 132	Applied Calculus II	3
CORE: Ethics		3
CORE: Theology and Religious Studies Tier 2		3
	Hours	**15**
Year 2		
Fall		
BIOL 282	Genetics	3
BIOL 283	Genetics Laboratory	1
CHEM 223	Organic Chemistry A Lec/Disc	3
MATH 215	Object-Oriented Programming with Mathematics	3
CORE: Historical Knowledge Tier 1		3
CORE: Philosophical Knowledge Tier 1		3
	Hours	**16**
Spring		
CHEM 224	Organic Chemistry B Lec/Disc	3
COMP 231	Data Structures & Algorithms for Informatics	3
CAS Elective		3
CORE: Historical Knowledge Tier 2		3
CORE: Philosophical Knowledge Tier 2		3
	Hours	**15**

Year 3

Fall

BIOL 388	Bioinformatics [1]	3
CHEM 361	Principles of Biochemistry [1]	3
CAS Elective		3
CAS Language Requirement 1		3
CORE: Literary Knowledge & Experience Tier 1		3
	Hours	**15**

Spring

STAT 335	Introduction to Biostatistics [1]	3
BIOL 387	Genomics [1, 2]	3
CAS Language Requirement 2		3
CORE: Literary Knowledge & Experience Tier 2		3
CORE: Societal and Cultural Knowledge Tier 1		3
Apply for B.S./M.S. Program		
	Hours	**15**

Year 4

Fall

BIOI 565	Exploring Proteins [3, 4]	3
Select one of the following:		3-4
	B.S. Bioinformatics COMP elective	
BIOL 390	Molecular Biology Laboratory	
CAS Elective		3
CORE: Societal and Cultural Knowledge Tier 2		3
CORE: Artistic Knowledge and Experience		3
	Hours	**15-16**

Spring

BIOI 501	Bioinformatics Seminar [5]	1
STAT 437	Quantitative Bioinformatics [3]	3
COMP 483	Computational Biology [3]	4
CAS Elective		3
Select one of the following (Undergraduate Capstone):		4
BIOI 397	Bioinformatics Survey	
BIOI 398	Bioinformatics Internship	
BIOI 399	Bioinformatics Research	
	Hours	**15**

Year 5

Fall

Bioinformatics Elective [5]		3
Bioinformatics Elective [5]		3
BIOI 498	Bioinformatics Internship [5]	1
	Hours	**7**

Spring

BIOI 500	Advanced Bioinformatics [5]	3
Bioinformatics Elective		3
Bioinformatics BIOL Elective [5, 6]		3
Bioinformatics Elective		3
	Hours	**12**
	Total Hours	**140-141**

[1]   Required courses for GPA requirement for admission into B.S./M.S. program.

[2]   Alternatively, BIOL 392 Metagenomics can be taken [Fall only]

[3]   Courses which could be applied towards both the B.S. and M.S. degrees.

[4]   Alternatively CHEM 465 Special Topics in Biochemistry can be taken [Spring odd years only]

[5]   Courses required of the M.S. degree, totaling 30 credit hours.

[6]   If BIOL 388 Bioinformatics taken at the undergraduate level, at least one BIOL elective must be completed.

Sample Schedule B.S. Bioinformatics/ M.S. Bioinformatics Thesis Track

[1]   Required courses for GPA requirement for admission into B.S./M.S. program.

[2]   Alternatively, BIOL 392 Metagenomics can be taken [Fall only]

[3]   Courses required of the M.S. degree, totaling 30 credit hours.

[4]   Courses which could be applied towards both the B.S. and M.S. degrees.

[5]   Alternatively CHEM 465 Special Topics in Biochemistry can be taken [Spring odd years only]

[6]   If BIOL 388 Bioinformatics taken at the undergraduate level, at least one BIOL elective must be completed.

Course	Title	Hours
Year 1		
Fall		
BIOL 101	General Biology I	3
CHEM 101	General Chemistry A Lecture/Discussion	3
MATH 131	Applied Calculus I	3
CORE: College Writing Seminar		3
CORE: Theology and Religious Studies Tier 1		3
	Hours	**15**
Spring		
CHEM 102	General Chemistry B Lecture/Discussion	3
COMP 141	Introduction to Computing Tools and Techniques	3
MATH 132	Applied Calculus II	3
CORE: Ethics		3
CORE: Theology and Religious Studies Tier 2		3
	Hours	**15**
Year 2		
Fall		
BIOL 282	Genetics	3
BIOL 283	Genetics Laboratory	1
CHEM 223	Organic Chemistry A Lec/Disc	3
MATH 215	Object-Oriented Programming with Mathematics	3
CORE: Historical Knowledge Tier 1		3
CORE: Philosophical Knowledge Tier 1		3
	Hours	**16**
Spring		
CHEM 224	Organic Chemistry B Lec/Disc	3
COMP 231	Data Structures & Algorithms for Informatics	3
CAS Elective		3

CORE: Historical Knowledge Tier 2		3
CORE: Philosophical Knowledge Tier 2		3
	Hours	**15**
Year 3		
Fall		
BIOL 388	Bioinformatics [1]	3
CHEM 361	Principles of Biochemistry [1]	3
Select one of the following (Undergraduate Capstone): [1]		3
BIOI 397	Bioinformatics Survey	
BIOI 398	Bioinformatics Internship	
BIOI 399	Bioinformatics Research	
CAS Elective		3
CAS Language Requirement 1		3
CORE: Literary Knowledge & Experience Tier 1		3
	Hours	**18**
Spring		
STAT 335	Introduction to Biostatistics [1]	3
BIOL 387	Genomics [1, 2]	3
Select one of the following (Undergraduate Capstone): [1]		1
BIOI 397	Bioinformatics Survey	
BIOI 398	Bioinformatics Internship	
BIOI 399	Bioinformatics Research	
CAS Language Requirement 2		3
CORE: Literary Knowledge & Experience Tier 2		3
CORE: Societal and Cultural Knowledge Tier 1		3
Apply for B.S./M.S. Program		
	Hours	**16**
Year 4		
Fall		
UNIV 370	Responsible Conduct in Research and Scholarship [3]	0
BIOI 494	Bioinformatics Research Design [3]	1
BIOI 565	Exploring Proteins [4, 5]	3
Select one of the following:		3-4
B.S. Bioinformatics COMP elective		
BIOL 390	Molecular Biology Laboratory	
CAS Elective		3
CORE: Societal and Cultural Knowledge Tier 2		3
	Hours	**13-14**
Spring		
BIOI 501	Bioinformatics Seminar [3]	1
COMP 483	Computational Biology [4]	4
STAT 437	Quantitative Bioinformatics [4]	3
CAS Elective		3
CORE: Artistic Knowledge and Experience		3
	Hours	**14**
Year 5		
Fall		
BIOI 499	Bioinformatics Research [3]	8
	Hours	**8**
Spring		
BIOI 500	Advanced Bioinformatics [3]	3

Bioinformatics Elective		3
Bioinformatics BIOL Elective [3, 6]		3
BIOI 595	Thesis Supervision [3]	1
	Hours	**10**
	Total Hours	**140-141**

[1] Required courses for GPA requirement for admission into B.S./M.S. program.

[2] Alternatively, BIOL 392 Metagenomics can be taken [Fall only]

[3] Courses required of the M.S. degree, totaling 30 credit hours.

[4] Courses which could be applied towards both the B.S. and M.S. degrees.

[5] Alternatively CHEM 465 Special Topics in Biochemistry can be taken [Spring odd years only]

[6] If BIOL 388 Bioinformatics taken at the undergraduate level, at least one BIOL elective must be completed.

Guidelines for Accelerated Bachelor's/Master's Programs

Terms

- Accelerated Bachelor's/Master's programs: In this type of program, students share limited credits between their undergraduate and graduate degrees to facilitate completion of both degrees.

- Shared credits: Graduate level credit hours taken during the undergraduate program and then applied towards graduate program requirements will be referred to as Shared credits.

Admission Requirements

Accelerated Bachelor's/Master's programs are designed to enhance opportunities for advanced training for Loyola's undergraduates. Admission to these programs must be competitive and will depend upon a positive review of credentials by the program's admissions committee. Accordingly, the admission requirements for these programs may be higher than those required if the master's degree were pursued entirely after the receipt of a bachelor's degree. That is, programs may choose to have more stringent admissions requirements in addition to those minimal requirements below.

Requirements:

- Declared appropriate undergraduate major,

- By the time students begin taking graduate courses as an undergraduate, the student has completed approximately 90 credit hours, or the credit hours required in a program that is accredited by a specialty organization,[1]

- A minimum cumulative GPA for coursework at Loyola that is at or above the program-specific requirements, a minimum major GPA that is at or above the program-specific requirements, and/or appropriate designated coursework for evaluation of student readiness in their discipline.[2]

Students not eligible for the Accelerated Bachelor's/Master's program (e.g., students who have not declared the appropriate undergraduate major) may apply to the master's program through the regular admissions process. Students enrolled in an Accelerated Bachelor's/Master's program who choose not to continue to the master's degree program upon completion of the bachelor's degree will face no consequences.[3]

Ideally, a student will apply for admission (or confirm interest in proceeding towards the graduate degree in opt-out programs) as they

approach 90 credit hours. Programs are encouraged to begin advising students early in their major so that they are aware of the program and, if interested, can complete their bachelor's degree requirements in a way that facilitates completion of the program. Once admitted as an undergraduate, Program Directors should ensure that students are enrolled using the plan code associated with the Accelerated Bachelor's/Master's program. Using the plan code associated with the Accelerated Bachelor's/Master's program will ensure that students may be easily identified as they move through the program. Students will not officially matriculate into the master's degree program and be labeled as a graduate student by the university, with accompanying changes to tuition and Financial Aid (see below), until the undergraduate degree has been awarded. Once admitted to the graduate program, students must meet the academic standing requirements of their graduate program as they complete the program curriculum.

[1] Programs that have specialized accreditation will adhere to the admissions criteria provided by, or approved by, their specialized accreditors.

[2] The program will identify appropriate indicators of student readiness for graduate coursework (e.g., high-level performance in 300 level courses). Recognizing differences between how majors are designed, we do not specify a blanket requirement.

[3] If students choose not to enroll in the Accelerated Bachelor's/Master's program, they still must complete all of the standard requirements associated with the undergraduate degree (e.g., a capstone).

Curriculum

Level and progression of courses. The Accelerated Bachelor's/Master's programs are designed to be competitive and attractive to our most capable students. Students admitted to Accelerated Bachelor's/Master's programs should be capable of meeting graduate level learning outcomes. Following guidance from the Higher Learning Commission, only courses taken at the 400 level or higher (including 300/400 level courses taken at the 400 level) will count toward the graduate program.[1,2] Up to 50% of the total graduate level credit hours, required in the graduate program, may come from 300/400 level courses where the student is enrolled in the 400 level of the course. Further, at least 50% of the credit hours for the graduate program must come from courses that are designed for and restricted to graduate students who have been admitted to a graduate program at Loyola (e.g., enrolled in plan code that indicates the Accelerated Bachelor's/Master's program, typically ending with the letter "D").[3]

In general, graduate level coursework should not be taken prior to admission into the Accelerated Bachelor's/Master's program. Exceptions may be granted for professional programs where curriculum for the Accelerated Bachelor's/Master's program is designed to begin earlier. On the recommendation of the program's Graduate Director, students may take one of their graduate level courses before they are admitted to the Accelerated Bachelors/Master's program if they have advanced abilities in their discipline and course offerings warrant such an exception.[4] Undergraduate degree requirements outside of the major are in no way impacted by admission to an Accelerated Bachelor's/Master's program.[5]

Shared credits. Undergraduate courses (i.e., courses offered at the 300 level or below) cannot be counted as shared credits nor count towards the master's degree. Up to 50% of the total graduate level credit hours, required in the graduate program, may be counted in meeting both the undergraduate and graduate degree requirements. Of those shared credits, students in an Accelerated Bachelor's/Master's program should begin their graduate program with the standard introductory course(s)

for the program whenever possible. So that students may progress through the Accelerated Bachelor's/Master's program in a timely manner, undergraduate programs are encouraged to design their curriculum such that a student can complete some required graduate credit hours while completing the undergraduate degree. For instance, some of the graduate curriculum should also satisfy electives for the undergraduate major.

The program's Graduate Director will designate credit hours to be shared through the advising form and master's degree conferral review process. Shared credit hours will not be marked on the undergraduate record as having a special status in the undergraduate program. They will be included in the student's undergraduate earned hours and GPA. Graduate credit hours taken during the undergraduate program will not be included in the graduate GPA calculation.

[1] If students wish to transfer credits from another university to Loyola University Chicago, the program's Graduate director will review the relevant syllabus(es) to determine whether it meets the criteria for a 400 level course or higher.

[2] Programs with specialized accreditation requirements that allow programs to offer graduate curriculum to undergraduate students will conform to those specialized accreditation requirements.

[3] In rare cases, the Graduate Director may authorize enrollment in a 400-level course for a highly qualified and highly motivated undergraduate, ensuring that the undergraduate's exceptional participation in the graduate class will not diminish in any way the experience of the graduate students regularly enrolled.

[4] For example, if a particular course is only offered once every 2-3 years, and a student has demonstrated the necessary ability to be successful, the Graduate Director may allow a student to take a graduate level course to be shared prior to the student being formally admitted to the graduate program. See, also, footnote 4.

[5] Students should not, for example, attempt to negotiate themselves out of a writing intensive requirement on the basis of admission to a graduate program.

Graduation

Degrees are awarded sequentially. All details of undergraduate commencement are handled in the ordinary way as for all students in the School/College/Institute. Once in the graduate program, students abide by the graduation deadlines set forth by the graduate program. Students in these programs must be continuously enrolled from undergraduate to graduate degree program unless given explicit permission by their program for a gap year or approved leave of absence.

LEARNING OUTCOMES

Loyola's BS Biology/MS Bioinformatics Program will prepare you with:

- technical skills at the interface of biology, computer science, chemistry and statistics;
- biological and chemical laboratory techniques;
- computer programming capabilities;
- statistical techniques to analyze results from laboratory experiments and computer outputs
- an understanding of key problems, proposed solutions, and future challenges of the bioinformatics field; and
- the ability to conduct bioinformatics study in industry and/or the research environment.