

Bioinformatics

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Bioinformatics is the study of biology and medicine using the discrete analytical tools of mathematics and computer science. Technologies spawned by the Human Genome Project have produced an avalanche of biological and biomedical data in the last two decades, with more being generated all the time. In order to make sense of this data computational and statistical techniques are essential, in addition to a deep understanding of biology.

The goal of the B.S. degree is to train students deeply in both computer science and biology, along with some training in math and chemistry. This will prepare students for a variety of options including:

- entering the workforce in the healthcare, biotechnology, and pharmaceutical industries, or in research institutes affiliated with governments, universities, and hospitals
- graduate programs at the Masters or Doctoral level
- pre-professional training programs such as medical school or dental school.

This is a growing field with a wide range of career opportunities at all degree levels; demand is high for individuals with the combination of biological knowledge and computational skills.

Bioinformatics at Saint Vincent College provides students with a distinctive combination of analytical and scientific training coupled with a broad-based liberal arts education. This mixture is a natural fit at Saint Vincent, allowing students to experience interdisciplinary connections both among the sciences and in relation to the world around them. Opportunities for exploring individual interests within and across disciplines are encouraged, including summer internships and research experiences, and students are able to design and carry out their own bioinformatics project as a capstone experience.

BS Bioinformatics

Requirements for a Bachelor of Science degree in Bioinformatics
(See Core Curriculum requirements.)

Major Requirements (66 credits)

The student must complete the requirements listed in the following categories:

Computing and Information Science Requirements (18 credits)

CS 110	Computing and Information Science I	3
CS 111	Computing and Information Science II	3
CS 170	Discrete Structures I	3
CS 221	Data Structures	3
CS 350	Database Concepts and Information Structures	3
Choose one from the following courses:		
CS 205	Web Site Design and Programming	3
CS 255	Introduction to Artificial Intelligence	3
CS 270	Introduction to Numerical Computation	3
CS 305	Web Technologies	3
CS 310	Programming Languages	3

Mathematics Requirements (4 credits)

MA 111	Calculus I	4
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Biology Requirements (23 credits)

BL 150	General Biology I	3
BL 151	General Biology Laboratory I	1
BL 152	General Biology II	3
BL 153	General Biology Laboratory II	1

BL 208	Cell Biology	3
BL 209	Cell Biology Laboratory	1
BL 214	Molecular Genetics	3
BL 215	Molecular Genetics Laboratory	1
BL 260	Biostatistics	3
Choose one lecture and associated lab from the courses listed below:		
BL 212	Microbiology	3
BL 213	Microbiology Laboratory	1
BL 216	Biotechnology	3
BL 217	Biotechnology Laboratory	1
BL 222	Developmental Biology	3
BL 223	Developmental Biology Laboratory	1
BL 224	Mammalian Physiology	3
BL 225	Mammalian Physiology Laboratory	1
BL 234	Evolution and Systematics	3
BL 235	Evolution and Systematics Laboratory	1
BL 250	Medical Microbiology	3
BL 251	Medical Microbiology Laboratory	1
CH 251	Proteins and Metabolism	3
CH 253	Proteins and Metabolism Laboratory	1
CH 252	Nucleic Acids and Membranes	3
CH 254	Nucleic Acids and Membranes Laboratory	1

Chemistry Requirements (12 credits)

CH 101	General Chemistry I	3
CH 102	General Chemistry II	3
CH 103	General Chemistry Laboratory I	1
CH 104	General Chemistry Laboratory II	1
CH 221	Organic Chemistry I	3
CH 223	Organic Chemistry I Laboratory	1

Bioinformatics Requirements (9 credits)

BIN 218	Bioinformatics, Genomics, and Proteomics	3
BIN 219	Biomedical Informatics	3
BIN 358	Bioinformatics Project I	1
BIN 359	Bioinformatics Project II	2

*General Chemistry I & II (or General Biology I & II) with laboratory fulfill the Natural Science core requirement. Calculus I fulfills the Mathematics core requirement.

**Students interested in applying for medical school should take CH 222/224 Organic Chemistry II and laboratory.

***Students interested in applying for PhD programs or medical school are encouraged to take CH 251 Proteins and Metabolism or CH 252 Nucleic Acids and Membranes. These courses require CH 221-224 as prerequisites.

Typical First-Year Schedule

	Fall	Spring
General Biology I and II	3	3
General Biology Laboratory I and II	1	1
Computing and Information Science I and II	3	3
General Chemistry I and II	3	3
General Chemistry Laboratory I and II	1	1
Language & Rhetoric and Exploring Religious Meaning (Core)	3	3
Total:	14	14

Course Descriptions

BIN 110 Genes, Cells, and Computers

This course provides an introduction to selected topics in biology that are necessary for taking one or both of the Bioinformatics courses, BIN 218 (Bioinformatics, Genomics, and Proteomics) and BIN 219 (Biomedical Informatics). It is targeted towards non-Biology students who are potentially interested in taking the upper-level Bioinformatics courses, such as CIS majors, Math

majors, and Physics majors, though any student with interest may take the course. Topics covered include cellular structure and function, gene structure and function, genetics, molecular evolution, and quantitative and computational approaches to biology. In addition some ethical and societal issues created by the vast amounts of biological data available will be discussed. This course is a Tier I Natural Science Core course. Spring semester. Three credits.

BIN 111 Genes, Cells, and Computers Lab

This course is the companion laboratory course to BIN 110. The labs will be evenly divided between wet lab experiments and computational labs. In the wet labs students will carry out some basic molecular biology techniques such as PCR analysis and molecular cloning, while in the computational labs they will apply computational techniques to answer complementary questions to those addressed in the wet lab. This course is a Tier 1 Natural Science Core course. Must be taken concurrently with BIN 110. Spring semester. One credit.

BIN 218 Bioinformatics, Genomics, and Proteomics

An introduction to various techniques used in bioinformatics, including the algorithms and statistical concepts upon which they are based. The focus is on comparison and analysis of DNA and protein sequences. Students will learn about the types of biological questions that can be addressed using computational methods, and develop a deeper understanding of the computational tools available to address these questions. This understanding will be demonstrated in an end-of-semester project. Topics covered will include pairwise sequence alignment, sequence database searching, multiple sequence alignment, genome analysis, protein structure modeling, and an introduction to proteomics. Students majoring in any of the natural sciences, computing and information science, or mathematics are welcome to take the course. Prerequisites: BL 150-154 (for Biology majors) or BIN 110/111 (for all others), MA 109 or MA 111. Offered every other Fall semester (Fall 2009). Three credits.

BIN 219 Biomedical Informatics

An introduction to a variety of data types, databases, and data structures used in bioinformatics. The focus is on relational databases and integration of diverse data types in a biomedical context. Students will learn how existing database tools, such as Microsoft Access, can be used in biomedical informatics using data from clinical trials as an example. Topics covered will include relational databases, data modeling, and integration of biological data. Also covered will be introductions to various biomedical assays (e.g. flow cytometry, microarrays, enzyme-linked immunosorbent assays) and the types of data they produce. Students majoring in any of the natural sciences, computing and information science, or mathematics are welcome to take the course. Prerequisites: BL 150-154 (for Biology majors) or BIN 110/111 (for all others), MA 109 or MA 111. Offered every other Fall semester (Fall 2010). Three credits.

BIN 333 Special Study

The student will pursue a faculty directed course of study. Variable credit. May be repeated.

BIN 358 Bioinformatics Project I

The capstone senior project is begun in this course. The student will pick a project, research the literature, and determine the requirements for completing the project. The student will present a project proposal, and may begin working on the project. Projects may be part of a team project, and students may have co-advisors from different departments. One credit. Fall semester.

BIN 359 Bioinformatics Project II

The capstone senior project initiated in BIN 358 is completed in this course. The student will give written and oral presentations on the project at the end of the semester. Two credits. Spring semester. Prerequisite: BIN 358.

BIN 550 Bioinformatics Internship

Work experience program extending the learning experience beyond the college into the world of work, through internships, fieldwork, and cooperative programs. Students may or may not be paid depending on the site. May be repeated. Variable Credit.