

MATHEMATICAL BIOLOGY

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Overview of the Concentration

Advances in the mathematical sciences — mathematics, statistics, and computer science — have brought new perspectives to biological research. By answering questions that cannot be addressed using other means, the mathematical sciences can provide indispensable tools for biological research. The result is the interdisciplinary field of mathematical biology, which involves developing analytical and computational predictive models of biological systems.

The concentration at St. Olaf is intended to train students in mathematical biology, allowing them to understand the development and applications of quantitative approaches to biological problems and how these handshake with experimental design. With the large number of subfields in mathematical biology today, the concentration allows students to pursue a path that best suits their interest (e.g., mathematical modeling, bioinformatics).

Students completing the concentration will be equipped with the skills necessary to enter the fast-growing field of mathematical biology or pursue graduate work in this area, other areas of applied mathematics, and especially in biological fields for which modeling or bioinformatics skills are expected.

Intended Learning Outcomes for the Concentration

Students will:

1. describe the range of biological questions dependent on or enhanced by mathematical approaches.
2. translate biological problems into mathematical models using appropriate mathematical, statistical, and computational tools.
3. validate mathematical models using appropriate biological experimentation and data analysis.
4. practice communication skills across the two disciplines.

Requirements

Requirements for the Concentration

The mathematical biology concentration consists of 5 credits, an integrative project, and participation in a Math Biology Symposium. A student may petition to count a course other than the pre-approved electives toward his or her concentration if the student can show and the director concurs that the course includes an integrative component related to mathematical and/or computational biology.

Code	Title	Credits
Mathematical Biology Core Course		
This course presents the essential modeling techniques of formulation, implementation, validation, and analysis and applies these tools to a wide variety of biological systems and disciplines.		

MATH 236 Mathematics of Biology 1.00

Mathematics/Computer Science/Statistics Electives

Select two of the following courses that focus on modeling, computational, or statistical techniques: 2.00

CSCI 251	Software Design and Implementation
MATH 230	Differential Equations I
MATH 242	Modern Computational Mathematics
MATH 330	Differential Equations II
SDS 264	Data Science 2
SDS 172	Statistics 1
SDS 284	Biostatistics: Design and Analysis

Biology Electives (select two): 2.00

BIO 233	Intermediate Genetics
BIO 247	Animal Physiology
BIO 261	Ecological Principles
BIO 315	Principles of Bioinformatics
BIO 324	Evolutionary Genetics
BIO 371	Field Ecology
BIO 383	Evolutionary Biology
ENVST 255	Remote Sensing and Geographic Information Systems
NEURO 239	Cellular and Molecular Neuroscience

Integrative Project

Students are required to work on an independent project that integrates mathematics, computer science, and/or statistics with biology.

Senior Math Biology Symposium

Seniors present their independent project in the form of a poster in a Mathematical Biology Symposium held at St. Olaf in the spring.

Total Credits 5

Integrative Project

The project must be approved by the director in order for the student to finish the concentration. There are many ways in which the project can be completed. For example, the level III biology electives in the concentration all include final projects that allow a student to work on an integrative project for the concentration. Other experiences that could fulfill this requirement include a research project such as a summer Research Experience for Undergraduates (REU); a project in the expanded Center for Interdisciplinary Research (CIR); working with faculty to develop a module for a course; an independent research or independent study with a faculty member; or working with a faculty member to develop a computational lab that could be incorporated into an existing course.

Senior Math Biology Symposium

The symposium is open to the public and provides students the opportunity to explain mathematical and biological concepts to a broad audience. In addition, the symposium is an event that brings

together all the students in the concentration, thus strengthening the mathematical biology community here at St. Olaf.

Courses

MABIO 130: *Exploring Biomathematics (0.25)*

Students spend one evening each week exploring topics at the interface of mathematics and biology. Faculty introduce topics supported by a reading assignment to be done prior to class. Class time is spent exploring the problem and developing the mathematical approach to solving it. Topics may include invasive species, sex-ratio evolution, neural networks, feedback control, graph theory, statistical ecology, and population genetics. P/N only. Offered annually in the spring semester.

Prerequisite: MATH 119 or MATH 120 or equivalent.

Faculty

Program Director, 2025-2026

Steven A. Freedberg

Professor of Biology

evolutionary biology; computer simulation modeling; bioinformatics