

Concentration in Mathematical Biology

Director: Becky Vandiver (RMS 501)

CATALOG DESCRIPTION

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 by 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 these models. 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 or 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 the field.

Requirements for the concentration

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

1. *Mathematical Biology Core.* The core course for the concentration is Math 236: *Mathematics of Biology*. 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.
2. *Mathematics/Computer Science/Statistics Electives.* Two electives are required in MSCS that focus on modeling, computational, or statistical techniques. Courses that fulfill this requirement include the following:
 - Mathematics 230: *Differential Equations I*
 - Mathematics 242: *Modern Computational Mathematics*
 - Mathematics 330: *Differential Equations II*
 - Computer Science 125: *Principles of Computer Science* or Computer Science 251: *Software Design and Implementation*
 - Computer Science 315: *Bioinformatics*
 - Statistics 212: *Statistics for the Sciences* or Statistics 272: *Statistical Modeling*
 - Statistics 282: *Topic: Biostatistics* (pending that this will be offered regularly)
3. *Biology Electives.* Two course electives in biology are required. Courses that fulfill this requirement include the following:
 - Biology 233: *Intermediate Genetics*
 - Biology 247: *Animal Physiology*
 - Biology 261: *Ecological Principles*
 - Biology 315: *Principles of Bioinformatics*
 - Biology 371: *Field Ecology*
 - Biology 383: *Evolutionary Biology*
 - Biology/Environmental Studies 350: *Biogeochemistry*
 - Neuroscience 239: *Cellular and Molecular Neuroscience*

4. *Integrative Project.* Students are required to work on an independent project that integrates mathematics, computer science, and/or statistics with biology. The project must be approved by the director in order for the student to finish the concentration. The 300-level biology electives in the concentration all include independent 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 (eCIR); 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.
5. *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. 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.

Proposed Learning Outcomes for the concentration

Students will demonstrate:

1. the ability to describe biological systems from molecular to ecosystem scales in terms of static and dynamic processes using appropriate terminology and resources to identify questions and the parameters needed to address these.
2. the ability to use computers to acquire and process data and graphically display data in a variety of representations.
3. the ability to select appropriate approaches/methods and tools to generate mathematical models of aspects of biology.
4. the ability to use mathematical and computational methods to analyze biological problems and to make informed decisions based on interpretations of the results.
5. the ability to effectively communicate quantitative ideas to biologists and biological ideas to mathematicians.