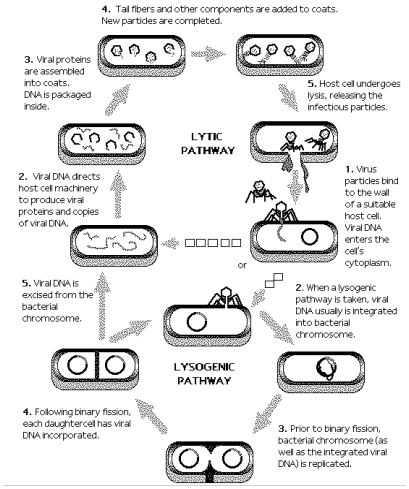
BMC-IMB

Biology Mathematics Connection Program
Integrating Mathematics and Biology Program

BMC pioneered a series of instructional modules for use in high school mathematics and biology classrooms to highlight the interconnections between the mathematical and biological sciences.

IMB follows up by developing the BMC modules into a textbook that will be the cornerstone of a new biomathematics course for high school seniors being created by the program.



BMC-IMB Activities

Developing, testing, and implementing an innovative mix of fifteen biomath instructional modules for grades 9-12

Developing, testing and implementing a new biomath course for high school seniors

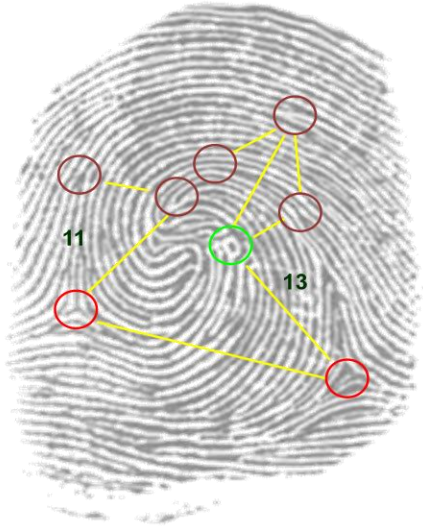
Expanding the fifteen BMC modules into textbook units, developing and testing five additional units to be combined with the previous fifteen units into a textbook for the course

Hosting workshops to assist authors in writing the modules/units and teachers in teaching them

Widely disseminating the materials we create

Sample Module Questions

- What role does behavior play in evolutionary fitness?
- What alignment of two sequences is biologically most meaningful?
- What digraph properties provide insight into predator/prey and food web behaviors?
- How do researchers determine the home range of a particular species?
- How effective are disease-outbreak intervention strategies?



DIMACS
Center for Discrete Mathematics & Theoretical Computer Science
Founded as a National Science Foundation Science and Technology Center

BMC-IMB Partners

- DIMACS, Rutgers University (PI: Fred Roberts; co-PI: Midge Cozzens)
- Consortium for Mathematics and Its Applications COMAP (Solomon Garfunkel)
- Colorado State University (Len Albright)
- Boston University (Gary Benson)
- IMB Partner Schools in ND, MO, OK, GA, MA

NSF

Evolution by Substitution
In this module students relate DNA changes and resulting amino acid substitutions to evolution by analyzing the various pathways of change which could occur in a single amino acid position and, facilitated by the use of transition matrices, develop a powerful model for explaining and predicting long-term mutation probabilities.

Imperfect Testing
This module uses an interrupted case study approach to answer the following two questions: What do the results of an imperfect medical test actually mean? How does this information affect public policy or personal decision making?

Genetic Inversions
In this module students explore the basic concepts of DNA and chromosomal inversions by introducing the idea of gene rearrangements in a game that leads students through a series of improved algorithms.

Spider Silk
This module invites students to pose and answer the fundamental question: "What alignment of two sequences is biologically most meaningful?" Students explore the field of bioinformatics by developing the principles used to align nucleotide and peptide sequences.

Biostatistics
This module investigates factors related to being overweight by exploring the relationship between waist circumference and being overweight.

Help! I'm Surrounded by Squirrels: Habitat Selection
This module has students develop a method to infer habitat preferences based upon species abundance measures and uses this method to predict changes in population as land use changes over time.

Food Webs
This module develops a directed graph (digraph) model for a food web. Students learn about predator-prey relationships and use digraph properties to provide insight into the food web and the species contained within.

What's My Ecological Impact?
This module helps students see themselves and humans in general as intimately connected to the environment. Ecological footprinting is developed as a tool for assessing humans' impact and as a decision- making tool.

Drawing Lines: Spatial Arrangements of Biological Phenomena
This module examines an underlying principle governing the partitioning of a space in a wide range of biological contexts. Students examine how the minimization of energy expenditure results in a "nearest-neighbor" dynamic that helps model biological phenomena.

Home Range Analysis
This module collects and analyzes actual data to determine the home range of a number of species, including the size and breadth of the home range, and how one would create a buffer zone for the home range.

Pass it on! Disease Competition
This module examines infectious diseases from the perspective of evolutionary biology on a basic level. Students gain an understanding of how different methods of pathogen reproduction can greatly affect the fitness of a disease.

Computer Modeling of Disease Outbreaks
This module uses two hypothetical infectious disease outbreaks, which students simulate, to introduce and develop mathematical models for disease spread.

Genetic Epidemiology: Finding Disease Susceptibility Alleles in Presence of Population Stratification
This module explores the potential for falsely identifying a genetic factor as increasing risk of disease when the individuals chosen for study are not genetically homogeneous.

CrIME: Criminal Investigations through Mathematical Examination
This module uses fingerprint analysis to introduce students to some basic mathematical forensics concepts and the biological concept of individual identification.

Neuroscience of Pain
Students are introduced to neuroscience by exploring how it relates to pain perception. Students learn how pain and its intensity are described and categorized by creating and analyzing their own survey.

Tomography
This module provides a real-life example to understand one of the important tools available to physicians in understanding the biological status of the human body.

Array of Hope
This module simulates a doctor with a patient diagnosed with melanoma. Students use microarrays to find the best treatment for this patient. Students learn how to read a microarray and analyze the individual results taking into consideration variability of tests and standard deviation.

Quorum Sensing
This module models the phenomenon of quorum sensing. Students will develop an understanding of the basic structure of a bacterium and how they grow through binary fission.

DNA Sequencing and Sorting
This module explores the laboratory and computer technique of genome sequencing, used to study DNA and identify variations that exist among people.