

Prof. **Glenn Ledder**: Avery 334 gledder@math.unl.edu 472-7382
Class web page: <http://www.math.unl.edu/~gledder/biomath/>
Office hours: _____

The class web page will contain schedule information, Matlab files, and copies of all handouts needed for the course. There is also a facility that allows you to send me anonymous feedback.

Text: We'll use notes prepared specially for the course.

Calculator: You are required to have a graphing calculator for this course. The TI-85 and TI-86 are recommended.

Scheduling: Because the course is new, it is not practical to list topics with dates. A tentative list of topics is provided and will be updated on the web as needed.

GRADING

Your grade will be based on the following items:

1 Final Exam	200 pts
5 Hour Exams	400 pts
Other stuff	200 pts (approximately)

The grading scale for exams will be determined **after** grading. The grading scale for the other stuff is predetermined :

A: 90 A-: 87 B+:84 B:80 B-:77 C+:74 C:70 C-:67 D+:64 D:60 D-:57.

The overall grading scale will be the sum of the individual grading scales and will be used to determine your base grade. The actual grade you receive in the course may be higher than the base grade if you show improvement on the final exam.

EXAMS

You will be allowed to use any calculator, but there may be questions for which calculator use is restricted. Exams are to test conceptual understanding as well as routine calculations, so some exam questions will not be exactly like the homework exercises.

Special Dates:

January 20 is the last day to withdraw without the course appearing on your transcript.

March 3 is the last day to change your grade option to or from Pass/No Pass.

April 7 is the last day to withdraw from the course with a grade of W.

The Final Exam is scheduled for Monday, May 1, from 3:30 to 5:30 pm in Oldfather 307. We'll reschedule only if we have unanimous agreement.

Departmental grading appeals policy: Students who believe their academic evaluation has been prejudiced or capricious have recourse for appeals to (in order) the instructor, the departmental chair, the departmental appeals committee, and the college appeals committee.

COURSE OVERVIEW

The National Research Council published a report in 2003 called *BIO2010: Transforming Undergraduate Education for Future Research Biologists*. This report outlines recommendations for improvements in the undergraduate biology curriculum, including significant changes in the mathematical preparation of biology students. The report identifies a number of topics at a level beyond Calculus I that are highly useful in biology, including sequences and difference equations, differential equations, linear algebra, and probability. The standard math curriculum, designed for physical sciences, requires a student to take 5 courses beyond Calc I to see all of this material. UNL is responding to the challenge by creating a course that requires only Calc I as a prerequisite and treats a number of these topics. There are a lot of useful mathematics concepts and techniques that ultimately come down to an understanding of the ideas of calculus along with proficiency in algebraic techniques. Problems that require sophisticated integration techniques, sophisticated linear algebra computations, or numerical approximation can be done by computer.

COURSE GOALS

The goals of Mathematical Methods in Biology and Medicine (MMBM) are for students to

1. learn a number of mathematical techniques that find application in biology
2. become comfortable thinking of biological problems in mathematical terms
3. become able to read biology materials that include some mathematics

COURSE TOPICS

The course is divided into 5 topic areas.

1. Models and Data

Mathematics (in the guise of statistics) is used to analyze data and to develop mathematical models for quantitative phenomena in biology. We'll start with a basic study of the interactions between mathematics and biology and between theory and experiment.

2. Univariate Dynamic Models

Difference equations and differential equations are used in ecology to create simple models of single populations. We'll focus particularly on resource management problems.

3. Probability

Probability arises in genetics and is used to develop statistical tools. We'll emphasize the use of probability in data analysis, otherwise known as "statistics."

4. Discrete Dynamical Systems

We will use linear algebra to extend our work on difference equations and develop stochastic models. We'll focus particularly on structured population dynamics and epidemiology.

5. Continuous Dynamical Systems

Systems of differential equations arise in ecology, biochemistry, epidemiology, and physiology. We will learn elementary techniques for understanding differential equation models. We'll focus particularly on biochemical kinetics, including Michaelis-Menten kinetics.

TOPICS for MATHEMATICAL METHODS IN BIOLOGY AND MEDICINE

1. MODELS AND DATA
 - 1.1. Characterizing Data
 - 1.2. Mathematical Models
 - 1.3. Linear Regression
 - 1.4. Fitting Models to Data

2. UNIVARIATE DYNAMIC MODELS
 - 2.1. Discrete Population Models
 - 2.2. Continuous Population Models
 - 2.3. Graphical Analysis
 - 2.4. Linearized Stability Analysis
 - 2.5. Discrete and Continuous Models

3. PROBABILITY
 - 3.1. Concepts of Probability
 - 3.2. Counting
 - 3.3. Set Relationships and Probability Rules
 - 3.4. Independence and Conditional Probability
 - 3.5. Discrete Random Variables
 - 3.6. Continuous Random Variables
 - 3.7. A Catalog of Probability Models
 - 3.8. Applications of Probability to Data Analysis

4. DISCRETE DYNAMICAL SYSTEMS AND STOCHASTIC PROCESSES
 - 4.1. Discrete Models and Matrices
 - 4.2. Eigenvalues and Eigenvectors
 - 4.3. Linear Approximation
 - 4.4. Stability of Discrete Nonlinear Systems
 - 4.5. Markov Chains
 - 4.6. Stopping Time and Extinction

5. CONTINUOUS DYNAMICAL SYSTEMS
 - 5.1. Continuous Models
 - 5.2. Phase Plane Analysis
 - 5.3. Nullclines
 - 5.4. Equilibria and Stability
 - 5.5. Stability of Continuous Nonlinear Systems