Biochemistry 570:
Computational Modeling of Biological Systems

Credits: 3

Course URL: https://canvas.wisc.edu/courses/?????

Course Designations and Attributes:
Breadth – Biological Science
Level – Advanced

Meeting Time and Location
MWF 1:20 – 2:10, 2131 Biochemistry

Instructional Mode: all face-to-face

Credit Hour Definition
This class meets for three 50-minute class periods each week over the spring semester and carries the expectation that students will work on course learning activities (reading, problem sets, studying, etc) for about 2 hours out of classroom for every class period.

INSTRUCTORS AND TEACHING ASSISTANTS

Instructors:

Dr. Philip Romero, Assistant Professor
3204B Biochemical Sciences
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Office hours: Mondays, 2:15-3:15

Dr. Ophelia Venturelli, Assistant Professor
3204C Biochemical Sciences
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Office hours: Fridays, 2:15-3:15

Teaching Assistant:

Jerry Duan, Graduate Student
3270 Biochemical Sciences
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Office hours: Wednesdays, 2:15-3:15

COURSE DESCRIPTION

Introduction to the mathematical and computational tools needed to model biological systems spanning from molecules to ecosystems. Topics include protein folding and dynamics, gene regulation, biomolecular networks, and population dynamics. The goal of this course is to teach life sciences undergraduates the fundamentals in quantitative thinking and analytical reasoning about complex biological systems. This course requires no prior knowledge of differential equations, linear algebra, or programming.

Requisites: MATH 222, and [BIOLOGY/ZOOLOGY 101, BIOLOGY/ZOOLOGY 102, and BIOLOGY/BOTANY 130] or ZOOLOGY/BIOLOGY/BOTANY 151, ZOOLOGY 153, or BIOCORE 381

LEARNING OUTCOMES

By the end of Biochemistry 375, students should be able to:

1. Perform scientific computations in the Python programming language
2. Design, simulate, and analyze mathematical models of biological systems
3. Understand how to model biological systems across different scales
4. Think critically about model assumptions/validity
5. Communicate scientific findings in oral and written form

GRADING

Grade breakdown

Homework	20%
Midterm exams (2)	30%
Final project	20%
Final exam	30%

Letter Grades

Points	Grade
96-100	A
91-95	AB
86-90	B
81-85	BC
71-80	C
61-70	D
0-60	F

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

- *Mathematical Modeling in Systems Biology: An Introduction*, by Brian Ingalls
    - Available free online: http://www.math.uwaterloo.ca/~bingalls/MMSB/

- Access to a computer with the Python programming language installed. Python is available on all UW-Madison Computer Labs (InfoLabs) computers https://it.wisc.edu/services/computer-labs-infolabs/

EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

- The course grade will consist of two midterm exams, a final project, and a final exam.
- Exams are cumulative, in-class, with open books/notes.

HOMEWORK & OTHER ASSIGNMENTS

- Homework should be submitted in class on the due date.

Course schedule

Week 1			**Weekly Reading**
	Jan 23	Modeling in biology	None
	Jan 25	Python basics	None
Week 2			
	Jan 28	Python basics	None
	Jan 30	Chemical reaction networks	Pages 17-25
	Feb 1	Chemical reaction networks	Pages 26-36
Week 3			
	Feb 4	Enzyme kinetics	Pages 47-54
	Feb 6	Enzyme kinetics	Pages 55-62
	Feb 8	Enzyme kinetics	Pages 63-69
Week 4			
	Feb 11	Analysis of dynamical systems	Pages 77-82
	Feb 13	Analysis of dynamical systems	Pages 83-88
	Feb 15	Analysis of dynamical systems	Pages 89-94
Week 5			
	Feb 18	Analysis of dynamical systems	Pages 95-100
	Feb 20	Analysis of dynamical systems	Pages 101-105
	Feb 22	Midterm #1	None
Week 6			
	Feb 25	Metabolic networks	Pages 111-120
	Feb 27	Metabolic networks	Pages 121-131
	Mar 1	Metabolic networks	Pages 132-142
Week 7			
	Mar 4	Signal transduction	Pages 149-158
	Mar 6	Signal transduction	Pages 159-170
	Mar 8	Signal transduction	Pages 171-179
Week 8			
	Mar 11	Gene regulatory networks	Pages 189-210
	Mar 13	Gene regulatory networks	Pages 211-230
	Mar 15	Gene regulatory networks	Pages 231-247
Week 9			
	Mar 18	Spring Recess	
	Mar 20	Spring Recess	
	Mar 22	Spring Recess	
Week 10			

	Mar 25	Midterm #2	None
	Mar 27	Molecular dynamics	None
	Mar 29	Molecular dynamics	None
Week 11			
	Apr 1	Molecular dynamics	None
	Apr 3	Molecular dynamics	None
	Apr 5	Molecular dynamics	None
Week 12			
	Apr 8	Electrophysiology	Pages 263-270
	Apr 10	Electrophysiology	Pages 271-274
	Apr 12	Electrophysiology	Pages 275-278
Week 13			
	Apr 15	Ecological systems	None
	Apr 17	Ecological systems	None
	Apr 19	Ecological systems	None
Week 14			
	Apr 22	Final project presentations	
	Apr 24	Final project presentations	
	Apr 26	Final project presentations	
Week 15			
	Apr 29	Final project presentations	
	May 1	Final project presentations	
	May 3	Final project presentations	

RULES, RIGHTS & RESPONSIBILITIES

- See the Guide's Rules, Rights and Responsibilities

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/