### Physioiology 472/572, Applied Mathematics 572  
**Quantitative modeling of biological systems (3 units)**  
**Fall 2021**

| Coordinator | Timothy W. Secomb, Ph.D.  
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|-------------|--------------------------------------------------|
| Time, location | 9:30-10:45 am Tuesday and Thursday  
Meinel Optical Sciences, Rm 432 |
| Office hours | By appointment, please email secomb@u.arizona.edu |
| Website | [http://physiology.arizona.edu/physiology-472572-fall-2021-information](http://physiology.arizona.edu/physiology-472572-fall-2021-information) |

**Grading**

Regular grades are awarded for this course: A B C D F  
The grades will be assigned on the following basis:  
PSIO472: Midterm 30%, Final exam 40%, Homework 15%, Report and presentation 15%  
PSIO572: Midterm 25%, Final exam 35%, Homework 10%, Report and presentation, 30%  
The final grade for the course will be based on the total score out of 100. Grades will not be lower than the following: 90% to 100%: A; 80% to 90%: B; 70% to 80%: C; 60% to 70%: D; 0% to 60%: F

**Prerequisite(s)**  
MATH 129 or equivalent. A course in ordinary differential equations is recommended but not required.

**Description**

Techniques for development of mathematical models for biological phenomena. Examples of molecular, cellular, tissue-level and population-level processes are considered. Underlying mathematical and biological concepts are introduced as needed.

**Student learning outcomes**

After successfully taking this course, students will be able to:  
- when given a verbal description of a simple biological system, formulate a mathematical model to describe the system;  
- describe the physical principles underlying biological processes such as diffusion, membrane transport, membrane resting potential, generation of action potentials, pitch sensitivity in the inner ear, exchange of substances between compartments of the body;  
- solve linear constant coefficient ordinary differential equations (ODEs) up to second order;  
- solve two coupled linear constant coefficient ODEs using eigenvalue analysis;  
- investigate behavior of two coupled nonlinear ODEs using phase plane analysis;  
- write a report and give an oral presentation on the use of mathematical model to investigate a biological phenomenon;  
- develop a mathematical model for a biological phenomenon, write a report and give an oral presentation on the model (specific to graduate students).

**Textbook**


**Homework**

Weekly assignments will review basic mathematical techniques and biological knowledge and will provide examples of model development for biological phenomena.

**Examinations**

A midterm and a final examination will be given. No makeup exams will be allowed. Examinations will test biological knowledge, mathematical skills, and ability to formulate models for biological systems related to those discussed in the course.

**Projects and presentations**

All students will be required to prepare a presentation on a chosen in consultation with the instructors. Presentations will take place on November 23 and 30 and December 2. Undergraduate students: develop a mathematical model or review a published model, and make a short oral presentation. Performance on this project will form 15% of the final grade.
Graduate students: develop a mathematical model, write a written report, and make a short oral presentation. Performance on this project will form 30% of the final grade.

| Course structure | Weeks 1 - 5: Molecular and cellular phenomena. Diffusion, membrane transport, nerve impulse conduction.  
|                  | Weeks 6 - 10: Tissue-level phenomena. Oxygen transport, blood flow, compartmental models.  
|                  | Week 15: Student presentations. |

| Special needs and accommodations | At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu/) to establish reasonable accommodations. Please plan to meet with me by appointment to discuss accommodations. |

| Academic integrity | Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity |

| Confidentiality | See https://deanofstudents.arizona.edu/student-assistance/confidentiality-privacy for policy on confidentiality of student records. |

| | Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor. |