

APPH 6238/BIOS 4238 Syllabus

Ion Channels in Health and Disease, 3 credit hours

Fall 2026

Instructor Information

Instructor:

Edward M. Balog, Ph.D.

Email:

Ed.balog@ap.gatech.edu

General Information

Description

This class will examine the structure, function, and regulation of ion channels from both excitable and non-excitable cells. Topics to be covered include the basic biophysical properties of ion channels including conductance, selectivity, gating and voltage sensing; structure-function relationships; cell physiology of ion channels; physiological regulation and pharmacological manipulation of channel function; and ion channel diseases. Although the textbook will provide background, there will be a heavy reliance on more recent literature.

Learning Objectives:

By the end of this class you will understand

- the fundamental biophysical properties of ion channel function, including gating, selectivity and permeability;
- the relationship between ion channel structure and function;
- the physiological role of ion channels in controlling the cell membrane potential, ion transport across membranes and in cell signaling;
- how impaired ion channel function can lead to a number of important human diseases and how pharmaceutical agents targeting ion channels ameliorate these disorders.

Prerequisites:

BIOS 3450: Cell and Molecular Biology OR

BIOS 3755: Human Physiology OR

BMED 3100: Systems Physiology OR

NEUR 3100: Cell and Molecular Neuroscience OR

Graduate Standing

Course Materials

Required textbook: Ashcroft, F. Ion Channels and Disease. Academic Press 2000.

Links to original research and review articles to be posted to Canvas.

Optional Additional Resources: Hille, B. Ion Channels of Excitable Membranes, 3rd edition, Sinauer, 2001. A copy of this book is on reserve at the library. Ask at INFODesk - Grove Level, Price Gilbert; QH603.I54 H54 2001

Required Software: Two free software programs, *Electrophysiology of the Neuron* and *ChimeraX* will be used for class homework.

Download *Electrophysiology of the Neuron* at: <https://www.eotnprogram.org/>

Download *ChimeraX* at: <https://www.rbvi.ucsf.edu/chimerax/>

Course Website and Other Classroom Management Tools

All course assignments, readings and grades will be posted and submitted via Canvas.

Course Requirements & Grading

Those enrolled in BIOS 4238

Assignments and Weight

- Exam 1 - 20%
- Exam 2 - 20%
- Final Exam - 20%
- Homework & Quizzes - 20%
- Poster - 20%

BIOS 4238

Exams:

Exams will in class and consist of both multiple choice and short answer questions. The final exam is not cumulative, it will cover only material from the last section of the course.

Homework:

There will be 5 homework projects. Three projects will use the program *Electrophysiology of the Neuron* to simulate the electrical response of the neuron membrane to various interventions. Two projects will use the molecular visualization program *ChimeraX* to exam the structure of a voltage-gated and a ligand-gated ion channel. Homework must be submitted via Canvas by midnight the due date

Quizzes:

There will be three quizzes given shortly before each exam. The quizzes are online, out side of class and are open book but must be completed individually. They are intended to help students review material from the upcoming exam. Quizzes must be submitted via Canvas by midnight the due date.

Poster:

The poster will be in the format of a posters presented at scientific meeting, a template will be provided. Students will choose an ion channel topic such as a disease, a basic mechanism or physiological function. **Submit the topic of your poster the Dr. Balog via email by October 1.** After reviewing the literature, the topic will be summarized on the poster. Components of the poster will include a title, abstract, introduction, methods, results, conclusion and references. Students will give 10-minute poster presentations to the class.

Those enrolled in APPH 6238

Assignments and Weight

- Exam 1 - 20%
- Exam 2 - 20%
- Final Exam - 20%
- Homework & Quizzes - 10%
- Oral Presentation - 10%
- Research Article Critique - 20%

Description of APPH 6238 Graded Components

Oral Presentations:

Students enrolled in APPH6238: Presentation of a recent research article; 20-30 minutes. This should be similar to a journal club presentation. Chose a paper and send a copy to me. I will post it on Canvas.

Your talk should provide a brief introduction to the problem addressed in the paper, a description of the methods and results. Describe the author's conclusions and state whether you agree with them and why or why not. Point out any improvements that could be made in the experimental design, methods, results and/or interpretation. Make sure to address the significance of the work and what questions remain. ***The class will be required to read and comment on all papers!***

The final exam will be given during the final exam period. The format will be the same as the mid-term exam and will only address material from the second half of the course.

Article Critique:

Students enrolled in APPH 6238: This is *not a review of the literature* but a *critique* of an ion channel related *original research* article. The goals of journal article critique are to foster critical analysis of the scientific literature and promote effective written communication. The paper should be 7-10 double spaced pages including references. Students will choose an original research article from a reputable peer-reviewed journal and send a PDF of the paper to me for approval prior to beginning work. I will simply make sure it is a research article is from a reputable journal. The topic of the journal article should be broadly related to an area covered in class. The critique should begin with a brief review of the literature leading to the reason why the work described in the article was performed and the hypothesis. The review of the literature will require that you read articles in addition to the one you will analyze. Included these articles in your references. The critique should also include a summary of the methods, results and the author's interpretation and conclusion. Your critique should include a discussion of whether the problem was significant, whether the experimental design and methods appropriate, do you agree with the author's interpretation of the results, is the work likely to have a significant impact on the field, what (if anything) would you have done differently and what should be done next. **Choose a paper and have it approved by October 1.**

Homework and Quizzes:

Graduate and undergraduate students will do the same homework projects and quizzes.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

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Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Attendance

Attendance will not be recorded however, it is vital for learning and active participation is critical for successful completion of the class.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Rescheduling an exam must be done in advance and receive approval from the instructor. An exam missed without prior approval will receive a zero.

Use of Generative AI (Artificial Intelligence) for Class Work

The use of AI-based assistance such as ChatGPT, will be considered the same as a collaboration with another person. You are encouraged to discuss your ideas and work with other people as well as AI-assistants. However, all work you submit must be your own. Never include in a submitted assignment anything that was not written directly by you without giving the proper citations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404) 894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.