

Bio74.01 Development, Plasticity and Dysfunction of the Synapse

Winter 2025: 10A timeslot: T, TH Room LSC 352

Professor: Michael Hoppa, D.Phil.

Office Hours: Wednesday afternoon by appointment (Mike)

Description:"

Seminar class on selected topics in neurobiology focusing on neuronal cell biology, synaptic transmission and neurobiological diseases of development and aging. We will also cover current techniques employed for studying neurobiology, including optogenetics, microscopy, genetic manipulations, and electrophysiology. Major questions in the field of neurobiology will be introduced through recent high-impact papers, scientific reviews and scientific commentary. The overriding goal will be to improve your ability to critically analyze and evaluate original research data presented in the form of papers published in the scientific literature. Student participation during the course is critical to ensure that we have an active and productive discussion of the topics. This year we will focus on two topics of considerable interest in synaptic function, "co-transmission" and "synaptic metabolism" with a higher disease focus on Parkinson's, where both of these newly discovered topics have the highest overlap.

The course has a written assignment, an organized paper discussion leader slot
Final projects will involve oral presentations on papers selected by students and approved by professors.

Learning Objectives

- Gain an appreciation for how neurobiologists approach answering questions using a variety of modern techniques including live cell imaging, super-resolution microscopy, optogenetics, electrophysiology and advanced fluorescent biosensors
- Develop skill critically read, interpret, evaluate, and synthesize peer-reviewed scientific literature
- Learn to express ideas about experimental rigor, scientific approaches, results and conclusion of studies clearly and succinctly in both written and verbal format.
- Learn to propose testable hypothesis related to experiments and propose appropriate follow up studies

The success of this course depends on your reading the assigned papers

BEFORE class.

Grading:

Grading: Grading will be, in part, based on two out-of-class written assignments and one oral presentation. The assignments will consist first of writing a scientific abstract, and the second will consist of analyzing a paper in the primary literature as a midterm exam. The final presentation will be a recorded oral presentation in class on a paper of the student's choice with consent of the instructor. In addition, there will be a class participation grade, which will include contributions to the discussions. **Mid-term 20%, Final Oral Presentation 30%, Prepared Notes as Presenter 20%, and Class Participation 30%.**

Honor Principle

During this course it is expected that students will abide by the Honor Principle. The Dartmouth College Student Handbook (page iii) states "Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work which is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth." If you have any questions regarding this, **please** contact Dr. Hoppa.

Artificial intelligence (AI) language models, such as ChatGPT, and online assignment help tools, such as Chegg®, are examples of online learning support platforms: they cannot be used for course assignments except as explicitly authorized by the instructor. The following actions are prohibited in this course:

Submitting all or any part of an assignment statement to an online learning support platform;

Incorporating any part of an AI generated response in an assignment;

Using AI to brainstorm, formulate arguments, or template ideas for assignments;

Using AI to summarize or contextualize source materials;

Submitting your own work for this class to an online learning support platform for iteration or improvement.

If you are in doubt as to whether you are using an online learning support platform appropriately in this course, I encourage you to discuss your situation with me (<https://provost.umn.edu/chatgpt-syllabus-statements>Links to an external site.).

If you have any questions regarding this during the course, please contact Dr. Hoppa.

Please visit Dartmouth's page on use of the honor principle, while working together on studying and labs is encouraged, all exams are to be done entirely on your own.

Reading Syllabus Advanced Neurobiology Winter 2025 BELOW

1/7 | Tuesday

How to read a scientific paper and synaptic transmission lecture with Discussion

1/9 | Thursday

Reading Synaptic Transmission with Discussion

1/14 | Tuesday

Preview 1: <https://pubmed.ncbi.nlm.nih.gov/23060181/>

Preview 2: <https://pubmed.ncbi.nlm.nih.gov/23095838/>

Paper: <https://www.nature.com/articles/nature11466>

Title: “Dopaminergic neurons inhibit striatal output through non-canonical release of GABA”

1/16 | Thursday

Preview: <https://www.nature.com/articles/nn.3840>

Paper: <https://www.nature.com/articles/nn.3823>

Title: “Single rodent mesohabenular axons release glutamate and GABA”

1/21 | Tuesday

Preview:

<https://movementdisorders.onlinelibrary.wiley.com/doi/10.1002/mds.27210>

Paper:

<https://www.sciencedirect.com/science/article/pii/S0896627317306864?via%3Dihub>

Title: “Neuronal Depolarization Drives Increased Dopamine Synaptic Vesicle Loading via VGLUT” Maryanne Justin

1/23 | Thursday

Preview:

<https://www.sciencedirect.com/science/article/pii/S0896627320305808>

Paper: <https://www.sciencedirect.com/science/article/pii/S0896627320304402>

Title: “VTA Glutamate Neuron Activity Drives Positive Reinforcement Absent Dopamine Co-Release” Ian and Amanda

1/28 | Tuesday

Paper: <https://www.jci.org/articles/view/95795>

Title: “Role for VGLUT2 in selective vulnerability of midbrain dopamine neurons” Olivia Jackson

1/30 | Thursday

Paper:

<https://www.sciencedirect.com/science/article/pii/S0896627323008462?via%3Dihub>

Title: “Mesoaccumbal glutamate neurons drive reward via glutamate release but aversion via dopamine co-release” Katie and Caitlyn

2/1 | Tuesday

Mid-Term Paper: Please write a “News and Views” article about the following paper, due on

Paper: <https://www.nature.com/articles/s41467-022-30756-z>

Title: “Induction of synapse formation by de novo neurotransmitter synthesis”

2/7 | MIDTERM DUE ON MONDAY DUE AT MIDNIGHT

2/11 | Tuesday

Preview: <https://www.sciencedirect.com/science/article/pii/S0896627320300507>

Review: https://rupress.org/jcb/article-pdf/217/7/2235/1614052/jcb_201803152.pdf

Paper:

<https://www.sciencedirect.com/science/article/pii/S0896627319309845?via%3Dihub>

Title: “Molecular Tuning of the Axonal Mitochondrial Ca²⁺ Uniporter Ensures Metabolic Flexibility of Neurotransmission” Emma and Aiden

2/13 | Thursday

Paper: <https://www.science.org/doi/epdf/10.1126/sciadv.adn6016>

Title: “Phosphoglycerate kinase is a central leverage point in Parkinson’s disease–driven neuronal metabolic deficits” Carter and Rim

2/18 | Tuesday

Paper: <https://www.sciencedirect.com/science/article/pii/S089662731730034X>

Title: “Axonal Endoplasmic Reticulum Ca²⁺ Content Controls Release Probability in CNS Nerve Terminals” Zaina and

2/20 | Thursday

Paper:

https://www.pnas.org/doi/abs/10.1073/pnas.2117135119?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub++0pubmed

Title: “Activity-dependent endoplasmic reticulum Ca²⁺ uptake depends on Kv2.1-mediated endoplasmic reticulum/plasma membrane junctions to promote synaptic transmission

2/25 | Tuesday

Paper: <https://www.science.org/doi/10.1126/sciadv.abp8701>

Title: “Ca²⁺ channels couple spiking to mitochondrial metabolism in substantia nigra dopaminergic neurons” Emma and David

2/27 | Thursday Final Project presentations

3/4 | Tuesday Final Project presentations

3/6 | Thursday Final Projects presentations and class wrap up

STUDENT ACCOMMODATION

DISABILITIES

Students with disabilities, including invisible disabilities such as chronic illnesses and learning disabilities, are encouraged to arrange for accommodations that might be helpful to them. Please meet with Dr. Hoppa as soon as possible, preferably during the first week of class, to discuss possible accommodations. All discussions will be confidential, although the Academic Skills Center may be consulted to verify the documentation of the disability.

RELIGIOUS OBSERVANCES

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that poses a conflict with your participation in the course, please contact Dr. Hoppa as soon as possible, preferably before the end of the second week of the term, to discuss appropriate accommodations. All discussions will be confidential.

EXTRACURRICULAR COMMITMENTS

Students with extracurricular activities that will cause them to miss class should plan on discussing this with Dr. Hoppa as soon as possible, and in cases where appropriate, provide a letter from their Coach or the Director of their activity confirming when the conflict will occur. Students should bring any issues like these to the attention of Dr. Hoppa as soon as possible during the term, particularly if it involves missing a scheduled exam. In terms of the material, the slides for the lectures will be on the course Canvas site and all lectures are video recorded and the videos put on the Canvas site using the ECHO360 feature. Note, the earlier the conflict is brought to the attention of the instructors, the more time there is to make arrangements, and therefore the greater the chance that arrangements can and will be made (conversely, last minute, "day before" notifications are not conducive to alternative arrangements being made).

SEXUAL MISCONDUCT

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational

and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.

The Sexual Respect Website (<https://sexual-respect.dartmouth.edu>) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community.

Please note that, as a faculty member, I am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see <https://sexual-respect.dartmouth.edu/reporting-support/all-resources/confidential-resources>).

Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator or the Deputy Title IX Coordinator for the Guarini School. Their contact information can be found on the sexual respect website at:

<https://sexual-respect.dartmouth.edu/reporting-support/all-resources/campus-resources>

Key COVID Items for WINTER 2021 Advanced Neurobiology

Much of this class will be hybrid – if feeling unwell, please attend virtually. See below for details

My plan will be not to record any office hours on Wednesday and certainly not one-on-one Zoom sessions. If I think that a question or answer from office hours would be good for the entire class to see, I will prepare a separate note or video, or include it in the next lecture. This is what I do normally in my classes. Friday Zoom Sessions will be recorded to enhance learning for other in the class, participation in the class acknowledges that you acquiesce to this consent this recording, see below agreement (article 5)

v Technology Expectations:

Given the online nature of this course, it is required that students have access to internet to allow streaming and downloading of content.

We will do our very best to plan for and accommodate any limitations to your access to the required technology. It is impossible for us to plan for every possible technology constraint. Therefore, please

let us know what barriers you have to completing the online course as soon as possible. Given current disruptions in the supply chain we would like to plan as far ahead as possible.

v Health Addendum

While the COVID-19 pandemic has already drastically disrupted this course, it has the potential to result in further personal impact which may prevent you from continuing engagement in the class. This may be due to contraction of the disease by you or a loved one, increased familial responsibilities, financial difficulties, or impacts on your mental/emotional health.

The Key to making this work is communication; Please email for arrangements.

In the event that you are directly or indirectly impacted by COVID-19 in such a way that will affect your performance in the course, it is imperative that you reach out to me as soon as possible. You may also reach out to your undergraduate Dean if that would make you more comfortable. We cannot assist you if we don't know there is a problem. Our first priority is your health and security. We will work to put you in touch with appropriate resources to assist you. In addition, appropriate accommodations (for example: deadline extensions and/or extra office hours) will be implemented.

v ONLINE RECORDING OBLIGATORY CONSENT
Proposed notification to students via course syllabus:

(1) Consent to recording of course and group office hours

- a) I affirm my understanding that this course and any associated **group** meetings involving students and the instructor, including but not limited to scheduled and ad hoc office hours and other consultations, may be recorded within any digital platform used to offer remote instruction for this course;
- b) I further affirm that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part, and distribution of any of these recordings in whole or in part without prior written consent of the instructor may be subject to discipline by Dartmouth up to and including expulsion;
- c) I authorize Dartmouth and anyone acting on behalf of Dartmouth to record my participation and appearance in any medium, and to use my name, likeness, and voice in connection with such recording; and
- d) I authorize Dartmouth and anyone acting on behalf of Dartmouth to use, reproduce, or distribute such recording without restrictions or limitation for any educational purpose deemed appropriate by Dartmouth and anyone acting on behalf of Dartmouth.

(2) Requirement of consent to one-on-one recordings

By enrolling in this course, I hereby affirm that I will not under any circumstance make a recording in any medium of any one-on-one meeting with the instructor without obtaining the prior written consent of all those participating, and I understand that if I violate this

prohibition, I will be subject to discipline by Dartmouth up to and including expulsion, as well as any other civil or criminal penalties under applicable law.

Proposed notification to faculty [from Dean's Office and/or Department Chair]

Please be aware that any recording you make within any digital platform used to offer remote course instruction may be regarded as an education record within the meaning of the Family Educational Rights and Privacy Act, which prohibits the disclosure to a third party of any student's personally identifiable information from such records, in the absence of that student's prior written consent, unless a specified exception to prior written consent applies.

- Please also be aware that you are prohibited from making a recording in any medium of any one-on-one meeting with a student without obtaining that student's prior written consent. If you violate that prohibition, please understand that you will be subject to discipline by Dartmouth up to and including dismissal, as well as any other civil or criminal penalties under applicable law. **This prohibition does not apply to recordings of the course and any associated group meetings, to which students are being asked to consent via their enrollment in this course.**

- Finally, please be reminded that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part. Distribution of another instructor's recordings in whole or in part without prior written consent of that instructor may be subject to discipline by Dartmouth up to and including dismissal.

If you have any questions about any of these prohibitions or instructions, please consult your Dean's Office.

Information from Doug van Citters:

Statement from the Office of Accessibility Services to be included in syllabus (sent 3/26) *Students requesting disability-related accommodations and services for this course are encouraged to schedule a phone/video meeting with me as early in the term as possible. This conversation will help to establish what supports are built into my online course. In order for accommodations to be authorized, students are required to consult with Student Accessibility Services*

(SAS; student.accessibility.services@dartmouth.edu; SAS website; 603-646-9900) and to email me their SAS accommodation form. We will then work together with SAS if accommodations need to be modified based on the online learning environment. If students have questions about whether they are eligible for accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.