NEU 365N (58320) /NEU 381N (58390) Syllabus Spring 2026

Nerve Regeneration in Invertebrates and Vertebrates/Basic Processes of Nerve cells

This is an in-person lecture course with a Discussion Section with Weekly Quizzes (20% of final grade), two Midterm Exams (each 20% of final grade), a Final Exam (30% of final grade), Class Participation (5% of final grade), and oral presentations (5% of final grade).

Meeting Time, Place as listed in UT Spring 2026 Course Schedule Below:

TTH 6:30 p.m.-8:00 p.m. PMA 5.112

T 5:30 p.m.-6:30 p.m. PMA 5.112

Faculty Instructor: George D. Bittner. PAT 321. 512-923-3735. bittner@austin.utexas.edu. **Research interests:** Biophysics of synaptic plasticity, plasmalemmal repair, nerve regeneration and nerve/glial interactions.

Graduate TA: Alexa Olivarez. PAT 322. 979-406-9607. alexaolivarez@utexas.edu. **Research interests:** PEG-fusion repair of spinal cords and peripheral nerves, allograft storage.

Graduate Consultants: Marshal Mencel. PAT 325. 262-490-7589. marshalmencel@utexas.edu. **Research interests:** biochemical/biophysical properties of membrane repair. Comparative biology.

Henry Garcia. PAT 324. 915-383-3162. henry.garcia@austin.utexas.edu. **Research interests:** PEG-fusion repair of peripheral nerve lesions; immunological suppression of viable peripheral nerve allografts.

Post-doctoral consultant: Kevin Zhou. PAT 325. liwen_zhou@utexas.edu. **Research interests:** PEG-fusion repair of peripheral nerve lesions; role of glia in PEG-fusion; optimizing PEG-fusion surgical protocols.

Office Hours: Office hours are scheduled by appointment. Students may email the instructor, TA, and/or consultants to arrange a time to meet.

Grading: 10%: Class Participation (5%)/presentations (5%) and 90% written quizzes/exams that are combinations of multiple choice, short answer, and short essay. 20% weekly quizzes in each Discussion Section, 20% each for two midterms, 30% cumulative final exam on Thursday 4/30/2026 at 7-9pm. Grading scale: 92-100 A, 90-92 A-, 88-90 B+, 82-88 B, 80–82 B-, 78-80 C+, 72-78 C, etc. Please note that “The University of Texas provides upon request appropriate academic accommodations for qualified students with disabilities. For information, contact the Office of the Dean of Students at 471-6259, 471-6441 TTY."

Learning Objectives: Working knowledge of developmental, molecular, cellular, systems, and behavioral concepts relating to neuronal regeneration following traumatic injuries to invertebrate and vertebrate organisms, especially peripheral and spinal axonal repair in mammals or repair of plasmalemmal/axolemmal damage in invertebrates and vertebrates. This course emphasizes **Critical Thinking, Good English Communication, Teamwork, and Personal Responsibility**. In this course, you need synthetize/utilize concepts and data from many sub-disciplines in Biology, Chemistry, Physics, and Mathematics.

Required Readings: Textbook chapters and/or other readings typically assigned each week.

Required text: Purves et al. Neuroscience (P). 6th edition. ebook. One source https://www.academia.edu/43014289/Neuroscience by Dale Purves_et al_eds_z_l. $0-$15.

Oral presentation (5%): a 15 minute oral presentation on a topic of your choosing directly related to a topic covered in the course approve by Dr. Bittner by the first midterm exam. Need schedule a 1-on-1 meeting in person with Dr. Bittner between 4/6 and 4/20.

Box 1. Definitions and concepts about PNS/CNS axons and their responses to traumatic severance

1A. Commonly held assumptions that are internally consistent with a Neuron Doctrine that currently defines neurons as individual cells not in a morphological syncytium with axons dependent on their soma for metabolic (trophic) support. Specifically:

(1) Axons are typically defined as membrane-bound cytoplasmic extensions that conduct action potentials from nerve cell bodies to sensorimotor or other targets.

(2) Axons receive most or all trophic support from their soma by slow and fast axonal transport.

(3) Axons rapidly (within seconds) seal their severed cut ends (mechanism unspecified).

(4) Axotomy produces obligatory, rapid (3-7d) Wallerian degeneration (WD) of distal anucleate axonal segments due to loss of fast axonal transport of proteins and other substances from the soma.

(5) PNS axons naturally repair by extending growth cones from proximal cut ends, whose rate (1-2mm/day) is determined by slow axonal (1-2mm/d) transport. These outgrowths in larger mammals like humans often reinnervate more-distal targets after months-to-years, by which time atrophy of long-denervated muscles or sensory end-organs has often occurred. Most CNS axons are actively inhibited and/or not stimulated to extend outgrowths after severance.

(6) Behavioral recovery following ablation-type peripheral nerve injuries (A-PNIs) is especially poor using autografts, synthetic conduits, viable peripheral nerve allografts (VPNAs) or acellular PNAs (ANAs). VPNAs, like other types of allografts, need be tissue-matched and/or immune-suppressed, undergo rapid WD -- and are poorly accepted, even with immune-suppression.

***1B. Revised assumptions that are internally consistent with a Revised Neuron Doctrine that defines neurons as individual cells always in a chemical syncytium and often a morphological and/or functional/ syncytium, with axons dependent not just on their soma for maintenance of proteins and trophic support. Specifically:**

(*1) Axons are properly defined as membrane-bound cytoplasmic extensions having much SER but that lacking rough endoplasmic reticulum (RER)—and therefore have less, if any, protein synthetic capability than cell bodies or their morphological dendrites. Axons may or may not conduct axon potentials in any direction, as may dendrites and cell bodies --all of which have RER.

(*2) Axons receive trophic support from their soma by slow and fast axonal transport, but also can receive proteins and other substances from various combinations of adjacent glia, neurons, or pre- or post-synaptic or other sources (e.g., muscle, connective, epithelial cells). Axonal protein synthesis and/or slow turnover of existing axonal proteins may also be important for axonal maintenance..

(*3) Axons seal severed proximal or distal axonal segments by calcium-induced accumulations of membranous structures, e.g., endocytotic vesicles, myelin delaminations, lysosomes, etc.

(*4) Axotomy can produce rapid WD of anucleate distal segments or their long-term survival (LTS) for weeks to years in some invertebrates, "lower" vertebrates (fish, amphibians) and some mammals.

(*5) PNS axonal repair can occur naturally by (a) slow outgrowths that form synapses or (b) fuse with, or activate, surviving distal segments in 1-10d; and/or (c) artificially in seconds-to-minutes by a well-specified sequence of solutions, one containing polyethylene glycol (PEG). Many behavioral functions mediated by severed axons in b and c are permanently restored within weeks and prevent sensorimotor atrophy. Some CNS axons naturally regenerate. CNS/spinal axons can be PEG-fused.

(*6) Behavioral recovery following segmental-loss A-PNIs can be very good within weeks using PEG-fused VPNAs that are not rejected in the absence of tissue-matching and immune-suppressed in non-privileged environments. Severed CNS spinal axons may also be repaired by PEG-fusion/VPNAs.

Weeks, Topics, Assigned Readings

(QUIZZES TEST READINGS/FACTS/CONCEPTS TO BE COVERED THAT WEEK)

Implications of the following topics for neuronal regeneration after traumatic injury

*You will not be tested on **clinical applications** in any reading assigned in **Purves (P)**; material covered in the first midterm is material you have covered in NEU 330

Week of		Topic	Readings
Jan	12	Overview of nervous systems, neuronal morphology, membrane potentials, Donnan/ Nernst concepts/equations	P-(pg.1-17); P-2~3; Hill pg.277-285
	19	GHK concepts/equation, changes in membrane potentials, myelin, repair of plasmalemmal damage	P-4; Delcomyn 1998; GHK handout
	26	Equivalent circuits, subcellular properties and metabolism, axonal transport	P-7, Kandel handout
Feb	2	Electrical and chemical synaptic transmission;	P-5~6
	9	Synaptic plasticity	P-8
	12	**First Midterm Exam**	
	16	Natural and artificially induced nerve regeneration: PNS; Rapid (Wallerian) vs slow degeneration of anucleate axons	P-26; Gaudet et al., 2011; Bittner et al., 2017
	23	Natural and artificially induced nerve regeneration: CNS	P-26; Silver et al. 2015
Mar	2	General properties of sensory systems	P-9-10
	9	Somatosensory systems, pain. And regeneration	P10, 26
	16	**SPRING BREAK**	
	23	Visual systems	P-11~12
	26	**Second Midterm Exam**	
	30	Evolution of and development of nervous systems	P-13, 22
Apr	6	Development and regeneration in sensory systems	P-23~25; PEG papers
	13	Muscles and motor systems	Hill handout; P-16~17, Guyton handout
	20	Development and regeneration in motor systems	P-23~25; PEG papers
	27	Review April 28	
	30	**Cumulative Final Exam, 7-9pm**	

All students should arrange to take the final exam on April 30th 7-9pm at the place determined by the Registrar. Any exceptions need be for official university reasons and be finalized at least two weeks prior to the date of the final exam.

Feedback

Feedback is an important part of any kind of learning. Without feedback on how well you understand the material, it is more difficult for you to make significant progress. During this course, you will give me feedback on your learning in informal and formal ways, such as questions, suggestions, assignments, quizzes, exams, or course instructor surveys. I want you to let me know when something we discuss is not clear. This enables me to provide additional information when needed or to explain a concept in different terms. I also ask for feedback from you about how our teaching strategies are helping or hindering your learning. Some of this feedback might be gathered from online anonymous surveys. I

encourage you to respond to these surveys so that together we can create an effective teaching and learning environment.

Classroom Expectations

The instructors want to reward hard work and dedication, not just an ability to take tests. Therefore, the course is structured such that regular attendance of lectures, thoughtful reading of the text, active participation, and assimilation of the concepts are a large part of what determines your grade. Participation means more than just showing up! Respectful and engaged participation is part of your grade. For more information, please read the policies of UT as they appear in the Catalog (Appendix I, Appendix J) as well as Handbook of Operating Procedures 9-1810. By participating in the class, you express your understanding of and consent to these regulations.

Graphing calculators and other electronic devices are not allowed in any form during quizzes or exams. Only simple calculators (e.g., TI-30X) will be allowed in the room during graded assignments. Smart watches and glasses must be removed prior to exams. **Any use of generative AI for assignments will NOT be tolerated.** Students are expected to be able to explain their reasoning behind any answers given on assignments.

Students are required to be on time for quizzes/examinations. On the day of a quiz or exam, no student will be allowed to take the exam if they arrive at the classroom 10 minutes or more after the announced starting time of the examination. Remember, unless you have been previously granted an excuse, you will receive a grade of **ZERO** for that exam. Make sure you know where and when any exams are given and make sure you are on time!

Academic Integrity

Make a real effort to learn, participate, and prepare for the lecture and discussion section. Use your own skills and intellectual qualities to improve your knowledge and understanding of the class. Have respect and consideration for everybody. Turn off cell phones and other electronic devices before the class. You must be honest and fair with other students and professors. Heated discussions ARE NOT a form of bullying, but all participants in the course must show respect for one another.

Make-up Exams

No written make-up exams will be given. In the event that a student cannot take a regularly scheduled exam, an oral exam will be given by the instructor. The oral make-up exam must be taken no later than one week after the regularly scheduled exam. If a student cannot attend the exam, it is the student's responsibility to contact the instructor prior to the time of the regular examination and obtain permission to miss the exam. Only those students with a verifiable medical excuse, or a family emergency, will be permitted to take a make-up exam. If a student fails to contact the instructor prior to the time of the regularly scheduled exam, or fails to provide an acceptable excuse, that exam will be assigned a zero.

The University Administration requests that faculty remind you of the following:

Please review the UT Honor Code (or statement of ethics) and an explanation or example of what constitutes plagiarism (Link to University Honor Code: http://catalog.utexas.edu/general-information/the-university/#universitycodeofconduct). **Your term paper and other written assignments must be your original writing.** By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work

assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Statement on Learning Success

We will all need accommodations because we all learn differently. If there are aspects of this course that prevent you from learning or exclude you, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course. I also encourage you to reach out to the student resources available through UT. Many are listed on this syllabus, but I am happy to connect you with a person or Center if you would like.

Grading Policies

Flexibility is built into the assignments to support your success in this course. If you miss a smaller assignment or don't do as well on your earlier journal entries, your grade will not be impacted significantly. Consequently, the final grades are firm, and no additional curve is available.

Grace Policy

Sometimes we have bad days, bad weeks, and bad semesters. If you find yourself struggling with unexpected personal events, I encourage you to e-mail me as soon as possible.

Absences

If you are absent or unable to participate on the day that the class meets, you are responsible for providing me and the TA with the necessary information to compensate for your absence. *It is crucial to keep in communication with me and the TA; you are responsible for letting us both know if you cannot attend a class or complete an assignment.*

Excused Absence: The only absences that will be considered excused are for religious holidays or extenuating circumstances due to an emergency. If you plan to miss class due to observance of a religious holiday, please let us know at least two weeks in advance. You will not be penalized for this absence, although you will still be responsible for any work you will miss on that day if applicable. Check with us for details or arrangements. *If you have to be absent, use your resources wisely.* Ask other classmates to get a run-down and notes on any lessons you miss. If you find there are topics that we covered while you were gone that raise questions, you may,text, come by during office hours or schedule a meeting to discuss. Email specific questions you have in advance so that we can make the most of our time. "What did I miss?" is not specific enough.

Student Rights & Responsibilities

- You have a right to a learning environment that supports mental and physical wellness.
- You have a right to respect.
- You have a right to be assessed and graded fairly.
- You have a right to freedom of opinion and expression.
- You have a right to privacy and confidentiality.
- You have a right to meaningful and equal participation, to self-organize groups to improve your learning environment.
- You have a right to learn in an environment that is welcoming to all people. No student shall be isolated, excluded or diminished in any way.

With these rights come responsibilities:

- You are responsible for taking care of yourself, managing your time, and communicating with the teaching team and with others if things start to feel out of control or overwhelming.
- You are responsible for acting in a way that is worthy of respect and always respectful of others.
- Your experience with this course is directly related to the quality of the energy that you bring to it, and your energy shapes the quality of your peers' experiences.
- You are responsible for creating an inclusive environment and for speaking up when someone is excluded.
- You are responsible for holding yourself accountable to these standards, holding each other to these standards, and holding the teaching team accountable as well.

Personal Pronoun Use (She / He / They / Etc.)

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name, unless they have added a "preferred name" with the Gender and Sexuality Center (http://diversity.utexas.edu/genderandsexuality/publications-and-resources/ (Links to an external site.)). I will gladly honor your request to address you by a name that is different from what appears on the official roster, and by the gender pronouns you use (she/he/they/ze, etc). Please advise me of any changes early in the semester so that I may make appropriate updates to my records.

Services for Students with Disabilities

This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice) or 512-410-6644 (Video Phone) as soon as possible to request an official letter outlining authorized accommodations. For more information, visit http://ddce.utexas.edu/disability/about/ (Links to an external site.).

Counseling and Mental Health Center

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress. All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, I strongly encourage you to seek support. http://www.cmhc.utexas.edu/individualcounseling.html (Links to an external site.)

The Sanger Learning Center

More than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance. All students are welcome to take advantage

of Sanger Center's classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit http://www.utexas.edu/ugs/slc (Links to an external site.) or call 512-471-3614 (JES A332).

Undergraduate Writing Center: http://uwc.utexas.edu/ (Links to an external site.)

Libraries: http://www.lib.utexas.edu/ (Links to an external site.)

ITS: http://www.utexas.edu/its/ (Links to an external site.)

Undergraduate Writing Center: http://uwc.utexas.edu/ (Links to an external site.)

Student Emergency Services: http://deanofstudents.utexas.edu/emergency/ (Links to an external site.)

BeVocal. BeVocal is a university-wide initiative to promote the idea that individual Longhorns have the power to prevent high-risk behavior and harm. At UT Austin all Longhorns have the power to intervene and reduce harm. To learn more about BeVocal and how you can help to build a culture of care on campus, go to: https://wellnessnetwork.utexas.edu/BeVocal (Links to an external site.).

Title IX Reporting

Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.