

NEU 365N /NEU 381N Syllabus Spring 2024
Nerve Regeneration in Invertebrates and Vertebrates

This is an in person lecture course with a Discussion Section with Weekly Quizzes (25% of final grade), a Midterm Exam (25% of final grade), a Final Exam (40% of final grade) and Class Participation (10% of final grade)

Meeting Time, Place as listed in UT Spring 2024 Course Schedule Below

| Unique | Day | Hour | Room | Instruction Mode | Instructor | Status |
|--|-----|---------------------|---------|------------------|-------------------|----------------|
| NEU 365N NERVE REGENRTN INVRTBRT/VRTBRT | | | | | | |
| 54695 | TTH | 6:30 p.m.-8:00 p.m. | BUR 220 | Face-to-face | BITTNER, GEORGE D | open; reserved |
| | T | 5:30 p.m.-6:30 p.m. | BUR 220 | | | |

NEU 381N BASIC PROCESSES OF NERVE CELLS

Faculty Instructor: George D. Bittner, PAT 321, 512-923-3735 (cell). bittner@austin.utexas.edu

Research interests: Biophysics of synaptic plasticity, plasmalemmal repair, nerve regeneration and nerve/glia interactions.

Graduate TA: Liwen (Kevin) Zhou, PAT 325, 336-618-0465 (cell), liwen_zhou@utexas.edu

Research interests: PNS/CNS axonal regeneration in mammals, neuroimmunology,

Graduate TA: Marshal Mencil. PAT 325 262-490-7589 (cell), marshalmencil@utexas.edu

Research interests: Biochemistry, subcellular morphology of axolemmal repair

Grading: 25% Class Presentations and 75% written quizzes/exams that are combinations of multiple choice, short answer, and short essay. 25% weekly quizzes in each Discussion Section, 25% midterm, 25% final exam on Thursday 5/2/2024 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. Graduate students additional assignment is a 6 page research proposal in NIH format for graduate fellowships in consultation with Dr. Bittner and that is due by 4/30/2024. Two quizzes will be dropped at student's choosing.

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 synthesize/utilize concepts and data from many sub-disciplines in Biology, Chemistry, Physics, and Mathematics.

Required Readings: Textbook chapters and/or original papers typically assigned each week

Required texts: Purves et al. Neuroscience (P). 6th edition. e book. One source is: https://www.academia.edu/43014289/Neuroscience_by_Dale_Purves_et_al_ed_z_1. \$0-15.

Squires et al., (S) ebook <https://www.textbooks.com/Fundamental-Neuroscience-4th-Edition/9780123858702/Larry-Squire.php> \$33

This course will be organized around the following “BOX 1”

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 COVER MATERIAL TO BE COVERED THAT WEEK)

Implications of the following topics for neuronal regeneration after traumatic injury
Readings until the Midterm are Chapters from two textbooks (P, S above) that cover topics whose basic understanding is necessary to understand regeneration of PNS/CNS neuronal connections

| Week o | Topic | Review Readings |
|--------|--|--------------------------------------|
| Jan 16 | Overview of nervous systems and regeneration | P-1,26; S1-3 |
| 23 | Neuronal morphology and electrophysiology | P-2,3; S-5 |
| 30 | Subcellular properties and metabolism of neurons | P-4,7; S-4 |
| Feb 6 | Electrical and chemical synaptic transmission | P-5,6,8 or S-6,7,8 |
| 13 | Sensory system properties, e.g., Somatosensory | S22. And P-9,10 or S24 |
| 20 | Motor system properties | Hill; and P-16,17; or S-27,28 |
| 27 | Midterm in Class | |

Readings are assigned papers from list of relevant reviews or research publications

| | | |
|-------|--|---|
| 29 | Repair of plasmlemmal/axolemmal damage | Mencel and Bittner, 2023 |
| Mar 5 | Rapid (Wallerian) vs slow degeneration of anucleate axons | P-23; Gaudet et al, 2011 . |
| 12 | SPRING BREAK | |
| 19 | Re-innervation by slow outgrowth vs distal stump activation | Hoy et al, 1967 ; Bittner,2012 P-26; Faucett, 2020 |
| 25 | Paper topic determined by 9am | |
| 26 | Peripheral nerve injuries repaired by artificial protocols | Bittner,1991 ; Bittner et al., 2016,2022 |
| Apr 2 | SCIs repaired by artificial protocols, | David and Aguayo, 1981 ; Houle et al., 2009 |
| 8 | Student presentation powerpoint upload due by 9am | |
| 9 | Student 15 minute presentations of a research paper | |
| 16 | Student 15 minute presentations | |
| 23 | Synthesis and Review of repair of PNS/CNS traumatic injury invertebrates and vertebrates | |

May 2 Comprehensive Final Exam, 7-9pm

All students should arrange to take the final exam on May 2nd, 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.

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> (Links to an external site.)). ***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 to notify me that you are using our grace policy. Two quizzes will be dropped at student's choosing.

Absences

If you are absent or unable to participate on the day that the class meets, you are responsible for providing me, the TA and your team with the necessary information to compensate for your absence. *It is crucial to keep in communication with me, the TA and your team members; you are responsible for letting both us and your team 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 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 / Ze / 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.

University Resources for Students *COVID-19 Update: "Keep Learning" Resources*

This course may be offered in a format to which you are unaccustomed. If you are looking for ideas and strategies to help you feel more comfortable participating in our class, please explore the resources available here: <https://onestop.utexas.edu/keep-learning/> (Links to an external site.)

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.)

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.).

Important Safety Information: COVID-19 Update: While we will post information related to the contemporary situation on campus, you are encouraged to stay up-to-date on the latest news as related to the student experience. <https://coronavirus.utexas.edu/students> (Links to an external site.) If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be

anonymous. If something doesn't feel right – it probably isn't. Trust your instincts and share your concerns.

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.