IMPORTANT: This syllabus form should be submitted to OAA (gsbs_academic_affairs@uth.tmc.edu) a week before the start of each semester.

NOTE to STUDENTS: If you need any accommodations related to attending/enrolling in this course, please contact one of the Graduate School's 504 Coordinators, Cheryl Spitzenberger or Natalie Sirisaengtaksin. We ask that you notify GSBS in advance (preferably at least 3 days before the start of the semester) so we can make appropriate arrangements.

Term and Year: **Fall 2024** Course Number and Course Title: **GS14 1214: Molecular and Cellular Neuroscience** **Credit Hours: 4** Meeting Location: **UT- McGovern Medical School** Building/Room#: **MSB B.620** WebEx/Zoom Link: **N/A**	Program Required Course: **Yes** Approval Code: **No** **Audit Permitted: Yes** Classes Begin: **August 28, 2024** Classes End: **December 6, 2024** Final Exam Week: **December 9-13, 2024**

Class Meeting Schedule

Day	Time
M/W/F	**9 am – 10:20am**

Course Director

Name and Degree: **Ruth Heidelberger, MD, PhD**
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Course Co-Director/s: (if any)
Name and Degree: **Michael Beierlein, PhD**
Title: Associate Professor
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Instructor/s

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Course Description: This course is a graduate level treatment of molecular and cellular neuroscience. It will introduce basic concepts of molecular, electrical and chemical signaling in individual neurons, synapses, and local neuronal circuits. Topics covered include the functional properties of membranes, receptors, and channels, intracellular signaling cascades, synaptic transmission, short- and long-term forms of synaptic plasticity, and information processing in neuronal dendrites and local circuits.

Textbook/Supplemental Reading Materials (if any)

(Textbook copies can be signed out from Amanda Williamson, MSB 7.262): electronic versions may be available through the TMC Library)

- Molecular Cell Biology, Lodish et al., eds. 7th edition
- From Molecules to Networks, Byrne et al., eds. 3rd edition (FMN)
- Cellular and Molecular Neurophysiology, 3rd, Constance Hammond (Academic Press/Elsevier)
- Neuroscience Online: An Electronic Textbook for the Neurosciences, http://nba.uth.tmc.edu/neuroscience/
- Neuron simulation program: MetaNeuron, download at http://www.metaneuron.org/

Course Objective/s:

Upon successful completion of this course, students will learn basic concepts of molecular, electrical, and chemical signaling in individual neurons, synapses, and local neuronal circuits.

***Specific Learning Objectives*:**

1. Understand the composition and electrical characteristics of biomembranes, including their passive and active properties.
2. Understand the structure and function of voltage- and ligand gated ion channels and G-protein coupled Receptors.
3. Understand the mechanisms underlying intracellular signaling pathways in neurons.
4. Understand the molecular and cellular properties underlying synaptic transmission and synaptic plasticity.
5. Understand the integration of signals in neuronal dendrites and circuits.

Student Responsibilities and Expectations:

Students enrolled in this course will be expected to perform the following activities each week.

1. Read assigned readings for each lecture prior to that lecture.
2. Attend class and be prepared to discuss possible solutions to questions posed by the lecturer
3. Attend and contribute to one of the lab sessions
4. Attend and be prepared to participate in the scheduled review sessions.
5. Participate in and contribute to course discussions during lectures and review sessions
6. Prepare for and take each of the three, non-cumulative take-home examinations

Students are expected to peruse all assigned reading material (textbook sections and research literature) prior to class. Take-home examinations must be individually completed by each student without the assistance of another human being, but course notes and reading materials may be utilized. Engaging in unethical behavior will be grounds for dismissal from the course without credit and further GSBS disciplinary action.

Grading System: **Letter Grade (A-F)**

Student Assessment and Grading Criteria : *(May include the following:)*

Percentage	Description
Take-home exams (100 %)	3 take-home exams of equal weight.

CLASS SCHEDULE – Fall 2024

Date	Duration (Hour(s) taught by lecturer)	Lecture Topic	Lecturer/s
8-26	**1 hour and 20 minutes**	Introduction to neuronal cell biology	**Stavoe**
8-28	**"**	Mechanisms of neuronal homeostasis	**Stavoe**
8-30	**"**	Membrane composition I – structural/functional roles of lipids –rafts	**Waxham**
9-4	**"**	Membrane composition II – Protein-lipid interactions	**Waxham**
9-6	**"**	Voltage-gated K+-channels	**Waxham**
9-9	**"**	Voltage-gated Na+-channels	**Waxham**
9-11	**"**	Introduction to neurons, synapses and neuronal networks	**Beierlein**
9-13	**"**	Ionic basis of resting membrane potential	**Beierlein**

9-16	**“**	Mechanisms of action potentials	**Beierlein**
9-18	**“**	Microscopic and macroscopic Na and K currents	**Beierlein**
9-20	**“**	Propagation of action potentials, space and time constant	**Beierlein**
9-23	**?**	Electrophysiological recording techniques	**Beierlein**
9-25	**“**	Neurophysiology lab, **MSE R419,** Time TBD.	**Beierlein**
9-30	**“**	**Review session 1**	**Stavoe, Waxham, Beierlein**
10-2	**“**	Intracellular signaling I – GPCR structure/signaling at the membrane	**Eckel-Mahan**
10-4	**“**	Intracellular signaling II – Diffusion, Ca2+ domains, intracellular stores	**Eckel-Mahan**
10-7	**“**	Intracellular signaling III – forward/backward signaling – phosphor	**Eckel-Mahan**
10-9	**“**	Voltage-gated Ca2+-channels	**Heidelberger**
10-11	**“**	Neurotransmitter release, Part I: “In the beginning”	**Heidelberger**
10-14	**“**	Neurotransmitter release, Part II: “Calcium and timing”	**Heidelberger**
10-16	**“**	Neurotransmitter release, Part III: "Synaptic design"	**Heidelberger**
10-18	**“**	Ionotropic synaptic signaling	**Heidelberger**
10-21	**“**	Metabotropic synaptic signaling	**Heidelberger**
10-23	**“**	Ligand-gated channels - nAChR and GABA	**Waxham**
10-25	**“**	Ligand-gated channels – Glycine/Glutamate	**Waxham**
10-28	**“**	Optical Approaches in Neurophysiology	**Heidelberger**
10-30	**“**	**Review Session 2**	**Heidelberger, Waxham, Eckel-Mahan**
11-1	**“**	Axons and dendrites	**Stavoe**
11-4	**“**	Neuronal Polarity	**Stavoe**
11-6	**“**	Synaptic integration in dendrites	**Beierlein**
11-8	**“**	Information processing in active dendrites	**Beierlein**
11-11	**“**	Electrical synaptic transmission	**Beierlein**
11-13	**“**	Control of synaptic signaling by astrocytes	**Beierlein**
11-15	**“**	Sensory Transduction 1	**Heidelberger**
11-18	**“**	Sensory Circuits 1	**Heidelberger**
11-20	**“**	Long-term synaptic Plasticity–Induction	**Shouval**
11-22	**“**	Long-term synaptic Plasticity–Expression	**Shouval**
11-25	**“**	Sensory Transduction 2	**Nagayama**
12-2	**“**	Sensory circuits 2	**Nagayama**
12-4	**“**	Advances in *in vivo* neurophysiological approaches	**Ma**
12-6	**“**	**Review session 3**	**Ma, Nagayama, Shouval, Beierlein, Heidelberger, Stavoe**