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 2021 Course Number and Course Title: **GS14 1214: Molecular and Cellular Neuroscience** Credit Hours: **4** Meeting Location. UT- McGovern Medical School Building/Room#: : **MSB B.603** WebEx/Zoom Link:	Program Required Course: **X Yes** No Approval Code: Yes **No X** **(If yes,** the Course Director or the Course Designee will provide the approval code.) Audit Permitted: **X Yes** No Classes Begin: Aug 29, 2022 Classes End: Dec 7, 2022 Final Exam Week: take home exam due

Class Meeting Schedule

Day	Time
M/W/F	**9 am – 10:20am**
In-person Lab Visit	**TBD**

Course Director Name and Degree: Ruth Heidelberger, MD PhD Title: Professor Department: Neurobiology and Anatomy Institution: *UTH* Email Address: Ruth.Heidelberger@uth.tmc.edu Contact Number: 713-500-5624 **Course Co-Director/s:** (if any) Name and Degree: Michael Beierlein, PhD Title: Associate Professor Department: Neurobiology and Anatomy Institution: *UTH* Email Address: Michael.Beierlein@uth.tmc.edu	**Instructor/s** 1. Name and Degree **M. Neal Waxham, PhD** Institution: MMS mail Address : M.N.Waxham@uth.tmc.edu 2. Name and Degree **Kristin Eckel-Mahan, PhD** Institution: IMM Email Address : Kristin.I.Mahan@uth.tmc.edu 3. Name and Degree **Harel Shouval, PhD** Institution: MMS Email Address Harel.Shouval@uth.tmc.edu

Contact Number: on request	4. Name and Degree **Shin Nagayama, PhD PhD** Institution: MMS Email Address Shin.Nagayama@uth.tmc.edu 5. Name and Degree. **Andrea Stavoe, PhD** Institution: MMS Email Address. andrea.k.stavoe@uth.tmc.edu

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

(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/ (Links to an external site.)

Neuron simulation program: MetaNeuron, download at http://www.metaneuron.org/ (Links to an external site.)

Course Objective/s:

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

***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:

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: **x** Letter Grade (A-F) Pass/Fail

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

Homework (%)	Description
Quiz (%)	Description
Presentation (%)	Description
Midterm Exams (100 %)	Description. **There will be 3 exams of equal weight.**

Final Exam (%)	Description
Workshop or Breakout-Session (%)	Description
Participation and/or Attendance (%)	Description

CLASS SCHEDULE - Please see appended syllabus below

Day/Date	Duration (Hr)	Lecture Topic	Lecturer/s

Molecular and Cellular Neuroscience Fall 2022 GS 14 1214 Course Syllabus

Class will be held M/W/F from 9:00 am -10:20 am in room MSB B.603

Week 1 (Aug. 29 - Sep. 2).

8-29, M: Introduction to neuronal cell biology (Stavoe)

8-31, W: Mechanisms of neuronal homeostasis. (Stavoe).

9-2, F: Membrane composition I – structural/functional roles of lipids –rafts (Waxham)

Week 2 (Sep. 5 – 9)

9-5, M: Labor Day, no class

9-7, F: Membrane composition II – Protein-lipid interactions (Waxham)

9-9, W: Voltage-gated K+-channels (Waxham)

Week 3 (Sep. 12 - 16)

9-12**:** M: Voltage-gated Na+-channels (Waxham)

9-14, W: Introduction to neurons, synapses and neuronal networks (Beierlein)

9-16, F: Ionic basis of resting membrane potential (Beierlein)

Week 4 (Sep. 19 – 24)

9-19, M: Mechanisms of action potentials (Beierlein)

9-21, W: Microscopic and macroscopic Na and K currents (Beierlein)

9-23, F: Propagation of action potentials, space and time constant (Beierlein)

Week 5 (Sep. 26 – Sep 30)

9-26, M: Electrophysiological recording techniques (Beierlein).

9-28 W: Laboratory

9-30, F: review session (weeks 1-5, Beierlein, Waxham, Stavoe)

Week 6 (Oct. 3-7)

10-3, M: Intracellular signaling I – GPCR structure/signaling at the membrane (Eckel-Mahan) and **Distribution of Exam 1, Due midnight October 11**

10-5, W: Intracellular signaling II – Diffusion, Ca2+ domains, intracellular stores (Eckel-Mahan)

10-7 F: No Class (NGP retreat)

Week 7 (Oct. 10 – 14)

10-10, M: Intracellular signaling III – forward/backward signaling – phosphor. *(*Eckel-Mahan*)*

10-12, W: Voltage-gated Ca2+-channels (Heidelberger)

10-14, F: Neurotransmitter release, Part I: "In the beginning" (Heidelberger)

Week 8 (Oct. 17 – 21)

10-17, M: Neurotransmitter release, Part II: "Calcium and timing" (Heidelberger)

10-19, W: Neurotransmitter release, Part III: "Synaptic design" (Heidelberger)

10-21, F: Ligand-gated channels - nAChR and GABA (Waxham)

Week 9 (Oct, 24 – 28)

10-24, M: Ligand-gated channels – Glycine/Glutamate (Waxham)

10-26, W: Ionotropic synaptic signaling (Heidelberger)

10-28, F: Metabotropic synaptic signaling (Heidelberger).

Week 10 (Oct 31 – Nov 4)

10-31, M: Optical Approaches in Neurophysiology (Heidelberger/optional topic)

11-2, W: Review session (weeks 5-9, Heidelberger, Waxham, Eckel-Mahan)

11-4, F: Axons and dendrites (Waxham)

Week 11 (Nov. 7 – 11)

11-7, M: Neuronal Polarity (Waxham) and

and **Distribution of Exam 2, Due midnight November 15**

11-9, W: Synaptic integration in dendrites (Beierlein)

11-11, F: Information processing in active dendrites (Beierlein)

Week 12 (Nov. 14 – 18)

11-14, M: Long-term synaptic Plasticity – Induction (Shouval).

11-16, W: Long-term synaptic Plasticity – Expression (Shouval)

11-18, F: Electrical synaptic transmission (Beierlein)

Week 13 (Nov. 21-25).

11-21, M: Control of synaptic signaling by astrocytes (Beierlein)

11-23: No class

11-25: Thanksgiving holiday, No class

Thanksgiving holiday Nov 24-25th

Week 14 (Nov. 28 – Dec. 2)

11-28, M: Sensory transduction I (Heidelberger)

11-30, W: Sensory transduction II (Nagayama)

12-2**,** F: Retrograde synaptic transmission (Beierlein)

Week 15 (Dec. 5 – Dec 9th).

12-5, M: Review session (weeks 10-14, Beierlein, Heidelberger, Shouval, Nagayama)

12-7: W: no class. **Distribution of EXAM 3, Due 9 am Thursday Dec 15th**.

12-9: F: no class

Week 16 (Dec 12-16th). "FINALS WEEK"

Exam 3 Due 9 am on Thursday Dec 15th.