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. MMS Building/Room#: : M**SB B610 (except for 5 dates when B610 is needed for clerkship NBME exams. On these dates, class will held in MSB. B620)** 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 30, 2021 Classes End: Dec 6, 2021 Final Exam Week: n/a

Class Meeting Schedule

Day	Time
M/W/F	**9 am – 10:20am**
Plus one, in-person lab visit	**TBD**

Course Director Name and Degree: Ruth Heidelberger, MD PhD Title: Professor Department: Institution: x *UTH* *MDACC* Email Address: ruth.heidelberger@uth.tmc.edu Contact Number: 713-500-5624 **Course Co-Director/s:** (if any) Name and Degree: Title: Department: Institution: *UTH* *MDACC* Email Address:	**Instructor/s** (Use additional page as needed) 1. Name and Degree **Michael Beierlein, PhD** Institution: MMS Email Address : Michael.beierlein@uth.tmc.edu 2. Name and Degree **M.Neal Waxham, PhD** Institution: MMS Email Address : m.n.waxham@uth.tmc.edu 3. Name and Degree **Kristin Eckel-Mahan, PhD** Institution: IMM Email Address Kristin.l.Mahan@uth.tmc.edu

Contact Number: **NOTE:** Office hours are available by request. Please email me to arrange a time to meet. **Teaching Assistant**: (if any) Name and Email Address Name and Email Address	4. Name and **Degree Harel Shouval, PhD** Institution: MMS Email Address harel.shouval@uth.tmc.edu **Cont. Instructor/s** 5. Name and Degree. **Shin Nagayama, PhD** Institution: MMS Email Address. Shin.nagayama@uth.tmc.edu 6. Name and Degree. Steve Massey PhD Institution: MMS Email Address. Steve.massey@uth.tmc.edu 7. 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 (if any)

(Textbook copies can be signed out from Amanda Williamson, MSB 7.262):

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

***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

NOTE: Provide other class information as needed.

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GS 14 1214: Molecular and Cellular Neuroscience, Fall 2021 (Each lecture is 80 minutes in length)

Week 1 (Aug. 30 - Sep. 3)

8-30, M: Introduction to neurons, synapses and neural networks (Beierlein)

9-1, W: Membrane composition I – structural/functional roles of lipids –rafts (Waxham)

9-3, F: Membrane composition II – Protein-lipid interactions (Waxham)

Week 2 (Sep. 6 – 10)

9-8, W: Voltage-gated K+-channels (Waxham)

9-10, F: Voltage-gated Na+-channels (Waxham) **room change to MSB B620

Week 3 (Sep. 13 - 17)

9-13, M: Resting membrane potential (Beierlein)

9-15, W: Ionic mechanisms of action potentials (Beierlein)

9-17, F: Modeling action potentials (Beierlein)

Week 4 (Sep. 20 – 24)

9-20, M: Microscopic and macroscopic Na and K currents (Beierlein)

9-22, W: Propagation of action potentials, space and time constant (Beierlein)

9-24, F: Electrophysiological recording techniques (Beierlein). **room change to MSB B620

Week 5 (Sep. 27 – Oct. 1)

9-27, M: review session (week 1-4, Beierlein, Waxham)

9-29, W: Intracellular signaling I – GPCR structure/signaling at the membrane (Eckel-Mahan)

10-1, F: Intracellular signaling II – Diffusion, Ca2+ domains, intracellular stores (Eckel-Mahan)

Week 6 (Oct. 4-8)

10-4, M: Intracellular signaling III – forward/backward signaling – phosphor. *(*Eckel-Mahan*)*

10-6, W: Voltage-gated Ca2+-channels (Heidelberger)

10-8, F: Neurotransmitter release, Part I: "In the beginning" (Heidelberger)

Week 7 (Oct. 11 – 15)

10-11, M: Neurotransmitter release, Part II: "Calcium and timing" (Heidelberger)

10-13, W: Neurotransmitter release, Part III: "Synaptic design" (Heidelberger)

10-15, F: Ligand-gated channels - nAChR and GABA (Waxham)

Week 8 (Oct. 18 – 22)

10-18, M: Ligand-gated channels – Glycine/Glutamate (Waxham)

10-20, W: Ionotropic synaptic signaling (Heidelberger)

10-22, F: Metabotropic synaptic signaling (Heidelberger). **room change to MSB B620

Week 9 (Oct, 25 – 29)

10-25, M: Optical Approaches in Neurophysiology (Heidelberger/optional topic)

10-27, W: Axons and dendrites (Waxham)

10-29, F: Neuronal Polarity (Waxham)

Week 10 (Nov. 1 – 5)

11-1, M: Review session (week 5-9, Heidelberger, Waxham, Eckel-Mahan)

11-3, W: Control of synaptic signaling by astrocytes (Beierlein)

11-5, F: Retrograde synaptic transmission (Beierlein)

Week 11 (Nov. 8 – 12)

11-8, M: Synaptic integration in dendrites (Beierlein)

11-10, W: Information processing in active dendrites (Beierlein)

11-12, F: Gap Junctions and electrical synapses (Beierlein)

Week 12 (Nov. 15 – 19)

11-15, M: Long-term synaptic Plasticity – Induction (Shouval)

11-17, W: Long-term synaptic Plasticity – Expression (Shouval)

11-19, F: Sensory transduction I (Heidelberger) **room change to MSB B620

Week 13 (Nov. 22-26)

11-22, M: Sensory transduction II (Nagayama)

Week 14 (Nov.29 – Dec. 3)

11-29, M: Retinal circuits I (Massey)

12-1, W: Retinal circuits II (Massey)

12-3: F: Mechanisms of neuronal homeostasis. (Stavoe). **room change to MSB B620

Week 15 (Dec. 6 – 10)

12-6, M: Review session (week 10-14, Beierlein, Heidelberger, Shouval, Nagayama, Massey, Stavoe)