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: **Spring 2025** Course Number and Course Title: **GS13 1024: Molecular Basis of Cell Signaling** Credit Hours: 4 Meeting Location: **UT-McGovern Medical School** Building/Room#: **MSB B.635** WebEx/Zoom Link: **In person only**	**Program Required Course: Yes** **Approval Code: No** **(If yes,** the Course Director or the Course Designee will provide the approval code.) **Audit Permitted: Yes** Classes Begin: **Jan 13, 2025** Classes End: **Apr 25, 2025** Final Exam Week: **May 2, 2025**

Class Meeting Schedule

Day	Time
Monday	1:00-2:30 pm
Wednesday	1:00-2:30 pm
Friday	1:00-2:30 pm

Course Director Name and Degree: **Guangwei Du, PhD** Title: **Professor** Department: **Integrative Biology & Pharmacology** Institution: **UTHealth Houston** Email Address: Guangwei.Du@uth.tmc.edu Contact Number: (713)500-7055 **NOTE:** Office hours are available by request. Please email me to arrange a time to meet. **Teaching Assistant**: N/A	**Instructor/s** (See attached Class Schedule)

Course Description:

Signal transduction is one of the most active fields in biomedical research. Precisely controlled activation of signaling molecules is essential for development, normal tissue homeostasis, tissue repair, and immunity. Dysregulation of cellular signaling pathways are responsible for diseases such as cancer, diabetes, cardiovascular disease. Accordingly, therapeutic strategies designed to specifically target altered signaling pathways in disease would achieve better outcomes.

The goal of Molecular Basis of Cell Signaling is to provide graduate students with an in depth understanding of the molecular mechanisms of signaling. The broad purview of signaling provides the fundamentals essential to many fields, and traditionally has served students from multiple disciplines such as cell biology, biochemistry, neurobiology, physiology, pharmacology, cancer and systems biology, and provides fulfillment of the GSBS molecular requirement. The prerequisites are a solid background in cell biology and biochemistry. This course includes the following topics:

1) mechanism of ligand activation and desensitization of G protein coupled receptors and other types of receptors, G proteins and second messengers;
2) fundamentals of ion channel structure, activation, function and control by ligands;
3) intercellular communications;
4) basic structure, function and localization of protein phosphorylation cascades and their role in growth factor regulation through the small G protein Ras family;
5) some key intracellular signaling cascades such as lipid signaling molecules, unfolded protein responses, proteolysis, inflammatory signaling, calcium, mTOR, AMPK, and autophagy;
6) state of the art studies of the network of transcriptional regulators including the steroid family of ligand-induced transcriptional factors, the complexity of transcriptional complexes, transcriptional control by cAMP/PKA and the circadian clock, and involvement of the cell cycle;
7) RNA modification and noncoding RNAs.

Topics covered are introduced by first providing access to a broad perspective with suitable reviews, followed by a focus on the primary literature. Student presentations will involve group discussions of a classic publication in each block in journal club style. Exams are take-home which provides a means of minimizing memorization and stimulating creativity, while in the process, driving home important concepts.

Textbook/Supplemental Reading Materials

- N/A

<u>Course Objective/s</u>:

Upon successful completion of this course, students will understand the basic principles of signal transduction mechanisms and major experimental approaches used in cell signaling studies.

***Specific Learning Objectives*:**

1. Have basic knowledge of the major signaling pathways.
2. Understand how different types of signaling molecules, e.g., GPCRs, RTKs, kinases, phosphatases, lipids, and transcriptional regulators, transduce signals and mediate cellular responses.
3. Develop a basic knowledge of methods used to study different signaling pathways.
4. Learn to design experiments related to cell signaling.
5. Appreciate the use of computational tools in signaling study and learn the concepts of analyzing gene expression in databases and protein structure-based modeling

Student responsibilities and expectations:

Students enrolled in this course will be expected to perform the following activities:

1. Prepare for and attend courses.
2. Attend and participate at the journal club review session.
3. Participate in and contribute to course discussions during lectures and journal clubs.
4. Prepare for and take take-home examination based on lecture and some reading material.

Students are expected to complete all assigned reading material (reviews and research literature) prior to class. While you may work and discuss all course materials and assignments in groups, all writing assignments must be your own. Plagiarism and failure to properly cite scientific literature and other sources will not be tolerated and are grounds for dismissal from the course and further GSBS disciplinary action. Cheating or engaging in unethical behavior during examinations (quizzes and final) 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 (80 %)	There will be 3 take-home exams
Participation and Attendance (20 %)	Include attendance, participation of journal clubs and discussion during lectures.

CLASS SCHEDULE (1-1:30 hour/lecturer)
Location: MSB B.635. Time: 1-2:30 pm

Date	Lecture Topic	Lecturer/s
I. **Membrane Receptor Signaling**		
Jan 13	Structural aspects of G protein signaling Covalent modifications; Oncogenic mutations and disease alpha & βγ subunit structure/function/effectors; adenylyl cyclase	C. Dessauer
Jan 15	GAPs: regulators of G-protein signaling (RGS) Structures/assays/mechanisms/regulation: GGL domains; RGS9; G protein effectors; structure/regulation	C. Dessauer
Jan 17	Additional complexities of G protein regulation GDI/Goloco motifs; Downstream effectors	C. Dessauer
Jan 20	**Martin Luther King Day (no class)**	
Jan 22	Localization/feedback of cAMP signals PKA anchoring proteins (AKAPs)	C. Dessauer
Jan 24	Wnt signaling in development and disease	R. Miller
Jan 27	Receptor tyrosine kinases	R. Zhao
Jan 29	Ion channels; overview of structure/function/regulation	M. Zhu
Jan 31	Regulation of ion channels: 2nd messengers, kinases, ions and G proteins	M. Zhu
Feb 3	Ion channels in epithelium	O. Pochynyuk
Feb 5	Ion Channels and Neuronal Plasticity	A. Bavencoffe

Feb 7	Lipids as signaling molecules	G. Du
Feb 10	Lipid regulation of the Ras-MAPK signaling pathway	G. Du
Feb 12	Intercellular communication: from physiology to disease	Y. An
Feb 14	**Student presentations**	Drs. An & Du, Students
Feb 17	**Exam I**	
II. **Intracellular Signaling Cascades**		
Feb 19	Overview of protein kinases and phosphatases	J. Frost
Feb 21	Rho GTPases	J. Frost
Feb 21	Ca^{++}compartmentation and signaling	K. Venkatachalam
Feb 24	mTOR	K. Venkatachalam
Feb 26	Regulation of local signaling networks by ankyrin adaptor proteins	S. Cunha
Feb 28	cAMP-mediated cell signaling	X. Cheng
Mar 3	The unfolded protein response signaling in health and diseases	H-E. Kim
Mar 5	AMPK	D. Frigo
Mar 7	Autophagy	Y. Liu
Mar 10-14	**Spring Break (no class)**	
Mar 17	RAS GTPases: structure, dynamics, and function	A. Gorfe
Mar 19	RAS GTPases: therapeutic targets	A. Gorfe
Mar 21	Intramuscular signaling regulating skeletal muscle proteolysis	Y-P. Li
Mar 24	Inflammatory signaling	K. Sun
Mar 26	**Student presentations**	Drs. Liu & Du, Students
Mar 28	**Exam II**	
III. **Regulation of Transcription and Translation**		
Mar 31	Overview of transcription regulation and epigenetics	W. Li
Apr 2	Enhancers: The Ultimate Genomic Executor of Many Signaling Events on Chromatin	W. Li
Apr 4	Nuclear Receptors: Steroid Sisters & Orphan Brothers I	V. Narkar
Apr 7	Nuclear Receptors: Steroid Sisters & Orphan Brothers II	V. Narkar
Apr 9	p53 signaling in cancers and stem cells	D. Lee
Apr 11	Growth, cell cycle and transcription	C. Denicourt
Apr 14	Regulation of gene expression by posttranscriptional modification of cellular RNA	C. Denicourt
Apr 16	The Hypoxia-Inflammation Link	H. Eltzschig
Apr 18	Epigenetic regulation of transcription	K. Mahan
Apr 21	Transcriptional regulation of circadian rhythms	K. Mahan
Apr 23	Non-coding RNAs and epigenetic regulation of gene expression	J. Wang
Apr 25	**Student presentations**	Drs. Narkar & Du, Students
Apr 30, May 2	**Exam III**	

MBCS 2025 Spring Teaching Faculty

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