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, Annually** 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.620** WebEx/Zoom Link: **In person**	**Program Required Course: X Yes** No **Approval Code:** Yes **X No** **(If yes,** the Course Director or the Course Designee will provide the approval code.) Audit Permitted: **X Yes** No Classes Begin: **Jan 10** Classes End: **April 27** Final Exam Week: **May 3**

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, Ph.D.** Title: Professor Department: Integrative Biology & Pharmacology Institution: X *UTH* *MDACC* Email Address: guangwei.du@uth.tmc.edu Contact Number: 713-500-7055 **Course Co-Director/s:** (if any) Name and Degree: **N/A** Title: Department: Institution: *UTH* *MDACC* Email Address: Contact Number:	**Instructor/s (See attached)** 1. Name and Degree Institution: Email Address : 2. Name and Degree Institution: Email Address : 3. Name and Degree Institution: Email Address

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 Institution: Email Address **Cont. Instructor/s** 5. Name and Degree Institution: Email Address

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) basic structure, function and localization of protein phosphorylation cascades and their role in growth factor regulation through the small G protein Ras family;
(4) Some key intracellular signaling cascades such as lipid signaling molecules, unfolded protein responses, proteolysis, inflammatory signaling, calcium, mTOR and AMPK;
(5) 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;
(6) RNA modification and noncoding RNAs;
(7) systems biology analysis of signaling networks; and
(8) fundamentals of computational dynamics for modeling ligand binding/docking to proteins and membrane interactions.

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 (if any)

- N/A

Course Objective/s:

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 attend all lectures and complete all assigned reading material. While you may work and discuss all course materials and assignments in groups, all take-home exams must be finished by yourself. Plagiarism and failure to properly cite scientific literature and other sources in the exam will not be tolerated and result in a failure of the course and further GSBS disciplinary action.

Grading System: **X** Letter Grade (A-F) Pass/Fail

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

Percentage	Description
Take-home exams (80 %)	There will be 3 take-home exams
Participation and/or Attendance (20 %)	Include attendance, participation of journal clubs and discussion during lectures.

CLASS SCHEDULE (1-1:30 hour/lecturer taught)

Date	Lecture Topic	Lecturer/s
I. **Membrane Receptor Signaling**		
Jan 10	Structural aspects of G protein signaling Covalent modifications; Oncogenic mutations and disease alpha & βγ subunit structure/function/effectors; adenylyl cyclase	C. Dessauer
Jan 12	GAPs: regulators of G-protein signaling (RGS) Structures/assays/mechanisms/regulation: GGL domains; RGS9; G protein effectors; structure/regulation	C. Dessauer
Jan 14	Additional complexities of G protein regulation GDI/Goloco motifs; Downstream effectors	C. Dessauer
Jan 17	**Martin Luther King Day (no class)**	
Jan 19	Localization/feedback of cAMP signals PKA anchoring proteins (AKAPs)	C. Dessauer
Jan 21	Wnt signaling in development and disease	R. Miller
Jan 24	Receptor tyrosine kinases	R. Zhao
Jan 26	Ion channels; overview of structure/function/regulation	M. Zhu
Jan 28	Regulation of ion channels: 2nd messengers, kinases, ions and G proteins	M. Zhu
Jan 31	Ion channels in epithelium	O. Pochynyuk
Feb 2	**Student presentations**	Drs. XXX & Du, Students
Feb 4	**Exam I**	
II. **Intracellular Signaling Cascades**		
Feb 7	Overview of protein kinases and phosphatases	J. Frost
Feb 9	Rho GTPases	J. Frost
Feb 11	Lipids as signaling molecules	G. Du
Feb 14	Lipid regulation of the Ras-MAPK signaling pathway	G. Du
Feb 16	Ion channel targeting by ankyrin proteins	S. Cunha
Feb 18	cAMP-mediated cell signaling	X. Cheng
Feb 21	The unfolded protein response signaling in health and diseases	H-E. Kim
Feb 23	Intramuscular signaling regulating skeletal muscle proteolysis	Y.P. Li
Feb 25	Inflammatory signaling	K. Sun
Feb 28	Ca^{++}compartmentation and signaling	K. Venkatachalam
Mar 2	mTOR	K. Venkatachalam
Mar 4	AMPK	D. Frigo
Mar 7	Autophagy	Y. Liu
Mar 9	**Student presentations**	Drs. XXX & Du, Students
Mar 11	**Exam II**	
Mar 14-18	**Spring Break (no classes)**	
III. **Regulation of Transcription and Translation**		
Mar 21	Overview of transcription regulation and epigenetics	W. Li
Mar 23	Enhancers: The Ultimate Genomic Executor of Many Signaling Events on Chromatin	W. Li
Mar 25	Nuclear Receptors: Steroid Sisters & Orphan Brothers I	V. Narkar
Mar 28	Nuclear Receptors: Steroid Sisters & Orphan Brothers II	V. Narkar
Mar 30	Transcriptional regulation by CREB	R. Berdeaux

Apr 1	Growth, cell cycle and transcription	C. Denicourt
Apr 4	Regulation of gene expression by posttranscriptional modification of cellular RNA	C. Denicourt
Apr 6	p53 signaling in cancers and stem cells	D. Lee
Apr 8	Transcriptional Mechanisms and Circadian Rhythms I: Basic chronobiology principles established using genetics and genomics	G. Breton
Apr 11	Transcriptional Mechanisms and Circadian Rhythms II: Examples of clock control on physiology (outputs)	G. Breton
Apr 13	Non-coding RNAs and epigenetic regulation of gene expression	J. Wang
Apr 15	**Student presentations**	Drs. XXX & Du, Students
IV. Structural and Systems Modeling		
Apr 18	Systems modeling I	J. Chang
Apr 20	Systems modeling II	J. Chang
Apr 22	Structure-based modeling: Concepts and Methods	A. Gorfe
Apr 25	Structure-based modeling: Applications to Ras proteins	A. Gorfe
Apr 27	Exam preparation	
May 3	**Exam III**	

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