BIOCHEMISTRY AND MOLECULAR BIOLOGY 802 **Spring 2023**
Metabolic Regulation & Signal Transduction

Faculty:
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Overall objectives of the course: This course is intended to provide an advanced treatment of key concepts in signal transduction and its intersection with metabolic regulation. Foundational principles will be covered, and general themes that are expected to dominate future research in a particular area will be emphasized. Lecture materials are intended to provide students with an appreciation of the similarities and differences in signal transduction systems found in diverse organisms, including animals, yeast, plants, and bacteria. Lecture material will be composed assuming that students have a solid foundation in basic principles of biochemistry and molecular biology. BMB 801, or a course with equivalent content, is recommended as a background for BMB 802.

General course information: This course will proceed via real-time lecture/discussion, though we will make efforts to record and distribute lecture materials online, when possible. The Room for lectures will be located in Biochemistry – Room 111. The course utilizes D2L course management system for the distribution of lecture slides, lecture recordings, supplemental materials (*e.g.*, scientific articles), and email correspondence. Registration in the course will enable access to the associated D2L site.

Examinations and Grading: Four take-home examinations will comprise the majority of the grade, each covering one of the 4 units of material. Each take home exam will be due the next Thursday by noon and can be returned via email (~6 days to return). Exam I: Provided Friday, Feb 4th and covering Unit I (Ducat, Orlando: **1/9-2/3**). (**110 pts.**); Exam II will cover Unit 2 **(**Orlando; **2/6-2/24 - 90 pts.)**; Exam III will cover Unit 3 (Ducat; **2/27-3/31 - 120 pts.**). Exam IV will cover Unit 4 (Martinez-Hackert & Ducat; **4/3-4/28 - 120 pts. total**). Final grades will be computed by summing grades (total 440 pts) from each examination. The final grade point assigned will be graded based on the curve of total class performance. A fraction of points for a unit (<10%) may be assigned for non-exam class activities, per instructor preferences.

Ethics policy regarding take-home examinations: Take home exams are fully open book and open notes. Take home exams will also permit use of online resources, indeed, some exam material may require online resources and an internet connection. As such, these exams require students to abide by academic and scientific ethical standards. *All answers for take-home exams must be solely the effort of the individual student.* All consulting and collaboration with other members of the class, former students, or scientific

colleagues more generally, is strictly prohibited. While some examination materials may encourage referencing to published scientific articles, written responses for questions should be original work of the individual student. If a student wishes to quote text from a published scientific work, the article should be properly cited, and the relevant text should be clearly marked. Evidence that a student has failed to meet one of these criteria will be treated as academic dishonesty and/or plagiarism and will result in reduced grades, official sanctions, and/or administrative actions.

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Metabolic Regulation & Signal Transduction
Instructors: Ducat, Howe, Martinez-Hackert, Orlando
Lecture Room: Biochemistry Room 111

Date	Instructor	Topic
		UNIT I
M 1/9	**Ducat**	**Class Objectives & Course Overview**
W 1/11	**Orlando**	**Common Themes of Signal Transduction**
F 1/13	**Orlando**	**Features of Membranes and Cellular Compartments**
M 1/16	**----**	***Martin Luther King, Jr. Day - no classes***
W 1/18	**Orlando**	**Classes of Lipids and Signaling Lipids**
F 1/20	**Orlando**	**Membrane proteins and receptors**
M 1/23	**Orlando**	**Journal Club: Membranes and/or Transmembrane Receptor Structure**
W 1/25	**Orlando**	**Eicosanoid signaling I**
F 1/27	**Orlando**	**Eicosanoid signaling II**
M 1/30	**Orlando**	**Endocannabinoid signaling**
W 2/1	**Orlando**	**Lipid signaling in bacteria**
F 2/3	**Orlando**	**Journal Club: Lipid signaling**
First Exam	**Take home exam due Thursday, February 9 -- by noon (covering 1/9 - 2/3 material)**	
		UNIT II
M 2/6	**Orlando**	**Ligand-receptor interactions**
W 2/8	**Orlando**	**G protein-coupled receptors**
F 2/10	**Orlando**	**Structure and function of trimeric G proteins**
M 2/13	**Orlando**	**Regulation of GPCR signaling**
W 2/15	**Orlando**	**Kinase cascades in signal transduction**
F 2/17	**Orlando**	**Protein scaffolding**
M 2/20	**Orlando**	**Protein Structure Methods**
W 2/22	**Orlando**	**The dawn of a new era: protein structure prediction**
F 2/24	**Orlando**	**Hands-On Practical: Exploring databases and receptor structure**
Second Exam	**Take home exam due Thursday, March 2 by noon (2/6 through 2/24 material)**	
		UNIT III
M 2/27	**Ducat**	**Quorum sensing I**
W 3/1	**Ducat**	**Quorum sensing II**
F 3/3	**Ducat**	**Journal Club: Secrete and Sense-based Signaling**
3/6-3/10	**---**	**Spring Break**
M 3/13	**Ducat**	**Nuclear receptors**

W 3/15	**Ducat**	**NK-kB signaling**
F 3/17	**Ducat**	**PII and Carbon/nitrogen balance I**
M 3/20	**Ducat**	**PII and Carbon/nitrogen balance II**
W 3/22	**Ducat**	**Ligand-gated Ion Channels I**
F 3/24	**Ducat**	**Ligand-gated Ion Channels II**
M 3/27	**Ducat**	**Two-component signaling systems: Histidine kinases structure/function**
W 3/29	**Ducat**	**Two-component signaling systems: Photoreceptors**
F 3/31	**Ducat**	**<u>Journal Club</u>: Two-component signaling in bacterial infection**
Third Exam	**<u>Take home</u> exam due Thursday, April 6 by noon (2/27 through 3/31 material)**	
		<u>UNIT IV</u>
M 4/3	**Martinez-Hackert**	**TGF-β signaling I**
W 4/5	**Martinez-Hackert**	**TGF-β signaling II**
F 4/6	**Martinez-Hackert**	**TGF-β signaling III**
M 4/10	**Ducat**	**Evolution of signal transduction pathways**
W 4/12	**Ducat**	**Modularity and Receptor evolvability**
F 4/14	**Ducat**	**Emergent complexity in signaling systems**
M 4/17	**Ducat**	**Engineering Signaling: Synthetic Biology & Circuits**
W 4/19	**Ducat**	**Engineering Signaling: Modularity in engineering**
F 4/21	**Ducat**	**Journal Club: Modularity in engineering**
M 4/24	**Ducat**	**Advanced Synthetic Signaling Circuits I**
W 4/26	**Ducat**	**Advanced Synthetic Signaling Circuits II**
F 4/28	**Ducat**	**<u>Journal Club</u>: Applications of Synthetic Circuits**
Fourth Exam (Final)	**Take-home exam; due Thursday, May 4 by noon (4/3 through 4/28 material).**	