Course Description
*** Systems Biology in Environmental Health ***
ENVR 630-001 Fall 2014
Course Number: 10741

Faculty:
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Website for course:
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Time and location:
Classroom: McGavran 2304
Class time: Tuesday and Thursday 11:00 AM to 12:15 PM

Target audience: Who should take this course? This is a graduate level course in systems biology as applied to environmental sciences. Environmental systems biology examines how environmental stressors influence the components of a biological system, and how the interactions between these components result in changes in the function and behavior of that system. This course will be of interest to those interested in public health, in toxicology, and more generally to students with basic science interests. ***Prerequisites***: One year of Biology is suggested but not required.

Course Description: Environmental systems biology examines how environmental stressors influence the components of a biological system, and how the interactions between these components result in changes in the function and behavior of that system. Systems biology integrates genomic, proteomic, and metabolomic technologies to construct models of complex biological systems and diseases. Together, these technologies allow us to interrogate and refine our knowledge of cellular processes.

This course will use a systems biological perspective to detail the most recent findings that link environmental exposures to human disease. The course will include an assessment of systems-based tools to evaluate environmental health risks, an overview of molecular pathways that are essential for cellular survival after exposure to environmental toxicants, recent findings on gene-environment interactions influencing environmental agent-induced diseases, and the development of computational methods to predict susceptibility to environmental agents.
The course will highlight environmental toxicants relevant to human health and disease, various high-throughput technologies, and biological pathways associated with disease. These topics will be integrated with introductory lectures on molecular and cellular biology, toxicology, and computational biology. Among others, this course will be of interest to graduate students in Environmental Science, Toxicology, Biology, Epidemiology, and Genetics. This course will consist of lectures, in-class discussions and examinations. The overall emphasis will be made on

biological pathways/systems associated with environmental toxicants and human disease. The students are expected to develop a comprehensive understanding of biological networks linked to disease caused by environmental chemicals and toxicants.

Course goals: What is the purpose of this course? The purpose of this course is to provide students who have no prior background in systems biology an overview of what systems biology is, and then move onto the more complex understanding of how (e.g. through which biological networks and pathways) environmental contaminants are associated with human disease. Students will achieve an understanding of key biological pathways that are known or suspected to be involved in environmental contaminant-induced disease. As well, a mission of this course is to introduce students to state-of-the-art tools and technologies applied in the systems biology field. This course aims to introduce students to the bioinformatics tools required to analyze large datasets and identify targets of interest.

How is the course run? To achieve this goal, we start with about 1.5 weeks of introductory lectures that cover biological fundamentals. The first few lectures introduce students to the basics of systems biology and how this field can be integrated with environmental science to help us better understand gene-environment interactions as they relate to human disease. We cover the basics of the -omics technologies and how these are emerging from global sequencing and tools. The class introduces students to diseases that are common in the US, including tracking them over time. It emphasizes links between environmental contaminants and disease. The course covers selected genes that are involved in disease, including oncogenes and tumor suppressors. It provides a review the cellular structure of eukaryotes and prokaryotes. It covers fundamental biological concepts such as how DNA is packaged, how cells divide, cellular replication, central dogma, transcription, translation, transcription factors, amino acids, and ways to control gene expression. The course describes gene sequence and links to variation in human health for example, gene expression and links to variation in human health, epigenetic processes, imprinting. It covers links between cancer and inflammation, and relative numbers of individuals affected by various disease types. Next, we move on to the set of biological pathways/systems that are known or suspected to link environmental exposure with detrimental human health effects. This includes pathways such as NF-kB, EGFR, TGF-B, WNT and Hedgehog, Toll-like receptor, PI3k/Akt/mTOR and Kras. The course intertwines computational assignments where students work with systems level data analyzed using bioinformatics approaches. Students use these tools/knowledge to research one of the pathways discussed in detail and present a project to the class. Overall, this class provides students with an understanding of systems level analyses as they relate to environmental sciences and health, key to understanding current literature.

Course Policies:

It is anticipated that students will attend class. Homework assignments that are turned in late will be penalized through the loss of one point per day. The course final exam is given in compliance with UNC final exam regulations and according to the UNC Final Exam calendar.

Course requirements:

Reading Material: One cutting edge research paper assigned each week. These readings are required for all students taking this course and form the basis for homework assignments. Other reading material is optional, but suggested.

Grading: Grades will be derived from the following:

*Exam I, in-class written exam	25% of final grade
Exam II, in class written exam	25% of final grade
Exam III, in class written exam	25% of final grade
**In-Class Presentation	10% of final grade
***Homework assignments (weekly)	15% of final grade
	100%

*Written exam material is derived from the in-class lectures and from the required weekly readings.

** In-Class Presentation: students will create a physical model of a biological pathway discussed in class and show how exposure to an environmental contaminant perturbs this pathway.

***Questions for weekly homework assignments will come from required weekly readings. Homework assignments will be handed out on Tuesdays and are due at the following class on Thursdays.

Other: While grades will not be given for in-class participation, it is my belief that participation in discussions is an integral component of learning. Therefore, it is expected that students will participate in discussions in class.

		Lecture #	Day	Brief Description
19-Aug	A	1	T	An Introduction to Environmental Systems Biology
21-Aug	B	2	Th	Fundamentals of Biology of the Cell
26-Aug	C	3	T	Biology of the Cell
28-Aug	D	4	Th	Biology of the Cell
2-Sep	E	5	T	Epigenetics and environmental contaminants
4-Sep	F	6	Th	Inflammation and immune response: NF-kB and arsenic
9-Sep	G	7	T	Inflammation and immune response:
11-Sep	H	8	Th	The Endocrine system and disruption
16-Sep	I	9	T	Oncogenes and environmental contaminants: KRAS
18-Sep	J	10	Th	DNA damaging agents in the environment
23-Sep			T	**Exam I**
25-Sep	K	11	Th	Immune response: Toll-like Receptors
30-Sep	L	12	T	DNA damage (part II)
2-Oct	M	13	Th	Neurotoxicity of metals
7-Oct	N	14	T	Apoptosis: its response to toxic agents
9-Oct	O	15	Th	Hands on Gene Expression/computational analysis
14-Oct	P	16	T	Understanding protein degradation and the proteosome
21-Oct	Q	17	T	Aflatoxin and hepatocellular carcinoma
23-Oct	R	18	Th	Brainstorming for Presentations
28-Oct	S	19	T	Metabolomics and environmental contaminants: Alcohol
30-Oct	T	20	Th	Advanced computational methods for systems biology
4-Nov	U	21	T	Hands On Presentations
6-Nov	V	22	Th	**Exam II**
11-Nov	W	23	T	guest lecture
13-Nov	X	24	Th	The risk assessment process
18-Nov	Y	25	T	Nutrigenomics
20-Nov	Z	26	Th	Medical Genomics
25-Nov	AA	27	T	Field trip to Air Chamber
2-Dec	AB	28	T	Final Lecture/Summary
TBD				**Exam III**