Molecular Toxicology: Chemical and Biological Mechanisms
GGPS-PHRM 590

Course Director: Trevor M. Penning, Professor of Systems Pharmacology and Translational Therapeutics

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Course Goals: Exposures to foreign compounds (drugs, carcinogens, and pollutants) can disrupt normal cellular processes leading to toxicity. This course will focus on the molecular mechanisms by which environmental exposures lead to end-organ injury and to diseases of environmental etiology (neurodegenerative and lung diseases, and reproduction and endocrine disruption). Students will learn the difficulties in modeling response to low-dose chronic exposures, how these exposures are influenced by metabolism and disposition, and how reactive intermediates alter the function of biomolecules. Mechanisms responsible for cellular damage, aberrant repair, and end-organ injury will be discussed. In addition, students will discuss the relationship between genetics and epigenetics and environmental exposures. Students will learn about modern predictive toxicology to classify toxicants, predict individual susceptibility and response to environmental triggers, and how to develop and validate biomarkers for diseases of environmental etiology. Students are expected to write a term paper on risk assessment on an environmental exposure using available TOXNET information. This course is required for those pursuing the Certificate Program in Environmental Health Sciences.

Lecture Course:	60 minute lectures meets twice per week on Monday's and Wednesday's and also some Friday's
Course Unit:	1 credit unit
Proposed Days:	Mon and Weds (and some Friday's)
Semester:	Spring
Course Materials:	Casarett & Doulls: Toxicology: The Basic Science of Poisons (7^{th} – 9^{th} Edition) and relevant literature.
Pre-requisites:	Undergraduate course work in biochemistry and chemistry essential. Exceptions allowed based on past course work. Please consult with the Course Director.
Students:	All 1^{st} and 2^{nd} year BGS students with required prerequisites; residents in Environmental and Occupational Health, and professional masters students (e.g. MPH and MTR).

Molecular Toxicology Course Schedule- IMPORTANT PLEASE READ

Mondays, Wednesdays and Fridays: **2:00PM-3:00 PM** and other classes are **2PM– 4PM** as highlighted in grey on the schedule. As noted, some classes are live via bluejeans and others are prerecorded and viewable on mediasite. All live bluejeans classes are highlighted in yellow on the schedule. The Risk Assessment Presentations occur during different timeframes as noted in yellow below and both the midterm and final exams are in a take home format.

There are also optional live Bluejeans tutorials with Dr. Trevor Penning every Friday from 3p – 4p beginning on Friday, January 29th. The purpose of these tutorials is to provide the students with an opportunity to address any questions or issues that they are having with the course or course materials.

BlueJeans link for all live sessions is https://upenn.bluejeans.com/5348332877.
Mediasite link for all recordings is https://mediasite.med.upenn.edu/Mediasite/Catalog/Full/bcaaf0fbc98a4f02abdc82d760877fef21

Location: As mentioned above, due to the COVID-19 University Restrictions, ALL classes will be held online. Some classes are prerecorded (see 'online recording') and others will be held live via BlueJeans (see 'BlueJeans Session' highlighted in yellow).

2021 Spring Schedule

Week	Date	Location	Topic	Lecturer
General Principles				
1	W, Jan 20	BlueJeans Session	Introduction /Orientation Live Session	Penning
	F, Jan 22	Online Recording	General Principles: Dose Response & Exposures	Penning
2	M, Jan 25	Online Recording	Regulatory Policy and EPA	Pepino
	W, Jan 27	Online Recording	Heavy Metal Toxicity	Osterhoudt
	F, Jan 29	Online Recording and Optional Live BlueJeans	Reactive Oxygen Species Recording (2p – 3p) w/Ischiropolous Optional Live Tutorial Session (3p – 4p) w/ Penning	Ischiropolous Penning
3	M, Feb 1	Online Recording	Metabolism Phase I	Penning
	W, Feb 3	Online Recording	Metabolism Phase II	Penning
	F, Feb 5	Online Recording and Optional Live BlueJeans	Chemical Carcinogenesis by Genotoxic Agents Recording (2p – 3p) w/Penning Optional Live Tutorial Session (3p – 4p) w/Penning	Penning
4	M, Feb 8 2:00 – 4:00	Online Recording & Mandatory Live BlueJeans Session	Chemical Carcinogenesis by Non-Genotoxic Recording (2p – 3p) w/Penning Live Problem Set Metabolism (3p – 4p) w/Penning	Penning
	W, Feb 10	BlueJeans Session	Mutagenesis / Mutational Signatures Live BlueJeans Session	Field
	F, Feb 12	Online Recording & Optional Live BlueJeans Session	DNA Adducts and their Repair Recording (2p- 3p) w/Penning Optional Live Tutorial Session (3p – 4p) w/Penning	Penning
5	M, Feb 15 2:00-4:00	BlueJeans Sessions	Mitochondrial Dysfunction Live Session (2p – 3p) w/Blair Live Problem Set Chemical Carcinogenesis (3p – 4p) w/Penning	Blair Penning

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Gene-Environment Interactions				
	W, Feb 17 2:00 – 4:00	BlueJeans Session	Toxicogenetics – Toxicology and DNA Variation Live Session Toxicogenomics- Toxicology and RNA Expression Live Session	Burczynski
	F, Feb 19	BlueJeans Sessions	Transcriptome-Analysis-Technologies and Experimental Design Live Session (2p – 3p) w/Tobias Optional Live Tutorial Session (3p – 4p) w/Penning	Tobias Penning
6	M, Feb 22	BlueJeans Session	Epigenetics Live Session	Heller
	W, Feb 24	Online Recording	Folate and Methylation	Whitehead
	F, Feb 26	BlueJeans Sessions	Risk Assessment Assignment (2p–3p) w/Penning Optional Live Tutorial Session (3p-4p) w/Penning	Penning
7	M, Mar 1	Take Home Exam	Midterm (Due March 8th)	
Exposure Science				
	W, Mar 3	Online Recording	Protein-Biomarkers-Proteomics	Mesaros
	F, Mar 5	Online Recording & Optional Live BlueJeans	Exposure and Response Biomarkers Recording (2p-3p) w/Mesaros Optional Live Tutorial Session (3p-4p) w/ Penning	Mesaros Penning
8	M, Mar 8	BlueJeans Session	Biosensors Live Session	Johnson
	W, Mar 10		Spring Break	
Organ-Based Toxicology				
Lung and Airway-Disease				
	F, Mar 12 (2p – 4p)	Online Recording NO LIVE TUTORIAL THIS WEEK	Inhalation Toxicology 1: Respiratory Physiology Inhalation Toxicology 2: Mechanisms of Lung Injury	Panettieri
9	M, Mar 15	Online Recording	Toxic Responses of the Respiratory System	Christofido Solomidou
	W, Mar 17	BlueJeans Session	Lung Cancer Live Session	Vachani
	F, Mar 19	Online Recording & Optional Live BlueJeans Session	Mesothelioma Recorded Session (2p-3p) w/Moon Optional Live Tutorial Session (3p-4p) w/Penning	Moon Penning
Nervous System				
10	M, Mar 22	Online Recording	Overview of the Nervous System and Neurotoxicants	Robinson
	W, Mar 24	Online Recording	Mechanisms of Neurotoxicity	Ischiropoulos
	F, Mar 26	BlueJeans Sessions	Sleep Disturbance and Neurodegenerative Disease Live Session (2p-3p) w/Veasey Optional Live Tutorial Session (3p-4p) w/Penning	Veasey Penning

Week	Date	Location	Topic	Lecturer
Reproductive & Endocrine Disruption				
11	M, Mar 29	Online Recording	In utero Genetic Imprinting	Bartolomei
	W, Mar 31	Online Recording	Mechanisms of Reproductive Disruption-Male	Gerton
	F, Apr 2	BlueJeans Sessions	Environmental Reproductive Epidemiology Live Session (2p-3p) w/Burris Optional Live Tutorial Session (3p-4p) w/Penning	Burris Penning
Data Integration & Predictive Toxicology				
12	M, Apr 5	Online Recording	Data-Integration-Bioinformatics	Weljie
	W, Apr 7	BlueJeans Session	Exposure Biology Informatics Live Session	Moore
	F, Apr 9	BlueJeans Sessions	Predictive Toxicology and TOX 21st Century Live Session (2p-3p) w/Penning Optional Live Tutorial Session (3p-4p) w/ Penning	Penning
13	M, Apr 12 (9a-11a)	BlueJeans Session	Risk Assessment Live Presentations – 9:00 am- 11:00 am	Penning, Field, Gerton, Howarth, Pepino
	W, Apr 14	Take Home	Final Examination (Due April 21st)	

Evaluation:
Mid-Term: 30%
Final Exam: 40%
Risk Assessment Paper: 30%
Text: Cassarett & Doull's: Toxicology: The Basic Science of Poisons
Questions on Individual Lectures Can be sent by Email to:

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