

Molecular Toxicology: Chemical and Biological Mechanisms (PHRM 5900) – Spring 2026

Course Director: Trevor M. Penning, Professor of Systems Pharmacology and Translational Therapeutics; Director, Center of Excellence in Environmental Toxicology

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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.

Format: 60-minute lectures; three times per week on Monday/Wednesday/Friday

Course Materials: Casarett & Doulls: Toxicology: The Basic Science of Poisons (7th – 9th Ed) and relevant literature. Full e-text of the 9th edition is available via Penn Libraries.

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 1st and 2nd year BGS students with required prerequisites; Residents in Environmental and Occupational Health, and Professional Master's Students (e.g. MPH and MTR).

Accommodations for Students with Disabilities: The University of Pennsylvania provides reasonable Accommodations to students with disabilities who have self-identified and received approval from the Office of Student Disabilities Services (SDS). If SDS has approved your request for accommodations, please make an appointment to meet with me as soon as possible in order to discuss the arrangements for your accommodations. If you have not yet contacted Student Disabilities Services, and would like to request accommodations or have questions, you can make an appointment by calling (215) 573-9235. The office is located in the Weingarten Learning Resources Center at Stouffer Commons, 3702 Spruce Street, Suite 300. Please visit the SDS website at <http://www.vpul.upenn.edu/lrc/sds/index.php>. SDS services are free and confidential.

Molecular Toxicology Course Schedule- IMPORTANT PLEASE READ

Course Times: Mondays, Wednesdays, and Fridays: **1:45PM - 2:45PM**; a few classes are **1:45PM - 3:45PM** as highlighted in gray on the schedule.

Location: **Smilow 10-146**
Smilow 11-146

Spring 2026 Schedule

Week	Date	Location	Topic	Lecturer
GENERAL PRINCIPLES				
1	W, Jan 14	Smilow 11-146	Introduction /Orientation	Trevor Penning, PhD
	F, Jan 16	Smilow 11-146	Regulatory Policy-FDA, EPA	Inna Strakovsky, MRA, RAC
2	M, Jan 19	MLK Day – No Class		
	W, Jan 21	Smilow 11-146	General Principles: Dose Response & Exposures	Trevor Penning, PhD
	F, Jan 23	Smilow 11-146	Metabolism Phase I Metabolism Phase II	Trevor Penning, PhD
3	M, Jan 26		No Class	Trevor Penning, PhD
	W, Jan 28		No Class	Trevor Penning, PhD
	F, Jan 30	Smilow 11-146	Chemical Carcinogenesis by Genotoxic Agents	
4	M, Feb 2 1:45-3:45pm	Smilow 11-146	Chemical Carcinogenesis by Non-Genotoxic Problem Set 1-Metabolism	Trevor Penning, PhD
	W, Feb 4	Smilow 11-146	DNA Adducts and Their Repair	Cátia Marques, PhD
	F, Feb 6	Smilow 11-146	Mutagenesis and Mutational Signatures	Jeffery Field, PhD
5	M, Feb 9	Smilow 11-146	Problem Set 2-Carcinogenesis	
	W, Feb 11	Smilow 11-146	Heavy Metal Toxicity	Clementina Mesaros, PhD
	F, Feb 13	Smilow 11-146	Reactive Oxygen Species	Vladimir Muzykantov, MD, PhD
6	M, Feb 16	Smilow 11-146	Mitochondrial Dysfunction	Ian Blair, PhD
GENE-DRUG INTERACTIONS				
	W, Feb 18	Smilow 11-146	Transcriptome-Analysis	John Tobias, PhD

Week	Date	Location	Topic	Lecturer
	F, Feb 20 1:45pm-3:45pm	Smilow 11-146	Toxicogenetics – Toxicology and DNA Variation Toxicogenomics – Toxicology and RNA Expression	Ted Burczynski, PhD
7	M, Feb 23 1:45pm-3:45pm	Smilow 11-146	Risk Assessment Assignment MID-TERM	Trevor Penning, PhD
BIOMARKERS & BIOSENSORS				
	W, Feb 25	Smilow 11-146	Exposure & Response Biomarkers	Clementina Mesaros, PhD
	F, Feb 27	Smilow 11-146	Protein Biomarkers – Proteomics	Cátia Marques, PhD
9	M, Mar 2	Smilow 11-146	Biosensors	Yuanwen Jiang, PhD
ORGAN-BASED TOXICOLOGY				
GI-TOXICITY				
	W, Mar 4	Smilow 11-146	Hepatotoxicity	Ian Blair, PhD
	F, Mar 6	Smilow 11-146	Microbiota	Gary Wu, MD
10	M, Mar 9 – F, Mar 13	Spring Break – No Classes		
11	M, Mar 16	Smilow 11-146	Biliary Toxicity	Rebecca Wells, MD
INHALATION TOXICITY				
	W, Mar 18	Smilow 11-146	Inhalation Toxicology 1: Respiratory Physiology	Jelte Kelchtermans, MD
	F, Mar 20 1:45pm-3:45pm	Smilow 11-146	Inhalation Toxicology 2: Mechanisms of Lung; Injury/Toxic Reponses of the Respiratory System	Sharon McGrath-Morrow, MBA, MD
12	M, Mar 23	Smilow 11-146	Asthma and Immune System	Hajera Amatullah, PhD
	W, Mar 25	Smilow 11-146	Lung Cancer	Roger Kim, MD, MSCE
	F, Mar 27	Smilow 11-146	Mesothelioma	Trevor Penning, PhD
NERVOUS SYSTEM				
13	M, Mar 30	Smilow 11-146	Overview of the Nervous System	Holly Elser, MD, PhD
	W, April 1	Smilow 11-146	Sleep Disturbance	Sigrid Veasey, MD
	F, April 3	Smilow 11-146	Mechanisms of Neurotoxicity	Aimin Chen, MD, PhD
14	M, April 6	Smilow 11-146	HTS Neurotoxicants	Eva-Maria Collins, PhD
REPRODUCTIVE & ENDOCRINE DISRUPTION				

Week	Date	Location	Topic	Lecturer
14	W, April 8 1:45pm-3:45pm	Smilow 10-146	Environmental Reproductive Epidemiology	Sunni Mumford, PhD
			Endocrine Disrupting Chemicals	Gregory Krischen, MD, PhD
	F, April 10	Smilow 11-146	Mechanisms of Reproductive Disruption-Male	Colin Conine, PhD
15	M, April 13	Smilow 11-146	In utero Genetic Imprinting	Marisa Bartolomei, PhD
	W, April 15	Smilow 11-146	Epigenetics	Yu-Chien Lien, PhD

ALTERNATIVE APPROACHES

	F, April 17	Smilow 11-146	Data Integration	Aalim Weljie, PhD
16	M, April 20	Smilow 11-146	High Throughput Screening	David Shultz, PhD
	W, April 22	Smilow 11-146	New Alternative Methods	Michael Pack, MD
	F, April 24	Smilow 11-146	Predictive Toxicology and TOX 21st Century	Joseph Romano, PhD
17	M, April 27	Smilow 11-146	Exposure Biology Informatics	Joseph Romano, PhD
	W, April 29 1:45pm-3:45pm	Smilow 10-146	Risk Assessment Presentations	
	FINAL- W, May 6	Smilow 11-146	Final Examination	

Evaluation:

Mid-Term: 30%

Final Exam: 40%

Risk Assessment Paper: 30%

Text: Casarett & Doulls: Toxicology: The Basic Science of Poisons (7th – 9th Ed)

Questions on individual lectures can be sent by email to:

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