

# Course Syllabus

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**Syllabus: ENV H 503 – Adverse Health Effects of Environmental and Occupational Toxicants**

**Spring quarter, 2021; 4 credits**

**Lectures: Mondays, Wednesdays & Fridays from 2:30 - 3:20 pm**

**Zoom access to the lectures:**

**Meeting ID: 963 8398 2763**

**Passcode: 066067**

**[Zoom Link for ENVH503 \(https://washington.zoom.us/j/96383982763?pwd=MmIRM3N0SWhncWhkQWliRGJZREMxUT09\)](https://washington.zoom.us/j/96383982763?pwd=MmIRM3N0SWhncWhkQWliRGJZREMxUT09)**

**Instructors:**

**Dr. Terry Kavanagh, Professor DEOHS; email: [tjkav@uw.edu](mailto:tjkav@uw.edu) (<mailto:tjkav@uw.edu>)**

**Ms. Natalie Soto, Teaching Assistant; email: [nds01@uw.edu](mailto:nds01@uw.edu) (<mailto:nds01@uw.edu>)**

**Guest lecturers:**

**Dr. Julia Cui**

**Others?**

**TA office hours: Wednesday and Thursday 10:30am-11:30am**

**Zoom access for TA Office Hours: <https://washington.zoom.us/j/4041893374>**

**Appointments with Dr. Kavanagh by arrangement only.**

## **Course Description**

Basic principles governing the effects of toxicants on biological systems, including: Dose response modeling; individual vs. population effects; acute, sub-acute and chronic toxicity models; derivation of toxicant potency estimates for use in risk assessment; disposition of toxicants in the body; modifiers of response toxicant exposure; biochemical and cellular mechanisms of toxicity and other health effects of toxicants, including cancer, birth defects and damage to major organs (nervous system, liver, gastrointestinal system, kidney, cardio/pulmonary system, immune system, endocrine system, skin,

sensory systems); and regulation of toxicants in agricultural, household, and ecological settings. The focus is on human health impacts of toxicants in a public health context. Additional readings and presentations/discussions provide graduate-level coverage of related issues. Designed for non-toxicology majors.

### Learning objectives for ENV H 503

The learning objectives for this course are based on fundamental concepts in the science and practice of toxicology. After having taken this course students will be able to:

- Identify people and seminal events important in the history of toxicology, and the professional disciplines, job classifications and scientific fields occupied by toxicologists.
- Explain the principles of dose-response, including quantal vs. continuous measures of response and the descriptors used to define individual susceptibility to toxicants.
- Discuss the different types of testing paradigms used to evaluate the adverse health effects of toxicants, including tests for acute, subacute and chronic toxicity; the various biochemical and molecular assays used to investigate mechanisms by which they cause injury; and the ethical principles surrounding *in vitro* and *in vivo* testing.
- Explain the concepts of absorption, distribution, metabolism and excretion, and their integral roles as determinants of adverse health outcomes caused by toxicant exposure.
- Explain the biochemical basis of toxicant biotransformation including the key enzymes systems involved, phases of metabolism, and their consequences for toxicant disposition in the body.
- Discuss the impact of genetic variation, diet, age, gender, the gut microbiome, and infectious disease status on toxicant disposition and dose-response relationships.
- Discuss the consequences of toxicant exposure for different organs and organ systems, including the liver, the kidneys, the gastrointestinal tract, the brain, the cardiovascular and respiratory systems, the immune system, the skin, sensory organs and the endocrine system, and why some toxicants target these organs/systems.
- Identify susceptible periods of embryonic/fetal development that predispose to various kinds of toxicant-induced birth defects, and explain the value of comparative animal approaches for understanding mechanism of action for developmental toxicants.
- Describe the basic processes of chemical carcinogenesis, including initiation, promotion and progression, and the types of toxicant-induced genetic, molecular and cellular changes that lead to cancer.
- Categorize toxicants with respect to chemical class, mode of action, and potency, including pesticides, heavy metals, halogenated hydrocarbons, polycyclic aromatic hydrocarbons, food additives and contaminants, solvents and vapors, and toxins produced by microbial pathogens, plants and animals.
- Define the statutory authority governmental agencies use to control toxicant releases to the environment, exposures in the workplace, and clean-up of toxicants; describe the means by which

exposure criteria and standards are established, and discuss the economic, political, and ethical dilemmas associated with the regulation of toxicants.

### Required Textbook:

*Casarett & Doull's Essentials of Toxicology, 4th Edition*, Curtis D. Klaassen & John B Watkins III, McGraw Hill, 2021

The text is available as an eBook through the UW Libraries. Or go directly to this website:

<https://accesspharmacy.mhmedical.com/book.aspx?bookID=3000>

(<https://accesspharmacy.mhmedical.com/book.aspx?bookID=3000>)

### ENVH 503 Website

The Canvas Website for this course is:

<https://canvas.uw.edu/courses/1449236>

**Prerequisites:** none, although it is strongly encouraged that students take ENVH 501 and ENVH 502 prior to enrolling in this course.

### Grading

There are 3 exams, and an optional final exam\*. Exams are worth 100 points each, for a total of 300 point for the course.

Exam I	100 pts
Exam II	100 pts
<u>Exam III</u>	<u>100 pts</u>
Total	300 pts

*Each exam is designed to be completed in 50 min.*

*\*An optional comprehensive final exam will be offered during the final examination period. This comprehensive final exam is worth 100 points, and is also designed to be completed in 50 min. Because the final exam period is scheduled for 1 hr and 50 min, there should be adequate time to take both the 3rd exam and the comprehensive optional comprehensive final exam, should you decide to do so. This optional final exam, will replace the lowest score of your other three exams, even if it is lower! Thus, turn in the optional final exam only if you feel confident that you did better on it than your previous worst exam.*

**Course Absence Policies:** It is your responsibility to notify the instructors by the end of the first week of any conflicts you may have with the exam schedule.

There will be no make-up examinations unless approved by the instructor in advance. If a test is missed because of an unexcused absence, it will not be rescheduled. Contact your instructor prior to or same day to notify him that you are unable to take the exam.

Your instructor will then set a date for a makeup exam, contingent on the student showing as soon as possible a valid medical note issued by a medical professional on the original exam date. For other reasons (car accident, death in the family etc.), arrange to speak with the instructor to explain the circumstances. Within reason we will expect to be notified prior to or the day of the exam for these instances.

If you have any concerns about the class, you may contact Dr. Kavanagh by email to arrange a meeting. If you are still not satisfied with the response that you receive, you may contact the Department Chair. You may also contact the Graduate School at G -1 Communications Bldg, by phone at (206) 543-5139 or by email at [raan@uw.edu](mailto:raan@uw.edu)

### **The University of Washington and Academic Integrity:**

Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity. The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). We expect you to know and follow the university's policies on cheating and plagiarism, and the [SPH Academic Integrity Policy \(Links to an external site.\)](https://sph.washington.edu/students/academic-integrity-policy) (<https://sph.washington.edu/students/academic-integrity-policy>). (Links to an external site.). Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington Community Standards and Student Conduct website.

### **University of Washington general policy statement:**

"Admission to the University carries with it the presumption that students will conduct themselves as responsible members of the University community. As a condition of enrollment, all students assume responsibility to observe standards of conduct that will contribute to the pursuit of academic goals and to the welfare of the University community. That responsibility includes, but is not limited to:

Practicing high standards of academic and professional honesty and integrity;

1. Refraining from any conduct that would violate the rights, privileges, and property of others;
2. Refraining from any conduct that would substantially disrupt or materially interfere with University operations;
3. Refraining from any conduct that could reasonably cause harm to or endanger the health, safety, or welfare of other persons; and
4. Complying with the rules, regulations, procedures, policies, standards of conduct, and orders of the University and its schools, colleges, departments, units, and programs."

<https://www.washington.edu/admin/rules/policies/SGP/SPCH210.html> (Links to an external site.)  
(<https://www.washington.edu/admin/rules/policies/SGP/SPCH210.html>) (Links to an external site.)

For web-resources on understanding and avoiding plagiarism, please see:

<https://guides.lib.uw.edu/hsl/writer/plagiarism> Links to an external site.  
(<https://guides.lib.uw.edu/hsl/writer/plagiarism>) (Links to an external site.)

### **Access and Accommodations:**

Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course. If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or [uwdrs@uw.edu](mailto:uwdrs@uw.edu) or [disability.uw.edu](http://disability.uw.edu). DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between you, your instructor(s) and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

### **Commitment to Multicultural Inclusion:**

The UW School of Public Health seeks to ensure all students are fully included in each course. We strive to create an environment that reflects community and mutual caring. We encourage students with concerns about classroom climate to talk to your instructor, your advisor, a member of the departmental or SPH Diversity Committee and/or the program director. [DCinfo@uw.edu](mailto:DCinfo@uw.edu) is a resource for students with classroom climate concerns.

### **Religious Accommodations:**

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/> (Links to an external site.)  
(<https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/>)). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (<https://registrar.washington.edu/students/religious-accommodations-request/> (Links to an external site.)  
(<https://registrar.washington.edu/students/religious-accommodations-request/>)).

**Please Note: All slide files are for your use only; they are not for distribution outside of class.**

**Lecture Schedule:**

<b>WK</b>	<b>Session #:</b>	<b>Date</b>	<b>Topic Covered</b>	<b>Assignment</b>
<b>MODULE 1: Basic Principles and Determinants of Toxic Responses</b>				
	<b>Session 1:</b>			Lecture notes; Textbook Chapter 1
		Mon, Mar 29	Introduction/History of Toxicology	
<b>1</b>	<b>Session 2:</b>			Lecture notes; Textbook Chapter 2
		Wed, Mar 31	Basic Principles of Toxicology: Dose response; individual vs. population modeling; acute, sub-acute and chronic exposure models; PK and cumulative effects of repeated dosing	
	<b>Session 3:</b>			Lecture notes; Textbook Chapter 5-7
		Fri, Apr 2	Xenobiotic biotransformation: Phase 1 metabolism; monooxygenases, reductases, hydrolases and esterases	
	<b>Session 4:</b>			Lecture notes; Textbook Chapter 5-7
		Mon, Apr 5	Xenobiotic biotransformation: Phase 2 metabolism; conjugation reactions	
<b>2</b>	<b>Session 5:</b>			Lecture notes; Textbook Chapters 5-7
		Wed, Apr 7	Xenobiotic biotransformation: Phase 3 metabolism; transporters and routes of excretion	
	<b>Session 6:</b>			Lecture notes; Textbook Chapter 2
		Fri, Apr 9	Factors that modify toxic responses: age/developmental status; sex; circadian rhythms; genetics; disease status; nutrition/diet/microbiome	
<b>3</b>	<b>Session 7:</b>			Lecture notes; Textbook Chapter 3
		Mon, Apr 12	Biochemical and Cellular Mechanisms of Toxicity; signal transduction; oxidative/nitrosative stress; disruption of cellular energetics; modes of toxicant-induced cell death	

	<b>Session 8:</b>	Toxicity testing: <i>In silico</i> , <i>in vitro</i> , <i>ex vivo</i> , and <i>in vivo</i> testing; The 3 Rs	Lecture notes; Textbook Chapter 2
	Wed, Apr 14		
	<b>Session 9:</b>	Toxicity testing: Reproductive and Developmental toxicology; Teratogenicity	Lecture notes; Textbook Chapter 12, 20
	Fri, Apr 16		
	<b>Session 10:</b>	Toxicity testing: Genetics and Epigenetics in Toxicology; DNA Damage/Mutagenesis, and Epigenetic Modulation of Chromatin	Lecture notes; Textbook Chapter 3, 8
	Mon, Apr 19		
<b>4</b>	<b>Session 11:</b>	Toxicity testing: Chemical Carcinogenesis	Lecture notes; Textbook Chapters 8, 9
	Wed, Apr 21		
	<b>Session 12:</b>	Exam 1: Covers Sessions 1 - 11	In class exam; see assignments
	Fri, Apr 23		

## MODULE 2: Organ systems toxicology

	<b>Session 13:</b>	Immunotoxicity and inflammatory responses 1	Lecture notes; Textbook Chapters 12
	Mon, Apr 26		
<b>5</b>	<b>Session 14:</b>	Immunotoxicity and inflammatory responses 2	Lecture notes; Textbook Chapters 12
	Wed, Apr 28		
	<b>Session 15:</b>	Hepatotoxicity	Lecture notes; Textbook Chapters 13
	Fri, Apr 30		
<b>6</b>	<b>Session 16:</b>	Nephrotoxicity	Lecture notes; Textbook Chapters 14
	Mon, May 3		

	<b>Session 17:</b>	Respiratory and Cardiovascular toxicity	Lecture notes; Textbook Chapters 15, 18, 31
	Wed, May 5		
	<b>Session 18:</b>	Neurotoxicity	Lecture notes; Textbook Chapters 16
	Fri, May 7		
	<b>Session 19:</b>	Endocrine system toxicology	Lecture notes; Textbook Chapter 17, 15
	Mon, May 10		
<b>7</b>	<b>Session 20:</b>	Dermal toxicity	Lecture notes; Textbook Chapters 19
	Wed, May 12		
	<b>Session 21:</b>	Exam 2: Covers Sessions 13 - 20	In class exam; see assignments
	Fri, May 14		

### MODULE 3: Toxic Agents

	<b>Session 22:</b>	Pesticide toxicology: Insecticides	Lecture notes; Textbook Chapter 22
	Mon, May 17		
<b>8</b>	<b>Session 23:</b>	Pesticide toxicology: Herbicides	Lecture notes; Textbook Chapter 22
	Wed, May 19		
	<b>Session 24:</b>	Solvents & persistent organic pollutants (POPs): PCBs, PBBs, PBDEs, dioxins/dibenzofurans,	Lecture notes; Textbook Chapter 24, 30
	Fri, May 21		
<b>9</b>	<b>Session 25:</b>	Toxins: Microbial, Plant, Animal	Lecture notes; Textbook Chapter 26
	Mon, May 24		

	<b>Session 26:</b> Wed, May 26	Household products/contaminants; clinical toxicology	Lecture notes; Textbook Chapter 33
	<b>Session 27:</b> Fri, May 28	Drugs	Lecture notes; Textbook Chapters multiple
	Mon, May 31	Memorial Day Holiday - NO CLASS	
10	<b>Session 28:</b> Wed, Jun 02	Food Toxicology	Lecture notes; Textbook Chapter 27
	<b>Session 29:</b> Fri, Jun 04	Regulatory Toxicology	Lecture notes; Textbook Chapters
	<b>Final Examination</b>	Exam 3: Covers Sessions 22-29; Optional Final Exam: Covers Sessions 1 -30	In class exam; see assignments

## Course Summary:

Date	Details	Due
Fri Apr 23, 2021	 <a href="https://canvas.uw.edu/courses/1449236/assignments/6290973">Exam 1</a> ( <a href="https://canvas.uw.edu/courses/1449236/assignments/6290973">https://canvas.uw.edu/courses/1449236/assignments/6290973</a> )	due by 3:20pm
Sat Apr 24, 2021	 <a href="https://canvas.uw.edu/courses/1449236/assignments/6290973">Exam 1</a> ( <a href="https://canvas.uw.edu/courses/1449236/assignments/6290973">https://canvas.uw.edu/courses/1449236/assignments/6290973</a> ) (1 student)	due by 11:59pm