DEPARTMENT: Environmental Health

COURSE NUMBER: EH 520      SECTION: 1      SEMESTER: Fall 2016

CREDIT HOURS: 3

COURSE TITLE: Human Toxicology

COURSE LOCATION: Claudia Nance Rollins Building, Room 1000

SUGGESTED READING: Casarett and Doull’s Essentials of Toxicology (2nd Ed). This book is an abbreviated version of the Casarett and Doull’s Toxicology: Basic Science of Poisons. I will post a PDF version of the Basic Science of Poisons on Blackboard.

INSTRUCTOR:
W. Michael Caudle, PhD
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OFFICE: Claudia Nance Rollins Building, Room 2033
OFFICE HOURS: By appointment

TEACHING ASSISTANT:
Aimee Vester
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BRIEF COURSE DESCRIPTION
Tuesdays and Thursdays 10:00-11:20a
The goal of this course is to introduce the student to the basic principles of toxicology. Humans are exposed to a variety of dangerous substances through occupational and environmental exposures. In order to interpret the public health implications of these exposures one must have a good understanding of how these compounds get into the body, how they are processed in the body, and how they damage particular organ systems. To accomplish this, students will gain practical knowledge of the workings of specific organ systems and will be able to identify particular environmental chemicals and their mechanisms of action that underlie organ toxicity. This information will be conveyed through lecture material and reinforced by relevant readings, in-class discussion, and additional assignments that are focused on ensuring that the toxicological topics are further evaluated and considered in the context of current environmental and human health concerns and do not simply exist as stand alone facts.

LIST SCHOOL LEVEL, DEPARTMENT, AND/OR PROGRAM COMPETENCIES
To learn how environmental and occupational exposures to chemicals and other agents impact human health.

To learn how to critically evaluate environmental and occupational health research
LIST LEARNING OBJECTIVES ASSOCIATED WITH THE COMPETENCIES

Be able to list the potential cellular targets of toxic compounds
Be able to discuss how metabolism can impact the toxicity of a compound
Be able to explain the basis of organ specific toxicity
Be able to give an example of a lung-, kidney-, liver-, CNS, immuno-toxin, and explain its mechanism of action
Be able to give an example of a carcinogen and its mechanism of action
Be able to explain how exposure science, epigenetics, metabolomics, and computational toxicology are utilized in environmental health
Be able to effectively communicate the toxicological concerns for a given agent

EVALUATION

Your grade in this class will be based upon four exams and a series of short assignments.

Exam 1 20%
Exam 2 20%
Exam 3 20%
Exam 4 20%
Additional Assignments 20%

Exams: Exams will be composed of multiple choice, short answer, and short essay questions. All information covered on the exam will be presented in the lecture. If exam material is coming from other sources I will be explicit about the sources and the material you need to understand.

Grading: Each exam will be worth 100 pts. Additional assignments will be worth 100 pts (cumulative) and will be made up of short, in-class and take home assignments that will serve to enrich the understanding of the lecture material. A major portion of these points will come during the Discussion sessions prior to each exam. Discussion sessions will occur during class time and will serve as a mini-review session for the upcoming exam. While the exact format of each Discussion session may be different, they will require the attendance and participation of each student. These sessions are designed to assist students in their exam preparation by reinforcing the lecture material through various exercises and ensuring that students are able to effectively synthesize, integrate, and apply the lecture material to novel toxicological situations. In other words, are you flexible with your toxicological knowledge and can you use it to solve similar toxicological problems not explicitly presented in class?

EHS PhD Students: Students in the PhD program will be responsible for completing 4 additional assignments related to the course material. These assignments will require interaction and understanding of relevant primary literature and the ability to critically appraise and discuss the toxicological aspects.

Extra Credit: I do not give extra credit assignments. I have purposefully designed this course to facilitate student success with the material. For example: 1). Limit amount of material students are responsible for on each exam (4-5 lectures), 2). Provide an in-class discussion session prior to each exam to allow students the opportunity to further solidify their understanding of the material, and 3). I am easy to reach and always willing to discuss class material, either via email or in person. But, I cannot help you if I do not know you are having a problem.

Attendance: I do not take attendance and it is not part of your grade. If you are going to miss a class, especially a Discussion session or an exam, please let me know ahead of time. I have no problem working with you to reschedule, within reason.
LEARNING ACCOMMODATIONS

If you have a documented disability and have anticipated barriers related to the format or requirements of this course, or presume having a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic), and are in need of accommodations for this semester, we encourage you to contact the Office of Access, Disability Services, and Resources (ADSR) to learn more about the registration process and steps for requesting accommodations.

If you are a student that is currently registered with ADSR and have not received a copy of your accommodation notification letter within the first week of class, please notify ADSR immediately. Students who have accommodations in place are encouraged to coordinate sometime with your professor, during the first week of the semester, to communicate your specific needs for the course as it relates to your approved accommodations. All discussions with ADSR and faculty concerning the nature of your disability remain confidential.

For additional information regarding ADSR, please visit the website: equity.emory.edu/access.
Lecture Schedule
Lectures will be held Tuesdays and Thursday, 10:00a-11:20a in CNR 1000

Week 1
Aug 25  Introduction to Course (Caudle)
Topics:
- Me, talking and saying weird stuff
- Overview of syllabus
- Why do we need to appreciate toxicology?
- Toxicology is current: A quick reminder that toxicology happens every day

Week 2
Aug 30  Toxicant Disposition (Caudle) Ch 5
Topics:
- Routes of exposure and absorption across biological membranes
- Distribution of toxicants in the body
- Toxicant excretion
- How toxicant disposition applies to toxicology research

Sept 1  Mechanisms of Toxicity (Caudle) Ch 4
Topics:
- Biological and physiological factors that affect toxicity
- Cellular targets of toxicity
- Cellular adaptation and repair
- MPTP and Parkinson disease: A model compound

Week 3
Sept 6  Biotransformation/Metabolism (Caudle) Ch 6
Topics:
- Goals of biotransformation
- Phase I and Phase II enzymes
- Genetic variation in biotransformation
- Chemical modification of biotransformation

Sept 8  Liver Toxicology (Caudle) Ch 13
Topics:
- General function and anatomy of the liver
- Pathology associated with liver damage
- Toxicants involved in liver toxicity

Week 4
Sept 13 Kidney Toxicology (Caudle) Ch 14
Topics:
- General anatomy and function of the kidney
-Chemicals that affect specific sites in the kidney
-Tattoo ink: Mickey Mouse kicking a soccer ball and kidney damage
-Crossfit: How can something so good hurt so bad?!

**PhD Assignment #1: Modulation of Biotransformation in Liver Toxicity**

Sept 15  
Class Discussion

Week 5  
Sept 20  
Exam I  
This exam will cover lecture material discussed:
1. Toxicant Disposition
2. Mechanisms of Toxicity
3. Biotransformation
4. Liver Toxicity
5. Kidney Toxicology

Sept 22  
Lung Toxicology (Caudle) Ch 15  
Topics:
- Anatomy and function of the respiratory pathway
- Pathology and mechanisms involved in lung damage
- Lung damage caused by specific toxicants

Week 6  
Sept 27  
Neurodevelopment and Neurotoxicology (Caudle) Ch 16  
Topics:
- General overview of neurodevelopment
- Specific aspects of the neuron that mediate its function
- Toxicants that target the neuron and neurological function
- Studying developmental neurotoxicology in the lab

Sept 29  
Immunotoxicology (Caudle) Ch 12  
Topics:
- Major organs of the immune system
- The immune response and cells that mediate it
- Specific chemicals and their impact on the immune system
- Asthma and allergies
- The hygiene hypothesis

Week 7  
Oct 4  
Developmental and Reproductive Toxicology (Easley) Ch 10 and 20  
Topics:
- Reproductive development
- Chemicals and mechanisms involved in reproductive toxicology
- Using stem cells to study reproductive toxicology
- **Chemicals involved in developmental toxicology**

Oct 6

**Environmental Carcinogenesis (Caudle) Ch 8**

Topics:
- Stages of carcinogenesis
- Proto-oncogenes and tumor suppressors
- Genotoxic and non-genotoxic mechanism of carcinogenesis
- Oxidative stress and receptor-mediated carcinogenesis
- Novel therapeutic approaches to cancer

**PhD Assignment #2: Neurotoxicity and Neurodevelopment**

Week 8

Oct 11  **Fall Break (No Class)**

Oct 13  **Class Discussion**

Week 9

Oct 18  **Exam II**

*This exam will cover lecture material discussed:*
1. Lung Toxicology
2. Neurodevelopment and Neurotoxicology
3. Immunotoxicology
4. Environmental Carcinogenesis
5. Reproductive Toxicology

Oct 20  **Analytical Toxicology (Barr) Ch 31**

Topics:
- Utility of biomonitoring in environmental health
- Application of biomonitoring to address specific EH questions
- Integration of biomonitoring into the exposome

Week 10

Oct 25  **The Exposome and Human Health (Miller)**

Topics:
- What is the exposome?
- Approaches to capturing and measuring the exposome
- Emory and the HERCULES Exposome Project: The path forward

Oct 27  **Epigenetics and Toxicology (Marsit)**

Topics:
- Mechanisms of epigenetic regulation
- Role of epigenetics control in human health and disease
- Evidence that exposures can impact epigenetic regulation
Week 11
Nov 1  Toxico-metabolomics (Walker)
Topics:
- Description of high-resolution metabolomics
- Importance of untargeted screening in environmental health research
- Metabolome-wide association studies
- Metabolic phenotyping: Insight into the human exposome

Nov 3  Computational Toxicology (Zhang)
Topics:
- Why are computational approaches necessary and what are they capable of in toxicology?
- Understanding toxicokinetics: physiologically-based pharmacokinetic (PBPK) modeling
- Understanding toxicodynamics: dynamic modeling of cellular and tissue responses

**PhD Assignment #3: Assessment of Halogenated Compounds in Human Tissue in Disease**

Week 12
Nov 8  Discussion

Nov 10  Exam III
This exam will cover lecture material discussed:
1. Analytical Toxicology
2. Exposome
3. Epigenetics and Toxicology
4. Toxico-metabolomics
5. Computational Toxicology

Week 13
Nov 15  Health Effects of Flame Retardant Exposure (Caudle) TBD
Topics:
- Overview and history of flame retardant use
- Monsanto and PCBs: Issues of health, social and environmental justice
- Common-use flame retardants and neurological impact

Nov 17  Pesticides (Vester) Ch 22
Topics:
- Overview of pesticide production, regulation, and policy
- Targets and health effects of commonly used insecticides
- Targets and health effects of commonly used herbicides
- How we study pesticide neurotoxicity in the lab

**Week 14**

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<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>Nov 22</td>
<td>Thanksgiving (No Class)</td>
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<tr>
<td>Nov 24</td>
<td>Thanksgiving (No Class)</td>
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**Week 15**

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<tr>
<td>Nov 29</td>
<td>Animal Toxins (Caudle) Ch 26 and 27</td>
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|         | **Topics:**
|         | - Animal venoms as toxicological agents |
|         | - Animal poisons and mechanism of toxicity |
|         | - Therapeutic properties of venoms and poisons |
| Dec 1   | Drugs of Abuse (Guillot) TBD       |
|         | **Topics:**
|         | - Why are drugs so much fun? Pathways and mechanisms |
|         | - Inhalants                         |
|         | - Amphetamines                      |
|         | - Dissociatives                     |
|         | - Up and coming drugs that will split your brain |

**PhD Assignment #4:** Shared Molecular Targets of Natural and Man-Made Neurotoxic Compounds

**Week 16**

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<tr>
<td>Dec 6</td>
<td><strong>Class Discussion</strong></td>
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<tr>
<td>Dec 8</td>
<td><strong>Exam IV</strong></td>
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|         | *This exam will cover lecture material discussed:*
|         | 1. Flame Retardant Toxicology |
|         | 2. Pesticides              |
|         | 3. Plant and Animal Toxins |
|         | 4. Drugs of Abuse          |

**ACADEMIC HONOR CODE**

The RSPH requires that all material submitted by a student in fulfilling his or her academic course of study must be the original work of the student.