

Syllabus

ENVR 430: Health Effects of Environmental Agents

Time of Class: 1:25 to 2:15 pm Mon-Wed-Fri

Class room: McGavran-Greenberg 1304

Dr. Kun Lu (course director)- kunlu@unc.edu

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Office Hours: 2:15 to 3:30 pm Wed, or by appointment

TA: Pengcheng Tu ptu@live.unc.edu

Course Information

Course Description

This course introduces students to the general principles underlying the health effects of environmental agents. Students will gain an understanding of the mechanisms of interactions between environmental agents and living systems.

Course Goals

This course will enable students to apply information derived from fundamental microbiology and toxicology studies to assessment of the health hazards associated with exposure to environmental agents, and to predicting the health effects of novel agents.

This course is intended to cover the following competencies:

I. Discipline-specific Competencies: Environmental Health Sciences

1. Describe the direct and indirect human, ecological and safety effects of major environmental and occupational agents
2. Describe genetic, physiologic and psychosocial factors that affect susceptibility to adverse health outcomes following exposure to environmental hazards.
3. Describe federal and state regulatory programs, guidelines and authorities that control environmental health issues
4. Specify current environmental risk assessment methods.
5. Specify approaches for assessing, preventing and controlling environmental hazards that pose risks to human health and safety.
6. Explain the general mechanisms of toxicity in eliciting a toxic response to various environmental exposures.
7. Discuss various risk management and risk communication approaches in relation to issues of environmental justice and equity.
8. Develop a testable model of environmental insult.

II. Discipline-specific Competencies: Public Health Biology

1. Specify the role of the immune system in population health.
2. Describe how behavior alters human biology.
3. Identify the ethical, social and legal issues implied by public health biology.
4. Explain the biological and molecular basis of public health.
5. Explain the role of biology in the ecological model of population-based health.
6. Explain how genetics and genomics affect disease processes and public health policy and practice.
7. Articulate how biological, chemical and physical agents affect human health.
8. Apply biological principles to development and implementation of disease prevention, control, or management programs.

9. Apply evidence-based biological and molecular concepts to inform public health laws, policies, and regulations.
10. Integrate general biological and molecular concepts into public health.

III. Environmental Sciences and Engineering Major-Specific Competencies

1. Identify the key environmental factors that affect human health.
2. Understand the mechanistic basis for human health effects.
3. Evaluate the potential impact of emerging environmental threats, and formulate appropriate control measures.

IV. MPH-Portion of ESE Competencies covered

1. Weigh the scientific bases of hazard identification to support environmental management and policy
2. Identify and evaluate the relationships between exposure pathways and health effects of contaminants in environmental systems
3. Describe, and critically evaluate the rationale for and approaches used to measure and model properties of human systems relevant to exposure, dose and health effects of environmental contaminants

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| <p>Introduction, Overview. The major categories of environmental agents. Review of basic metabolism and biochemistry relevant to health effects. Apoptosis, necrosis, inflammation. Detection of adverse health effects. Development of protective exposure standards.</p> | <p>Competencies addressed: I.1, I.3, I.4, I.5, I.6, I.8 II.1, II.4, II.7, II.9, II.10 III.1, III.2, III.3 IV.1, IV.2</p> |
| <p>Metabolism and disposition of Xenobiotics. How exogenous chemicals enter the body, are broken down, transported and eliminated from the body. Phase I, phase II, phase III reactions. Major enzyme systems, specificity for different functional groups. Species differences. Detoxication and activation. Role in generation of species- and organ-specific health effects. Kinetics of distribution and elimination: Kinetics of enzymic and carrier-mediated processes, zero-, first-, second-order reactions, classical kinetics (one-, Two-, three-compartment models, half-life, AUC), physiologically-based pharmacokinetics, use in prediction of dose-response relationships.</p> | <p>I.2, I.6 II.5, II.6, II.7 III.1, III.2 IV.1, IV.2, IV.3</p> |
| <p>Genetic Toxicology: From DNA damage and DNA repair to mutations to cancer. Formation of DNA adducts, mechanisms of DNA damage, how DNA damage can lead to mutations, how mutations can lead to cancer. Repair of DNA damage, role in carcinogenesis. Non-genotoxic carcinogens. Biological effects of radiation.</p> | <p>I.2, I.6 II.5, II.6, II.7 III.1, III.2, III.3 IV.1, IV.3</p> |
| <p>Damage to specific organ systems. Structure and function of the liver, lung and other major organ systems, and how they are damaged by exposure to environmental agents.</p> | <p>I.2, I.5, I.6, I.8 II.5, II.6, II.7 III.1, III.2, III.3 IV.1, IV.3</p> |
| <p>Environmental Pathogens: Environmental transmission and mechanisms of disease, defenses and control measures. Characteristics of microorganisms that enable them to survive in the environment, and to act as pathogens. Mechanism of uptake into cells, major routes of exposure, pathways of entry into the body,</p> | <p>II.2, II.4, II.7, II.8, II.9, II.10 III.1, III.2, III.3 IV.1, IV.2, IV.3</p> |

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| distribution and elimination. The principal environmental pathogens and the mechanisms by which they cause disease. Measures that control the spread of environmental diseases; the immune system, disinfection, disinfection kinetics | II.1, II.2, II.8, II.9, II.10 III.1, III.2, III.3 |
| Drinking water, wastewater, sanitation. How drinking water and wastewater are treated to minimize spread of waterborne diseases – conventional and alternative approaches. | I.5, I.7, I.8, II.5 III.1, III.2, III.3 IV.2 |
| Food safety. Major food-borne pathogens, foods which are susceptible to carrying pathogens, how foodborne infection can be controlled. | III.1, III.2, III.3 IV.2 |
| Risk assessment. The process of risk assessment, comparison of risks. | I.4, I.7, I.8, IV.3 |

Prerequisites

Biology (UNC-CH: BIOL202), chemistry through organic (UNC-CH CHEM261), mathematics through calculus (UNC-CH: MATH232); biochemistry (UNC-CH CHEM430) is recommended. If these prerequisites are not all met: students may remedy weak areas by independent study (suitable texts are listed below), and permission of the course coordinator is required.

Textbooks

The reading material for this course consists mainly of journal articles available through on-line links. There is no assigned textbook. The books listed below are **recommended not required**.

CASARETT AND DOULLs Toxicology: The Basic Science of Poisons. Seventh Edition, McGraw-Hill, New York, 2008, pp. 1236. Edited by Curtis D. Klaassen. ISBN 0-07-147051-4, Hardback, \$105.00. An in-depth treatment of toxicology, suitable as a long-term reference for students who intend to specialise in this field.

This book is accessible as an [E-book](http://web.b.ebscohost.com/ehost/detail/detail?sid=396263ae-5922-44f7-9b68-7dda95a07c19%40sessionmgr114&vid=0&hid=115&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=nlebk&AN=219515) through the UNC-Chapel Hill Libraries
<http://web.b.ebscohost.com/ehost/detail/detail?sid=396263ae-5922-44f7-9b68-7dda95a07c19%40sessionmgr114&vid=0&hid=115&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=nlebk&AN=219515>

MICROBIOLOGY

Environmental Microbiology, 2nd Edition. Edited By Raina M. Maier, Ian L. Pepper & Charles P. Gerba 624 pages, Copyright 2009 USD 79.95, Hardcover. Academic Press ISBN: 978-0-12-370519-8

E-book: [Encyclopedia of Microbiology](#) Full Text Available By: Maczulak, Anne E. In: Facts on File Science Library. New York : Facts On File. 2011.

<http://web.a.ebscohost.com/ehost/detail/detail?vid=0&sid=188a5d4a-342a-4637-9ce7-25ed7701a6fa%40sessionmgr4009&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=nlebk&AN=368728>

FOR REVIEW of basic biochemistry, chemistry, and microbiology, as required:

GILBERT, H. F.: Basic Concepts in Biochemistry: A Student's Survival Guide. 2nd Ed.,

McGraw-Hill Inc., New York, NY, 2000. ISBN 0-07-135657-6, Softcover, \$29.95. LEMKE, T. L.: Review of Organic Functional Groups: Introduction to Medicinal Organic

Chemistry. 4th Ed., Lippincott Williams & Wilkins, Philadelphia, 2003. ISBN 0-7817-4381-8, Softcover (with CD-ROM), \$37.95.

BROOKS, G.F., Butel, J.S. and Morse, S.A.: Jawetz, Melnick and Adelberg's Medical Microbiology. 23rd Ed., McGraw-Hill/Appleton and Lange, Stamford, CT, 2004. ISSN 1054-2744, Softcover, \$49.95.

Attendance

This class meets in person MWF 1:25 to 2:15 pm. Attendance will not be formally tracked. I expect students to be responsible for anticipating absences and making appropriate arrangements to cover course material and assignments.

Grading

Grades will be based on twelve homework sets, two in-class examinations, one group project and one final examination.

| Assignment | % of Final Grade |
|-------------------|-------------------------|
| 12 Homework Sets | 48%, 12 @ 4% |
| Exam 1 | 6% |
| Exam 2 | 6% |
| Group project | 10% |
| Final | 30% |

Homework Sets

The homework sets will consist of three-four short-answer questions. They will be posted on the course website on Monday and will be due the following Monday by 5:00 PM. Completed hard-copy homework sets will be collected by the TA in class, or should be placed in the box marked "ENVR 430 HOMEWORK SETS," located in Room 148 Rosenau Hall. Each homework set counts for 4% of the total course grade; collectively, these sets count for 48% of the entire course grade. Each homework set is graded out of 10 points and weighted equally. Work turned in late will incur a penalty commensurate with the delay (10% per day or fraction of a day), and only if an excuse acceptable to the instructor is presented.

In-class Examinations

The in-class examinations count for 6% each (and collectively for 12%) of the overall course grade. These examinations (held in late September and late October/early November) cover defined material and are not cumulative.

Group presentations

Every group (3 students/group) will pick up an environmental health related topic (you do not have to select the topic from the following list of examples). The presentation should be within 10 minutes. The format (slide-based presentation, video, etc) is determined by the group. It will count for 10% of the overall course grade. Grading will be based on organization/content, delivery, use of audio/visual tools and overall effectiveness of communication.

Example topics for group presentations

1. Nano-materials and nano-particles in environment

2. *Endocrine-disrupting environmental chemicals*
3. *Environmental exposure and neurodegeneration and neurodegenerative diseases*
4. *Environmental chemical exposures and human epigenetics*
5. *Prenatal environmental exposure and diseases*
6. *Childhood obesity and environmental chemicals*
7. *Arsenic exposure, toxicity and risk assessment*
8. *Pesticides in U.S.*
9. *Indoor ultrafine particles and childhood asthma*
10. *Antibiotic resistance*
11. *The concept of exposome*
12. *Environmental chemicals in food*
13. *Foodborne disease*
14. *Human carcinogens*
15. *Chemicals and their potential effects in personal care products*

Final Examination

The final examination will be held at the regularly-scheduled exam time for MWF 1:25 pm courses. It will count for 30% of the overall course grade, and will include the material covered in the entire course.

The following grading scheme is used:

| % | Descriptor | Assigned Grade | Undergraduate Grade |
|-----------|-------------------|-----------------------|----------------------------|
| 95 - 100 | Outstanding | H | A |
| 90-94.9 | Excellent | | A- |
| 85 - 89.9 | Very good | P (P+)* | B+ |
| 80 - 84.9 | Good | P | B |
| 75 - 79.9 | Satisfactory | P (P-)* | B- |
| 70 - 74.9 | Adequate | P (P-)* | C |
| 60 - 69.9 | Marginal | L | D |
| 50 - 59.9 | Insufficient | F | F |

Honor Code

The Honor Code is in effect whether or not a formal pledge is included in each assignment. Each weekly assignment is an individual grading opportunity. You may gripe about the assignments collectively, but the material that you turn in should be your own unaided work. The weekly assignments are open book, any source material consulted other than the class material (notes and reference books) should be cited appropriately.

Syllabus changes

The Management Reserves the Right to Make Changes to the Schedule (Swap lecturers, re-time topics etc). The in-class tests will be re-scheduled only in case of major catastrophe.

The content of the course is outlined in the following table:

| Date | Topic |
|--------------------|--|
| Wed Aug 22 | Introduction (by Dr. Lu) |
| Fri Aug 24 | Life and Metabolism (by Dr. Ball) |
| Mon Aug 27 | Risk assessment, exposure standards (by Dr. Ball) |
| Wed Aug 29 | |
| Fri Aug 31 | Exposure to Environmental Agents (by Dr. Ball) |
| Mon Sept 3 | Labor Day No class |
| Wed Sept 5 | Metabolism and Disposition of Xenobiotics: Phase I (by Dr. Ball) |
| Fri Sept 7 | Metabolism and Disposition of Xenobiotics: CYP450 (by Dr. Ball) |
| Mon Sept 10 | Metabolism and Disposition of Xenobiotics: Phase II (by Dr. Ball) |
| Wed Sept 12 | Metabolism and Disposition of Xenobiotics: Phase III (by Dr. Ball) |
| Fri Sept 14 | Metabolism and Disposition of Xenobiotics: Applications (by Dr. Ball) |
| Mon Sept 17 | Oxidative stress (by Dr. Ball) |
| Wed Sept 19 | Classical and Physiologically-Based Pharmacokinetics (by Dr. Ball) |
| Fri Sept 21 | |
| Mon Sept 24 | Dose-response, Bioassays, Biomarkers (by Dr. Ball) |
| Wed Sept 26 | |
| Fri Sept 28 | In-class Exam Covering August 24 to Sept 14 |
| Mon Oct 1 | DNA damage: adducts and mutations (by Dr. Avram Gold) |
| Wed Oct 3 | |
| Fri Oct 5 | |
| Mon Oct 8 | DNA repair (by Dr. Jack Ridpath) |
| Wed Oct 10 | Carcinogenesis: Mechanisms, Initiation, Promotion, Progression (by Dr. Lu) |
| Fri Oct 12 | Carcinogenesis: Carcinogen identification, Genotoxic and Non-genotoxic Carcinogens (by Dr. Lu) |
| Mon Oct 15 | Ionizing Radiation: Damage and Protection (by Dr. Rodger Sit) |
| We Oct 17 | Fall Break |
| Fri Oct 19 | Fall Break |
| Mon Oct 22 | Environmental Pathogens: Diseases, Mechanisms of Disease (by Dr. Lu) |
| Wed Oct 24 | |
| Fri Oct 26 | In-Class Examination (covering Sept 17th - Oct 15th) |

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| Mon Oct 29 | Liver Physiology and Toxicology (by Dr. Jane Simmons) |
| Wed Oct 31 | |
| Fri Nov 2 | |
| Mon Nov 5 | Other major organ systems (by Dr. Lu) |
| Wed Nov 7 | |
| Fri Nov 9 | |
| Mon Nov 12 | Pulmonary Physiology and Toxicology (by Dr. Mehdi Hazari) |
| Wed Nov 14 | |
| Fri Nov 16 | |
| Mon Nov 19 | Food safety (by Dr. Lu) |
| Wed Nov 21 | Thanksgiving Break |
| Fri Nov 23 | |
| Mon Nov 26 | Drinking water treatment, wastewater treatment (by Dr. Lu) |
| Wed Nov 28 | Analytical methods in environmental health research (by Dr. Lu) |
| Fri Nov 30 | Group presentations and discussions (led by Dr. Lu) |
| Mon Dec 3 | Group presentations and discussions (led by Dr. Lu) |
| Wed Dec 5 | Group presentations discussions (led by Dr. Lu) |
| Mon Dec 10 | Final Exam |