DEPARTMENT: Environmental Health

COURSE NUMBER: EHS 710  SECTION NUMBER: 001  SEMESTER: Fall 2014

CREDIT HOURS: 2

COURSE TITLE: Advanced Laboratory and Field Methods in Exposure Science

INSTRUCTOR NAME: Stefanie Sarnat, Sc.D.

INSTRUCTOR CONTACT INFORMATION

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MAILBOX LOCATION: CNR 2035

OFFICE HOURS: By appointment

BRIEF COURSE DESCRIPTION

This class examines methodological issues associated with designing and conducting field-based studies of environmental exposures to chemical and biological contaminants. The course will integrate text and journal manuscript readings, discussions and field research to provide doctoral and advanced masters students with a fundamental understanding of environmental exposure science methodology and practice. A core component is a student-led environmental field investigation, in which students design and execute an exposure assessment project to address a community problem.

Prerequisite: EH 540 or equivalent; EHS students; 2nd year masters students may enroll with instructor permission.

LIST SCHOOL LEVEL, DEPARTMENT, AND/ OR PROGRAM COMPETENCIES

The completion of EHS 710 will allow students to learn and apply advanced exposure science methods to address public health issues.

EHS competency for this course: Exposure Science – Students will be able to assess the presence and fate of chemical and microbiological contaminants in the environment and their impact on human exposures. This competency will include training in environmental chemistry, environmental microbiology, environmental exposure assessment and the use of exposure biomarkers.
LIST LEARNING OBJECTIVES ASSOCIATED WITH THE COMPETENCIES

After completing this course, students should be able to:

1. Demonstrate knowledge of the role of exposure assessment in promoting environmental health
2. Display familiarity with methods for measuring environmental pollution including direct and indirect sampling and modeling techniques
3. Design and conduct a pilot field exposure assessment to measure environmental exposure to chemical and biological contaminants
4. Demonstrate proficiency for processing raw pollutant data into relevant measures of environmental exposure
5. Interpret results of studies in environmental exposure to chemical and biological contaminants

EVALUATION

Grades in this class will be based upon:
- Homework assignments (25%)
  - Presentation of journal article reading (5%)
  - Descriptive data analyses (4 assignments, 5% each)
- Exam (15%)
- Field Investigation (60% total):
  Field Investigation groups will select their project from a list of projects that will be provided by the instructors. Each study design is required to include a sampling and laboratory analysis component.
  - Project design presentation and write-up (20%)
  - Final presentation (20%)
  - Final report (20%)

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.
### COURSE OVERVIEW

This class meets every Wednesday, 10:00 – 11:50 am in GCR P39

<table>
<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Topic</th>
<th>Instructor</th>
<th>Assignments Due</th>
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<tbody>
<tr>
<td>1</td>
<td>August 27, 2014</td>
<td>Course introduction and exposure science overview</td>
<td>Sarnat S.</td>
<td>n/a</td>
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<tr>
<td>2</td>
<td>September 3, 2014</td>
<td>Exposure assessment and introduction to field investigation</td>
<td>Sarnat S.</td>
<td>Lab safety course, reading</td>
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<td>3</td>
<td>September 10, 2014</td>
<td>Analytical Methods (with lab tour)</td>
<td>Ryan</td>
<td>Data analysis 1 (T/A survey data), reading</td>
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<td>4</td>
<td>September 17, 2014</td>
<td>Media I – Water / Soil (Chemical)</td>
<td>Ryan</td>
<td>Data analysis 2 (QA/QC calcs), soil sample collection, reading</td>
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<td>5</td>
<td>September 24, 2014</td>
<td>Media II – Air</td>
<td>Sarnat J.</td>
<td>Field investigation project ideas, reading</td>
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<td>6</td>
<td>October 1, 2014</td>
<td>Media III – Water (Microbial)</td>
<td>Levy / Lee</td>
<td>Data analysis 3 (USEPA air data), water sample collection, reading</td>
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<td>7</td>
<td>October 8, 2014</td>
<td>Media IV – Biological</td>
<td>Barr</td>
<td>Data analysis 4 (Water lab), reading</td>
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<td>8</td>
<td>October 15, 2014</td>
<td>Field investigation considerations</td>
<td>Sarnat S.</td>
<td>Take-home exam</td>
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<td>9</td>
<td>October 22, 2014</td>
<td>Study design presentations</td>
<td>Class</td>
<td>Study design presentation and write-up</td>
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<td>10</td>
<td>October 29, 2014</td>
<td>Study check-in</td>
<td>Class</td>
<td>Study design write-up update</td>
</tr>
<tr>
<td>11</td>
<td>November 5, 2014</td>
<td>Study check-in</td>
<td>Class</td>
<td>Field and lab work</td>
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<td>12</td>
<td>November 12, 2014</td>
<td>Study check-in</td>
<td>Class</td>
<td>Field and lab work</td>
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<td>13</td>
<td>November 19, 2014</td>
<td>Study check-in</td>
<td>Class</td>
<td>Field and lab work</td>
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<td></td>
<td>November 26, 2014</td>
<td>No class (Thanksgiving Break)</td>
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<td>Field and lab work</td>
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<td>14</td>
<td>December 3, 2014</td>
<td>Study check-in</td>
<td>Class</td>
<td>Field and lab work</td>
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<td>15</td>
<td>December 10, 2014</td>
<td>Final presentations</td>
<td>Class</td>
<td>Final presentation</td>
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<td></td>
<td>December 17, 2014</td>
<td>No class – Congrats, you’re done!</td>
<td></td>
<td>Final report</td>
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DETAILED SCHEDULE AND ASSIGNMENTS

1. August 27, 2014: Course Introduction (S. Sarnat)
   - Overview of course syllabus
   - Exposure science overview
     o What is exposure science?
     o Why is it important?
     o History / state of exposure science

   **Assignments due next week**
   a) Complete Emory Environmental Health & Safety Research Laboratory Safety course
   c) Optional readings: Zartarian et al. (1997), Lioy (2010)

2. September 3, 2014: Exposure Assessment (S. Sarnat)
   - Basic concepts in exposure assessment
   - Exposure assessment approaches
   - Field investigation introduction
   - Exposure measurement error: overview of concepts and sources of error in field investigations
   - Logistics: expectations for assignments (journal article presentations, data analysis homework)

   **Assignments due next week**
   a) Data analysis 1: Analysis of survey data

   - Homework review: data analysis 1 (T/A survey data)
   - General principles: calibration, interferences, limits of detection, quality control, accuracy and precision, blanks
   - Methods: gravimetric, extraction, chromatography (GC, HPLC, IC, GC/MS), spectroscopy (UV/VIS, AA, ICP, IR)
   - Tour of lab facilities
   - Logistics: introduction to field investigation project

   **Assignments due next week**
   a) Data analysis 2: QA/QC calculations
   b) Soil contamination reading: Zimmerman AJ, Weindorf DC. Heavy metal and trace metal analysis in soil by sequential extraction: a review of procedures
   c) Class prep: Collect soil samples at Lullwater and near RSPH within 24-hrs of next class

4. September 17, 2014: Media I – Chemical Contamination in Water & Soil (Ryan)
   - Homework review: data analysis 2 (QA/QC)
   - Student journal article presentation # 1
   - Basic principles of chemical contamination of soil and water (e.g., pesticides, metals)
   - Soil sampling methods
Assignments due next week
a) Submit a short written summary of the steps that your group has taken to come up with final project ideas (potential hypotheses and study designs of interest) and to become familiar with lab and field logistics of conducting your field investigation

5. September 24, 2014: Media II – Air (J. Sarnat)
   - Homework review: discussion of field investigation project ideas and logistics
   - Student journal article presentation # 2
   - Basic principles of air quality and air sampling methods
   - Characterizing personal and population exposures to urban air pollution
   - Understanding the ecologic fallacy and measurement error in air pollution exposure and epidemiology

Assignments due next week
a) Data analysis 3: Analysis of air monitoring data
c) Optional readings: Ashbolt et al. (2001), CDC fact sheet
d) Class prep: Collect water samples at Lullwater within 24-hrs of next class

6. October 1, 2014: Media III – Microbial Contamination in Water (Levy / Vereen)
   - Homework review: data analysis 3 (USEPA air data)
   - Student journal article presentation # 3
   - Basic principles of water quality and water sampling methods
   - Sources of error in water quality measurements
   - Water quality lab (IDEXX, membrane filtration, other indices)

Assignments due next week
a) Data analysis 4: Analysis of water quality data (note, on Thursday after class, students will be required to come in to the lab to read their water sample test results)

7. October 8, 2014: Media IV – Biological (Barr)
   - Homework review: data analysis 4 (water lab)
   - Student journal article presentation # 4
   - Basic principles of biologic monitoring and sampling methods (blood, urine, saliva, expired air)
   - Which matrix and why?
   - Interpreting the data
   - Case studies: Bisphenol A, Chlorpyrifos, Phthalates, PBDEs
   - Logistics: take-home exam instructions

Assignments due next week
a) Complete 24-hr take-home exam
b) Continue project prep for group discussion next class – see ‘Field Investigation Instructions’
8. October 15, 2014: Field Investigation Considerations (S. Sarnat)
   - Defining study objectives and hypotheses
   - Study design elements
   - Field and lab logistics
   - Quality control
   - Data analysis, hypothesis testing
   - Logistics: Discuss project design considerations and timelines

   **Assignments due next week** - see ‘Field Investigation Instructions’
   a) Meet with Stefanie outside of class to discuss project designs, if needed
   b) Study design write-up (2-pages max)
   c) Study design presentation (20 minutes)

9. October 22, 2014: Study Design Presentations (Class)
   - Group presentations and discussion for each project
   - All EHS 710 faculty are invited to attend

   **Assignments due next week**
   a) Update 2-page study design write-up based on feedback received
   b) Prepare for field and lab work

10. October 29, 2014: Study Check-In (Class)
    - Review updated study designs, field prep progress

    **Assignments from now until end of course (see ‘Field Investigation Instructions’)**
    a) Attend weekly Study Check-In sessions, held during regular class time
    b) Conduct field and lab work
    c) Document all methods and data collected
    d) Conduct statistical analyses to address original study question
    e) Examine and interpret results
    f) Present findings to class on December 10th
    g) Submit final data set(s) and final report by December 17th

11. November 5, 2014: Study Check-In (Class)
    - Review data collection progress, problems encountered in the field and/or lab

12. November 12, 2014: Study Check-In (Class)
    - Review data collection progress, problems encountered in the field and/or lab

13. November 19, 2014: Study Check-In (Class)
    - Review data collection progress, preliminary data analysis

**November 26, 2014: Class cancelled for Thanksgiving Break (but work on projects!)**

14. December 3, 2014: Study Check-In (Class)
    - Review data analysis and report writing

15. December 10, 2014: Final Presentations (Class)
    - Final presentations by each group

**December 17, 2014: Final reports due (no class)**
FIELD INVESTIGATION OVERVIEW

Exposure scientists are often called upon to perform field investigations in which a design will be proposed, samples collected and analyzed and data interpreted and presented. The purpose of the field investigation portion of the class is to give students an opportunity to participate in all aspects of the exposure science process. Students will work in small groups of 2-3 to implement their field investigations. This allows division of labor, which is likely to be substantial, and development of team approaches common to exposure science field work.

Exposure science field work can be divided, broadly, into two general components. These include the gathering of exposure-related data via “indirect methods”, including questionnaires, surveys and modeling, and “direct methods” whereby exposure information is gathered through the use of field monitoring equipment. The direct methods include the use of relatively inexpensive, but low-resolution monitors, or more expensive, high-resolution monitors.

**Questionnaire-based Survey Work.** The use of questionnaires and observation of factors that may influence exposures to a specific contaminant are an integral part of performing exposure studies. During the course, students will receive exposure to this form of data collection, and may apply it to their field investigation.

**Low-Resolution, Inexpensive Field Monitoring Equipment.** Relatively inexpensive, low-resolution monitoring equipment is common in the exposure science field. Use of such sampling apparatus is an integral part of many exposure studies. Often such samplers use passive diffusion of gases as the sampling mechanism. Such samplers are usually small and unobtrusive and can even be used as personal sampling apparatus; they can be worn while participating in daily activities. During the course, students will be made aware of such apparatus, their utility, and their shortcomings.

**High-Resolution, Expensive Field Monitoring Equipment.** Many exposure studies make use of sophisticated, high-resolution, and expensive field monitoring apparatus. Such apparatus give excellent results but are restricted in their use by their cost; only a few such apparatus may be available for use at any given time. Many such apparatus are not conducive to personal monitoring; they are too bulky or require electrical current not available in battery form. During the course, students will be made aware of such apparatus, their utility, and their shortcomings.

In the field investigation component, students will use both direct and indirect methods to address a specific exposure science research question.