

Lecture 1, Course Introduction-Review of Occupational/ Environmental Health-Regulations and History

EOH 2504 - Principles of Environmental Exposure

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EOH 2504 - Principles of Environmental Exposure

- Who are you and why do you want to take Exposure Assessment?
- **Location and time: EOH 2504 - Principles of Environmental Exposure Fall Term, 2009-2010 Tuesdays & Thursdays 3-4:25 pm, Room A719 Crabtree Hall, GSPH .**

Course Description

- We will explore the **methods, models, concepts, calculations, statistics and theory necessary for the assessment of human and ecological exposure** to contaminants and physical factors. Contaminants can include inorganic as well as organic species like **elements, metals and metalloids, simple hydrocarbons, persistent organic pollutants (PCB's, DDT). Physical factors include heat, and ionizing radiation.** We will be particularly interested in understanding **human exposure modes-inhalation, skin absorption and ingestion for toxic and carcinogenic substances-either through each mode separately or through each combination of exposure modes** and also the modes of exposure for **ionizing radiation-penetrating ionization paths or internal dose.** We will explore the monitoring choices for exposure characterization including **air personnel and area sampling, water and food sampling, soil and Superfund sampling and the use of human and ecological biomonitoring and biomarkers.** Methodologies used to estimate exposure from these monitoring methods will be explored in depth. Students will be taught to understand the exposure sequence from **source term, rate of release, transport through environmental media, concentration and mode's of exposure, internal dose and dose to specific organs.** Finally ways to reduce exposure to both chemical contaminants and physical factors will be described.

Course Rationale

- **Exposure assessment** methodologies and concepts form the **basic building blocks** for the practice of **environmental health**. Accurate exposure assessment is necessary for the justification of **appropriate concentrations of contaminants** to be used in cell culture or basic toxicological studies, proper assessment of **environmental health risk**, connection of exposure to health outcomes in **epidemiology studies** and the **development of engineering, institutional and administrative occupational or environmental controls** to contaminants from one or all modes of exposure or from physical factors.

Course Objectives

- The objectives of the course are to combine didactic teaching, reviews/presentations of actual exposure literature and case studies by students.
- Understand standard occupational and environmental health hazards and appreciate the incremental policymaking protecting the public and workers, respectively.
- Explain the term exposure assessment and identify all variables that can affect internal dose and thus health effect's including **the source, source release rate, environmental media, media transport mechanisms, exposure scenarios, absorption, pharmacodynamics, elimination rates, population groups, special sub-population group dynamics.**
- Understand the modes of human and ecological exposure.

Course Objectives Continued:

- Explain the primary methods to assess airborne dusts, mists, fumes, gases and vapor concentrations to estimate exposure including area and personnel sampling.
- Understand water-sampling methods for pathogens, metals and elements, and organic and inorganic compounds.
- Apply EPA Exposure Guidelines for assessment of sites contaminated by regulated substances including soil sampling.
- Explain the term biomonitoring in both humans and ecological species; understand what it can tell us concerning source identification and exposure mechanisms.
- Explain the term biomarkers and what they can tell us about human and/or ecological exposure.

Course Objectives Continued

- Understand physical exposures including ionizing and non-ionizing radiation and noise.
- Explain the difference and significance of indoor versus outdoor environmental health exposures.
- Apply appropriate statistical methodologies to the preparation for and analysis of human exposure.
- Explain the importance of geographical information and spatial systems in the estimation of exposure, apply geostatistical analysis packages to estimate exposure, and risk and help explain environmental public health disease patterns.

Course Objectives Continued:

- Explain and prepare conceptual site models.
- Identify and explain exposure categories that are emerging in importance such as pharmaceutical estrogens and xenoestrogens.
- Explain exposure issues that are unique to different age classes including children.
- Identify methods to eliminate or decrease exposure in both occupational and environmental settings. To include product or process elimination and substitution, administrative and institutional controls, use of personal protective equipment and the institution of engineering control systems.

Course Structure

- The course is designed to have **3 classroom hours and twice this amount of class preparation and reading per week**. Classroom lectures will be used to present essential vocabulary and concepts in occupational and environmental exposure assessment for; airborne dusts, mists, fumes, gases and vapors; surface and ground water waterborne pathogens, chemicals, metals, pH disturbances and persistent organic pollutants; physical hazards such as ionizing and non-ionizing radiation and noise. **Class readings will include reading case histories and up to date literature to learn exposure assessment application and practice. Each student will be expected to present and analyze topical peer reviewed papers** (at least 2 papers each over the course of the semester, approximate presentation time 10 minutes with 5 minutes of questions and answers), pertaining to the major theme of the lecture (these presentations will be class led discussions without the use of PowerPoint presentations). Students may choose the paper to present but Dr. Volz must approve it before presentation. Dr. Volz will suggest papers to students having difficulty finding appropriate peer reviewed literature for class room discussion.

Text:

- **Text:** While there are several texts pertaining to exposure assessment there is no text that unifies the sampling and analysis of contaminants from all environmental media and presents underlying preliminary concepts such as conceptual modeling. Primary course materials are attached as pdfs at the **Center for Healthy Environments and Communities (CHEC)** Website <http://www.chec.pitt.edu>. Go to the site and click **Info for Experts and Academic Courses** then click on and choose **EOH 2504: Principals of Environmental Exposure** then choose **Primary Course Materials**. Other required readings will be handed out in class. Extensive use of UNITED NATIONS ENVIRONMENT PROGRAMME INTERNATIONAL LABOUR ORGANISATION WORLD HEALTH ORGANIZATION
- INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY
- **Environmental Health Criteria 214 HUMAN EXPOSURE ASSESSMENT** by MacIntosh and Spangler will be made over the semester and it should be considered the primary text for this class.

Office Hours

- **Office Hours:** Dr Volz will hold office hours by appointment only on Wednesday mornings from 9am until noon. Schedule appointments by contacting:
- **Sara Gillooly**
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Grading:

- Letter grades (A, B, C, D, F) are based on attendance, quality of in-class peer reviewed literature presentations and class participation (20%), a midterm examination (40%), a final examination (40%).

Syllabus

- The syllabus is not final but a living document and due to scheduling of semester onset and breaks we lose classes this year.
- Additionally, Dr Volz wants to keep course content fresh and current so some updating will be done to the syllabus over the next few weeks.
- Readings will be added to the outline.
- Assignment of presentations will occur over the next few weeks.
- **Immediately Read these pieces--Review of Occupational/ Environmental Health Gochfeld, M., Chronologic History of Occupational Medicine JOEM, Volume 47, Number 2, February 2005. Hatch Papers in Advances in Modern Environmental Toxicology, Volume III, Occupational and Industrial Hygiene Concepts and Methods, Esmen and Mehlman Editors, Princeton, 1984-Conditions of Work and Mans Health, Tomorrows Problems.-Significant Dimensions of the Dose Response Relationship.-Criteria for Hazardous Exposure Limits.-Priorities in Preventative Medicine.**

Next Class

8/28 Conceptual Site Modeling –Readings-

ASTM Standard Guide for Developing Conceptual Site Models for Contaminated Sites

Burger et al., Conceptual site models as a tool in developing Ecological Health: The case of the Department of Energy's Amchitka Island Nuclear Test Site.

Modeling Munitions and Explosives of Concern (MEC) CBRN Hazards: Novel Tools and Approaches for Strengthening the Conceptual Site Model for Public Health Preparedness Tomjanovic and Volz (First Student Led Discussion)

Background

- Pliny the Elder (23AD–79AD)
 - “The fumes from silver mines are harmful to all animals” and “when well shafts have been sunk deep, fumes of sulfur or alum rush up to meet the diggers and kill them.”
 - Pliny wrote also about veils made from animal bladders worn on the face to protect miners from inhalation exposure.

From Gochfeld-Chronologic History of Occupational Medicine -20th Century

- 1902 Thomas Oliver (England) “Dangerous Trades”.
- 1910 Crystal Eastman Work Accidents and the Law.
- 1910 John Fitch, Pittsburgh “The Steel Workers” describes working conditions and hazards in foundries.
- 1914 W. Gilman Thompson “The Occupational Diseases, Their Causation, Symptoms, Treatment and Prevention” (1914).
- 1925 Harrison Martland, New Jersey Report on osteogenic sarcoma in radium dial painters.
- 1925–1943 Alice Hamilton 1869–1970 “Industrial Poisons” in the United States (1925), “Industrial Toxicology” (1934), “Exploring the Dangerous Trades” (1943).
- 1946 Harriet Hardy 1906–1993 Publicizes beryllium disease.
- 1970 Occupational Safety and Health Act Initiates OSHA and NIOSH.

Scope of the Occupational Disease and Injury Problem in the United States

Each day, an average of 9,000 U.S. workers sustain disabling injuries on the job, 16 workers die from an injury suffered at work, and 137 workers die from work-related diseases.

The Liberty Mutual 2005 Workplace Safety Index estimates that employers spent \$50.8 billion in 2003 on wage payments and medical care for workers hurt on the job.

Worldwide Problem of Silicosis as an Example of Worldwide Burden of Occupational Disease

- During the period 1991 to 1995, China recorded more than 500,000 cases of silicosis, with around 6,000 new cases and more than 24,000 deaths occurring each year mostly among older workers.
- In Viet Nam the cumulative number of diagnosed cases has now reached 9,000. They constitute 90% of all cases of occupationally compensated diseases. Some 18% of workers engaged in surface coal mining, quarrying, foundry and metallurgy have been found to have silicosis.

Worldwide Problem of Silicosis as an Example of Worldwide Burden of Occupational Disease

- In India, a prevalence of 55% was found in a group of workers, many of them very young, engaged in the quarrying of shale sedimentary rock. Studies on silicotic pencil workers in Central India demonstrated high mortality rates; the mean age at death was 35 years and the mean duration of the exposure was 12 years.
- In Brazil in drought-affected regions in the north-east of the country the hand-digging of wells through layers of rock with very high quartz content resulted in a prevalence of 26% of silicosis, with many cases of accelerated forms. The state of Rio de Janeiro banned sandblasting after a quarter of shipyard workers were found to have silicosis.

Silicosis in the United States

- In the USA, it is estimated that more than one million workers are occupationally exposed to free crystalline silica dusts (more than 100,000 of these workers are sandblasters), of whom some 59 000 will eventually develop silicosis. It is reported that each year in the USA about 300 people die from it, but the true number is not known.
- Abrasive blasting with silica sand, often used to prepare surfaces for painting, has been associated with exposures 200 times greater than the level recommended by the US National Institute for Occupational Safety and Health. This agency recommended that silica sand be prohibited as an abrasive blasting agent.

Occupational Safety and Health Administration

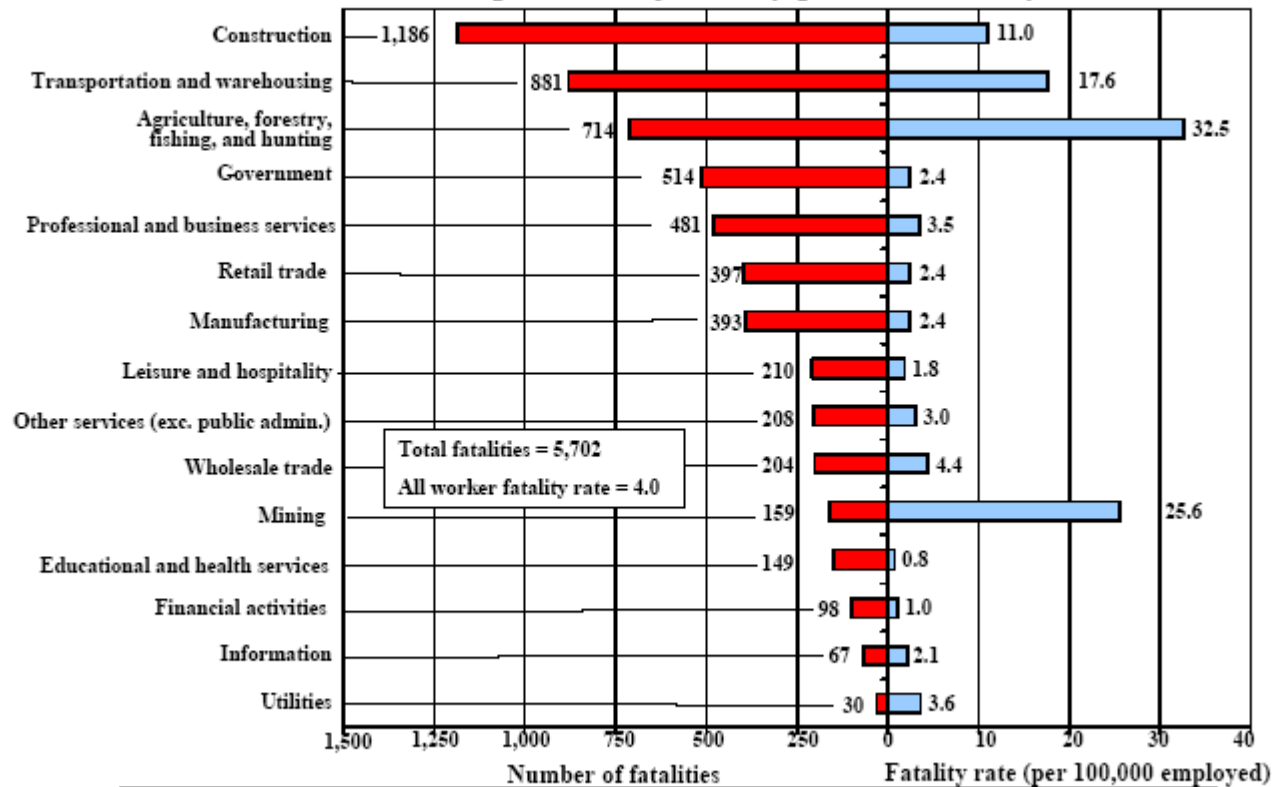
<http://www.osha.gov/>

- OSHA's mission is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.

Occupational and Environmental Health Legislation- Offshoots of the Civil Rights and Anti-War Movements

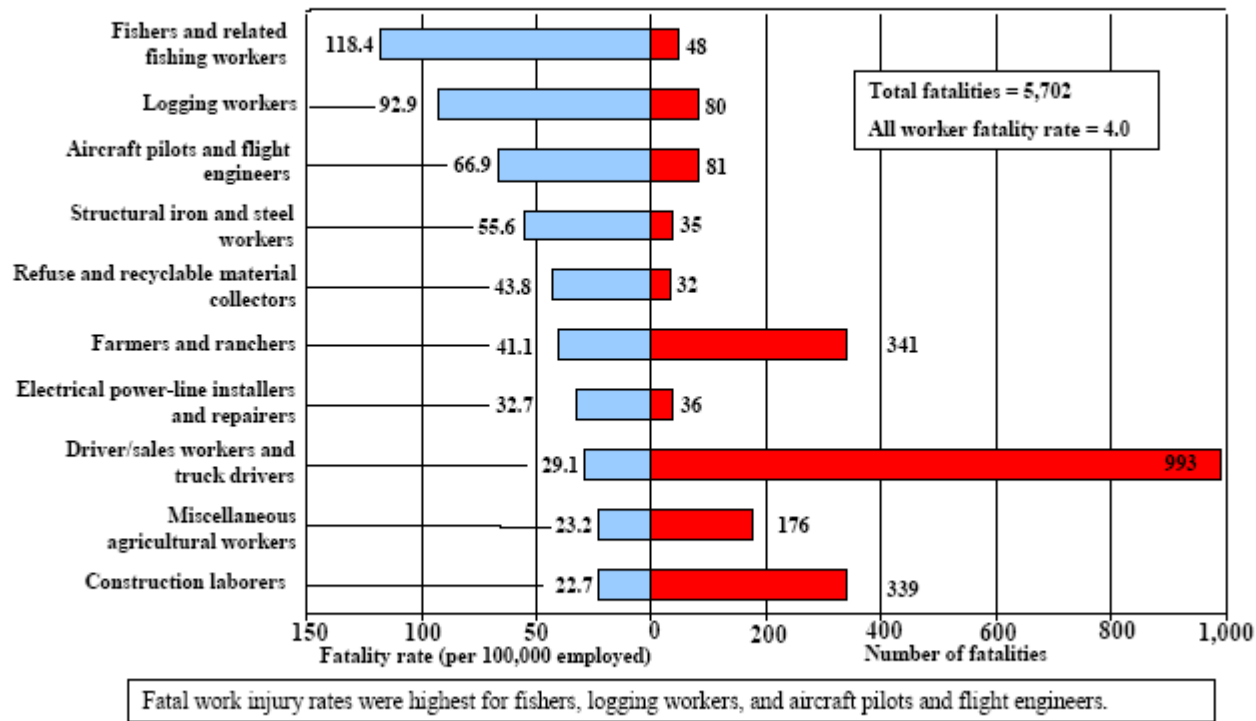
- **Occupational Safety and Health Act of 1970-**
Adopted the 1968 American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values (TLV's) for airborne contaminants. Antecedent-Walsh Healy Public Works Act of 1936.
- A TLV is an exposure concentration that most workers can be exposed to 8 hours/day, 40 hours/week over a working lifetime with no adverse effect.

Number and rate of fatal occupational injuries by private industry sector, 2005



Although the construction sector recorded the highest number of fatal injuries, the highest fatality rates were in agriculture, forestry, fishing, and hunting and in mining.

Selected occupations with high fatality rates, 2005



Rate = (Fatal work injuries/Employment) x 100,000. Employment data based on the 2005 Current Population Survey (CPS) and Department of Defense (DOD) figures.
NOTE: Occupations had to meet predetermined employment and fatality count criteria to be considered for inclusion
SOURCE: US Department of Labor, Bureau of Labor Statistics, Current Population Survey, Census of Fatal Occupational Injuries, and US Department of Defense, 2005.

The National Institute for Occupational Health and Safety (NIOSH)

- <http://www.cdc.gov/niosh/homepage.html>
- The National Institute for Occupational Safety and Health (NIOSH) is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the [Centers for Disease Control and Prevention \(CDC\)](#) in the [Department of Health and Human Services](#).

Specific Functions of NIOSH

- Develop recommendations for occupational safety and health standards;
 - Perform all functions of the Secretary of Health and Human Services under Sections 20 and 21 of the Act
 - Conduct Research on Worker Safety and Health (Section 20)
 - Conduct Training and Employee Education (Section 21)
- Develop information on safe levels of exposure to toxic materials and harmful physical agents and substances

Functions of NIOSH continued.

- Conduct research on new safety and health problems;
- Conduct on-site investigations (Health Hazard Evaluations) to determine the toxicity of materials used in workplaces (42 CFR Parts 85 and 85a); and
- Fund research by other agencies or private organizations through grants, contracts, and other arrangements.

Additional NIOSH Functions Under the Federal Mine Safety and Health Amendments Act of 1977

- Develop recommendations for mine health standards for the Mine Safety and Health Administration;
- Administer a medical surveillance program for miners, including chest X-rays to detect pneumoconiosos (black lung disease) in coal miners;
- Conduct on-site investigations in mines similar to those authorized for general industry under the OSH Act; and
- Test and certify personal protective equipment and hazard-measurement instruments

Environmental Protection Agency (EPA)

- In July of 1970, the White House and Congress established the EPA in response to the growing public demand for cleaner water, air and land.
- EPA develops and enforces regulations that implement environmental laws enacted by Congress.

Occupational and Environmental Health Legislation

- Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)- commonly called Superfund
 - To provide for remediation of sites not cleaned-up by the responsible party.
 - To establish priorities for the clean-up of the nation's worst toxic and radiological waste sites.

CERCLA continued.

- Conduct human and ecological risk assessments through the Agency for Toxic Substances and Disease Registry (ATSDR).
- Conduct remedial investigation and feasibility studies.

Occupational and Environmental Health Legislation

- Resource Conservation and Recovery Act of 1976 (RCRA)
 - Creates cradle to grave regulatory scheme to manage, store, transport and dispose of hazardous waste.
 - Designed to prevent current hazardous waste disposal from causing future environmental health problems.

Clean Air Act of 1970

- A comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources.
- Authorizes the EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.
- Particulate emissions (PM 2.5) and oxides of nitrogen and sulfur are regulated under this legislation.

Clean Water Act

- Started out as the Federal Water Pollution Control Act Amendments of 1972 and has been amended many times.
- This act set up the structure for regulating discharges of point and non-point pollutants into U.S. waters.
- Includes construction of sewage plants, water quality criteria for surface waters, and pollution control programs for industrial plants.
- Pittsburgh rivers are in violation of this law approximately 75% of the recreational year for fecal coliform bacteria and 100% of the year for Sanitary Sewer Overflows. (\$5-10 billion regional price tag/Southwestern Pennsylvania)

Toxic Substances Control Act (TSCA) of 1976

- EPA tracks the approximately 75,000 industrial chemicals currently produced or imported into the U.S.
- EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard.
- EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk.

National Environmental Policy Act of 1969

- One of the first laws ever written that establishes the broad national framework for protecting the environment.
- NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. This requires environmental impact statements for transportation projects etc.