

FINAL PERFORMANCE REPORT

**Purdue University
School of Health Sciences
West Lafayette, IN 47907**

Project Title: Occupational Safety and Health Training Grant

Total Project Period: July 1, 1996 - June 30, 2001

Project Director: Frank S. Rosenthal, Ph.D.

NIOSH Grant Number: T01/CCT510467

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ABSTRACT

The Purdue University Graduate Program in Industrial Hygiene, which offers programs at both the masters and doctoral levels, developed and expanded considerably in the past grant period. The overall goals of the program are to prepare students for advanced careers in Industrial Hygiene and Occupational Safety and Health, to contribute to the regional and national pool of highly skilled professionals in these fields, and to provide research and service in solving occupational health problems. During the period of performance of this grant the program added faculty, increased enrollment, expanded the curriculum, initiated several new research projects, and obtained new funding for research. The program achieved accreditation from the Accreditation Board for Engineering and Technology (ABET). The achievements of the faculty and students are demonstrated by numerous works published and awards received during the grant period. New activities were initiated for student recruitment. The program received a merit award from the director of NIOSH.

SIGNIFICANT FINDINGS AND DEVELOPMENTS

During the last project period, there was considerable progress and enhancement of the academic and research aspects of the Graduate Program in Industrial Hygiene. After stabilizing for a period, student enrollment has again increased with the largest number of IH graduate students since the program began. Highlights of the progress during the project period are as follows:

1. The core faculty was expanded to four full time core faculty with the addition of a specialist in Ergonomics.
2. The curriculum was expanded with the addition of five new courses
3. The program was accredited by the Accreditation Board for Engineering and Technology (ABET).
4. The program received a merit award from the NIOSH director
5. Several students and faculty received awards for excellence in scholarship and teaching.
7. Several new, funded research initiatives were begun, many involving students.
8. The program continued to provide assistance on occupational safety and health problems to local and regional industry and government.
9. The program collaborated with University of Cincinnati and other regional occupational safety and health academic programs in a NIOSH funded program to fund pilot research projects.
10. The program increased its interdisciplinary ties with other University programs
11. New strategies for student recruitment were developed and implemented.

PROGRESS REPORT

1. Background

This grant supported training in Occupational Safety and Health through the Graduate Program in Industrial Hygiene (IH) at Purdue University. The program, which awards both M.S. and Ph.D. degrees, began in 1981 as a component of the School of Health Sciences. Since that time, the program has produced a small but steady flow of graduates. Since NIOSH support began in 1993, the program has expanded in graduate enrollment, courses offered, faculty, facilities and research. Accreditation by the Accreditation Board for Engineering and Technology (ABET) was achieved in 1996.

The program is complimented by an undergraduate program in Industrial Hygiene, which is also ABET accredited. (It is one of only five accredited undergraduate IH programs in the U.S.). The program also works closely with two other programs in the School of Health Sciences: Health Physics (undergraduate and graduate) and Toxicology (graduate).

Although there are several graduate IH programs in the Midwest, Purdue's program is the only one in Indiana. The program draws many of its applicants from Indiana and nearby states, and in turn graduates of the program often serve in industrial hygiene, safety and occupational health positions in this region. The program also serves the state and surrounding region through research projects on occupational health problems in local and regional workplaces.

The program has several notable strengths. It has a dedicated core of four faculty, three in Industrial Hygiene and one in toxicology, whose instructional efforts are supplemented by associated faculty from several other Purdue University Schools and Departments. Student and faculty research projects in Occupational Safety and Health often involve interdisciplinary collaborations. In addition to covering the essential elements of Industrial Hygiene, program faculty are involved in several important and relatively unique research areas nationwide, which include biochemical toxicology of industrial solvents, pulmonary aerosol deposition, nonionizing radiation exposure assessment, and markers of indoor air quality. With the addition of Dr. James McGlothlin, a specialist in ergonomics, in 1999, the program has expanded course offerings in ergonomics and provided an enhanced environment for graduate study in this area.

Although the program is supported by University resources, as well as other sources of funding (e.g. research grants), NIOSH support has played a key role in making the program available to students, and in enhancing the academic resources of the program.

2. Training objectives

The overall objective of this training program is to provide graduate education that prepares students for advanced careers in Industrial Hygiene and Occupational Health. We achieve these objectives by 1) providing a thorough core curriculum in the basic and applied sciences, 2) developing critical thinking through thesis research and other independent student work, 3)

complimenting classroom instruction with laboratory exercises, internships and student projects, 4) utilizing guest speakers and seminars to provide information and discussion on state-of-the-art issues in Industrial Hygiene and Occupational Health, emphasizing the development of oral and written and communication skills in coursework, and 5) tailoring supplemental coursework and educational experiences to suit the needs of individual students.,

Developments in the last grant period have enhanced the extent and quality of the educational experiences provided to students and increased the number of students to which this education is provided. Further details are given in the sections below:

3. Expansion of the faculty

In 1999 Dr. James McGlothlin joined the core faculty. Dr. McGlothlin, formerly with NIOSH, is an internationally recognized expert in ergonomics. He has established a new laboratory for ergonomics and real-time exposure assessment, developed three new graduate courses, and is advising several graduate students. Dr. McGlothlin's expertise significantly broadens our faculty and enhances the educational opportunities in our program.

In 2000 we enhanced the occupational medicine and nursing aspects our program by adding two faculty to the Associate Faculty: Dr. Carol Blue of the Purdue University School of Nursing and Dr. Stephen Wintermeyer of the Indiana University School of Medicine. Both Dr. Blue and Dr. Wintermeyer gave seminars to our graduate students in the fall of 2000.

4. Enhancements to the curriculum

a. New Courses

In the past period five new courses have been added to the curriculum. These are described below:

1. Health Sciences 547: Environmental Epidemiology

The course focuses on the principles of analytical epidemiology as applied to problems in occupational and environmental health. Lectures are supplemented by problem sets, student presentations and team projects. As part of the course, students are introduced to the use of statistical tools such as the Statistical Analysis System (SAS) for analyzing Epidemiological Data.

2. Health Sciences 580: Occupational Ergonomics

In this course students learn the principles of occupational ergonomics including analytical methods and use of biomechanical models to recognize and evaluate work-related musculoskeletal disorders. Final class projects consist of real-life applications where student teams perform ergonomic evaluations of Purdue University workers in various jobs (i.e., food service, residence hall cleaning, library staff, laboratory researchers). These projects include recommendations to decrease work-related musculoskeletal disorders and are given to the workers and management of Purdue University.

3. Health Sciences 581: Applied Occupational Ergonomics

This course is designed for students who have a background in ergonomics and want to learn how to apply their skills in manufacturing plants near Purdue University. Every other week graduate students meet at a different plant (i.e., Alcoa, TRW, Caterpillar, Siemens, Fairfield, Wabash National, SIA, etc) and conduct a walk-through evaluation of ergonomic hazards at these plants. The students are required to write complete reports including evaluation methods, hazard recognition, and recommendations. These reports are graded and copies are given to the companies to help their employees. On alternate weeks classroom lectures are given to strengthen the students' understanding of ergonomics from advanced quantitative modeling of field data to practical approaches in solving "real" manufacturing world problems.

4. Health Sciences 582: Video Exposure Monitoring Methods

This course is specifically designed for Industrial Hygiene majors in the School of Health Sciences who want to use video exposure monitoring methods to evaluate and control hazardous physical, chemical, and biological agents in the occupational environment. This course is unique because it combines videography with real-time sampling instruments to obtain on the spot exposure assessments and control of workplace hazards. Qualitative and quantitative models can be developed and tested in the laboratory, then applied in the field. The combination of videography and real-time sampling instruments to evaluate and control workplace contaminants will give the next generation of students solid footing as health and safety professionals in the workplace.

5. Health Sciences 546: Advanced Topics in Ventilation and Control Technology

This course, which was taught prior to the grant period on an experimental basis, was approved by the Purdue University Graduate Council in 2000. The course addresses key topics in the engineering control of workplace hazards, which are not normally addressed in introductory courses. Topics include a critical assessment of the philosophy and hierarchy of control approaches, the relationship of environmental to occupational controls, methods of evaluating the effectiveness of personal protective equipment, the effects of ambient pressure, and humidity on ventilation calculations. Ventilation computation software is introduced and applied. Students work on case studies in occupational health hazard control. Each student makes several presentations to the class during the course.

b. Teaching innovations:

We have continued to innovate in our instructional techniques utilizing a variety of techniques to involve students in the learning process, and develop their critical thinking and communication skills. Students make numerous oral presentations and take part in critiquing other student's work. We used a debate format in HSCI 547 Environmental Epidemiology to explore the controversy over the causes of "Gulf War Syndrome". We have experimented with some examinations being taken by small groups rather than individuals. Computer literacy is promoted in several courses. Students make frequent use of Internet resources, computer database searches,

statistical software, spreadsheets and plotting programs. The lab exercises in HSCI 552 utilize computer-based data acquisition systems. HSCI 582 makes substantial use of videography and video-computer interfaced systems.

5. Student enrollment and degrees awarded

During the period 7/1/96- 6/30/01, there were 26 students enrolled in the program, 23 Masters students and 3 doctoral students. Fifteen M.S. degrees and 2 Ph.D degrees were awarded. Fourteen students were supported on the NIOSH training grant. Currently we have five Ph.D. students (3 full time and 2 part time) and nine MS students (6 full time and 3 part time). This is the largest enrollment since the program began. There are currently three students on NIOSH support.

6. Accreditation by the Accreditation Board for Engineering and Technology (ABET)

Both graduate and undergraduate Industrial Hygiene programs were accredited by ABET in 1996.

7. Award from NIOSH Director

We received a merit-based supplemental award to our grant from NIOSH Director Linda Rosenstock in 1999.

8. Faculty and Student Awards Received

Mark Powley won an award for the best student poster at the AIHCE in 1998. Erica Peterson won the Tichauer Award for the best ergonomics poster presentation at the AIHCE in 2000. Erica Peterson (2000), Mark Powley (2000, 2001), Jason Roggenbauer (2001), Randy Boylstein (1998) and Lila Albin (1997) won awards in the student poster competition at the Chicago local section of the American Industrial Hygiene Association. The School of Health Sciences Kessler award for excellence in graduate study was won by Brent Yeagy in 1997 and Mark Powley in 2001. Michael Hunt and John Vosicky were awarded funds for pilot research from the University of Cincinnati/NIOSH sponsored Pilot Research Program (1999). Since 1996, seven (7) students have won awards from the American Industrial Hygiene Foundation. Many of the students winning awards were NIOSH trainees.

Dr. McGlothlin received several awards for his work in ergonomics in the last five years including the Quality Assurance Special Achievement Recognition Award from the National Aeronautics and Space Administration (1999) and the Alice Hamilton Award for Excellence in Science (1998). Dr. Carlson received the Society of Toxicology Education Award and the School of Health Sciences Excellence in Teaching Award in 2000 and 2001. Dr. Zimmerman was elected to the Council of the Academy of Industrial Hygiene in 2000.

During the performance period of the grant the School of Health Sciences was awarded status as a designated site for the Department of Energy (DOE) fellowship program in Industrial Hygiene. One graduate student (Eric Coates) was supported as a DOE Industrial Hygiene fellow in 1998 – 1999. However, unfortunately the program was subsequently discontinued by DOE.

9. Faculty – student research projects

New faculty-student research projects initiated in the last grant period include:

1) Exposure assessment to acetonitrile at a chemical process plant using real time sampling and videography (Dr. McGlothlin), 2) Preventing musculoskeletal disorders within the petrochemical industry (Dr. McGlothlin), 3) The role of the lung in the metabolism of benzene (Dr. Carlson), 4) Styrene-induced pneumotoxicity (Dr. Carlson). 5) The validation of a real-time aerosol monitor for Metal Working Fluid aerosols (Dr. Rosenthal), 6) Endotoxin exposures in horse confinement areas (Dr. Rosenthal), 7) Use and efficacy of natural fungicides to improve indoor air quality (Dr. Zimmerman), and 8) Prototype bioaerosol sampler for highly contaminated environments (Dr. Zimmerman).

10. Outreach to Local Industry

During the last grant period we conducted and analyzed a survey of local industrial establishments on the extent of occupational health services available to them and their awareness of the fields of industrial hygiene and related fields. Thirty-one of 142 establishments, identified through the Greater Lafayette Chamber of Commerce responded. 94% indicated an awareness of Industrial Hygiene, with 50% specifically aware of Purdue's Industrial Hygiene program. Various health and safety programs were in place at these establishments, despite the fact that only 13% employed an industrial hygienist. Most did not have an ergonomics program. The survey identified both a moderate awareness of our program and an obvious opportunity to increase our local and regional outreach.

In the last few years we have increased efforts to interact with local and regional industry through class projects in Exposure Assessment, Ergonomics, and Real-time Exposure Assessment, contracts to provide ergonomic and industrial hygiene services to local or regional companies (e.g. Eli Lilly & Co., ALCOA, Abbott Laboratories) and consultative services provided as part of Purdue's statewide Technical Assistance Program. Examples of the latter are: exposure assessment and recommended controls for 1) an automotive electronics component manufacturer, 2) a mattress component manufacturer, and 3) a castings machining firm. A collaboration of Dr. McGlothlin with the Department of Forestry recently was funded by the Indiana Wood Products Association to study ergonomic hazards of wood products workers.

11. Industrial Hygiene Advisory Committee

In order to enable more frequent meetings and provide more in depth discussion, it was decided for the Industrial Hygiene Advisory Committee to meet in between the meetings of the larger School of Health Sciences Advisory Council, of which it is a subset. The first meeting under this plan was held as a teleconference in April 2000. The IH Advisory Committee includes members from corporate, governmental and labor organizations.

12. New recruitment initiatives

We ran a recruiting booth for the first time at the AIHCE in 2000, receiving over 100 visitors. Inquiries were primarily about the Ph.D. program. The booth was run again at the AIHCE in 2001 with similar successful results. We developed a new recruiting poster and distributed it to over 400 undergraduate chemistry, biology, engineering departments as well as Schools of Public Health and environmental health and safety programs. Forty-one (41) responses were received. We also expanded internal outreach, through meetings with academic counselors in other Purdue schools such as Science and Engineering. Two additional new recruiting strategies were begun during the performance period: 1) The program was listed on the website "Gradschools.com", and 2) We sent recruitment mailings and electronic mailings to a list of potential candidates generated from the data base of all students who have taken the GRE examinations. Both of these strategies have generated increased interest in our program and an increased number of inquiries.

12. Conclusions

The NIOSH training grant significantly contributed to the enhancement and expansion of the Graduate Program in Industrial Hygiene at Purdue University. During the performance period of the grant, the faculty was expanded and student enrollment increased. The curriculum was enhanced with several new courses. Many new projects both by the faculty and in collaboration with students have been initiated. The national prestige and recognition of the program considerably increased due to numerous awards and publications. The recruiting strategies were developed and implemented. All of these things increased the potential of the program towards realizing its training objectives, and contributed towards fulfilling occupational health needs on regional and national levels.

PUBLICATIONS

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Abstracts

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McGlothlin, J., J. Vosicky, E. Protopapas, E. Peterson. Multimedia Video-based Data Acquisition and analysis applications for ergonomics Research. International Ergonomics Association 2000, Human Factors and Ergonomics Conference, San Diego, California (July 30 - August 4, 2000)

McGlothlin, J. Development and Evaluation of a Cost Effective Office Ergonomics Program using a Multi-Disciplinary Partnership at Purdue University. International Ergonomics Association 2000, Human Factors and Ergonomics Conference, San Diego, California (July 30 - August 4, 2000)

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APPENDIX

Outlines for New Courses

Course Outline

- | | | |
|-----|----|---|
| Aug | 24 | The use of epidemiology in environmental health. Relationships to toxicology, standard setting, health surveillance, and risk assessment.. |
| | 31 | Association vs. Causation |
| Sep | 7 | Mortality and Morbidity, Direct and Indirect Adjustment, SMR studies |
| | 14 | Bias and Confounding in SMR studies; the person years approach |
| | 21 | SMR studies: Case studies |
| | 28 | Sources of data for outcomes and exposures: death certificates, disease registries, exposure and disease data bases, field studies, interviews. |
| Oct | 5 | Principles of Case control studies |
| | 12 | Case Control Studies: bias, confounding, stratified analysis |
| | 19 | MIDTERM EXAMINATION |
| | 26 | Case control studies-- modeling, logistic regression |
| Nov | 2 | Case Control Studies -- case studies |
| | 9 | Other study designs |
| | 16 | Team project preliminary report |
| | 30 | Other study designs: case studies |
| Dec | 7 | Team Project: final report |

1. Problem Sets.

Because of the quantitative aspects of this course, problem sets are emphasized. In preparing your answers, show and explain all of your work, using complete sentences whenever possible. You will be graded both on your answers and presentation. Note that some essay questions do not have a specific "correct" answer. Consultation between students in working on the problem sets is encouraged. However, copying of answers is not allowed. Feel free to use computer programs in making your calculations. Reference the program used and include a copy of the printout. To avoid a grade penalty all assignments must be submitted on time.

2. Student Presentations

Students will be required to make several oral presentations to the class, related to research papers or other material. The presentations should include: 1) a concise statement of the question addressed and its importance to environmental health, 2) an overview of the study design(s), 3) key quantitative results, 4) a critique, including points which you felt were difficult to comprehend and/or conclusions about which are most skeptical. Following your presentation, submit a summary incorporating clarifications and comments arising out of the class discussion.

3. Team project

The class will work on a team project to be presented at the end of the semester. The topic for the project will be selected based on discussions between the instructor and students.

4. Grades will be based on:

1. Problem sets (25)
2. Classroom presentations (20%)
3. Midterm exam (15%)
3. Team project (20%)
4. Final exam (20%)

5. Textbooks

There is no single textbook for the course. The following books will be used for readings and reference. These will be supplemented by assigned readings from the research literature.

1. Lillienfeld: Foundations of Epidemiology
2. Hernberg: Introduction to Occupational Epidemiology
3. Aldrich and Griffith: Environmental Epidemiology and Risk Assessment
4. Albohm: Biostatistics for Epidemiologists.
5. Maussner: Introduction to Epidemiology

6. Computer Software:

Several programs are useful in epidemiology. We will use Epi-Info (avail. in in public domain) and SAS (available on various on computers on campus)

7. Miscellaneous

Please bring to the class any issue, question or resource relating to Environmental Epidemiology for discussion. We will make time for this at the beginning of the class period.

PURDUE UNIVERSITY
SCHOOL OF HEALTH SCIENCES

HSCI 546

Advanced IH Control Technology

(1 credit)
Spring, 2001

Instructors: Neil J. Zimmerman, Ph.D., CIH
Frank Rosenthal, Ph.D., CIH

Meeting Time: alternate Mondays, 12:30-2:20 p.m.

Location: CIVL 1263B

<u>Date</u>	<u>Topic</u>	<u>OUTLINE</u>	<u>Readings</u>
1/12/01-Fri	Course Introduction Definition, Purpose, Philosophy of Control		K. Caplan "Philosophy of Engineering Control", Patty's IH, Vol. IIIA, 2nd ed., 1985, Chapter 12
1/22	General Control Strategy Topics	issue papers on: -application of ALARA to IH -respirators vs. engr. control -management's input into control -substitution methodology -control education	
2/5	Advanced Topics in PPE	technical papers on: -fit testing method analysis -workplace exposure testing -heat stress exposure protection -dermal protection, permeation	
2/19	Advanced Topics in Ventilation	technical papers on: Junction Pressure Calcs Effects of Shape on Entry Loss Model Bilateral Junctions Air-Flow Redistribution	
3/5	Introduction of Vent. Software	Heavent Software Manual (activity: perform computer design project)	
3/19	Discussion of Temp. Pressure Affects on Vent System Operation	ACGIH Vent Manual (activity: solve temp. related design problem with software)	
4/2	Evaluation of Software Discussion of Pollution Prevention - Similarities & Interface with IH Control Principles	Pollution Prevention Act, Various EPA Support Documents	
4/23	Presentation of Case Studies	Case Studies in IH, Perkins & Rose, 1987	

SCOPE OF COURSE

DISCUSSION TOPICS

Control Strategy

- philosophy
- the big picture-fitting control into perspective with the rest of IH activities (for example, major emphasis of exposure/evaluation or control/prevention, ala Sherwood)
- management's views
- PPE (respirators in lieu of engineering)
- Other considerations; e.g. can/should an ALARA concept be applied to IH

PPE Technical Issues

- fit testing method analysis
- workplace exposure respirator testing
- heat stress exposure protection
- dermal protection, permeation issues

Ventilation

- current journal articles on new aspects in ventilation design
- temperature, pressure affects on system operation
- software applications
- ventilation needs vs. energy efficiency

Pollution Prevention

- EPA/IH interface: is it really something new or just IH control repackaged in EPA jargon

PRACTICAL APPLICATIONS

Case Studies

- 1) stepped solution (semester-long project)
 - select case study by 1/22 class
 - read recognition phase; answer questions on evaluation and turn in by 2/19 class
 - read evaluation phase; answer questions on control and turn in by 3/19 class
 - read control phase and prepare presentation
- 2) class presentation and discussion on 4/23/01
 - presentation should be 20-25 min
 - discussion should include a *brief* description of the process, the IH problem, the method of evaluation and results, but should focus on the method(s) of control (also, compare your thoughts on the control approach, based on your answers, to the authors' approach)
 - presentation should include a few overheads to help make your ideas clearer, and a *brief*, outline type handout for the rest of the class

Ventilation Design

- 1) solve a complex ventilation design problem manually
- 2) become familiar with ventilation design software; then, apply it to same design problem
- 3) change design and temperature characteristics
- 4) evaluate and compare manual and software methods

HSCI 582:
Video Exposure Monitoring Methods

2 Credits – Spring 2001

Information Sheet

Lecturer:

James D. McGlothlin, M.P.H., Ph.D., C.P.E.
School of Health Sciences
Office: CIVL 1269 Tel: (765) 496-6359, Fax (765) 496-1377
E-mail address: jdm3@purdue.edu
Mailing address: School of Health Sciences
CIVL 1338
Purdue University
West Lafayette, IN 47907

Scheduled Class Time:

Tuesdays/Thursdays: 12:30- 1:30 PM

Class Meeting Location: CIVL 2117

Texts:

1. *The Occupational Environment – its Evaluation and Control*, Ed. Salvatore R. NiNardi, American Industrial Hygiene Association Press, 1997.
2. *Air sampling Instruments for Evaluation of Atmospheric Contaminants. 8th Edition*, ACGIH, Cincinnati, OH. 1995,
Description: Hard Cover Book, 651 p.
3. NIOSH Field Manual: Video Exposure Monitoring: A new Hazard Assessment Tool. (M. Gressel, P. Jensen editors), 1992.

Reading List: As assigned.

Grade Breakdown:

Participation:	10%
Quizzes:	20%
Final Exam:	25%

Field Projects:	20%
Final Project:	25%

Examination Dates:

Quizzes (approximately 3 – spaced evenly throughout semester)
Final: To be Announced.

Quizzes:

Will be in class.

Office Hours:

Thursdays 4:00 PM to 5:00 PM or by appointment.

Lecture: Students will learn about the kinds of real-time sampling instruments available, how they are used, and the strengths and weaknesses of these instruments when used in work settings. After the students become familiar with real-time sampling instruments, they will learn how to use these instruments in conjunction with videography equipment. Specifically, students will learn how to develop and use a real-time exposure assessment equipment in conjunction with videography to estimate personal worker exposures to dusts, vapors, and gases in industrial and laboratory settings. Advances in digital technology, miniaturizations of electrical components and computer computational speed and storage capacity have made this exposure assessment method a reality only in the last few years. The goal of this course is to provide students with the latest tools and industrial hygiene monitoring techniques so they can more effectively monitor, evaluate, and control hazardous airborne contaminants in the workplace.

Group Participation and Discussions:

Students will engage in discussions about video exposure monitoring methods (from topics noted in the class syllabus, textbook, and peer-reviewed articles). Group participation will help each student better understand the science of real-time sampling.

Field Projects:

This course will offer some hands-on experience in using real-time instruments and emphasize laboratory and field research projects. Field reports will include an introduction, background, materials and methods, discussion, results, and references. All field reports will be 5 pages or less (including tables, figures, and references). The class will collectively design, execute, and write up a field research project that can be published as a case study in a conference proceedings or peer-reviewed journal.

Video Exposure Monitoring Methods

HSCI 581

Instructor: Dr. James D. McGlothlin

Spring 2001 Course Syllabus

PART I: INTRODUCTION

- REAL-TIME EXPOSURE MONITORING TECHNIQUES.
- AEROSOL MECHANICS

PART II: THE MEASUREMENT PROCESS

- SAMPLING AND ANALYSIS OF AIR CONTAMINANTS: AN OVERVIEW.
- OCCUPATIONAL AIR SAMPLING STRATEGIES
- INSTRUMENT CALIBRATION AND QUALITY ASSURANCE
 - The measurement Process: Precision, Accuracy, and Validity.
 - Direct-reading Instrument Precisions.

PART III: INSTRUMENTATION

- DIRECT-READING INSTRUMENTS FOR AIRBORNE PARTICLES
- GASES AND VAPORS
 - Detector Tubes, Direct-Reading Passive Badges, and Dosimeter Tubes
 - Direct-Reading Gas and Vapor Instruments

PART IV: REAL-TIME INSTRUMENTATION AND OVERLAYING EXPOSURE DATA.

- ERGONOMIC EVALUATION TECHNIQUES USING VIDEOGRAPHY.
- LABORATORY: JOB ANALYSIS - QUALITATIVE AND QUANTITATIVE METHODS.

CASE STUDIES – ANALYZING WORKPLACE EXPOSURES USING
DIRECT READING INSTRUMENTS AND VIDEO EXPOSURE
MONITORING TECHNIQUES.

PART V: LABORATORY/FIELD EXERCISES

HANDS-ON APPLICATION IN USING DIRECT READING
INSTRUMENT WITH VIDEO EXPOSURE MONITORING TO EVALUATE
AND MODIFY A WORK SITUATION.

HSCI 580:
Occupational Ergonomics I

3 Credits - Fall

Syllabus

Lecturer:

James D. McGlothlin, M.P.H., Ph.D., C.P.E.
School of Health Sciences
Office: CIVL 1269 Tel: (765) 496-6359, Fax (765) 496-1377
e-mail address: jdm3@purdue.edu
Mailing address: School of Health Sciences
CIVL 1338
Purdue University
West Lafayette, IN 47907

Scheduled Class Time:

Tuesdays/Thursdays: 3:00- 4:20 PM

Class Meeting Location: CIVL 2117

Text:

1. *Occupational Ergonomics : Principles and Applications* / F. (Fairborz) Tayyari and J. L. Smith. London : Chapman & Hall, 1997. ISBN: 0412586509

Description: Book xii, 452 p.: ill. ; 24 cm.

2. *Work Design: Industrial Ergonomics* / Stephan Konz, Steven Johnson: Holcomb Hathaway, 2000: ISBN 1-890871-07-9

Reading List:

Listed below and as assigned by the instructor. All reading list materials are available in the Pharmacy and Industrial Engineering Libraries.

- *Applications Manual for the Revised Lifting Equation*, DHHS (NIOSH), Publication No. 94-110.
- *Musculoskeletal Disorders and Workplace Factors*, DHHS (NIOSH), Publication No. 97-141.

- Putz-Anderson, Vern, ed., *Cumulative Trauma Disorders: A Manual for Musculoskeletal Diseases of the Upper Limbs*, Bristol, PA: Taylor & Francis Inc., 1998.
- *Elements of ergonomics Programs: A Primer Based on Workplace Evaluations of Musculoskeletal Disorders*, DHHS (NIOSH) Publication No. 97-117.

Grade Breakdown:

Homework:	20%
2 Hourly Exams:	30% (15% each)
Field Projects:	25%
Final Exam:	25%

Examination Dates:

- Test 1: Tuesday, September, TBA (in class)
- Test 2: Tuesday, November, TBA (in class)
- Final: (Finals week: December, 2001)

Homework:

Regular homework will be assigned and collected.

Office Hours:

Tuesdays 1:30 pm to 2:30 pm or by appointment.

Lecture:

Occupational ergonomics is a branch of science that focuses on optimizing the relationships between workers and their work environment. This course focuses on the principles and applications of ergonomics and the health and safety of the worker. The first part of the course will consist of lectures on anatomy, physiology, neurology, anthropometry, and biomechanics. The second part of the course will consist of lectures on development of work-related musculoskeletal disorders, ergonomic risk factors including work practices, tools and workstation design. The last part of the course will consist of identification and use of ergonomic controls to reduce and prevent work-related musculoskeletal disorders. Please see course syllabus for additional information.

Group Participation and Discussions:

Students will engage in discussions about ergonomics issues they read (from topics noted in the class syllabus, newspapers, and assigned articles). Group participation

will help the each student better understand the science of ergonomics as well as the contemporary issues associated with Federal Standards and the “politics of ergonomics.”

Field Projects:

This course will require students to apply what they have learned by conducting an ergonomics evaluation in the field. The field projects are assigned to groups of 3-4 students in the last month of the course. The students will conduct field investigations to identify potential ergonomic hazards, associate these hazards with specific musculoskeletal disorders, and devise control strategies to reduce these disorders through good work practices, administrative, and engineering controls. The field reports will include an introduction, background, materials and methods, discussion, results, and references. The field project also includes a class presentation in PowerPoint where each group member has responsibility for presenting part of the project. The field report and group project presentations will be scored and used to compile final grades.

Participating Purdue partners: Cary Quad Residence Hall service workers; Meredith Residence Hall food preparation workers; Purdue Library workers; Purdue Police dispatch station workers; Purdue Airport workers, and Purdue Production Studio workers.

Occupational Ergonomics I

HSCI 580, Fall

SECTION I (35% of course)

An introduction to ergonomics

- Introduction
- Contributing disciplines
- Objectives of ergonomics
- Occupational ergonomics
- Workplace stress factors
- Occupational factors affecting the worker
- Workplace hazards
- Results of ergonomics applications
- Basic terminology
- Applications and discussions

Skeletal system

- Introduction
- The skeletal system
- Joint movements
- The back structure
- The hand structure
- Applications and discussion

Muscular system and work

- Introduction
- Chemical reactions during muscular contractions
- Muscle fiber stimulation
- Functional characteristics of muscle tissues
- Muscle contraction

- Skeletal muscles and their functions
- Musculoskeletal system as a lever system
- Guidelines for muscle use

Applications and discussion

Engineering anthropometry

Introduction

Basic ergonomic design philosophies

Statistical basis of anthropometry

Anthropometric data

Body surface area

Body segments

Use of anthropometric data in design

Applications and discussion

Biomechanical bases of ergonomics

Introduction

Definitions and basic mechanics

Newton's laws of motion

Biomechanical analysis and models

Muscular strength

Applications and discussion

Work physiology

Introduction

Physiological responses

Energy and energy sources of the body

Categories of work

Respiration

The Circulatory system

Metabolism

Physical work capacity

Fatigue and its evaluation

Classification of workload

Endurance in physical work

Work-rest scheduling

Applications and discussion

Cumulative Trauma Disorders (CTDs)

Introduction
Musculoskeletal disorders
The back and back problems
The neck and neck problems
CTDs in the upper extremities
Fundamental risk factors of CTDs
Prevention of CTDs
Treatment of CTDs
Applications and discussion

Manual Materials Handling (MMH)

Introduction
Manual lifting task evaluation
Original versus new lifting guide
Other MMH activities: pushing and pulling
Back-injury-preventive techniques
Applications and discussion

SECTION II (35% of course)

Workstation design

Introduction

Workplace and workspace
Workplace design problems
General principles for workstation design
Ergonomics principles for workplace design
Using anthropometric data in workstation design
Recommendations for seated workstations
Ergonomic guidelines for standing tasks
Some critical problems and easy solutions
Applications and discussion

Work-tool design

Introduction
Grip strength and endurance

- Types of work-tools
- New development in tool handle design
- Ergonomics guidelines for hand-tool design
- Safety guidelines for tool use
- Applications and discussion

Human-machine systems

- Introduction
- The workplace characteristics
- The worker's functions
- Ergonomics of human-machine systems
- Human-machine system analysis and design
- Controls and displays
- Guidelines for designing displays and controls
- Applications and discussion

Light and vision

- The Ergonomics of Light and Vision
- Quantity of illumination
- Glare
- Visual problems
- Illumination guidelines
- Applications and discussion

Occupational vibration

- Introduction
- Vibration terminology
- Types of vibration with respect to its source
- Types of vibration with respect to the human body
- Assessment of vibration
- Acceptable exposure limits to segmental vibration
- Vibration control and prevention of vibration
- white finger
- Applications and discussion

SECTION III (30% of course)

Shift work

- Introduction
- Shift-work terminology and notations
- Shift organization and patterns
- A conventional format for shift pattern notation
- Effects of shift work on workers
- Comparison of the three shift schedules
- Guidelines for shift work
- Criteria for selection of shift workers
- Alternative work schedules
- Applications and discussion

Office ergonomics

- Introduction
- Postural and habitual problems
- Health risks in offices
- Office problems
- Solutions to office health problems
- Examples (workstation design for VDT users)
- Workstation design for office work
- Relief from work tension
- Applications and discussion

Ergonomics assessment of the workplace

- Introduction
- Ergonomics assessment approaches
- Ergonomics assessment of the workplace design
- Ergonomics worksite assessment
- Injury Investigation
- Assessment of ergonomics efforts
- Applications and discussion

Implementation of ergonomics program

- Introduction

Managing an ergonomics program
Objectives of ergonomics program
Components of an effective ergonomics program
Justification for an ergonomics program
Implementation obstacles
Applications and discussion

HSCI 581
Applied Occupational Ergonomics

3 Credits – Spring 2001

Syllabus

Lecturer:

James D. McGlothlin, M.P.H., Ph.D., C.P.E.
School of Health Sciences
Office: CIVL 1269 Tel: (765) 496-6359, Fax (765) 496-1377
E-mail address: jdm3@purdue.edu
Mailing address: School of Health Sciences
CIVL 1338
Purdue University
West Lafayette, IN 47907

Scheduled Class Time:

Thursdays: 7:30- 10:20 AM

Class Meeting Location: CIVL 2117

Text:

Occupational Ergonomics: Theory & Applications / A. Bhattacharya and J.D. McGlothlin.
New York, New York, Marcel-Dekker 1996. ISBN: 0-8247-9419-2
Description: Hard Cover Book, 832 p.

Reading List: As assigned.

Grade Breakdown:

Participation:	10%
Quizzes:	15%
Field Projects:	50%
Final Project:	25%

Examination Dates:

Quizzes (approximately 3 – spaced evenly throughout semester)
Final: To be Announced.

Quizzes

Will be in class.

Office Hours:

Thursdays 4:00 PM to 5:00 PM or by appointment.

Lecture:

Fifty percent of this course will consist of lectures on the theory and application of ergonomics. The other 50% will consist of field visits to local industries in greater Lafayette, Indiana to conduct ergonomic evaluations. Lecture content will be coordinated with field visits so the student can apply what they learn in class. As the semester progresses the student will use more sophisticated ergonomics evaluation instruments to perform job risk assessments. Also, the student will be required to provide ergonomic control strategies that will start with work practice modifications to reduce biomechanical stresses, and end with engineering solutions to eliminate the job hazard altogether. Please see course syllabus in more details.

Group Participation and Discussions:

Students will engage in discussions about ergonomics issues they read (from topics noted in the class syllabus, newspapers, and assigned articles). Group participation will help the each student better understand the science of ergonomics as well as the contemporary issues associated with Federal Standards and the "politics of ergonomics."

Field Projects:

This course will emphasize field research projects, where approximately 50% of the class time will be spent conducting field research and generating reports from the field research. The field reports will include an introduction, background, materials and methods, discussion, results, and references. All field reports will be 10 pages or less in length (including tables, figures, and references). Also, each student will be given a final field project that will be no more than 15 pages in length. The hands-on experience and report generation will greatly enhance the student's learning experience.

Participating companies for scheduled field trips every other week during the spring term:

Alcoa; Caterpillar; Siemens; Wabash National; Fairfield; TRW; SIA; State Farm Insurance; Revington Furniture factory; Lafayette Venetian Blind; and Kirby Risk.

Applied Occupational Ergonomics

HSCI 581, Spring

Company Visits for Spring 2001*

January 2001: Field trips

Caterpillar

Fairfield

February 2001: Field Evaluations

Siemens

Wabash National

March 2001: Field Evaluations

Fairfield;

TRW;

April 2001: Field Evaluations

SIA;

AICOA

Revington Furniture factory;

May 2001: Field Evaluations

Lafayette Venetian Blind; or Kirby Risk.

*Students will provide their own transportation, or will make arrangements to ride with the instructor.

Classroom Lectures and Reading Assignments

January 2001

PART 1: PRINCIPLES OF ERGONOMICS

Anthropometry

Physiology of body movement

Physiological aspects of neuromuscular

Biomechanical aspects of body movement

Biomechanical models in ergonomics

Psychophysical methodology and the evaluation of manual materials handling and upper extremity intensive work

Instrumentation for occupational ergonomics

Physical work capacity: principles and applications

Worker participation: approaches and issues

February 2001

PART II: APPLICATION OF ERGONOMIC PRINCIPLES

Job Analysis

Workstation evaluation and design

Tool evaluation and design

Manual material handling

Manual materials assist devices

Evaluating physical qualifications of workers and jobs

Office ergonomics

The human factors aspects of shiftwork

Ergomost: an engineer's tool for measuring ergonomic stress

The design and evaluation of a musculoskeletal and work history questionnaire

Fall prevention in industry using slip resistance testing

March 2001

PART III: MEDICAL SURVEILLANCE FOR ERGONOMICS PROGRAMS

Record-based ("passive") surveillance for cumulative trauma disorders

Active surveillance of work-related musculoskeletal disorders: an essential component in ergonomic programs

PART IV: ERGONOMIC CASE STUDIES

Development and implementation of an ergonomics process in the automotive industry: reactive and proactive processes

Ergonomic control measures in the health care industry

Ergonomic case studies in industry: health care

Injuries and ergonomic applications in construction

An ergonomic analysis and abatement recommendations to reduce musculoskeletal stress in warehousing operations: a case study

April 2001

PART V: CURRENT TOPICS

Upper extremity cumulative trauma disorders: current trends

Occupational human vibration

Revised NIOSH lifting equation

OSHA's ergonomic program

The Americans with Disabilities Act: implications for the use of ergonomics in rehabilitation

Legal aspects of ergonomics

Real-time exposure assessment and job analysis techniques to solve hazardous workplace exposures

Ergonomics and concurrent design

May 2001

Final project – Comparative analysis of ergonomics issues and controls for companies visited – spring 2001.



Memorandum

Date July 23, 2002

From Principal Engineer, OEP, NIOSH

Subject Final Progress Report for entry into NIOSHTIC2/NTIS for
NIOSH Training Grant No. T01 CCT 510467

To Vern P. Anderson, Chief, IRB, EID (C-18)

The enclosed report has been received from the Program Director to document work performed during the specified grant project period. The following information applies to the designated Training Project Grant (TPG):

Title: Occupational Safety and Health Training Grant

Project Director: Frank S. Rosenthal, Ph.D.
School of Health Sciences
Purdue University
West Lafayette, IN 47907

Grant No.: T01 CCT 510467

Project Period: 7/1/96 - 6/30/2001

Please place the report in DIDS and I also recommend it for entry into NIOSHTIC2 and submission to NTIS.

Thanks for your assistance.

A handwritten signature in black ink that reads "John Talty".

John T. Talty, P.E., DEE

cc: S. Board/B. Kuchinski, OEP

Enclosure

fpr.pur