Final Progress Report

Industrial Hygiene Training

Grant No. T01/OH008614

July 1, 2009 to June 30, 2014

Margaret L. Phillips, PhD, CIH
Program Director

Department of Occupational and Environmental Health
College of Public Health
University of Oklahoma Health Sciences Center
Oklahoma City, Oklahoma 73104

margaret-phillips@ouhsc.edu

September 20, 2014

Revised October 10, 2014

Table of Contents

List of Abbreviations

ABET	Accreditation Board for Engineering and Technology (officially known only by the acronym)
AFB	Air Force Base
ASAC	Applied Science Accreditation Commission
BSE	[Department of] Biostatistics and Epidemiology
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
CPH	Certified in Public Health [credential]
CSP	Certified Safety Professional
DEE	Diplomate in Environmental Engineering
DrPH	Doctor of Public Health
EM/IH	Environmental Management and Industrial Hygiene
GPA	Grade point average
HAP	[Department of] Health Administration and Policy
HPS	[Department of] Health Promotion Sciences
IH	Industrial Hygiene
IH/EHS	Industrial Hygiene and Environmental Health Science
JD	Juris Doctor (Doctor of Law)
MPH	Master of Public Health
MS	Master of Science
NIOSH	National Institute for Occupational Safety and Health
OEH	[Department of] Occupational and Environmental Health
OK	[State of] Oklahoma
OS&H	Occupational Safety and Health
OUHSC	University of Oklahoma Health Sciences Center
PE	Professional Engineer
PhD	Doctor of Philosophy
RS	Registered Sanitarian
RSO	Radiation Safety Officer
QSE	Quantitative Skills Examination
TPG	Training Project Grant
URM	Under-represented minorities

Abstract

The Department of Occupational and Environmental Health (OEH) at the University of Oklahoma Health Sciences Center (OUHSC) College of Public Health provides graduate education leading to the Master of Science (MS) degree in Industrial Hygiene and Environmental Health Sciences (IH/EHS). The goal of the IH/EHS program is to prepare professional practitioners to apply scientific knowledge to the anticipation, recognition, evaluation, and control of environmental hazards or stresses affecting human health. The IH/EHS degree has been prized by employers and students because graduates are prepared to direct environmental compliance programs as well as occupational health and safety programs.

The program has been accredited by the Applied Science Accreditation Commission (ASAC) of ABET since 2000. The curriculum consists of 48 semester hours of coursework, including masters thesis research and a field practice experience, and can be completed in 21-24 months of full-time study. The OEH Department consists of 8 full-time faculty with diverse research interests and rich experience in professional practice.

The program received its first NIOSH Training Project Grant in 1999, and was awarded five-year continuations of the project in 2004 and 2009. Since 1999, 38 trainees have been supported on the grant, including 11 trainees who received their initial appointments in the 2009-2014 project period. A total of 29 NIOSH trainees have graduated from the program, including 10 trainees from the 2009-2014 cohort. Approximately thirty percent of NIOSH trainees, and a similar proportion of graduates, have been members of minority groups. The availability of NIOSH training support has been instrumental in attracting highly qualified students of diverse educational and ethnic backgrounds into the industrial hygiene field.

Only four academic institutions in the south-central United States offer ABET-accredited masters level industrial hygiene programs; the IH/EHS program is thus a key factor in building, sustaining, and enhancing the occupational health and safety workforce in the region. Program graduates are in high demand by employers, especially in the energy sector. Eighty-eight percent (22/25) of masters graduates during the 2009-2014 project period were employed in jobs with occupational or environmental health and safety responsibilities.

Highlights/Significant Results

- The NIOSH training grant has helped to recruit well-qualified students into the program who have subsequently found employment in industrial hygiene or closely related fields. Thirty-six percent (4/11) of new trainee appointments during the project period were made to under-represented minority students, two of whom are already among the program graduates working as occupational safety and health professionals. The NIOSH training grant was instrumental in recruiting these students.

- The high graduation rate and low attrition rate for NIOSH-supported trainees reflects the academic strength and level of commitment of these trainees, as well as the benefits of receiving financial support that enables the trainees to maintain full time enrollment for up to two years.

- Enrollments have been robust throughout the project period and have been trending upward since 2012. On average about 20 students, including four NIOSH trainees, were enrolled in the program every year. Between July 1, 2009 and June 30, 2014, the Department of Occupational and Environmental Health enrolled 36 new students in the program and graduated 5 Masters of Science (MS) in Industrial Hygiene (IH) and 20 MS in Industrial Hygiene and Environmental Health Sciences (IH/EHS), 12 of whom were current or past NIOSH trainees.

- Program graduates are in high demand by employers. The program has particularly strong ties to companies in the energy sector. The number of our graduates hired overall by energy companies has increased over previous project periods, and the number of different energy companies hiring our graduates has also increased.

- The MS IH/EHS program was reaccredited by ABET in 2012 for six years with no interim reports required. ABET selected the program's self-study report to be included in a display of well-prepared self-study reports at the ABET Symposium in 2012 and 2013.

Outcomes/Relevance/Impact

The goal of the Industrial Hygiene Training project grant was to sustain and enhance the innovative and technically strong Industrial Hygiene programs at the University of Oklahoma Health Sciences Center. Between July 1, 2009 and June 30, 2014, the programs enrolled 36 new students, including 11 new NIOSH trainees, and graduated 5 Masters of Science (MS) in Industrial Hygiene (IH) and 20 MS in Industrial Hygiene and Environmental Health Sciences (IH/EHS), 12 of whom were current or past NIOSH trainees.

One aim of the training program is to attract highly-qualified individuals, including American Indians and members of other under-represented minorities, into the occupational and environmental health workforce. Four new trainee appointments and one continuing trainee appointment during the project period were made to minority students; two of these minority trainees are progressing toward completion of the degree and three are among the program graduates working as occupational safety and health professionals. The NIOSH training grant was instrumental in recruiting and retaining these students.

Only four academic institutions in the south-central United States offer ABET-accredited masters level industrial hygiene programs; the IH and IH/EHS programs are thus a key factor in building, sustaining, and enhancing the occupational health and safety workforce in the region by training professional practitioners who can apply scientific knowledge to the anticipation, recognition, evaluation, and control of occupational and environmental hazards affecting human health.

Program graduates are in high demand by employers, especially in the energy sector. Eighty-four percent (21/25) of masters graduates during the 2009-2014 project period were employed in jobs with occupational or environmental health and safety responsibilities.

Technical Report

Background

The Department of Occupational and Environmental Health (OEH) at the University of Oklahoma Health Sciences Center (OUHSC) College of Public Health provides graduate education in industrial hygiene (IH) leading to the Master of Science (MS). The department formerly also offered Master of Public Health (MPH) and Doctor of Philosophy (PhD) degrees in IH. The industrial hygiene program has been in existence for more than 40 years and has over 300 doctoral and masters graduates. The MS and MPH degree tracks in Industrial Hygiene (IH) were accredited by the Accreditation Board for Engineering and Technology (ABET) in 1994, and the department's innovative "dual track" in Environmental Management and Industrial Hygiene (EM/IH), which was begun in 1994, received separate ABET accreditation in 2000. The program was reaccredited by ABET in 2006 and 2012. Effective at the beginning of the 2008-2009 academic year, the dual track was renamed as Industrial Hygiene and Environmental Health Science (IH/EHS).

The IH "single track", which was closed to new enrollments in 2011, consisted of 43 semester hours of didactic coursework, two semester hours of field practice (requiring a minimum of 160 contact hours), and a minimum of four semester hours of thesis research. The IH/EHS track was streamlined in 2012 from a total of 56 hours to a total of 48 hours, including 44 hours of didactic course work and four hours of thesis research, plus 160 contact hours of field practice as a zero-credit-hour requirement. The streamlining of the dual track curriculum was done in close consultation with the program's advisory body, the Industrial Hygiene Constituent Committee, and was fully described in the department's reaccreditation self-study report that was submitted to ABET in 2011. The MS IH and MS IH/EHS curricula are provided in Appendix A.

Departmental policy has required completion of a research masters' thesis for the MS degree since 1997. While recognizing that only a small proportion of masters level graduates will pursue doctoral work or a research career, the department faculty believes, and alumni surveys confirm, that the graduate research experience greatly enhances the education of the professional industrial hygienist by teaching the scientific method, providing a platform for the development of skills in experimental design, data analysis, and technical communication, and fostering independent study aimed at acquiring greater depth of understanding of a subject than would typically occur in didactic coursework. Moreover, the research experience prepares graduates to use scientific knowledge more critically in their professional lives through increased insight into the way such knowledge is obtained.

Graduates of the program are in high demand as practitioners and readily find IH-related professional employment in government, industry, consulting, and the military. Students in the program often find permanent employment before graduation on the strength of their training in didactic coursework. Most graduates who are Oklahoma residents initially take jobs in the south central or southwestern regions of the United States. The available regional job market for program graduates includes a very active energy industry, as well as manufacturing, military bases, industrial hygiene consulting firms, healthcare organizations, state government, and tribal governments. Additionally, program graduates compete successfully for jobs on the national level.

The applicant pool for the department is ethnically very diverse, resulting in the enrollment over the past five years of well-qualified Native American students from the local tribes in Oklahoma, as well as African-American students. Recruitment of Hispanic-American students is more challenging because Hispanics are under-represented in Oklahoma universities relative to their proportion of the state's population. The industrial hygiene program has also attracted individuals with established careers in professions such as radiologic technology and law enforcement who wanted to make the transition into industrial hygiene practice.

The department has eight tenure lines, three of which are allotted to core industrial hygiene faculty. A faculty list is provided in Appendix B, Table 1. The program director is Margaret Phillips, PhD, CIH, a tenured associate professor. The other core IH faculty are Professor David Johnson, PhD, PE, DEE, CIH, and Assistant Professor Evan Floyd, PhD. In addition, Assistant Professor Jun Wang, PhD, effectively serves as a fourth member of the core IH faculty in view of his teaching interest in engineering controls and his research interests in welding fume. Another assistant professor, Alicia Salvatore, DrPH, who joined the department faculty in May 2014, is a social/behavioral scientist with extensive experience studying occupational and environmental hazards in under-served communities.

The NIOSH training project grant (TPG) has been a crucial part of the program's advancement and success. The following report will review the outcomes of the TPG in terms of its impact on the students directly supported, the industrial hygiene program more generally, and employers who hire occupational safety and health professionals.

Specific Objectives

The goal of the training project grant was to sustain and enhance the innovative and technically strong Industrial Hygiene programs at the University of Oklahoma Health Sciences Center. The specific aims were:

(1) to attract highly qualified and motivated students, including members of under-represented minorities, into the industrial hygiene profession.
(2) to recruit students with diverse technical backgrounds who are interested in entering the industrial hygiene field.

In the program plan for the 2009-2014 competing continuation of the grant, the following measures of success of the training program grant were specified:

- Filling traineeship slots
- Distribution of traineeship awards by educational/professional background and by ethnicity.
- Performance of trainees relative to all program enrollees on the program's Quantitative Skills Examination (QSE) and IH Knowledge Survey. The QSE consists of 50 applied math problems, written by the department faculty and typical of calculations that industrial hygienists and other environmental professionals have to perform. The passing score for individuals is 70%. IH/EHS or IH majors are required to answer a certain number of problems in each of six sections of the exam: unit conversions; powers and logarithmic formulas; geometry; manipulations, proportions, and extrapolations; air contaminant concentrations; and weighted averages. The IH Knowledge Survey is an ungraded test consisting of about 100 qualitative short answer or multiple choice questions.
- Completion by trainees of the masters thesis.

Additional metrics for performance of the training program as a whole were established within the framework of ABET's "outcomes based" accreditation criteria. In this framework, we evaluated achievement of both the program educational objectives, defined as the intended level of achievement by program graduates early in their careers, and the student outcomes, defined as the knowledge, skills and abilities demonstrated by students at graduation. The metrics for achievement of educational objectives were:

- Employment of former trainees in professional positions where they apply scientific knowledge to protect human health and the environment.
- Achievement of relevant professional certification by the American Board of Industrial Hygiene and other recognized bodies. It should be noted that because professional certifications typically require four or more years of professional practice in addition to the masters degree, the time scale for this metric may be long relative to the duration of a training project period.
- Intention to seek appropriate professional certification, as indicated in triennial alumni surveys.
- Positive evaluation in employer surveys of graduates' communication skills.

The metrics for achievement of student outcomes were:

- Aggregated performance on the department's Quantitative Skills Examination, analyzed by six different skill areas.
- Aggregated performance on the IH Knowledge Survey, analyzed by 16 different knowledge areas.
- Aggregated ratings in employer surveys of certain outcomes (understanding of business practices and impact of professional activities, professional ethics, and lifelong learning) that are appropriately assessed in the postgraduate work setting.

Results and Discussion

Specific Aim 1: Attract highly qualified and motivated students, including members of under-represented minorities, into the industrial hygiene profession.

Metric: Distribution of awards by ethnicity. A summary of the trainee appointments is given in Table 2 (see Appendix B). Three continuing and eleven new appointments to NIOSH traineeships were made during the project period. The NIOSH trainees were an ethnically diverse group. The distribution of new trainees by ethnicity and gender was: three Native American males, one African-American female, four white males, and three white females.

Metric: Performance of trainees. The performance of NIOSH-supported trainees on the department's Quantitative Skills Examination (QSE) was comparable to that of other trainees in the program. NIOSH trainees had an average score of 89.8% on the examination, compared to an average score of 88.8% among other trainees. The QSE, which is considered part of the final comprehensive examination required for graduation, tests students' mastery of applied mathematics skills for solving typical problems encountered in industrial hygiene practice.

The IH Knowledge Survey is intended for use as an aggregate measure of student mastery of qualitative knowledge. The test is administered anonymously. Due the lack of identifiers, NIOSH trainees could not be separated from other trainees for comparison as originally planned. As an alternative measure of overall trainee performance in the program, the

average grade point average (GPA) of NIOSH trainees at graduation was 3.70, compared to an average GPA of 3.66 among other trainees at graduation.

It should be noted that the NIOSH traineeships were not administered as scholarships intended to reward and recognize the most outstanding students. Rather, the objective of the NIOSH training project grant was "to attract highly qualified and motivated students" of diverse backgrounds. Traineeships were awarded on the basis of eligibility criteria and the importance of a traineeship offer for attracting or retaining a promising student. The measured performance of NIOSH trainees confirms that these trainees were highly qualified and motivated to perform well in the department's rigorous training program.

Metric: Completion of the masters thesis. Seventy-one percent (10/14) of the trainees supported on the NIOSH TPG during the 2009-2014 project period have completed the masters thesis and graduated from the program. Masters theses by NIOSH-supported trainees are listed among the publications in Appendix C. It should be noted that a thesis focusing on an environmental issue does not indicate the trainee was not interested in a career in occupational health; trainees who do their thesis on an environmental topic often go on to work in jobs with an occupational safety and health focus.

Three NIOSH trainees are still enrolled in the program and progressing toward completion of the thesis. One NIOSH trainee left the program (7% attrition). This individual had received a bachelors degree from the Fire Protection and Safety Technology program at Oklahoma State University, whose graduates have an excellent record of success in our IH/EHS graduate program, and she seemed sincerely committed to becoming an industrial hygienist. When she was offered the NIOSH traineeship, she did not disclose that she was also applying to medical school. After one semester in the IH/EHS program, she withdrew in order to attend medical school.

Among trainees in the same cohort who did not receive NIOSH support, the graduation rate as of the end of summer 2014 was 46% (13/28) and the attrition rate was 29% (8/28). Seven non-NIOSH trainees in this cohort remain enrolled in the program. Students who are not on NIOSH support often hold full-time or part-time jobs, which slows their progress through the curriculum and their thesis project. The attrition count included students who changed their major (2), withdrew from the program to pursue other opportunities (1), dropped out (3), or were dismissed for poor performance (2).

Specific Aim 2: Recruit students with diverse technical backgrounds who are interested in entering the industrial hygiene field.

Metric: Filling traineeship slots. NIOSH support was limited to Master of Science students in Industrial Hygiene (IH) or Industrial Hygiene and Environmental Health Science (IH/EHS). Trainees received up to two years (six semesters) of support, during which time they were required to be enrolled as full-time students. The funding level was sufficient to support four trainees each year with a modest stipend and a substantial portion of their tuition and fees. All four traineeship slots were filled in each year of the project. In addition, during Year 2 (2010-2011), carryover funds were used to appoint a fifth trainee for the second half of the year.

Metric: Distribution of awards by educational/professional background. As shown in Table 2 (see Appendix B), the new trainees appointed in 2009-2014 had very diverse technical backgrounds: biology, chemistry, wildlife management, environmental health science, geography with minor in electrical/computer engineering, microbiology, biological engineering, and fire protection. Diversity of professional backgrounds among students enriches the classroom

experience. The trainee with the degree in wildlife management was a nontraditional student who had previously been a National Park Service law enforcement ranger. The offer of NIOSH traineeships was instrumental in recruiting many of these students into the program, and enabled other students to study full time and so enter the industrial hygiene workforce more rapidly.

Program-Wide Results

Maintaining the TPG from year to year entails continuous assessment, reporting, and improvement of the program that reinforce similar processes required for maintenance of ABET accreditation. The program achieved reaccreditation in the 2011-2012 cycle for the full six-year period without interim review. The program's self-study report for ABET reaccreditation was selected by ABET for display at its Symposium in 2012 and 2013.

The NIOSH TPG, together with ABET accreditation, raises the stature of the program nationally. During the department's successful search for new IH faculty in 2013, faculty candidates mentioned the NIOSH TPG as one factor that made the department attractive.

Program Enrollment. In addition to the direct effect of NIOSH training funds on recruitment, the impact of the NIOSH training grant on attracting students into the industrial hygiene field is multiplied by word-of-mouth, as other potential applicants have learned about the industrial hygiene program from current and past NIOSH trainees. Enrollments have been robust throughout the project period and have been trending upward since 2012. On average about 20 students, including four NIOSH trainees, were enrolled in the program every year. Between July 1, 2009 and June 30, 2014, the Department of Occupational and Environmental Health enrolled 36 new students in the program and graduated 5 Masters of Science (MS) in Industrial Hygiene (IH) and 20 MS in Industrial Hygiene and Environmental Health Sciences (IH/EHS).

Minority Recruitment and Retention. Nine members of under-represented minorities (URM) applied for admission to the program during the 2009-2014 project period, all were accepted, and eight matriculated. URM students represented 22% (8/36) of trainees matriculating in the program during the current project period. The retention rate of minority students enrolled during the 2009-2014 project period was 80% (8/10). Specifically:

- A Hispanic American trainee, who was continuing on NIOSH support at the beginning of the project period, graduated from the program.
- Two American Indian applicants enrolled, received NIOSH traineeships, and graduated from the program.
- One continuing and one new African-American student graduated from the program.
- One American Indian trainee enrolled, received NIOSH support during the final half-year of the project while completing his didactic coursework, is now working on his thesis, and expects to graduate by Spring 2015.
- Two African-American students, including a NIOSH trainee, enrolled, completed their didactic coursework, are now working on their thesis projects, and are expected to graduate in Spring 2015.
- One American Indian student dropped out after completing the didactic portion of the curriculum, but found employment with an occupational/environmental health consulting firm.
- One African-American student, who was admitted on probation, was dismissed from the program. Despite the trainee's appropriate undergraduate science background and strong motivation, and close monitoring of his progress by the Program Director, the

student failed to achieve the grade point average necessary to remain in the graduate program.

In summary, recruitment and retention of minority students has been robust during the 2009-2014 project period. The availability of NIOSH support has been an important contributor to this success. Additionally, several URM applicants were accepted for Fall 2014 admission and have matriculated in the program.

Achievement of Program Educational Objectives and Student Outcomes. The following metrics reflect program effectiveness during the 2009-2014 project period.

- As shown in Appendix B, Table 3, 88% (22/25) of trainees who graduated during the project period are employed in an occupational safety and health field. Even in jobs with primarily environmental responsibilities, program graduates serve as a resource for occupational health issues.
- Two members of the 2009-2014 graduation cohort have achieved professional certification by the American Board of Industrial Hygiene. One of these diplomates had received NIOSH support during the 2009-2014 project period.
- 86% (6/7) of graduates responding to the 2013 alumni survey intended to seek professional certification.
- The average score on five out of six sections the department's Quantitative Skills Examination exceeded the target of 85%. Interconversion of air contaminant concentration units (mass per unit volume vs. parts per million) remained an area of relative weakness, with an average score of 75%.
- The average overall score on the IH Knowledge Survey was 69% and the average scores for particular student outcomes (competencies) ranged from 42% to 82%. The two competencies with the lowest aggregate score of 42% were addressed by only one or two questions; additional questions are needed to provide a better sampling of knowledge in these areas. Otherwise the aggregated scores for each competency were above 59%. Though below the desired target of 80%, this performance is similar to passing scores in nationally normed examinations such those for the CPH, CIH, and CSP credentials. The Department of Occupational and Environmental Health is continuing to refine the IH knowledge Survey and monitor the scores.
- Only one response was received from the 2013 employer survey. This employer rated the graduate highly on technical knowledge and ethics and moderately well on communication skills and business knowledge. As a supplement to employer surveys, which tend to have a low response rate, the department plans to implement structured interviews of employers as part of a college-wide effort to evaluate performance of graduates in their professional employment.

Conclusions

Both specific aims of the TPG were met:

(1) "To attract highly qualified and motivated students, including members of under-represented minorities, into the industrial hygiene profession." The NIOSH training grant was instrumental in attracting well-qualified students into the program who have subsequently found employment in industrial hygiene or closely related fields. Thirty-six percent (4/11) of new trainee appointments during the project period were made to minority students, two of whom are now among the program graduates working as industrial hygienists. The high graduation rate and low attrition rate for NIOSH-supported trainees reflects the academic strength and level of

commitment of these trainees, as well as the benefits of receiving financial support that enables the trainees to maintain full-time enrollment for up to two years.

(2) "To recruit students with diverse technical backgrounds who are interested in entering the industrial hygiene field." Due to robust recruitment and enrollment of eligible full-time students, all NIOSH training slots were filled throughout the project period. About half of the NIOSH trainees had backgrounds in biological science; the rest had backgrounds in various other physical or applied sciences.

Beyond achievement of these specific aims, the TPG continues to support the broader goal of sustaining and enhancing the IH/EHS graduate program by raising the stature of the program in the view of prospective faculty and students and by reinforcing the continuous improvement process required for ABET accreditation.

Appendix A: Curricula

Master of Science (MS) Degree in Industrial Hygiene

Course Requirements

Required Courses (49 credit hours)

OEH 5013	Environmental Health
OEH 5102	Occupational and Environmental Health Sampling Strategies
OEH 5262	Occupational and Environmental Law
OEH 5702	Principles of Safety
OEH 5723	Fundamentals of Occupational & Environmental Health Science
OEH 5730	Occupational Noise and Vibration (3 hours)
OEH 5743	Industrial Hygiene and Environmental Measurements
OEH 5783	Radiation Hazards
OEH 5940	Field Practice – 2 credit hours (160 contact hours)
OEH 5972	Technical Reporting
OEH 5980	Research for Master's Thesis (4 hours)
OEH 6514	Occupational and Environmental Toxicology
OEH 6753	Occupational Hazards Control

OEH 5801	Basic Ergonomics
or	
IE 4824	Introduction to Ergonomics

BSE 5113	Principles of Epidemiology
BSE 5163	Biostatistics Methods I
HPS 5213	Social and Behavioral Science in Public Health
HAP 5183	Organizational Theory/Behavior
or	
HAP 5453	U.S. Health Care Systems

Additional Degree Requirements

- Quantitative Skills Examination
- IH Knowledge Survey
- Oral Thesis Defense
- Master's Thesis

Master of Science (MS) Degree in Industrial Hygiene and Environmental Health Science

Streamlined Course Requirements (effective Spring 2012)

Course Requirements (48 credit hours)

OEH 5013 Environmental Health
OEH 5102 Occupational and Environmental Health Sampling Strategies
OEH 5213 Principles of Environmental Health and Safety Management
OEH 5262 Occupational and Environmental Laws and Regulations
OEH 5702 Principles of Safety
OEH 5723 Fundamentals of Occupational & Environmental Health Science
OEH 5734 Noise and Radiation Hazards
OEH 5743 Industrial Hygiene and Environmental Measurements
OEH 5972 Technical Reporting and Professional Ethics
OEH 5980 Research for Master's Thesis (4 credit hours)
OEH 6553 Occupational and Environmental Toxicology
OEH 6752 Occupational Hazards Control
OEH 6252 Risk Communication
OEH 5801 Basic Ergonomics
BSE 5113 Principles of Epidemiology
BSE 5163 Biostatistics Methods I
HPS 5213 Social and Behavioral Science in Public Health
HAP 5183 Organizational Theory/Behavior
or
HAP 5453 U.S. Health Care Systems

Additional Degree Requirements
• Quantitative Examination
• Field Practice (160 contact hours)
• Industrial Hygiene Knowledge Survey
• Oral Thesis Defense
• Master's Thesis

Appendix B: Tables

Table 1. Program Faculty

Name	Title and Department	Role in IH/EHS Program	Expertise
Margaret L. Phillips, PhD, CIH†	Associate Professor, OEH	Program Director, instructor for 3-4 required IH/EHS courses, IH researcher, IH thesis mentor, academic advisor, ABET accreditation coordinator	Occupational and environmental exposure assessment, radiation, physical chemistry
David L. Johnson, PhD, PE, DEE, CIH†	Professor, OEH	Instructor for 2-3 required IH/EHS courses, IH researcher, IH thesis and dissertation research mentor, academic advisor	Aerosol behavior and control, occupational and environmental exposure assessment, indoor air quality
Evan L. Floyd, PhD†	Assistant Professor, OEH	Instructor for 1-3 required IH/EHS courses, IH researcher, IH thesis mentor, academic advisor	Analytical chemistry, sorbent sampling, nanotechnology
Robert A. Lynch, PhD, RS	Associate Professor and Chair, OEH	Instructor for 2-3 required IH/EHS courses, Analytical Laboratory Director, IH thesis and dissertation mentor, academic advisor	Human risk and ecological risk assessment, environmental justice, environmental risk management
Daniel T. Boatright, PhD, RS	Professor, OEH; Senior Associate Dean, College of Public Health	Instructor for 1-3 required IH/EHS courses, IH thesis and dissertation research mentor, academic advisor	Risk communication, public health workforce development, environmental program management
James L. Regens, PhD	Professor, OEH; Associate Dean for Research, College of Public Health	IH thesis and dissertation research mentor	CBRN terrorism modeling and countermeasures, transmission dynamics of infectious diseases, risk assessment, decision analysis
Alicia Salvatore, DrPH	Assistant Professor, OEH	Instructor for 1 required IH/EHS course, IH researcher, IH thesis mentor, academic advisor	Community-based participatory research on occupational and environmental hazards
Jun Wang, PhD	Assistant Professor, OEH	Instructor for 1-3 required IH/EHS courses, IH researcher, IH thesis mentor, academic advisor	Aerosol behavior and control, environmental engineering, air pollution
Cheryl Marcham, PhD, CIH, CSP, CHMM	Adjunct faculty, OEH	Instructor for 1 IH/EHS course	Occupational safety and health management
Tommy Klepper, MPH, JD	Adjunct faculty, OEH	Instructor for 1 IH/EHS course	Occupational and environmental law and regulations

†Core IH faculty

Table 2. Trainees Appointed during Project Period

Trainees appointed to the training program during the project period July 1, 2009 to June 30, 2014 (Project Years 1-5). All trainees pursued the Master of Science degree in Industrial Hygiene and Environmental Health Science (IH/EHS).

Trainee Ethnicity & Gender	Academic and/or Occupational Background	Appointed to NIOSH Traineeship	Graduated
Hispanic female	Biology/Spanish	Fall 2008*	Fall 2010
White male	Biology	Spring 2009*	Fall 2010
White male	Radiologic Technology	Summer 2009*	Summer 2010
Native American male	Biology; pharmacy tech	Fall 2009	Summer 2011
White male	Chemistry	Fall 2009	Fall 2013
White male	Geology	Fall 2010	Fall 2012
White female	Wildlife Management; law enforcement	Fall 2010	Spring 2012
White male	Biology	Spring 2011	Fall 2013
Native American male (Chickasaw)	Environmental Health Science	Fall 2011	Fall 2013
White female	Geography/Electrical & Computer Engineering	Fall 2012	Spring 2014
African American female	Microbiology	Fall 2012	Continuing
White male	Biological Engineering/Business Management	Spring 2013	Continuing
White female	Fire Protection and Safety Technology	Fall 2013	Withdrew after 1 semester
Native American male (Cherokee)	Biology	Spring 2014	Continuing

*Continuation of appointment under previous grant

Table 3. Employment of 2009-2014 Program Graduates

NIOSH Support Status	Date Entered Program	Date Degree Awarded	Degree	Job Title/Employer/2 Digit NAICS	Employed in OS&H Field?
Year 1: July 1, 2009 to June 30, 2010					
Not supported by NIOSH grant	08/04	05/10	MS IH	Safety Manager/Flintco/23	Y
Not supported by NIOSH grant	08/05	05/10	MS IH	Industrial Hygienist/Phillips 66/32	Y
Year 2: July 1, 2010 to June 30, 2011					
Supported on 2004-2009 NIOSH grant	01/07	12/10	MS IH	IH/St. John Medical Center/62	Y
Supported on 2004-2009 and 2009-2014 NIOSH grant	08/08	12/10	MS IH/EHS	Regulatory Specialist/Chesapeake/21	Y
Supported on 2004-2009 and 2009-2014 NIOSH grant	08/08	08/10	MS IH/EHS	IH & RSO/Tinker AFB/98	Y
Supported on 2004-2009 and 2009-2014 NIOSH grant	08/08	12/10	MS IH/EHS	Safety Engineer/BP America/21	Y
Not supported by NIOSH grant	01/08	8/10	MS IH/EHS	Consultant/GreenLINK/54	Y
Year 3: July 1, 2011 to June 30, 2012					
Supported on 1999-2004 NIOSH grant	08/02	08/11	MS IH/EHS	Safety Manager/OK Dept. of Corrections/92	Y
Not supported by NIOSH grant	08/08	08/11	MS IH	Industrial Hygienist/Phillips 66/32	Y
Supported on 2009-2014 NIOSH grant	08/09	08/11	MS IH/EHS	Industrial Hygienist/Phillips 66/32	Y
Not supported by NIOSH grant	01/09	08/11	MS IH/EHS	EHS Professional/Devon Energy/21	Y
Not supported by NIOSH grant	08/09	12/11	MS IH/EHS	Project Manager/noodleStream/54	Y
Supported on 2009-2014 NIOSH grant	01/10	05/12	MS IH/EHS	Industrial Hygienist/Enercon Services/54	Y
Year 4: July 1, 2012 to June 30, 2013					
Not supported by NIOSH grant	08/09	12/12	IH/EHS	Industrial Hygienist/Marshall Environmental Management/54	Y
Supported on 2009-2014 NIOSH grant	08/10	12/12	MS IH/EHS	International Field Representative/Cru Global/81 (This trainee has recently returned to the U.S. after two years of missionary work abroad, and is now actively seeking OS&H employment)	N

(continued)

Table 3. Employment of 2009-2014 Masters Program Graduates (continued)

NIOSH Support Status	Date Entered Program	Date Degree Awarded	Degree	Job Title/Employer/2 Digit NAICS	Employed in OS&H Field?
Year 5: July 1, 2013 to June 30, 2014					
Supported on 2009-2014 NIOSH grant	1/11	12/13	MS IH/EHS	EHS Technician/Access Midstream/21	Y
Supported on 2009-2014 NIOSH grant	08/11	12/13	MS IH/EHS	Public Health Specialist/Oklahoma State Department of Health/92	Y
Supported on 2009-2014 NIOSH grant	08/12	05/14	MS IH/EHS	Fellow/US Environmental Protection Agency/92	Y
Supported on 2009-2014 NIOSH grant	01/09	12/13	MS IH/EHS	Industrial Hygiene Associate/Marshall Environmental Management/54	Y
Not supported by NIOSH grant	08/10	12/13	MS IH/EHS	Maternal-Child Health Specialist/Tulsa City-County Health Department/92	N
Not supported by NIOSH grant	01/11	07/13	MS IH	Graduate student/Tulane University/61	N
Not supported by NIOSH grant	01/12	12/13	MS IH/EHS	Industrial Hygienist/Boeing/32	Y
Not supported by NIOSH grant	01/12	05/14	MS IH/EHS	Industrial Hygiene Associate/Marshall Environmental Management/54	Y
Not supported by NIOSH grant	08/12	05/14	MS IH/EHS	Industrial Hygienist/Boeing/32	Y
Not supported by NIOSH grant	01/13	05/14	MS IH/EHS	Industrial Hygienist/Phillips 66/32	Y

MS: Master of Science
IH: Industrial Hygiene
IH/EHS: Industrial Hygiene and Environmental Health Science

Appendix C: Publications during the Project Period (2009-2014)

Only publications by NIOSH trainees are listed.
NIOSH trainee authors are indicated by **bold underlined type**
Student authors are indicated by **bold type**

Journal Articles

Phillips ML, **Johnson AC**: [2012] Prevalence of Dry Methods in Granite Countertop Fabrication in Oklahoma. Journal of Occupational and Environmental Hygiene 9:437-442.

Phillips ML, Johnson DL, **Johnson AC**: [2013] Determinants of Respirable Silica Exposure in Stone Countertop Fabrication: A Preliminary Study. Journal of Occupational and Environmental Hygiene, 10:368-373.

> The trainee author (AC Johnson) was supported on the NIOSH TPG for two years, including during the thesis research on which these articles were based in part.

Johnson DL, Lynch RA, **Marshall CJ**, Mead KR, Hirst DVL: [2013] Aerosol Generation by Modern Flush Toilets. Journal of Aerosol Science and Technology 47(9):1047-1057.

> The trainee author (CJ Marshall) was supported on the NIOSH TPG during one year of didactic training and subsequently conducted the thesis research on which this article was based in part.

Cooper JH, Johnson DL, Phillips ML: [2014] Respirable Silica Dust Suppression during Artificial Stone Countertop Cutting. Annals of Occupational Hygiene, accepted for publication.

> The trainee author (JH Cooper) was supported on the NIOSH TPG for two years, including during the part of thesis research on which this article was based.

Masters Theses

Theses by trainees supported in the 1999-2004 project period

Roberts JN: [2011] Comparing Chloroprene Exposure at Two Production Facilities, MS Thesis, University of Oklahoma Health Sciences Center.

Theses by trainees supported in the 2004-2009 project period

Janah Y: [2010] Spectral Response Error of Commonly Used Solar Ultraviolet Measuring Instruments, MS Thesis, University of Oklahoma Health Sciences Center.

Theses by trainees supported in the 2009-2014 project period

El-Bakoush CM: [2010] An Analysis of Surveillance Systems for Hunters' Tree Stand Accidents in the United States, MS Thesis, University of Oklahoma Health Sciences Center.

Peterson V: [2010] Field Applicability of the Immunoassay Test Kit for Testing Concentrations of Pentachlorophenol in Environmental Soil Samples, MS Thesis, University of Oklahoma Health Sciences Center.

Britt JA: [2010] Analysis of Mall Food Court Trays for Bacterial Contamination, MS Thesis, University of Oklahoma Health Sciences Center.

Johnson AC: [2011] Survey of Granite Countertop Manufacturing Practices, MS Thesis, University of Oklahoma Health Sciences Center.

Thompson SJ: [2012] Noise Characteristics of Riding Lawn Mowers, MS Thesis, University of Oklahoma Health Sciences Center.

Borgstrom AJ: [2012] Assessment of Fluoride in Hair and Drinking Water among Ethiopian Villagers, MS Thesis, University of Oklahoma Health Sciences Center.

Marshall CJ: [2013] The Influence of Suspension Particle Size on Aerosolization during Toilet Flushing, MS Thesis, University of Oklahoma Health Sciences Center.

Carter BM: [2013] Efficiency of AGI-4 Impingers while Characterizing Airborne Cyanobacteria-Related Contaminants, MS Thesis, University of Oklahoma Health Sciences Center.

Cooper JH: [2013] Pilot study of Dust Suppression Methods for Stoneworking Tools, MS Thesis, University of Oklahoma Health Sciences Center.

Hollen HR: [2014] An Analysis of the Effect of Alkaline, Neutral, and Acidic Solutions on Melamine Leachate from Melamine Bowls, MS Thesis, University of Oklahoma Health Sciences Center.