FINAL PROGRESS REPORT
NIOSH TRAINING PROJECT GRANT

The Industrial Hygiene Curriculum
Western Kentucky University
7/1/98 – 6/30/01

Project Director: Dennis K. George, Ph.D., CIH
Department of Public Health
Western Kentucky University
Bowling Green, KY 42101

CDC/NIOSH Grant Number: T02/CCT410463

Date: October 19, 2001

Table of Contents

Abstract

Over the course of this project period, the Industrial Hygiene Program faculty have taken the opportunity to take a serious look at our direction and focus. We have sought input from our alumni as well as the regional industrial constituency in an effort to determine the degree to which we are meeting the occupational health needs and expectations of our region. In two independent surveys, one of alumni and one of regional occupational health professionals, it became clear that our academic program in Industrial Hygiene needed to broaden its focus and include additional material in the area of occupational safety and applied industrial environmental management. The crying need was for a practitioner who could effectively manage environmental, industrial health, and safety issues for an industrial facility.

Industrial Hygiene program faculty responded by rethinking our vision and mission as well as the overall objectives of our academic program. Again with input from relevant constituencies, we developed a detailed set of Program Educational Objectives and Program Outcomes that are consistent with our Institutional Mission and the needs and expectations of regional industry. We are now in the process of aligning the curriculum with these objectives and outcomes and developing outcomes-based assessment tools to provide continuous feedback for improvement.

Throughout this process we have reaffirmed our belief that the most effective education is a combination of strong curricular components coupled with extensive field experience and project work. Thus, we have also greatly expanded the project and "hands on" opportunities for our students throughout this project period. We have also significantly increased our equipment holdings and support facilities to insure that our students have access to modern industrial hygiene equipment and facilities.

Support provided through the NIOSH Training Project Grant has made a significant difference in terms of strengthening our curriculum and expanding the collection of course offerings and professional development experiences available to our students. This grant enables our students to graduate as well rounded individuals, ready to begin their practice as occupational safety and health professionals.

Significant Developments and Accomplishments

- Detailed Program Educational Objectives and Program Outcomes have been developed for the program. We are now in the process of developing an effective Assessment Plan that utilizes appropriate test instruments and strategies to determine the extent to which we are achieving these objectives and outcomes at the program level. This plan will incorporate formal feedback loops and mechanisms of continuous quality improvement.

- The number and quality of faculty-led, "hands-on" student projects being conducted within local industries has increased significantly. Virtually every student in the IH major has opportunities to engage in applied activities that dramatically enhance their understanding of the field and their ability to enter professional practice upon graduation.

- A major gap in the academic program, that of institutionalized instruction in occupational safety, has been filled with the addition of ENV 485, Educational Experiences in Industrial Hygiene. Through this avenue, all IH majors receive 120 contact hours of courses that include Fundamentals of Occupational Safety, Complying with OSHA, and two additional electives. In addition to these courses, students take an additional 40-hour HAZWOPER course to complete the requirements for ENV 485. This opportunity was made available solely through support from the NIOSH TPG.

- Students now have an opportunity to take an ergonomics course from a qualified instructor, Ms. Tamara James, C.I.E., C.P.E. This also is made available as a result of the NIOSH TPG.

- The Environmental, Health, and Safety Resource Laboratory has been expanded to include additional equipment and computing resources. Additionally, this facility provides excellent literature and electronic research opportunities for students and is also a significant resource for local and regional industries.

Discussion

As with any enterprise, the critical issues faced by academic programs relate to the services and programs provided to its most important stakeholders. Although subsequent sections of this report address constituencies in more detail, arguably the principal stakeholders in any academic program are the students who access it for their education and vocational preparation. Thus, the long term strategic focus for the WKU Industrial Hygiene program was developed from the perspective of; "What constitutes the most effective academic preparation for students choosing a career in Industrial Hygiene?". Obviously, the answer to this question differs from institution to institution. The WKU Industrial Hygiene faculty is convinced that from the perspective of a regional institution in Southcentral Kentucky, our response must reflect not only the state of Industrial Hygiene practice on a national/global scale, but also the demands and expectations placed on graduates upon their initial hires into the regional industrial community. These issues are discussed in the following paragraphs and will hopefully serve as an explanation for the exciting changes and developments that have taken place in the WKU Industrial Hygiene program.

The Discipline of Environmental, Health, and Safety

Industrial Hygiene is principally an ***applied*** discipline dedicated to the recognition, evaluation, and control of environmental factors or stresses arising in the occupational environment that may cause sickness, impaired health and well-being, or significant discomfort among workers or among citizens of the community. These factors or stresses may be chemical (e.g. solvents, heavy metals), physical (e.g. noise, heat stress), biological (e.g. bloodborne pathogens, tuberculosis,), or ergonomic (e.g. manual materials handling, repetitive motion) in nature and may arise in virtually any sector of the industrial environment. Practitioners in the field of Industrial Hygiene must be able to:

- identify situations in the workplace that pose a potential risk of adverse consequences to employee health and well-being,
- determine the nature and extent of the health risk by thoroughly researching all pertinent background information and by qualitatively and quantitatively assessing the environmental stressors involved,
- judge the acceptability or unacceptability of the risk upon careful observation of all relevant factors and a thorough analysis of all pertinent qualitative and quantitative data, and
- design and implement adequate measures of prevention and/or remediation for those situations posing unacceptable risk.

Essentially, the industrial hygienist is an individual who is concerned with the nature and behavior of hazardous agents generated from industrial processes *while these pollutants are still within the industrial facility* and potentially posing a hazard to plant employees.

Industrial Environmental Management is also concerned with hazardous agents or pollutants generated from industrial processes. Whereas industrial hygiene focuses on

the health and well-being of workers *inside* the plant, industrial environmental management is concerned with the impact of these agents on the health of the surrounding community and the fate of these pollutants in the neighboring environment. Thus, an industrial environmental manager focuses on the behavior of the contaminant *outside* the plant and the assessment and control of hazardous materials escaping from the plant and into surrounding air, water, or soil. He or she must be prepared to address air quality, water quality (including wastewater, stormwater, and groundwater) and hazardous/ industrial waste management for their facility.

The types of industrially-generated hazardous agents of concern to the industrial hygienist/environmental manager are as many and varied as the industrial processes from which they originate. Extensive knowledge of contaminant generating processes, mechanisms of pollutant behavior and transport, and the means by which these materials cause harm to individuals in both the occupational and community environments is necessary to deal effectively with the associated risks. Managing the environmental issues of an industrial concern is, indeed, a highly complex challenge requiring a strong technical background coupled with a very diverse set of applied skills.

The discipline of Industrial Safety involves assessing and controlling issues that are more acute or "real time" in nature and includes accident prevention, hazard and loss control, and system safety activities. A hazard is defined as any existing or potential condition in the workplace that, by itself or by interacting with other variables, can result in death, injuries, property damage, and other losses[1]. Industrial Safety Professionals must effectively deal with "potentially" hazardous situations as well as those existing at the moment due to carelessness and the unguarded or inadequately organized uses of both devices and substances in the workplace.[2]

Industrial Safety Professionals practice hazard control; that is they develop programs to recognize, evaluate, and eliminate (or at least reduce) the destructive effects of hazards arising from human errors and from conditions in the workplace.[1] They are also responsible for developing and implementing loss control strategies as well as for achieving accident prevention through a complete safety and health hazard control program. Loss control involves preventing employee injuries, occupational illnesses, and accidental damage to the company's property. It also includes preventing injuries, illnesses, and property damage that may involve visitors and the public.[1]

In addition to the ethical concerns over the health and safety of employees and surrounding communities, companies are constrained to control employee exposures and environmental releases of contaminants by a plethora of governmental occupational health, safety and environmental regulations. Indeed, dealings with agencies such as the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) are a routine part of the job for industrial hygienists, industrial environmental managers, and industrial safety professionals. Insuring compliance with OSHA and EPA regulations, while important, is often a tedious, time-consuming, and, to say the least, often challenging experience for occupational and environmental health professionals.

To make matters even more challenging, it is quite common for the "lean and mean" industry of today to merge what has traditionally been the three distinct functions of industrial hygiene, environmental management, and industrial safety into a single role, creating what has come to be known as the Environmental, Health, and Safety (EHS) Manager. In the current climate of corporate downsizing taking place within many organizations, the day of the narrowly-focused specialist with expertise in only one of these technical areas is rapidly giving way to the era of the broad-based generalist whose duties encompass the entire gamut of environmental, health, and safety issues. Increasingly, the plant-level professional is required to possess a varied background and a broad technical knowledge base that includes a combination of each of these areas of professional practice in their role as EHS Manager.

The necessity of applying a broad base of technical skills and problem solving abilities within such a complicated regulatory framework makes the field of Industrial EHS Management one of the most complex and challenging of the current scientific disciplines. On the other hand, the opportunity to prevent occupational disease and injury, protect public health and natural resources, and improve the overall quality of life for a number of individuals in our society also make this career one of the most rewarding.

Ramifications for the Western Kentucky University Industrial Hygiene Program

The effect of the shift in the scope of professional practice from specialist to generalist has been especially acute for industrial hygienists as has been documented in several reliable surveys. For example, a recent survey of industrial hygienists showed that 33% of facilities surveyed operate consolidated Environmental, Health, and Safety departments at the highest level of the organization with only about 25% having separate safety, industrial hygiene, health and environmental departments. The 1997 American Industrial Hygiene Association (AIHA) Membership Survey Report stated that "On average, respondents spend 54% of their time in industrial hygiene, 20% in safety, 14% on other and 12% in environment. In 1996, the AIHA Redefinition Task Force, a group created specifically "to examine the changing role of industrial hygienists and to identify the scope and importance of the industrial hygienist's role as it relates to occupational health, safety, and the environment", documented the following among the AIHA constituency:

- Only 15% still spend 100% of their time in a traditional industrial hygiene role.
- 54% spend no more than 51% of their time in industrial hygiene.
- 67% spend 10 – 50% of their time in safety functions.
- 51% spend some time in environmental functions.
- 82% said that in 5 years the profession as a whole would be an integration of environment, safety, and occupational health.
- 62.4% anticipated that their jobs would combine safety, industrial hygiene and environmental functions.

In the recent past, the AIHA has asked its membership to consider changing the name of the association to the Occupational Health, Safety, and Environment Association (OHSEA) to address the broadening scope of the industrial hygiene profession. Although

these measures have been defeated to date, this does provide evidence that the combination of industrial environmental, health, and safety into one job function is a trend that will exist well into the future.

In view of the seemingly permanent national trend towards consolidation of the industrial hygiene, environmental, and safety functions, it behooves educational institutions to assess how this might impact the design and delivery of their Industrial Hygiene (IH) instructional program. In order to confirm the evidence of the national trend and its application to our region, a survey was undertaken in the Spring/Summer of 2000. The member list of a professional organization, the South Central Kentucky Association of Environmental Managers, was surveyed by telephone. In general, the purpose of this survey was to determine whether or not most industries in this region hired EHS generalists and, if so, did this individual's job function include the provision of IH services for their company. A summary and analysis of the results, including a copy of the test instrument, is included as Appendix I.

This survey highlighted three very obvious points:

1. Companies in the WKU service region do, indeed, hire generalists in the area of Environmental, Health, and Safety with the same individual generally handling all three functions.
2. Of the three areas of responsibility encompassed by Environmental, Health, and Safety management, professionals in this region assessed themselves to be least equipped (by both education and experience) to handle the IH issues.
3. Very few individuals performing the IH function for a given company in this region have any formal training in IH whatsoever either in terms of a degree, college course work, or professional development courses.

During Summer, 2000, the WKU IH faculty also surveyed the alumni of our program to assess the extent to which they practice the spectrum of IH, environmental management, and safety. The results are presented in Appendix II. From this data it was again clear that the majority of our graduates are not just practicing IH but rather a mix of the EHS functions. To fail in preparing our IH students to address industrial environmental and safety issues is to fail in our responsibility to prepare them to competitively enter the regional and national job market and, more importantly, to function effectively in their profession.

Clearly, if the WKU IH Program is to meet the needs of our students and the regional industrial community, we must present an academic program that prepares students with both a strong IH background, currently lacking in many regional EHS Managers, as well as with the ability to address industrial environmental and safety issues. The WKU IH Program is committed to developing in its students the scientific foundation, technical background, and applied skills necessary to take on the manifold challenges of EHS Management.

The WKU Institutional Mission and the Industrial Hygiene Program

In addition to its sensitivity to the regional professional need, the IH Program has also evolved in the context of the Western Kentucky University Mission, Vision, Core Values, and Strategic Plan. As stated in the WKU Strategic Plan, *Challenging the Spirit*, strategic planning is an open, dynamic, and continuing process which ensures that any organization remains flexible and responsive to a changing environment. In a university setting in particular, the planning process is highly dependent upon broad university acceptance and participation. The resulting strategic plan charts a course for the future and a means of developing priorities and actions to achieve intended outcomes.

Western Kentucky University's Strategic Plan is about enhancing academics – the strength of our faculty, students, and programs – and the Western experience. The Plan will guide program decisions and direct allocation of resources as Western enters into the 21st century.

The Strategic Goals are consistent with the University's mission to be nationally competitive in its educational programs and provide optimum service to the citizens of Kentucky. Collectively, these Strategic Goals and the subsequent Objectives will focus institutional energies; sustain the vision of the Commonwealth's reconceptualized postsecondary education system; and guide us in achieving the vision to "be the best comprehensive public institution in Kentucky and among the best in the nation.

Accordingly, the Mission, Program Educational Objectives, and Program Outcomes and Assessments of the IH Program are inextricably linked to the Mission Parameters and Strategic Goals of the University. In the subsequent sections, which detail the Industrial Hygiene Academic Program Objectives, Outcomes, and Assessments, each objective is mapped to the specific sections of the Institutional Mission and/or Strategic Goals which it supports. As the IH Program continues to evolve and develop in response to constituent needs, the faculty are committed to maintaining flexibility in our Educational Objectives and consistency between these program-centered principles and those of the Institution as a whole.

Industrial Hygiene Program Constituencies

In accordance with Appendix B of the institutional Strategic Plan, Western Kentucky University, through its programs of instruction, research, and service, responds to the needs and interests of diverse stakeholders which include:

- Students - to whom the university owes its primary responsibility. The University provides a rich array of educational and training opportunities in a variety of undergraduate, graduate, and professional courses and degrees. Students will come away as critical thinkers and lifelong learners, with quality preparation in their disciplines and competent in a technologically advanced world.
- Faculty and Staff - from whom the University draws its primary strength. The University provides employment, resources, and environment that supports professional development of faculty and staff within the context of fulfilling its mission.

- Alumni- in whom the University takes special pride. The university fosters a mutually supportive relationship with its alumni by maintaining quality programs, encouraging lifelong learning, and ensuring opportunities for continuing involvement in the University community.
- Employers - for whom the University provides educated citizens and a capable workforce. The University is a partner in expanding employment opportunities and preparing those who fill them.
- Communities served - with whom the University works collaboratively to provide resources and services to meet their distinctive needs. The University is a partner in assuring that the communities it serves have the educational support and resources needed to flourish and prosper.
- Business and Industry - to whom the University supplies new ideas, innovative technologies, just-in-time education to upgrade skills, consulting and entrepreneurial services, and an applied research infrastructure that provides innovation and support for new generation businesses and corporate enterprises.
- The Commonwealth - to which the University contributes intellectual, cultural, and civic leadership that enhances economic development and quality of life. The University serves the state with educational and training programs, research, scholarship, and creative activities that advance statewide development and quality of living.

To insure stakeholder input into all of our activities, an external Advisory Board, comprised of representatives from each of these constituencies, has played, and continues to play, an active part in the development of the Educational Objectives for the WKU IH Program.

On February 23, 2001, the Advisory Board met with the express purpose of considering the direction of the IH Program, its role in the region, state, and nation, and, most importantly, the appropriate set of objectives for its graduates.

Industrial Hygiene Program Mission, Objectives, Outcomes, and Assessments
In conjunction with the aforementioned guiding philosophies of Western Kentucky University and the input of our constituencies as described above, the mission of the Industrial Hygiene Program is as follows:

> ***To produce graduates capable of proactively anticipating, recognizing, evaluating, and controlling a broad spectrum of environmental, occupational health, and safety problems in a variety of industrial settings and effectively managing these issues in a manner consistent with sound ethical practice and current regulatory directives.***

Pursuant to this mission, the WKU Industrial Hygiene faculty has developed the following set of Program Educational Objectives. As mentioned, these objectives were established in conjunction with the university mission, constituent input (including current students, faculty, alumni, and regional industrial partners), regional professional needs, and national trends. Please note that for the purposes of this document, Program

Educational Objectives are defined as statements that describe the expected accomplishments of graduates *during the first few years after graduation.* The audiences for objective statements are external constituencies such as prospective students, employers, and student sponsors. Each Educational Objective is followed by a set of Program Outcomes. Program Outcomes are statements that describe what students are expected to know and are able to do *by the time of graduation.* Achievement of all the Program Outcomes indicates the student is equipped to achieve the Program Educational Objectives. Achievement of Program Outcomes by each student should be verified before certification for graduation.

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University provides students with rigorous academic programs in the liberal arts and sciences, and traditional and emerging professional programs, with emphasis at the baccalaureate level.**
- **Western Kentucky University is committed to assuring quality of programs, competence of graduates, and opportunities for lifelong learning.**
- **Western Kentucky University is dedicated to the importance of achieving excellence in all of its programs.**

Program Educational Objective 1:

- **Graduates of the WKU Industrial Hygiene Program demonstrate a depth and breadth of understanding of the technical aspects of the field of Industrial Hygiene and in the scientific and mathematical foundations upon which this field is based.**

Program Outcome 1(a) in Support of Educational Objective 1:

- **Industrial Hygiene Program graduates are prepared to apply knowledge of mathematics, basic science, and Industrial Hygiene applied science to the practice of industrial hygiene.**

Program Outcome 1(b) in Support of Educational Objective 1:

- **Industrial Hygiene Program graduates are prepared to draw upon their knowledge of a broad spectrum of industrial hygiene-related disciplines, including physiology, toxicology, epidemiology, environmental science, and statistics, to competently implement and practice the scientific and technical aspects of Industrial Hygiene.**

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University ensures that students are proficient in their major fields and can apply information technologies to function competitively in their respective disciplines.**
- **Western Kentucky University provides student access to excellent facilities, state-of-the-art equipment, information technology, and alternative instructional opportunities that maximize learning.**

- **Western Kentucky University responds to educational, social, cultural, and economic development needs through increased outreach, applied scholarship, service, and innovative opportunities for lifelong learning.**

Program Educational Objective 2:

- **Graduates of the WKU Industrial Hygiene Program are application-oriented, hands-on problem solvers who apply their technical knowledge to the practical resolution of workplace Industrial Hygiene issues.**

Program Outcome 2(a) in Support of Educational Objective 2:

- **Industrial Hygiene Program graduates are prepared to use the techniques, skills, modern scientific/technical tools and instrumentation necessary to assess the nature and extent of potential occupational health risks by designing and conducting qualitative and quantitative Industrial Hygiene surveys and analyzing and interpreting the resulting data.**

Program Outcome 2(b) in Support of Educational Objective 2:

- **Industrial Hygiene Program graduates are prepared to resolve industrial hygiene problems by recommending, designing, and/or evaluating engineering, administrative, and personal protective equipment controls and/or other interventions to reduce or eliminate risks.**

Program Outcome 2(c) in Support of Program Educational Objective 2:

- **Industrial Hygiene Program graduates are prepared to participate in the development and implementation of applicable industrial hygiene-related programs, systems, or processes to meet desired needs and/or regulatory directives;**

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University recognizes that its mission continues to evolve in response to regional, national, and global changes, and the need for lifelong learning.**

Program Educational Objective 3:

- **Graduates of the WKU Industrial Hygiene Program practice Industrial Hygiene in the broader professional context of Regulatory Environmental Science and Occupational Health and Safety.**

Program Outcome 3(a) in Support of Program Educational Objective 3:

- **Industrial Hygiene Program graduates are prepared to understand the fundamental technical aspects of industrial environmental management and occupational safety;**

Program Outcome 3(b) in Support of Program Educational Objective 3:

- **Industrial Hygiene Program graduates are prepared to interpret and apply applicable industrial environmental and occupational safety regulations.**

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University emphasizes cooperation, teamwork, and mutual respect for individual differences in scholarship, diversity, and culture.**
- **Western Kentucky University increases global and international awareness and experiences of students and faculty.**

Program Educational Objective 4:

- **Graduates of the WKU Industrial Hygiene Program integrate Industrial Hygiene practice into the objectives of the business enterprise and interact effectively with a wide variety of professionals at all organizational levels.**

Program Outcome 4(a) in Support of Program Educational Objective (4):

- **Industrial Hygiene Program graduates are prepared to understand the impact of solutions in a global and societal context.**

Program Outcome 4(b) in Support of Program Educational Objective (4):

- **Industrial Hygiene Program graduates are prepared to communicate effectively through verbal and written means including the preparation of scientific and technical summaries and reports.**

Program Outcome 4(c) in Support of Program Educational Objective 4:

- **Industrial Hygiene Program graduates are prepared to participate effectively as a member of a team in projects that may involve multi-disciplinary activities or that encompass other health, engineering, or scientific disciplines.**

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University expects for all conduct to be characterized by integrity, honesty, and commitment to moral and ethical values and principles.**

Program Educational Objective 5:

- **Graduates of the WKU Industrial Hygiene Program practice Industrial Hygiene in a professional manner, cognizant of related**

ethical and contemporary issues. They recognize that their paramount professional responsibility is to protect the health and well being of workers under their cognizance.

Program Outcome 5(a) in Support of Program Educational Objective 5:

- **Industrial Hygiene Program graduates are prepared to understand the appropriateness of ethical performance and professional practice.**

Program Outcome 5(b) in Support of Program Educational Objective 5:

- **Industrial Hygiene Program graduates are prepared to comprehend contemporary issues and utilize a variety of resources in order to obtain pertinent information.**

Institutional Mission Parameter, Core Value, or Strategic Goal:

- **Western Kentucky University provides lifelong learning opportunities designed to equip students with the ability to adapt to a rapidly changing world.**
- **Western Kentucky University is defined by the value we add to the credentials of those students who access us and to the collegiate experience which produces informed and dedicated citizens.**

Program Educational Objective 6:

- **Graduates of the WKU Industrial Hygiene Program are committed to continued professional growth and development through lifelong learning.**

Program Outcome 6(a) in Support of Educational Objective 6:

- **Industrial Hygiene Program graduates are prepared to engage in lifelong learning and attain recognized professional certification.**

The WKU IH Curriculum

Based upon the expanding role of industrial hygienists to incorporate safety and industrial environmental management and the set of Program Educational Objectives and Outcomes developed among faculty and constituents, the IH faculty has proposed various changes to the academic program. Pedagogically, the curriculum in IH at Western Kentucky University addresses and develops necessary skills through a combination of classroom instruction, laboratory training, and field experiences. Please refer to Appendix V. which lays out the curricular elements of the proposed IH academic program. Please note that as of the time of this writing, these changes have not been approved beyond the Departmental level. Please note also that in addition to curricular revisions, a recommendation has been made to change the title of the program from Industrial Hygiene to Environmental, Health, and Safety (EHS) to more accurately reflect the graduates skills and capabilities. However, the IH content of the program remains very

much the same (reduced only by one three credit hour course) with substantial increases in safety content as well as IH related courses such as epidemiology.

Note that all EHS students graduate with a solid foundation in the basic sciences and mathematics (e.g. chemistry, physics, biology, anatomy/physiology, and college algebra). Building upon the science foundation, courses in IH emphasize the fundamental observational techniques and basic qualitative skills necessary for identifying those potential health hazards associated with specific occupational situations including the types of chemical/physical contaminants generated by these processes (e.g. EHS 321, EHS 442 EHS 471, BIOL 420). In addition, a significant portion of the IH curriculum, including laboratories, is spent in discussion and demonstration of the principles involved in the accurate measurement of these contaminants and in the proper assessment and interpretation of the results (EHS 440, EHS 441, EHS 442, EHS 443, PH 383). A course in epidemiology (PH 384) allows students to examine current methodologies of studying distribution, etiology and control of communicable and chronic diseases and other insults on human health. Similarly, the elements of basic control strategies and their applications to specific situations are discussed in the classroom along with opportunities for students to design simple control systems (e.g. local exhaust ventilation) for various unit processes (EHS 442, EHS 471). In this manner, the instructional program delivers the basic industrial hygiene principles of recognition, evaluation, and control.

Each graduate also has a fundamental preparation in Industrial Environmental Management with courses such as Air Pollution (ENV 360), Hazardous and Solid Waste Management (ENV 480), and Water Treatment Processes (ENV 410 – covering industrial water management issues). As a result, these students possess an understanding of the behavior of pollutants in air, water, and land, and they have a firm basis from which to understand the control techniques utilized to solve problems associated with the release of pollutants into these media. Through these courses students are also introduced to the regulatory background governing the management of important environmental issues in the industrial setting.

Industrial Safety issues are formally introduced in the curriculum in EHS 120 (Introduction to Occupational Safety and Health) and elaborated upon in a significantly expanded collection of safety courses (EHS 221, EHS 322, EHS 331, EHS 423). In addition, a course in Fire Science (EHS 420) as well as a course in Emergency Care and Transportation (EHS 271) are also now a component of the curriculum.

Further pedagogical treatment of various topics is accomplished through a unique course entitled Educational Experiences in Industrial Hygiene (EHS 485). Realistically, in the process of delivering a regular academic curriculum, it is virtually impossible to provide adequate coverage of each important and relevant topic in all three of the areas of IH, Industrial Environmental Management, and Industrial Safety. Due to the already excessive number of credit hours in the program, adding additional academic requirements is simply not feasible. However, the professional development courses available under the ENV 485 course focus exclusively upon these issues and provide

detailed coverage that fills the gap in the student's academic preparation. The ENV 485 course provides students with the opportunity to:

- obtain focused, in-depth instruction in vitally important areas of environmental, health, and safety which are not sufficiently covered in the regular curriculum,
- interact with environmental, health, and safety professionals in business, industry, government, and education from all across the United States and several foreign countries, and
- attain credentials/certifications that will significantly improve competitiveness in the job market.

The course is administered through the Department of Public Health in collaboration with the NIOSH Education and Research Center at the University of North Carolina, Chapel Hill, North Carolina, (UNC ERC). Collectively these experiences comprise approximately 120 contact hours in a variety of short, professional development courses, the content of which is directly applicable to majors in the Environmental, Health, and Safety curriculum. The instruction is offered during the ERC's Occupational Safety and Health Summer and Winter Institutes. These institutes consist of 1-week sessions and are typically held in July or August in Virginia and in January or February in Florida. Some courses at the Institutes are 5 days in length and some are 2 ½ days in length. Obviously, a student may take 2 courses that are 2 ½ days in length during a single week. Students are required to attend three Institutes to obtain the total 120 hours of instruction.

Fundamentals of Occupational Safety (5 days) and **Complying with OSHA** (5 days) are both required in order to receive credit for ENV 485. This counts for 80 of the required Institute hours. The other 40 hours of instruction may be selected from a list of electives that includes Confined Space Safety and Compliance, Safety Management Systems, Machine Guarding, Materials Handling, Fire Safety, etc. Please note that students following this track are eligible to participate in the UNC ERC **Safety Technician Certificate Program**. This involves passing an examination given at the conclusion of each course. This is an excellent credential from an outstanding institution. The funding that allows students to attend these institutes comes totally from the NIOSH Training Project Grant.

Another important component of ENV 485 is a course in Occupational Ergonomics. Ms. Tamara James, MA, CIE, CPE, Senior Ergonomist for Duke University Medical Center, has been contracted to teach this course every other Spring Break in a 40-hour format. NIOSH TPG funds also support this effort. This course allows our IH students to take advantage of the special expertise of Adjunct Professor James in presenting this course and fills a gap in an important area of our curriculum.

Alternating with the Occupational Ergronomics course every other Spring Break is a course in Applied Industrial Environmental Management that is taught by EnSafe, an external environmental consulting company. This course covers specific, "hands on" information that must be mastered by persons performing the Environmental Management function of an industrial facility. Issues such as Hazardous Waste

Management (Form R's, Tier II's, etc.), Air Quality Management (Title V Air Permits, etc.), and Water Quality Management (Stormwater Management Plants, Groundwater Protection Plans, etc.) are covered in this course.

To complete the requirements of the ENV 485 course, a 40-hour HAZWOPER course is required of all students. Thus, graduates of the IH program have the UNC Safety Technician Certificate and are 40-hour HAZWOPER trained.

ENV 485 is required of all students majoring in Environmental, Health, and Safety. Please note also that training funds provided by the NIOSH TPG support travel costs and UNC ERC reimbursement for course materials. Mr. Larry Hyde, Director of Continuing Education for the UNC ERC, graciously waives the course tuition for our students.

Importance of "Real World" Experiences

At WKU, each of the classroom/laboratory experiences and extracurricular activities described above is an integral part of a student's preparation for a career in EHS. The importance of these experiences should not be minimized. However, very often in the classroom or laboratory, students receive the false sense that everything flows just as smoothly in the field as it does on the chalk board or the lab bench top where variables and opportunities for errors are minimized. Additionally, opportunities for personal interactions with workers, supervisors, management, etc. which is such a vital component of competent professional practice, are not possible in a laboratory setting. Obviously, the real world does not operate in such a sterile environment.

Thus, the EHS program of Western Kentucky University is actively seeking to create an even more unique and effective learning environment for its students by integrating project-based learning into the academic program. Project-based learning essentially involves incorporating into the curriculum a steady progression of "hands on" experiences that allow for increasing student involvement and responsibility as they make the transition from observer, to participant, to practitioner. Project-based learning seeks to lead the student through a guided discovery process in the real world whereby they gain knowledge and wisdom from their experiences, and often, from their mistakes. It extends educational opportunities for our students beyond routine classroom/laboratory exercises and into problem solving experiences in "real-world" industrial settings. The practice of this philosophy allows students to interact with actual workers, supervisors, and management personnel in genuine industrial workplaces and gives them the excitement and satisfaction of applying problem solving skills in a setting in which their contributions will make a material difference. The WKU EHS faculty are committed to this project-based approach because we believe that combining a solid academic foundation with these real-world experiences is the best method of producing technically competent practitioners in the field of environmental, health, and safety.

Returning to a premise discussed earlier, it is clear that our country is in need of qualified professionals to manage the broad spectrum of environmental, health, and safety issues facing American industry. It is imperative that students experience a comprehensive range of EHS activities, projects, and problem solving situations to adequately prepare

them for the complex issues they will be expected face upon employment. The importance of these project-based learning experiences in the educational process is underscored when one considers the increasing level of expectations for *entry-level* EHS positions. Even as corporate downsizing has tightened the market for mid- and upper-level EHS managers, the market is still strong for entry-level positions. Companies are hiring inexperienced people, saddling them with heavy responsibilities, and are expecting them to step in and perform immediately. Unfortunately, individuals who have had little or no real-world experience or opportunity to work under the supervision of competent professionals in the field are at an extreme disadvantage in this situation. In view of this trend, it is obvious that providing these opportunities as an integral part of the baccalaureate degree experience becomes even more critical. Adequate academic preparation of these individuals is no accident but is rather the result of a carefully planned curriculum supplemented by extracurricular activities and project-based learning experiences.

Project-based learning creates a totally new academic environment for our students; a unique, project-oriented approach to education that provides students with unparalleled learning opportunities. Students are extremely enthusiastic about the opportunity to practice their EHS problem solving skills in actual industrial situations. The benefits reaped by the students and the eagerness with which they approach these industrial experiences cannot be overemphasized. They encounter first hand the reality of interacting with both workers and management personnel in a "real" workplace.

Opportunities for Project Based Learning

Opportunities for WKU IH students to engage in project based learning basically come in two different forms;

(1) *ad hoc* IH projects in local industry undertaken by faculty with student input and assistance, and
(2) the summer student internship experience.

The first avenue for student experiences comes in the form of assisting a faculty member in a specific IH project with a local industrial facility. A tremendous opportunity exists in local industry to involve students in a variety of these meaningful activities. Within the Western Kentucky University service region exist numerous small to medium sized industrial concerns employing anywhere from 10 to 250 people. Each of these companies is compelled, legally and ethically, to adequately control employee exposures to all contaminants generated and to properly manage the environmental release of those contaminants into the surrounding community. In the majority of these industries, a single person is designated as the EHS Manager. Often, particularly in the smaller companies, this is a secondary or even tertiary responsibility. For example, in many cases this individual is also the plant manager, personnel manager, or human resources manager.

In these situations, the individual responsible for occupational and environmental health has little or no technical background in these complex issues and precious little time to

deal with them. Even in the larger companies where a person may have EHS management as his or her sole dedicated responsibility, the designated individual may have limited training in the technical skills necessary to properly evaluate and control the problems and scant knowledge of the pertinent laws and regulations. Moreover, in situations where measurements are necessary, the equipment required to conduct the evaluation is not available in most cases. Consequently, even though these EHS managers recognize the need, they, unfortunately, lack the resources to meet the need. As a result, in many of our regional industries, employee health and community environmental protection goes sadly wanting. Bringing together this lack of EHS expertise with the "hands on" focus of the WKU IH program creates a natural "win-win" situation.

In participating as an assistant to a qualified faculty member, the student takes a more active role in a specific industrial hygiene/environmental project in a local industrial facility. As mentioned, these projects typically take place in the context of a company that may have a designated EHS manager but for whatever the reason, expertise or resources may be lacking in a particular area. In this case, the company contracts with an ES/IH faculty member to design and implement a project to meet the particular need at hand. These projects are very specific and well defined with a definite end point.

For example, a company may wish to have an assessment of the personal noise exposure of certain employees in their facility. The faculty member takes the lead in the organization and direction of the project and works with the company representative to define the project and determine an effective monitoring strategy. The student assists by functioning as a technician to calibrate noise dosimeters, place them on workers, retrieve and download data, fill out sampling data sheets, and provide the information to the cognizant faculty member. The faculty member interprets the information, decides upon recommendations, and makes the report to the industry.

To increase the effectiveness of these activities as learning experiences, the faculty member functions in an in-depth teaching role by thoughtfully interacting with the students to discuss various aspects of the project such as the sampling strategy and data interpretation. This interaction greatly facilitates the student's learning and understanding of what is taking place. Through this process, students gain valuable experience in equipment calibration and utilization as well as in interacting with workers and supervisors in the real world. They are also introduced to important concepts relating to the assessment of exposure risks including the development of monitoring strategies, interpretation of results, making of recommendations, and writing of reports.

The faculty role is, of course, critical in the success of these efforts. Although this is one of the last steps before launching their professional EHS Manager career, the students are still in training. Faculty supervision and oversight is essential to make sure that the services provided to the industry are of the utmost quality and that all aspects of the program are administered competently and ethically. Faculty are also important in drawing out the experiences both in the industrial setting and in the classroom to ensure that these activities are maximized in terms of a learning experience.

Inasmuch as these projects are initiated at the request of a local industry and thus are, in a sense, *ad hoc*, they are not incorporated in a formal way into the academic program. However, a number of students are involved in these activities. Specifically, since Fall 1996, 37 students have been involved with 33 supervised projects. Perhaps the most satisfying aspect of these projects is the fact that by conscientiously measuring and recording the chemical or physical stressors, students can actually make a meaningful contribution to the occupational safety and health program of a particular company. This provides a service to these companies that may be very difficult for them to obtain otherwise. The students are understandably excited to participate in surveys in which the data collected is used to make meaningful decisions relative to the prevention of exposures.

The second opportunity for real world experiences comes through the summer internship program. Going hand in hand with the applied emphasis of the program, the intern experience truly provides students with the ultimate opportunity to apply basic IH skills in the real world under the oversight of a practicing occupational safety and health professional. In addition to valuable experience in the fundamental practice of IH, the student has opportunities to do such things as:

- practice verbal and written communication skills,
- sharpen and further develop computer skills,
- observe how major programs such as Hazard Communication, Hearing Conservation, etc. are implemented in practice, and
- conduct safety and health training sessions for workers.

Additionally, since intern positions are competitive, students gain valuable experience in the process of preparing a resume', searching for open positions, and planning for and participating in a job interview.

Resources in Support of Project-Based Learning

Significant resources are allocated to the WKU IH Program in support of both the instructional program delivery and the development of the project-based learning concept. Obviously, engaging students and faculty in meaningful projects with local industries necessitates a substantial inventory of modern equipment and instrumentation. Additionally, an institutional climate of support and reward for faculty contributions is also essential for success. The IH Program is fortunate to have substantial assistance both financially and intellectually.

Regarding the institutional climate, the Ogden College of Science, Technology and Health at Western Kentucky University has established an Applied Research and Technology Program, which provides multidisciplinary scientific and technical assistance needed to help solve industrial and environmental problems in the Commonwealth and the Nation. Through the Program, undergraduate and graduate students in science and technology majors have expanding opportunities to engage in hands-on research as an integral part of their academic program.

Funded through the Kentucky Council on Post Secondary Education, The Applied Research and Technology Program (ARTP) is structured as a cooperative and collaborative consortium of Centers located within the Ogden College. The Centers are supported financially by a combination of general fund money, external grants, contracts and income from services performed for industry. The ARTP is a focal point for undergraduate opportunities to acquire the problem-solving skills and hands-on experience they need to enable their future career goals. Faculty participation in these projects is encouraged and rewarded in terms of recognition as scholarly activity for tenure and promotion and in merit pay increases.

One of the centers supported under the ARTP umbrella is the Environmental, Health, and Safety Resource Center (EHSRC). This center, directed by IH Program faculty member Dr. Rodney Handy, provides the administrative context for project-based learning implementation. The EHSRC receives approximately $40,000 per year in funding from ARTP. These funds are utilized in a variety of ways including; compensating students for work on projects, purchasing equipment for use in the program, periodic calibration of equipment, faculty/staff travel, etc.

Another principal resource supporting the IH Program in its delivery of a project-based education is the Environmental, Health, and Safety Resource Laboratory (EHSRL). The primary purpose of the EHSRL is to assist IH students in learning the fundamental skills of qualitative industrial hygiene risk assessment as well as the basic processes involved in defining and researching occupational and environmental health problems. However, through this facility students also assist regional EHS professionals in obtaining and evaluating information needed to solve actual occupational health and environmental problems in their particular industry.

This NSF-ILI funded laboratory, located in Science and Technology Hall Room 204, is outfitted with five computers and associated supporting hardware (printer, CD-ROM tower, scanner, etc.). These computers are networked to a wide variety of software, CD-ROM databases, and on-line capabilities specifically selected to enable students to research EHS information related to specific industries, processes, or chemicals.

Sources of data from which the students draw information include software and CD-ROM based resources (e.g. RTECS, NIOSHTIC, etc.), trade association data bases, NIOSH case studies and criteria bulletins, specific plant histories (freedom of information requests), SIC code research, Internet searches (e.g. NIOSH or OSHA on-line resources), printed source literature review, etc. Students are encouraged to explore the many information sources available to them and to develop innovative skills in acquiring the qualitative information needed to define and ultimately evaluate and control a variety of EHS problems. Thus, in addition to the specific information gained from the assessment of the given situation, students learn how to obtain qualitative information on hazards of specific industries, how to utilize the resources available to assess the toxicology of a given material, how to do research on the hazards of a given process and how to work and communicate with other environmental health and safety professionals.

A third vital resource for the program is the IH Instrumentation Laboratory. This lab is equipped with an impressive array of portable, direct-reading instruments commonly used to characterize both chemical and physical hazards in the field. Several courses in the ES/IH Program use the capabilities of this laboratory as a means to provide "hands on" instruction and training in the modern techniques of sampling and monitoring. The instrumentation available in this lab includes a portable XRF, a field gas chromatograph, and two multigas meters. In addition, new personal noise and air sampling equipment was acquired recently as an enhancement to an already strong inventory. Future plans include the acquisition of several bench-type instruments currently used to analytically characterize stressors found in the environment and industry.

In conclusion, the Western Kentucky University EHS program faculty are committed to producing graduates that are among the best prepared, most competent EHS practitioners in the entire country. We feel strongly that it is impossible to fulfill this commitment without a strong "hands on" component. We constantly strive to make these opportunities possible for our students. Without these activities, our students are missing out on a vital aspect of their preparation as an EHS professional.

The support provided by NIOSH in this Training Project Grant is invaluable. The opportunity to send students to the University of North Carolina ERC Summer and Winter Institutes not only addresses a significant need but also is a unique professional development experience that is rarely afforded to college students. Additionally, the funds used to bring a qualified ergonomics professor to campus to teach a course in ergonomics is also critical to the effectiveness of our program.

List of Publications Resulting from the Grant

- D.K. George and M.R. Flynn, *Industrial Hygiene Education, Training, and Information Exchange,* published in the 5th edition of **Patty's Industrial Hygiene and Toxicology,** John Wiley and Sons, 2000.

- D.K. George, "The Industrial Hygiene Program at WKU" published in **Proceedings of the American Society for Engineering Education**, Southeast Section, Spring Meeting, Clemson, SC, April 1999. This paper will also be presented at this conference.

- Co-author of the following presentation which was delivered by John Zey at the American Industrial Hygiene Conference and Exhibition in Atlanta in May, 1998: "Development of Training Modules for the NIOSH Small Business Train the Trainer Program", J.N. Zey, D.K. George, B. Hayes, M.J. Colligan, J. Palassis, and A. Greife.

- D.K. George presented a paper at a plenary session at ABET 2000 Annual Meeting in Atlanta on October 26-27, 2000. The conference was entitled "The Knowledge Triangle – Partnerships in Education". This paper was presented in the session entitled "Jump-starting your IAC: Enhancing Successful Industry/Education Partnerships". This invitation was extended based upon the national reputation of the Industrial Hygiene Program and its emphasis on field project experiences. The WKU program was the only undergraduate Industrial Hygiene program to present at this conference and the only program of any type to be invited from the state of Kentucky. The paper, entitled "Industrial Partnerships for Industrial Hygiene Curricula - A Necessity, Not a Luxury", was published in the Proceedings of this conference.

Referemces

1. **Supervisor's Safety Manual, 7th Edition, National Safety Council, 1991.**

2. **System Safety Engineering and Management, 2nd Edition, Harold E.Roland and Brian Moriarty, John Wiley and Sons, New York, 1990.**

Participants for this survey were drawn from the South Central Kentucky Association of Environmental Managers Member Roster List. This group contains those individuals who normally perform the industrial hygiene function for a number of companies in the Western Kentucky University service region. The roster list contains approximately 120 names, of which 37 (31%) responded to a telephone survey at the time of this writing. The following is a synopsis of the 37 responses gathered.

Job responsibilities include:

Environmental only:	0
Industrial Hygiene only:	0
Safety only:	0
Environmental/Industrial Hygiene:	1 (3%)
Environmental/Safety	2 (6%)
Industrial Hygiene/Safety	3 (8%)
Environmental/Industrial Hygiene/Safety	30 (83%)

Rank of functions from 1st (strongest) to 3rd (weakest):

1st	2nd	3rd	Totals
Environmental	Safety	Industrial Hygiene	10 (27%)
Environmental	Industrial Hygiene	Safety	2 (5%)
Safety	Environmental	Industrial Hygiene	6 (16%)
Safety	Industrial Hygiene	Environmental	8 (22%)
Industrial Hygiene	Environmental	Safety	0
Industrial Hygiene	Safety	Environmental	0
All functions equal			8 (22%)
Environmental	Safety and Industrial Hygiene equal		1 (3%)
Safety	Environmental and Industrial Hygiene equal		1 (3%)
Environmental and Safety Equal	Industrial Hygiene		1 (3%)

Educational Background:

	College Degree	College Courses	Short Courses	None
Environmental	2 (5%)	9 (24%)	13 (35%)	16 (43%)
Safety	4 (11%)	2 (5%)	17 (46%)	14 (38%)
Industrial Hygiene	1 (3%)	4 (11%)	8 (22%)	23 (62%)

Company Size:

< 25	5 (14%)
25 – 100	16 (43%)
100 – 250	6 (16%)
250 – 500	6 (16%)
> 500	4 (11%)

Questionnaire for Environmental, Health, and Safety Managers

1. What is your job title?

   _____

2. Do your job responsibilities include the following:

   Environmental management _____ yes _____ no
   Examples of environmental management responsibilities include hazardous waste management (Form R's, Tier II's), developing Stormwater Permits, SPCC Plans, Risk Management Plans, Air Permits, etc.

   Safety _____ yes _____ no
   Examples of safety responsibilities include Lock Out/Tag Out Program, Confined Space procedures, Hazcom Program, personal protective equipment (PPE) selection (safety glasses, hard hats, etc.), machine guarding, etc.

   Industrial Hygiene _____ yes _____ no
   Examples of industrial hygiene responsibilities include determining employees' exposures to chemicals (e.g. air sampling), measuring employees' exposures to noise, maintaining the Hearing Conservation Program, assessing contaminant control ventilation systems, etc.

   If you do not perform Industrial Hygiene functions for company, who does?
   _____ Someone else in company _____ Corporate IH _____ Consultant
   _____ Other _____ No one

3. Of the three areas; Environmental, Safety, and Industrial Hygiene, which do you consider to be your strongest? Please rank from 1 to 3 with 1 being your area of greatest strength.

   _____ Environmental Management _____ Safety _____ Industrial Hygiene

4. What is your formal educational background in the following areas:

   Environ. _____ degree _____ college courses _____ short courses _____ none

   Safety _____ degree _____ college courses _____ short courses _____ none

   IH _____ degree _____ college courses _____ short courses _____ none

5. How many people are employed at this location? _____

Appendix II. Graduates of the WKU Industrial Hygiene Program

Name	Company	Job Title	% IH	% Env	% Sfty
Garrett Addington 8/98	FERMCO Cincinnati, OH	Industrial Hygienist	90	0	10
Leigh Ann Barry	May 2000 Graduate				
Jami Bastin (West) 5/98	Scott R. Smith Env. Mgt. Louisville, KY	Environmental Scientist	10	80	10
Robert Birdsell 12/96	American Sunroof Corp. Bowling Green, KY	EHS Specialist	20	40	40
Kim Campbell (Leigh) 5/98	Nuclear Regulatory Comm Rockville, MD	Physical Scientist	0	80	20
Amada Corley (Bills) 5/97	Kentucky Middle School System	Teacher	0	0	0
Bryon Craig 12/95	United States Navy Bremerton, WA	Industrial Hygiene Officer	35	5	45
Randall Farris 12/97	Borg Warner Fuel Systems Grand Rapids, MI	Division EHS Coordinator	25	25	50
Jenny Guest 5/99	Environmental Consultant Louisville, KY				
Joe Hickey 8/99	Cook Sales, Inc. Carbondale, IL	EHS Manager	33	33	33
Shawn Jacob 5/2000	Metalco – College Grove Murfreesboro, TN	IH/Safety Manager	60	30	10
Dain Keown 5/97	KY Natural Resources Madisonville, KY	Environmental Inspector	0	100	0
Gabe Leigh 8/98	ManTech Corp. Rockville, MD	Industrial Hygienist	100	0	0
Trever Lindemier 5/97	Scott R. Smith Env. Mgt. Louisville, KY				
Marty Link 8/97	Kentucky Labor Cabinet Frankfort, KY	IH Consultant	90	0	10
David Minor 12/97	Yuasa Battery Manuf. Sumter, SC	IH/Safety	80	0	20
Mike Overton 5/99	United States Navy Burston, CA	Industrial Hygiene Officer	60	10	30
Mark Pendley 5/98	KY Natural Resources Bowling Green, KY	Environmental Inspector	10	85	5
Jeff Robinson 12/97	Unknown	Unknown			
Grady Russell 12/98	TruSeal Corbin, KY	Health and Safety Engineer	60	0	40
Tony Stewart 8/99	Motorola Energy Systems Atlanta, GA	EHS Manager	33	33	33
Shannon Tyndall 12/00	Cottrell, Inc. Gainesville, GA	EHS Engineer	20	40	40
Laura Wells 12/97	Western Kentucky Univ. Bowling Green, KY	Graduate Student in Chemistry			
Traci Whitaker 12/99	Univ. South Carolina Columbia, SC	Graduate Student in Industrial Hygiene			
Amy Wilkins 12/96	Unknown	Unknown			
Mary Wilson (Grant) 5/98	Virginia Dept. of Labor Richmond, VA	Compliance Safety and Health Officer	15	0	85

Appendix V

Bachelor of Science in Environmental, Health and Safety Curriculum Description

General Education – 46 hours

A. Organization and Communication of Ideas			
	I.	English Composition (ENG 100, ENG 300)	6 hrs
	II.	Foreign Language	3 hrs
	III.	Public Speaking (SCOM 145)	3 hrs
B. Humanities			
	I.	Literature (ENG 200)	3 hrs
	II.	Electives	6 hrs
C. Social and Behavioral Studies (ECON 202, HIST 119 or 120, PSY 100)			9 hrs
D. Natural Sciences - Mathematics			
	I.	Science (listed in major requirements)	6 hrs
	II.	Mathematics (listed in major requirements)	3 hrs
E. World Cultures and American Cultural Diversity			3 hrs.
F. Health and Wellness (PH 100)			3 hrs
University College (UC 101)			2 hrs
		Total:	**47 hrs**

Major Courses – 82 hours

Communication Skills		
SCOM 145	Fundamentals of Public Speaking	(3 hrs)*
ENG 307	Technical Writing	3 hrs
Basic Sciences and Mathematics		
BIOL 131	Anatomy and Physiology	4 hrs
BIOL 207	General Microbiology (or BIOL 120 Biological Concepts)	3 hr
BIOL 208	General Microbiology Lab (or BIOL 121 Biological Concepts Lab)	1 hr
CHEM 105	General Chemistry I	(3 hrs)*
CHEM 106	General Chemistry I Lab	1 hr
CHEM 107	General Chemistry II	(3 hrs)*
CHEM 108	General Chemistry II Lab	1 hr
MATH 116	College Algebra	(3 hrs)*
PHYS 231	Introduction to Physics & Biophysics I	3 hrs
PHYS 232	Introduction to Physics & Biophysics I Lab	1 hr
Environmental/Industrial Hygiene/Safety-Related		
BIOL 420	Introduction to Toxicology	3 hrs
PH 383	Biostatistics	3 hrs
PH 384	Introduction to Epidemiology	3 hrs
EHS 491	Internship in Environmental, Health, and Safety	3 hrs

Environmental Sciences		
ENV 360	Air Pollution Control	3 hrs
ENV 410	Water Treatment Processes	3 hrs
ENV 480	Hazardous and Solid Waste Management	3 hrs
Safety		
EHS 120	Introduction to Occupational Safety and Health	3 hrs
EHS 221	Safety and Health Standards, Codes, and Regulations	3 hrs
EHS 271	Emergency Care and Transportation	6 hrs
EHS 322	Physical Hazards Recognition and Control	3 hrs
EHS 331	Hazardous Materials Recognition and Control	3 hrs
EHS 420	Fire Prevention for the Environmental, Health, and Safety Professional	3 hrs
EHS 423	Safety Program Management	3 hrs
Industrial Hygiene		
EHS 321	Elements of Industrial Hygiene	3 hrs
EHS 440	Industrial Hygiene I	3 hrs
EHS 441	Industrial Hygiene I Lab	1 hr
EHS 442	Industrial Hygiene II	3 hrs
EHS 443	Industrial Hygiene II Lab	1 hr
EHS 471	Industrial Ventilation	3 hrs
EHS 485	Educational Experiences in Industrial Hygiene	3 hrs
	Total:	**82 hrs**

Grand Total Hours – 129

* Please note that these credit hours are counted under General Education. Grand total credit hours for the EHS major is 129.

DEPARTMENT OF HEALTH & HUMAN SERVICES

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 410463

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: The Industrial Hygiene Curriculum

Project Director: Dennis K. George, Ph.D., CIH
Department of Public Health
Western Kentucky University
Bowling Green, KY 42101

Grant No.: T02 CCT 410463

Project Period: 7/1/98 - 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.

John T. Talty, P.E., DEE

cc: S. Board/B. Kuchinski, OEP

Enclosure

fpr.wku