Core Competencies for the Practice of Industrial/Occupational Hygiene

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ACADEMY OF INDUSTRIAL HYGIENE

AIHA Protecting Worker Health

ABIH american board of industrial hygiene

ACGIH Defining the Science of Occupational and Environmental Health

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Definition of Industrial/Occupational Hygiene

The practice of employee health protection is called industrial hygiene in North America, and occupational hygiene throughout most of the rest of the world. For the purpose of this document, both terms are considered equivalent. Industrial hygiene is generally defined as the art and science dedicated to the anticipation, recognition, evaluation, communication, and control of environmental stressors in or arising from the workplace that may result in injury, illness, impairment, or affect the well-being of workers and members of the community. These stressors are divided into the categories biological, chemical, physical, ergonomic, and psychosocial.

The British Occupational Hygiene Society (BOHS) defines occupational hygiene as “the science behind minimising the risk of ill health due to the workplace” and occupational hygienists “use science and engineering to prevent ill health caused by the work environment - specialising in the assessment and control of risks to health from workplace exposure to hazards.” The International Occupational Hygiene Association (IOHA) refers to occupational hygiene as the discipline of anticipating, recognizing, evaluating, and controlling health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large. The term "occupational hygiene" (used in the U.K. and Commonwealth countries as well as much of Europe) is synonymous with industrial hygiene (used in the United States, Latin America, and other countries that received initial technical support or training from U.S. sources). The term "industrial hygiene" traditionally stems from the construction, mining, or manufacturing industries, and "occupational hygiene" refers to all types of industry, such as those listed for "industrial hygiene" as well as financial and support services industries and refers to "work," "workplace," and "place of work" in general. Environmental hygiene addresses similar issues but is likely to be about broad industry or broad issues affecting the local community, broader society, region, or country.

The profession of industrial hygiene uses strict and rigorous scientific methodology and often requires professional experience in determining the potential for hazard, exposures, or risk in the workplace, and environmental studies. This aspect of industrial hygiene is often referred to as the "art" of industrial hygiene and is used in a similar sense to the "art" of medicine. In fact "industrial hygiene" is both an aspect of preventive medicine, in that its goal is to prevent industrial disease, and risk management, risk assessment, and industrial safety, in that it also seeks "safe" systems, procedures, or methods to be applied in the workplace or to the environment.

Expertise Profile

Industrial hygiene is the science of preventing ill health from work activities. Its practitioners come from varied backgrounds. They can be chemists, engineers, biologists, physicists, doctors, nurses, and other professionals, all of whom have chosen to apply their skills to protecting the health of workers. Industrial hygiene is multidisciplinary, so its practitioners must acquire a broad and solid foundation of knowledge across all these disciplines and more. Common to all practitioners is a core of knowledge that can only be described as "industrial hygiene," a strategic approach to managing health hazards at work.

Employment Profile

The National Institute for Occupational Safety and Health (NIOSH) conducted an assessment of the future need for occupational safety and health professionals. The agency estimated that as of 2010, there were over 7300 employees with the primary occupation of industrial hygiene employed in the United States. Of these individuals, 41% had received a bachelor's degree, 51% a master's degree, 9% a doctorate, and 61% held a professional certification in industrial hygiene.

Respondents were asked to indicate whether they expected to hire professionals in each of the OS&H disciplines of interest over the next 5 years. The survey asked respondents to indicate how many professionals they expected to hire for each discipline (considering both new positions and positions to replace staff who leave).

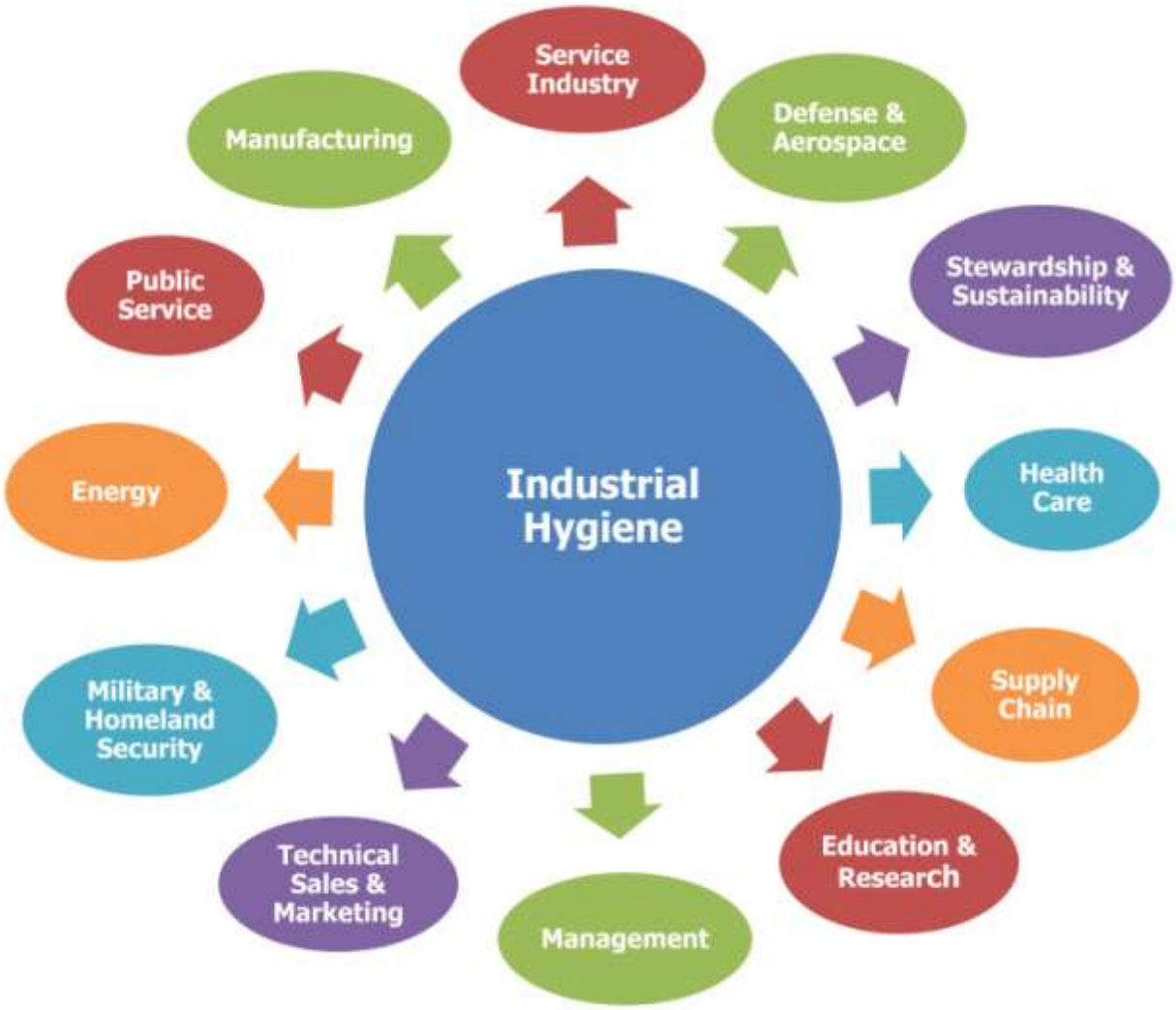
Employers reported that they expected to hire over 2300 industrial hygienists (95% confidence interval 801 to 3819). NIOSH, in 2011, stated that the estimates of future hiring of OS&H professionals are likely to be underestimates, for two (perhaps related) reasons. First, data collection for this survey took place during a time of significant uncertainty and relatively high unemployment in the U.S. economy. Second, predicting how many professionals (of any type) an establishment will need to hire over the next 5 years was a difficult task for many respondents. In fact, many respondents told NIOSH that they simply did not know if they expected to hire any OS&H professionals. Those employers who reported an expectation to hire within a given discipline often did not report a specific number of persons they expect to hire.

From an international perspective, the International Labour Organization (ILO) estimated that work-related accidents and illnesses take 2 million lives annually and cost the global economy an estimated US 1.25 trillion. The ILO also estimated that work-related illness and accidents cost up to 10% of Gross Domestic Product in Latin America and between 2.6% and 3.8% in the European Union. It is estimated that between 2% and 6% of cancers are work related, and approximately 20,000 cancer deaths and 40,000 new cases of cancer each year in the United States are attributable to occupation.

Good occupational hygiene benefits workers and industry alike, resulting in:

- Improved worker health and increased life expectancy
- Reduction in the number of people who have to leave employment early through injury or illness
- Lower social and health care costs as well as maximizing worker potential
- More efficient working processes with technological improvements and increased productivity.

Industrial hygienists are employed in a variety of different industries, for government agencies, in consulting practices, and within academic institutions.



Core Competencies Defined

Air Sampling and Instrumentational Analysis

Determine appropriate sampling strategy. Select and describe the advantages and disadvantages of using the various types of air sampling instruments and the collection of full-shift, task-based, and grab samples. Describe principles and application of laboratory analytical procedures and appropriate methods of detection for sample analyses (i.e., gas chromatography, spectrophotometry, atomic absorption spectrophotometry, etc.). Demonstrate knowledge of instrument calibration and quality assurance practices.

Basic Science

Know and apply scientific concepts from the fields of general chemistry, organic chemistry, biochemistry, analytical chemistry, biology, anatomy, physiology, physics, mathematics, and statistics. Describe physical properties of substances, such as reactivity, combustibility, and flammability. Perform calculations related to gas laws, airborne concentrations, units of measures and conversions, and pressure and temperature adjustments.

Biohazards

Identify biological agents such as viruses, bacteria, fungi, molds, allergens, toxins, recombinant products, bloodborne pathogens, and infectious diseases that are potentially harmful to humans and other biological organisms. Evaluate the potential exposures to biohazards and recommend controls to reduce or eliminate exposures.

Biostatistics and Epidemiology

Demonstrate knowledge of the principles and techniques used in epidemiology to study the distribution of occupationally induced diseases, physiological conditions, and factors in workplaces that influence their frequency. Interpret and evaluate prospective and retrospective studies, morbidity and mortality, and animal experimental studies using data and data distribution knowledge of statistical and non-statistical data.

Chemical Hazards

Apply scientific and technical aspects to natural, controlled, accidental, and intentional releases of chemical agents into occupational and non-occupational environments. Understand toxic characteristics of hazardous materials and wastes and the concepts of dose-response relationships. Specify approaches to prevent, control, and remediate chemical exposure.

Community Exposure

Describe general and technical topics related to ambient air quality, air cleaning technology, emission source sampling, atmospheric dispersion of pollutants, ambient air monitoring, and health and environmental effects of air pollution. Be familiar with peripheral disciplines such as emergency planning and response, water pollution, hazardous waste, and environmental fate and transport.

Engineering Controls/Ventilation

Recommend and apply local exhaust ventilation, dilution ventilation, isolation, and process change engineering principles to control chemical, biological, and physical exposures. Application of these principles requires knowledge of the mechanics of airflow, ventilation measurements, design, in-plant air circulation and recirculation, air cleaning technology, and related calculations.

Ergonomics

Identify, evaluate, and recommend controls to mitigate ergonomically stressful jobs using principles from anthropometry, human factors engineering, biomechanics, work physiology, human anatomy, occupational medicine, and facilities engineering for the purpose of preventing injuries and illnesses.

Health Risk Analysis and Hazard Communication

Demonstrate knowledge of the principles of health risk analysis: establish an exposure assessment strategy; collect basic characterization information (workplace, work force, and agents); assess exposures to the work force; prioritize health risks; implement monitoring and control strategies for unacceptable exposures; schedule and perform periodic reassessments as necessary; and document and communicate health risk exposures.

Ionizing Radiation

Apply knowledge of the physical characteristics and health and biological effects associated with exposure to alpha, beta, gamma, neutron, and x-radiation to recommend controls based on measurement and evaluation of exposure.

Management

Describe methods to acquire, allocate, and control resources to accomplish anticipation, recognition, evaluation and control of workplace hazards in an effective and efficient manner. Apply principles of cost-benefit analysis, auditing, investigation methods, data management and integration, establishment of policies, planning, delegation of authority, accountability, business acumen, risk communication, organizational structure and culture, and decision making.

Possess the ability to recognize system level properties that result from dynamic interactions among human and social systems and how they affect the relationships among individuals, groups, organizations, communities, and the environment. Follow a code of ethics.

Noise and Hearing Loss Prevention

Demonstrate knowledge of and apply principles of the physics of noise and vibration to conduct appropriate measurements to evaluate worker exposure, to identify situations with the potential to cause noise-induced hearing loss or vibration-related injury, and to recommend methods to eliminate or control excessive exposure. Demonstrate knowledge of the anatomy and physiology of the ear with respect to the development of impaired hearing. Evaluate audiograms and audiometric testing programs.

Non-Engineering Controls

Recommend and evaluate use of personal protective equipment to control exposures using the principles governing selection, use, care, and limitations of the equipment. Apply knowledge of respirator fit testing, breathing air specifications, material permeability, eye protection, dermal protection training, and the use of worker rotation as an administrative control.

Nonionizing Radiation

Apply knowledge of the physical characteristics, potential hazards, and health effects of exposure to electromagnetic fields, static electric and magnetic fields, lasers, radio frequencies, microwaves, ultraviolet, visible, infrared radiation, and illumination to recommend controls based on measurement and evaluation of exposure.

Thermal Stressors

Describe heat strain pathophysiology and hypo- and hyperthermic enviromarkers and biomarkers, recommend comprehensive heat strain prevention programs, and recognize special human risk factors for heat-related disorders and deaths. Demonstrate knowledge of medical/first aid care in case of emergency.

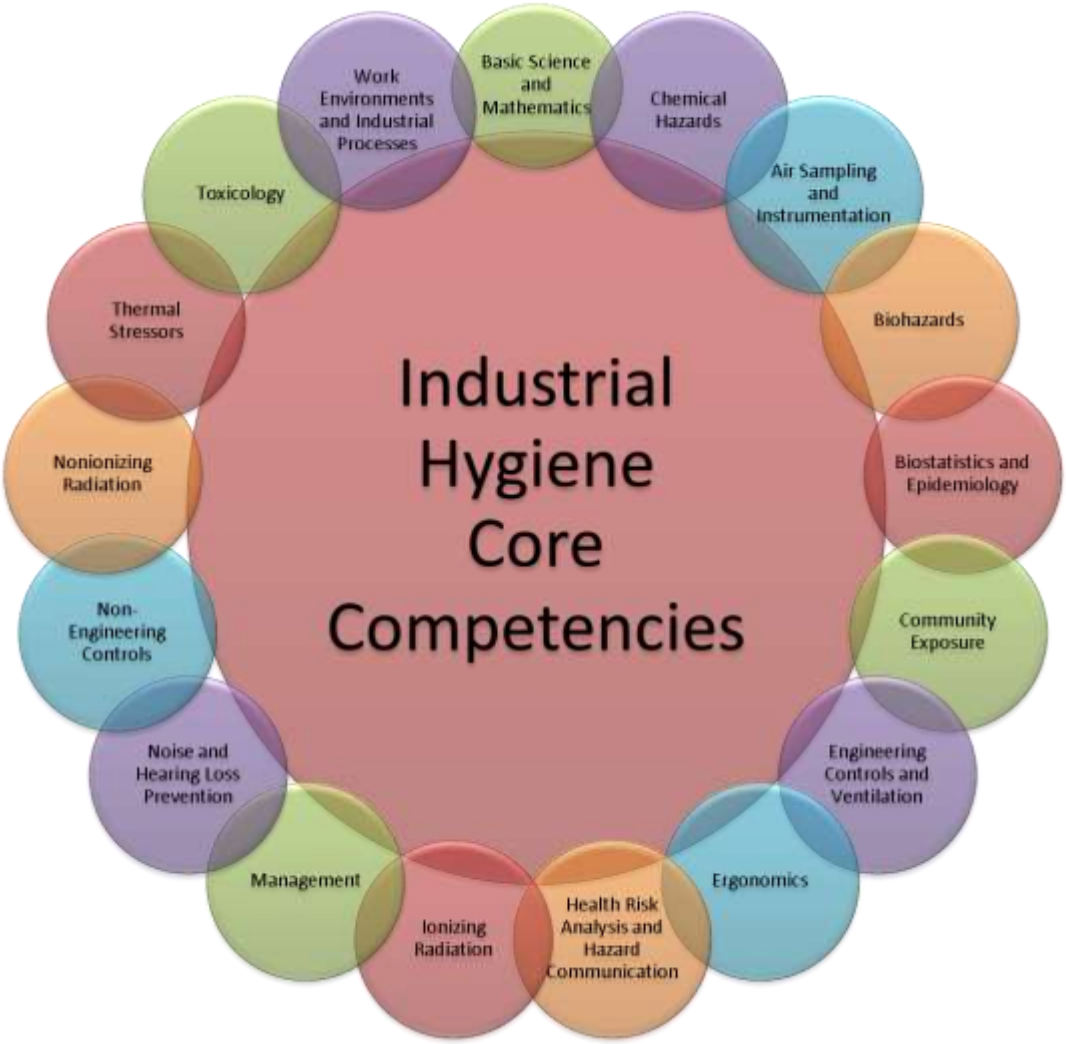
Toxicology

Demonstrate knowledge of the principles of toxicology, including symptomatology; pharmacokinetics; mode of action; additive, synergistic, and antagonistic effects; routes of entry; absorption; metabolism; excretion; target organs; toxicity testing protocols; aerosol deposition; clearance in the respiratory tract; carcinogenic, mutagenic, teratogenic, and reproductive hazards. Apply the toxicological principles to evaluating and predicting health effects from exposures to single contaminants, mixtures of contaminants, and natural and synthetic agents.

Work Environments and Industrial Processes

Anticipate, recognize, evaluate and control of workers' and others' exposures associated with specific industries and/or processes. Apply knowledge and skills to address hazards that can potentially cause related diseases and/or dysfunctions from exposures such as confined space entry, spray painting, welding, abrasive blasting, vapor degreasing, foundry operations, hazardous waste site remediation, and indoor environmental conditions.

Key Competencies Diagram



Key Definitions

Certificate: Given when a student passes an exam, or even completes a course. It certifies that something being stated in the certificate has been completed. Shorter duration in comparison to a diploma and not necessarily related to graduation requirements. It shows that the recipient has mastered a skill.

Diploma: A diploma is a document issued by an educational institution at the completion of a course,, which states that the recipient successfully completed the study. Diplomas also can confer an academic degree to the recipient; courses are usually longer in duration than certificate courses but shorter compared to a bachelor's degree. The document that certifies your course completion can be a certificate from the university or educational institution.

Associate Degree: An associate degree is conferred on completion of a college study and is typically a 2-year program. Associate degrees are conferred by community colleges and universities. One can transfer associate degree credits to a bachelor's degree. In some countries, a college diploma is equated with an associate degree.

Bachelor's Degree: Represents a higher level of education in comparison to a Diploma and Certificate. A bachelor's degree is awarded to a student on completion of a college or university education.

Technician: Is a job title given to persons who are trained to assist professionals and paraprofessionals with task-specific assignments. Technicians may collect air samples, operate direct-reading instruments, and provide other services based on specific training received and instructions received from professionals and paraprofessionals.

Paraprofessional: Is a job title given to persons in various occupational fields who are trained to assist professionals but are not themselves licensed or certified by an accreditation body recognized by the National Accreditation Recognition Committee of IOHA at a professional level. The Industrial Hygiene paraprofessional is able to perform tasks requiring significant knowledge and skill in the industrial hygiene field, such as conducting worker exposure monitoring and, in some cases, may even function independently of a professional industrial hygienist but may not be involved in the breadth of industrial hygiene practice nor have the level of responsibility of an professional industrial hygienist by examination. The Industrial Hygiene paraprofessional requires a certain level of education that can be obtained from an accredited university or equivalent. Additional training in specific skill sets that provide additional career paths to the industrial hygiene paraprofessional can also be obtained.

Professional: Is a job title given to persons who have obtained a bachelor's degree in hygiene, public health, safety, environmental sciences, biology, chemistry, physics, or engineering or who have a degree in another area that meets the standards set forth in the next section, Knowledge and Skill Sets of Occupational Hygiene Practitioners, and

has had 4 years of practice after graduation. Alternatively, this title is given to persons who have earned a Diploma of Professional Competence in Occupational Hygiene.

Knowledge and Skill Sets of Industrial Hygiene Practitioners

Technician

Knowledge:

Minimum of a high school diploma with basic knowledge of biology, mathematics, physics, and chemistry with specific training or receipt of a Certificate in specific area or areas of practice. Basic knowledge of hierarchy of controls, sampling techniques, properties of hazardous materials, and personal protective equipment.

Skills:

- Conduct basic Internet searches to obtain relevant data
- Follow sampling methods for chemical, noise, radiation, direct reading, etc.
- Perform instrument calibration
- Compare sampling results with applicable standards
- Use of data contained in safety data sheets
- Conduct respirator fit testing
- Demonstrate appropriate verbal and written communication skills
- Select appropriate personal protective equipment – clothing, glasses, escape respirators, etc.

Paraprofessional

Knowledge:

Bachelor's degree or higher in any related scientific field, or an associate degree in safety, health, or the environment with at least four courses (with 12 semester hours or 18 quarter hours) in industrial hygiene from an accredited university or equivalent (i.e., 160 certificate hours). Additional training in specific skill sets as required.

Skills:

- Conduct basic Internet searches to obtain relevant data
- Follow sampling methods for chemical, noise, radiation, direct reading, etc.
- Perform instrument calibration
- Compare sampling results with applicable standards
- Use data contained in safety data sheets
- Know and understand the rationale and application of the hierarchy of controls
- Demonstrate appropriate verbal and written communication skills

- Select appropriate personal protective equipment to prevent or reduce exposures.

Professional

Knowledge and Experience:

Graduation from a regionally accredited college or university with one of the following:

- A bachelor's degree in hygiene, public health, safety, environmental sciences, biology, chemistry, physics, or engineering, or
- Any other bachelor's degree program that contains at least 60 semester hours of creditable subjects, with at least 15 of those hours at the upper level (junior, senior, or graduate level) and at least four courses (with 12 semester hours or 18 quarter hours) in industrial hygiene. Creditable subjects are undergraduate or graduate level courses in science, mathematics, engineering, and science-based technology, and
- Four years of practice after graduation, or
- Receipt of the Diploma of Professional Competence in Occupational Hygiene.

Skills:

- Research information pertaining to the business or operation using appropriate tools and references (e.g., Internet resources, regulations, standards, and industry information to obtain general risk data)
- Evaluate business and operations data (e.g., monitoring and surveillance data, injury and illness data, incident reports, and safety and health programs) by comparing the data against internal history as well as national or industry standards in order to recognize and define risks
- Conduct surveys of the business or operation in accordance with accepted survey methodology (e.g., observing the facility, referring to process flow charts, verifying safety and health systems, programs and documentation, and interviewing employees and management) in order to recognize hazards and recommend controls
- Communicate the results of surveys to management with appropriate documentation to educate management about risks and to recommend and justify appropriate actions for managing current and potential loss scenarios
- Evaluate risks using established analytical techniques in order to prioritize corrective actions
- Select hazard control measures by reviewing available options and choosing the most appropriate in order to manage risk
- Communicate the identified hazard control measures (e.g., recommend engineering, administrative, and personal protective equipment controls) by identifying essential resources and implementation strategies in order to manage risk

- Design and implement controls as appropriate (e.g., organize committees; plan, conduct, or provide training; maintain records; collect data; collaborate with contractors; select equipment; and manage respirator, confined space entry, lock out/tag out, and other safety and health programs) in order to manage risk.

Professional by Examination

After receiving 4 years of professional experience, occupational hygienists should then demonstrate proficiency by examination administered by an organization that is recognized by the IOHA NAR Committee.

Professional and Ethical Responsibility

Industrial hygiene practitioners have the obligation to maintain high standards of integrity and professional conduct, accept responsibility for their actions, continually seek to enhance their professional capabilities, practice with fairness and honesty, and encourage others to act in a professional manner consistently.

They are obligated to follow appropriate health and safety procedures, in the course of performing professional duties, to protect clients, employers, employees, and the public from conditions where injury and damage are reasonably foreseeable. Deliver competent services with objective and independent professional judgment in decision making, and recognize the limitations of one's professional ability and provide services only when qualified.

Lifelong Learning

Industrial hygiene practitioners have an ethical duty to continually seek enhancement of their technical and professional capabilities for effective practice of exposure risk assessment and risk management. Capability building can include a multitude of methods, including formal and non-formal types of education, training, and experience. Individuals should be motivated to engage in lifelong learning in the key competencies ultimately needed for serving the public, employees, employers, clients, and the industrial hygiene profession.

Core Competency Breakdown by Practitioner Level

Air Sampling and Instrumental Analysis			
Core Competency	Technician	Paraprofessional	Professional
Determine appropriate sampling strategy.	Appropriately apply a sampling strategy for specified	Develop and determine appropriate	Design and evaluate sampling strategies for

	contaminants, settings, and conditions.	application of sampling strategy for limited compounds.	multiple contaminants or stressors.
Select and describe the advantages and disadvantages of using the various types of air sampling instruments and the collection of full-shift, task-based and grab samples.	Describe the appropriate air sampling instrument for full-shift, task-based, and grab samples.	Select the appropriate instrument to collect full-shift, task-based, and grab samples.	For a selected instrument, describe the advantages and disadvantages for its use in the collection of full-shift, task-based, and grab samples.
Describe principles and application of laboratory analytical procedures and appropriate methods of detection for sample analyses (i.e., gas chromatography, spectrophotometry, atomic absorption, spectrophotometry, atomic absorption spectrophotometry).	Recognize which laboratory analytical instrument and which method is required for applicable sample analysis.	Apply the specific knowledge about analytical techniques in choosing how to analyze for a specific contaminant.	Determine options for selection and use of different laboratory analytical procedures, instruments, and methods to provide a broad range of detection and measurement of target compounds.
Demonstrate knowledge of instrument calibration and quality assurance practices.	Conduct appropriate calibration of instruments appropriate for sampling strategy.	Conduct appropriate instrument calibration and interpret results in alignment with sample strategy.	Evaluate and modify instrument calibration in keeping with quality assurance practices for sampling validation.

Basic Science			
Core Competency	Technician	Paraprofessional	Professional
Know and apply scientific concepts from the fields of general chemistry, organic chemistry, biochemistry, analytical chemistry, biology, anatomy, physiology, physics, mathematics, and statistics.	Recognize basic concepts of chemistry, biology, anatomy, physiology, physics, mathematics, and statistics.	Explain key concepts and problem-solving processes in chemistry, biology, anatomy, physiology, physics, mathematics, and statistics.	Apply critical thinking and problem-solving skills in chemistry, biology, anatomy, physiology, physics, mathematics, and statistics.
Describe physical properties of substances, such as reactivity, combustibility, and flammability.	Understand the effects of these physical properties on potential human exposures.	Apply the specific principles about physical properties to evaluate and prevent exposures.	Interpret the various physical properties to determine options for exposure control for a variety of chemicals.
Perform calculations related to gas laws, airborne concentrations, units of measures and conversions, and pressure and temperature adjustments.	Recognize the relationship of pressure and temperature on potential exposure. Perform basic calculations.	Explain key concepts and apply problem-solving processes to convert units of measures and to make adjustments.	Interpret results from calculations to establish appropriate sampling strategies, storage conditions, etc.

Biohazards			
Core Competency	Technician	Paraprofessional	Professional
Identify biological agents such as viruses, bacteria, fungi, molds, allergens, toxins, recombinant products, bloodborne pathogens, and infectious diseases that are potentially harmful to humans and other biological organisms. Evaluate potential exposures and recommend appropriate controls.	Appropriately apply a sampling strategy for a specified contaminant.	Develop and determine appropriate application of sampling strategy for limited number of biohazards. Determine if controls are needed to reduce or prevent exposure.	Design and evaluate sampling strategies for multiple types of biohazards. Design and implement controls to reduce or prevent exposures.

Biostatistics and Epidemiology			
Core Competency	Technician	Paraprofessional	Professional
Demonstrate knowledge of the principles and techniques used in epidemiology to study the distribution of occupationally induced diseases and physiological conditions and factors in workplaces that influence their frequency.	(Intentionally left blank)	Understand relative risk and differences in relevance of cohort, case, and animal studies for the use of assessing risk.	Interpret relative risk and differences in relevance of cohort, case, and animal studies for the use of assessing risk. Using this information, identify studies that best identify exposure risk.
Interpret and evaluate prospective and retrospective studies, morbidity and mortality, and animal experimental studies using data and data distribution knowledge of statistical and non-statistical data.	(Intentionally left blank)	Select and review appropriate studies to understand health effects associated with exposure to a specific compound.	Interpret field studies, experimental studies, and morbidity and mortality studies to establish appropriate control measures and to assess risk to cohort.

Chemical Hazards			
Core Competency	Technician	Paraprofessional	Professional
Understand toxic characteristics of hazardous materials and wastes and the concepts of dose-response relationships.	Understand classes of chemical hazards by characteristics (i.e., toxic, flammable, reactive, and explosive).	Understand potential adverse interactions or effects.	Analyze complex interactions. Apply knowledge of effects of exposure, dose-response relationships, and disease potential.
Specify approaches to prevent, control, and remediate chemical exposure.	Understand the categories of basic exposure control methods.	Calculate/estimate and interpret potential exposures from exposure assessment measurements and potential methods to reduce exposures.	Design, develop, implement, and evaluate controls to reduce or prevent exposures.

Community Exposure			
Core Competency	Technician	Paraprofessional	Professional
Describe general and technical topics related to ambient air quality, air cleaning technology, emission source sampling, atmospheric dispersion of pollutants, ambient air monitoring, and health and environmental effects of air pollution.	Understand basic principles related to emission sampling and health effects of air pollution.	Understand potential adverse interactions or effects of emissions.	Design, develop, and implement emission source sampling and air monitoring programs. Implement controls to prevent community exposure.
Be familiar with peripheral disciplines such as emergency planning and response, water pollution, hazardous waste, and environmental fate and transport.	Understand emergency preparedness and response program.	Participate in planning and managing emergency response programs.	Design and implement emergency preparedness and response programs.

Engineering Controls and Ventilation			
Core Competency	Technician	Paraprofessional	Professional
Recommend and apply local exhaust ventilation, dilution ventilation, isolation, and process change engineering principles to control chemical, biological, and physical exposures.	Able to use proper test equipment to verify local exhaust equipment (such as hoods) complies with expected standards. Verify dilution ventilation equipment is functioning as designed.	Review design drawings and verify that dilution ventilation and local exhaust equipment meets the necessary exhaust rates in compliance with ASTM and other recognized standards.	Design local and dilution exhaust system to properly provide protection for biological, chemical, and physical exposure. Incorporate appropriate monitoring equipment for variable airflow system to ensure exposure levels are not exceeded.
Knowledge of the mechanics of airflow, ventilation measurements, design, in-plant air circulation and recirculation, air cleaning technology, and related calculations.	Identify the components of a ventilation system. Properly operate and read test instruments and report results.	Interpret airflow and ventilation measurements and compare to accepted standards. Inspect ventilation system components to identify causes of deviations from standards.	Design and supervise installation of necessary and appropriate ventilation equipment, including air cleaning components for dilution and local exhaust systems. Provide necessary design components for air quality consideration, including temperature, humidity, and adequate make-up air.

Ergonomics			
Core Competency	Technician	Paraprofessional	Professional

Identify, evaluate, and recommend controls to mitigate ergonomically stressful jobs using principles from anthropometry, human factors engineering, biomechanics, work physiology, human anatomy, occupational medicine, and facilities engineering for the purpose of preventing injuries and illnesses.	Recognize ergonomic risk factors such that one can identify ergonomically stressful jobs and potential controls to reduce ergonomic risk factors.	Apply specific principals of anthropometry, human factors engineering, biomechanics, work physiology, human anatomy, occupational medicine, and facilities engineering to analyze ergonomically stressful jobs.	Evaluate and recommend the most effective controls to mitigate ergonomically stressful jobs.

Health Risk Analysis and Hazard Communication			
Core Competency	Technician	Paraprofessional	Professional
Demonstrate knowledge of the principles of health risk analysis.	Understand the principles of health risk analysis and application of a sampling strategy for relevant information gathering. Identify health hazards at the workplace.	Evaluate the degree of exposures to workplace health hazards and evaluate the adequacy of existing control measures.	Participate in overall risk analysis and management of a health hazard, process or workplace, and contribute to the establishment of priorities for risk management (i.e., recommending further appropriate control measures to prevent or reduce risk, implementing monitoring and control strategies for unacceptable exposures, and communicating health risk exposures to workers).

Ionizing Radiation			
Core Competency	Technician	Paraprofessional	Professional
Apply knowledge of the physical characteristics and the health and biological effects associated with exposure to alpha, beta, gamma, neutron, and x-radiation to recommend controls based on measurement and evaluation of exposure.	List major health effects associated with exposure to different forms of ionizing radiation. Understand the categories of basic radiation exposure control methods. Use proper instrumentation to collect exposure measurements.	Calculate/estimate and interpret potential exposures from field measurements. Identify radiation sources and potential methods to reduce exposures.	Design, develop, implement, and evaluate controls to reduce or prevent exposures.

Management			
Core Competency	Technician	Paraprofessional	Professional
Describe methods to acquire, allocate, and control resources to accomplish anticipation, recognition, evaluation and control of workplace hazards in an effective and efficient manner.	Appropriately schedule monitoring and other tasks. Manage others' time. Solicit information and feedback to make adjustments.	Develop and determine appropriate application of occupational hygiene programs.	Design strategies to acquire, allocate, and manage resources for assessment and control programs.
Apply principles of cost-benefit analysis, auditing, investigation methods, data management and integration, establishment of policies, planning, delegation of authority, accountability, business acumen, risk communication, organizational structure and culture, and decision making.	Conduct work site assessments, evaluate results against standards, communicate sampling results, and determine further steps.	Select and apply appropriate tools to assess workplace hazards. Analyze results and make recommendations for improvement.	Evaluate effectiveness of occupational hygiene program, communicate results to management, and establish polices and procedures.
Possess the ability to recognize system-level properties that result from dynamic interactions among human and social systems and how they affect the relationships among individuals, groups, organizations, communities, and	Recognize the basic interaction between similar exposure groups and multiple types of exposures.	Apply the specific principles of systemic interactions to improve occupational hygiene programs.	Design, develop, and interpret the testing of hypotheses to assess the effects of various interactions for program improvement.

the environment.			
Follow a code of ethics.	Follow work assignments, honestly communicate results and concerns, and understand limitations.	Recognize limitations of scope of practice.	Follow ethics code of the NAR-recognized certification board in country of practice.

Noise and Hearing Loss Prevention			
Core Competency	Technician	Paraprofessional	Professional
Demonstrate knowledge of and apply principles of the physics of noise and vibration to conduct appropriate measurements to evaluate worker exposure.	Know how to calibrate and use equipment to determine worker noise exposure.	Develop and determine appropriate sampling strategy for assessing worker exposure to noise.	Interpret results of worker noise exposure with respect to compliance with standards and potential for hearing loss.
Identify situations with the potential to cause noise-induced hearing loss or vibration-related injury, and recommend methods to eliminate or control excessive exposure.	Recognize situations where workers are at risk of excessive noise exposure.	Select the appropriate instrument and method to collect valid samples of noise exposure to use as the basis of control.	Develop and implement strategy to ensure valid information is obtained to design and recommend measures to eliminate worker exposure to excessive noise.
Demonstrate knowledge of the anatomy and physiology of the ear with respect to the development of impaired hearing.	Explain the mechanics of incurring hearing loss.	Describe the relationship between the physics of noise and its consequences with respect to the auditory system.	Recommend and ensure implementation of specific controls and hearing loss prevention measures to protect workers from noise.
Evaluate audiograms and audiometric testing programs.	Interpret an audiogram.	Determine that audiometric testing procedures and an audiometric testing program are valid and appropriate.	Recommend when audiometric testing and/or an audiometric testing program are warranted, and evaluate effectiveness in preventing hearing loss.

Non-Engineering Controls			
Core Competency	Technician	Paraprofessional	Professional
Recommend and evaluate use of personal protective equipment to control exposures using the principles governing selection, use, care, and limitations of the equipment.	Identify user concerns about protective clothing and dermal protection.	Conduct personal protective equipment hazard assessments. Recognize the interaction between the worker, task, and materials when selecting PPE.	Establish a dermal exposure/personal protective equipment management program.
Apply knowledge of respirator fit testing and breathing air specifications.	Conduct and document respirator fit tests. Collect breathing air samples following established protocols.	Interpret fit test and breathing air results.	Evaluate fit test and breathing air quality testing requirements. Develop appropriate test systems and protocols.
Apply knowledge of material permeability, eye protection, and dermal protection training.	Recognize limitations of PPE to provide worker protection.	Describe the limitations of protective equipment devices and materials, and conduct training.	Define and conduct PPE training objectives and content. Troubleshoot PPE failures.
Analyze the use of worker rotation as an administrative control.	Implement established worker rotation practices.	Describe regulatory constraints on use of worker rotation.	Evaluate the use and limitations of worker rotation as an exposure control method.

Nonionizing Radiation			
Core Competency	Technician	Paraprofessional	Professional
Apply knowledge of the physical characteristics, potential hazards, and health effects of exposure to electromagnetic fields, static electric and magnetic fields, lasers, radio frequencies, microwaves, ultraviolet, visible, and infrared radiation and illumination to recommend controls based on measurement and evaluation of exposure.	Understand the health effects associated with exposure to different forms of nonionizing radiation. Understand the categories of basic radiation exposure control methods. Use proper instrumentation to collect exposure measurements.	Calculate/estimate potential exposures from field measurements. Identify radiation sources and potential methods to reduce exposures.	Design, develop, implement, and evaluate controls to reduce or prevent exposures.

Thermal Stressors			
Core Competency	Technician	Paraprofessional	Professional
Describe heat strain pathophysiology and hypo- and hyperthermic enviromarkers and biomarkers, recommend comprehensive heat strain prevention programs, and recognize special human risk factors for heat-related disorders and deaths.	Understand the risk factors associated with the development of a thermal stress illness.	Evaluate the workplace to identify risk factors associated with the development of heat-related disorders.	Develop and implement comprehensive heat strain prevention programs.
Demonstrate knowledge of medical/first aid care in case of emergency.	Identify and differentiate symptoms associated with various thermal-related disorders. Apply appropriate first aid treatments.	Develop training programs to increase worker awareness. Prepare appropriate emergency procedures.	Evaluate work environments to predict the likelihood of workers developing a thermal stress-related illness. Evaluate, revise, and implement thermal stress programs and training. Develop and implement preventive controls.

Toxicology			
Core Competency	Technician	Paraprofessional	Professional
Demonstrate knowledge of the principles of toxicology, including symptomatology; pharmacokinetics; mode of action; additive, synergistic and antagonistic effects; routes of entry; absorption; metabolism; excretion; target organs; toxicity testing protocols; aerosol deposition and clearance in the respiratory tract; and carcinogenic, mutagenic, teratogenic, and reproductive hazards.	Recognize the primary acute and chronic effects of specific materials based on information provided on Safety Data Sheets.	Interpret toxicological information provided on Safety Data Sheets and other standard sources. Convey effects to workers in an organized manner that workers can understand and apply to protect themselves.	Review and apply scientific literature to develop proper toxicological information to be used on Safety Data Sheets and to develop worker hazard training programs.
Apply the toxicological principles to evaluate and predict health effects from exposures to single contaminants, mixtures of contaminants, and natural and synthetic agents.	Interpret labels and Safety Data Sheets and communicate the hazards to workers using the Global Harmonized System (GHS) of classifying and labeling of chemicals.	Explain each of the components of the GHS. Apply the definitions to chemicals found in the workplace.	Categorize a new chemical using the GHS based on collected data or data available in the scientific literature. Review exposure data of employees to evaluate potential adverse effects and recognize when employees may be exhibiting effects from exposure.

Work Environments and Industrial Processes			
Core Competency	Technician	Paraprofessional	Professional
Anticipate, recognize, evaluate and control of workers' and others' exposures associated with specific industries and/or processes.	Recognize and understand that in different work environments and industrial processes, the health and well-being of workers have the potential of being affected by the occurrence (real or potential) of chemical, physical, and biological agents and other stresses, and their interactions with other factors.	Apply principles and practices to address hazards that can potentially cause related diseases and/or dysfunctions from exposures to specific industrial processes (e.g., confined space entry, spray painting, welding, abrasive blasting) and work environments (e.g., foundry operations, hazardous waste site remediation, and indoor environmental conditions).	Work effectively on a multidisciplinary team to investigate or evaluate work processes and methods from the point of view of the possible generation and release/propagation of potentially harmful agents and other factors, with the aim of eliminating exposures or reducing them to acceptable levels.

Appendix

Comparison of Core Competencies with Accrediting Bodies and Other Providers

Higher education programs may be accredited by external organizations such as ABET and CEPH. Other training may be obtained from certificate programs such as OH Learning. This section compares the list of core competencies for the practice of occupational hygiene with these three organizations. If the program includes specific training in a core competency area, the word Yes is written in that column under the name of the external organization.

Required Knowledge Area	ABET	CEPH	OHL
Air Sampling and Instrumentational Analysis Determine appropriate sampling strategy. Select and describe the advantages and disadvantages of using the various types of air sampling instruments and the collection of full-shift, task-based, and grab samples. Describe principles and application of laboratory analytical procedures and appropriate methods of detection for sample analyses (e.g., gas chromatography, spectrophotometry, atomic absorption spectrophotometry). Demonstrate knowledge of instrument calibration and quality assurance practices.	Yes	Yes	Yes
Basic Science Know and apply scientific concepts from the fields of general chemistry, organic chemistry, biochemistry, analytical chemistry, biology, anatomy, physiology, physics, mathematics, and statistics. Describe physical properties of substances, such as reactivity, combustibility, and flammability. Perform calculations related to gas laws, airborne concentrations, units of measures and conversions, and pressure and temperature adjustments.	Yes	Yes	
Biohazards Identify biological agents such as viruses, bacteria, fungi, molds, allergens, toxins, recombinant products, bloodborne pathogens, and infectious diseases that are potentially harmful to humans and other biological organisms.	Yes		

Required Knowledge Area	ABET	CEPH	OHL
Biostatistics and Epidemiology Demonstrate knowledge of the principles and techniques used in epidemiology to study the distribution of occupationally induced diseases and physiological conditions and factors in workplaces that influence their frequency. Interpret and evaluate prospective and retrospective studies, morbidity and mortality, and animal experimental studies using data and data distribution knowledge of statistical and non-statistical data.	Yes	Yes	
Chemical Hazards Apply scientific and technical aspects to natural, controlled, accidental, and intentional releases of chemical agents into occupational and non-occupational environments. Understand toxic characteristics of hazardous materials and wastes and the concepts of dose-response relationships. Specify approaches to prevent, control, and remediate chemical exposure.	Yes	Yes	Yes
Community Exposure Describe general and technical topics related to ambient air quality, air cleaning technology, emission source sampling, atmospheric dispersion of pollutants, ambient air monitoring, and health and environmental effects of air pollution. Be familiar with peripheral disciplines such as emergency planning and response, water pollution, hazardous waste, and environmental fate and transport.		Yes	
Hygiene Controls/Ventilation Recommend and apply local exhaust ventilation, dilution ventilation, isolation, and process change engineering principles to control chemical, biological, and physical exposures. Application of these principles requires knowledge of the mechanics of airflow, ventilation measurements, design, in-plant air circulation and recirculation, air cleaning technology, and related calculations.	Yes	Yes	Yes
Ergonomics Identify, evaluate, and recommend controls to mitigate ergonomically stressful jobs using principles from anthropometry, human factors engineering, biomechanics, work physiology, human anatomy, occupational medicine, and facilities engineering for the purpose of preventing injuries and illnesses.	Yes		Yes

Required Knowledge Area	ABET	CEPH	OHL
Health Risk Analysis and Hazard Communication Demonstrate knowledge of the principles of health risk analysis: establish an exposure assessment strategy; collect basic characterization information (workplace, work force, and agents); assess exposures to the work force; prioritize health risks; implement monitoring and control strategies for unacceptable exposures; schedule and perform periodic reassessments as necessary; document and communicate health risk exposures.	Yes	Yes	Yes
Management Describe methods to acquire, allocate, and control resources to accomplish anticipation, recognition, evaluation and control of workplace hazards in an effective and efficient manner. Apply principles of cost-benefit analysis, auditing, investigation methods, data management and integration, establishment of policies, planning, delegation of authority, accountability, business acumen, risk communication, organizational structure and culture, and decision making. Possess the ability to recognize system level properties that result from dynamic interactions among human and social systems and how they affect the relationships among individuals, groups, organizations, communities, and the environment. Follow a Code of Ethics.	Yes		
Noise and Hearing Loss Prevention Demonstrate knowledge of and apply principles of the physics of noise and vibration to conduct appropriate measurements to evaluate worker exposure to identify situations with the potential to cause noise-induced hearing loss or vibration-related injury, and to recommend methods to eliminate or control excessive exposure. Demonstrate knowledge of the anatomy and physiology of the ear with respect to the development of impaired hearing. Evaluate audiograms and audiometric testing programs.	Yes		Yes
Non-Engineering Controls Recommend and evaluate use of personal protective equipment to control exposures using the principles governing selection, use, care, and limitations of the equipment. Apply knowledge of respirator fit testing, breathing air specifications, material permeability, eye protection, dermal protection, training, and the use of worker rotation as an administrative control.	Yes		

Required Knowledge Area	ABET	CEPH	OHL
Nonionizing Radiation Apply knowledge of the physical characteristics, potential hazards, and health effects of exposure to electromagnetic fields, static electric and magnetic fields, lasers, radio frequencies, microwaves, ultraviolet, visible, and infrared radiation and illumination to recommend controls based on measurement and evaluation of exposure.	Yes		
Thermal Stressors Describe heat strain pathophysiology and hypo- and hyperthermic enviromarkers and biomarkers, recommend comprehensive heat strain prevention programs, and recognize special human risk factors for heat-related disorders and deaths. Demonstrate knowledge of medical/first aid care in case of emergency.	Yes		Yes
Toxicology Demonstrate knowledge of the principles of toxicology, including symptomatology; pharmacokinetics; mode of action; additive, synergistic and antagonistic effects; routes of entry; absorption; metabolism; excretion; target organs; toxicity testing protocols; aerosol deposition; clearance in the respiratory tract; and carcinogenic, mutagenic, teratogenic, and reproductive hazards. Apply the toxicological principles to evaluating and predicting health effects from exposures to single contaminants, mixtures of contaminants, and natural and synthetic agents.	Yes		
Work Environments and Industrial Processes Anticipate, recognize, evaluate and control of workers' and others' exposures associated with specific industries and/or processes. Apply knowledge and skills to address hazards that can potentially cause related diseases and/or dysfunctions from exposures such as confined space entry, spray painting, welding, abrasive blasting, vapor degreasing, foundry operations, hazardous waste site remediation, and indoor environmental conditions	Yes		

ABET

ABET, Inc., is the recognized accreditor for college and university programs in applied science, computing, engineering, and technology. Among the most respected accreditation organizations in the United States, ABET has provided leadership and quality assurance in higher education for over 75 years. ABET accredits over 3100 programs at more than 600 colleges and universities worldwide.

The program must demonstrate that graduates have necessary knowledge, skills, and attitudes to competently and ethically implement and practice applicable scientific, technical, and regulatory aspects of Industrial Hygiene. To this end, graduates will be prepared to anticipate, recognize, evaluate, and control exposures of workers and others to physical, chemical, biological, ergonomic, and psychosocial factors, agents, and/or stressors that can potentially cause related diseases and/or dysfunctions. More specifically, graduates must be able to:

(a) identify agents, factors, and stressors generated by and/or associated with defined sources, unit operations, and/or processes;

(b) describe qualitative and quantitative aspects of generation of agents, factors, and stressors;

(c) understand physiological and/or toxicological interactions of physical, chemical, biological, and ergonomic agents, factors, and/or stressors with the human body;

(d) assess qualitative and quantitative aspects of exposure assessment, dose-response, and risk characterization based on applicable pathways and modes of entry;

(e) calculate, interpret, and apply statistical and epidemiological data;

(f) recommend and evaluate engineering, administrative, and personal protective equipment controls and/or other interventions to reduce or eliminate hazards;

(g) demonstrate an understanding of applicable business and managerial practices;

(h) interpret and apply applicable occupational and environmental regulations;

(i) understand fundamental aspects of safety and environmental health;

(j) attain recognized professional certification.

CEPH

The Council on Education for Public Health (CEPH) is an independent agency recognized by the U.S. Department of Education to accredit schools of public health and public health programs offered in settings other than schools of public health. These schools and programs prepare students for entry into careers in public health. The primary professional degree is the Master of Public Health (MPH), but other master's and doctoral degrees are offered.

The areas of knowledge basic to public health include the following:

- Biostatistics – collection, storage, retrieval, analysis, and interpretation of health data; design and analysis of health-related surveys and experiments; and concepts and practice of statistical data analysis
- Epidemiology – distribution and determinants of disease, disabilities, and death in human populations; the characteristics and dynamics of human populations; the natural history of disease; and the biologic basis of health
- Environmental health sciences – environmental factors, including biological, physical, and chemical factors that affect the health of a community
- Health services administration – planning, organization, administration, management, evaluation, and policy analysis of health and public health programs
- Social and behavioral sciences – concepts and methods of social and behavioral sciences relevant to the identification and solution of public health problems

OH Learning

The Occupational Health Training Association (OHTA) was formed to promote better standards of occupational hygiene practice throughout the world. OHTA develops training material that it makes freely available for use by students and training providers. OHTA also promotes an international qualifications framework so that all hygienists are trained to a consistent, high standard recognized in all participating countries.

The OHTA developed an international qualifications scheme that allows individuals to study occupational hygiene at the level that suits them, with qualifications that are recognized in many countries. Its training programs have been widely reviewed by professional hygienists and tutors to ensure high quality and consistency.

The scheme recognizes the following three levels of qualification:

1. Foundation level for those who have studied the basic principles of occupational hygiene, an Award of Successful Course Completion. The Foundation level provides core knowledge to develop a career in occupational hygiene.
2. Intermediate level for those who have studied the technical knowledge and practical skills needed to undertake occupational hygiene in the workplace, the International Certificate in Occupational Hygiene (ICertOH). The certificate demonstrates technical knowledge and practical skills in identifying health hazards, assessing occupational exposure, and testing control measures. It is suitable for technicians and technologists who carry out measurements and testing in workplaces. The qualification has been designed so that it can be recognized by national associations as contributing to their own requirements for accreditation.
3. Advanced level for those who achieve the levels of knowledge and skill expected of a professional hygienist. This normally requires academic qualifications that may be the basis for obtaining recognized professional qualifications as an occupational hygienist. Professional qualifications are generally issued by

national associations. Requirements vary from country to country, but the International Occupational Hygiene Association has developed a National Accreditation Recognition program. Participating countries recognize each other's professional qualifications.

The Foundation and Intermediate levels use a formative approach to learning that makes assessment an integral part of the learning process. At the Advanced level, assessment may be part of the academic process for a postgraduate degree or diploma. The scheme can thus serve the needs of students from early technician training through to professional development. It encourages a process of "spiral learning," where materials are studied to progressively higher levels.

It is important to note that the international qualifications cover the core science and practice of occupational hygiene but does not the details of local legislation or local custom and practice. Hence, national associations may impose additional requirements before recognizing hygienists with international qualifications to practice in their country.