



## National Fire Academy

**N0247 – Advanced Life Support Response to Hazardous Materials Incidents  
Version: 4th Edition, 2nd Printing, June 2018**

**Quarter:**

**ACE Credit: In the upper division baccalaureate degree category, four semester hours in fire science, fire management or emergency management.**

**IACET Continuing Education Units: 6.6**

**Length of Course: 10 Days (65 hr., 10 min. contact hours, Monday - Friday)**

**Prerequisite: Yes**

**Curriculum: Hazardous Materials**

**Training Specialist: Wayne Yoder**

**Instructor:**

**Instructor email/phone:**

**Classroom: J-**

**Meeting Time: 8 AM – 5 PM**

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### Course Description (Catalog)

R0247 – “Advanced Life Support Response to Hazardous Materials Incidents.” This 10-day course is designed for paramedic personnel who have an advanced life support (ALS) emergency medical responsibility at hazardous materials incidents, and it promises a rigorous experience for the student. In-depth chemistry, as it relates to hazardous materials, the medical management of victims, and the development and management of the hazardous materials components of the medical support system are the three primary focuses of this course. Toxicology

and decontamination procedures are covered from an advanced EMS viewpoint. Strategies for safe emergency medical interaction with contaminated victims are discussed in detail.

## **Student Qualifications (Primary and Secondary Audience)**

ALS emergency medical personnel who, as a part of their normal duties, may be needed to perform patient care in the warm zone at hazardous materials incidents or patient care of individuals or groups exposed or contaminated with hazardous materials or weaponized chemical agents. (These may include paramedics, physician assistants, medical doctors or registered nurses.)

## **Course Scope (Goal)**

This 10-day course is designed for paramedic personnel who have an advanced life support (ALS) emergency medical responsibility at hazardous materials incidents, and it promises a rigorous experience for the student. In-depth chemistry, as it relates to hazardous materials, the medical management of victims, and the development and management of the hazardous materials components of the medical support system are the three primary focuses of this course. Toxicology and decontamination procedures are covered from an advanced Emergency Medical Services (EMS) viewpoint. Strategies for safe emergency medical interaction with contaminated victims are discussed in detail.

## **Course Objectives (Course Learning Outcomes – TLOs)**

After successfully completing this course, you will be able to accomplish the following:

- Explain the course and their role in Advanced Life Support Response to Hazardous Materials Incidents.
- Summarize the roles of the health care provider in a xenobiotic exposure.
- Interpret a periodic table to identify atoms, types of elements, atomic weights and atomic numbers of elements.
- Compare salts and inorganic nonsalts, their names and hazards.
- Given a name, structure or formula, identify organic compounds and their hazards.
- Describe the fundamental biochemical reactions.
- Interpret the concepts of basic cellular physiology, energy production, and the manufacture of biomolecules.
- Evaluate the effects of hazardous materials on the blood and blood components.
- Evaluate effects of hazardous materials on the nervous systems.
- Evaluate the effects of hazardous materials on the respiratory system.
- Evaluate the effects of hazardous materials on the cardiovascular system.
- Evaluate effects of hazardous materials on the digestive system.
- Evaluate effects of hazardous materials on the hepatic and renal systems.
- Evaluate the effects of hazardous materials on the skin.
- Given a category of pesticides, identify the potential target organs and predict the effects on the human body system.
- Given a category of selected hazardous materials, identify the potential target organs and predict the effects on the human body system.

- Given a category of xenobiotics, identify the potential target organs and predict the effects on the human body system.
- Given a scenario, analyze the toxicological event presented in the scenario and develop an appropriate Initial Care Plan.
- Identify the potential acute or chronic medical sequelae that may result from single or recurring occupational exposures to hazardous materials.

### **Course Delivery Method**

The National Fire Academy (NFA) offers specialized training courses and advanced management programs of national impact in an academic classroom environment [on campus at the National Emergency Training Center \(NETC\) in Emmitsburg, Maryland](#) and through their State, local, tribal, and US territories training partners. All course materials are designed for interactive classroom environments, in either paper notebook or electronic formats.

## Course Schedule

The purpose of the course schedule is to give you, at a glance, the required preparation, activities, and evaluation components of your course.

| <b>DAY 1</b>   | <b>DAY 2</b>   |
|--|--|
| Unit 1: Introduction<br>Activity 1.1: Student Introductions<br>Unit 2: Standard of Care<br>Activity 2.1: Define the Standard of Care | Unit 3: Basics of Chemistry<br>Unit 4: Inorganic Chemistry                 |
| <i>Lunch</i>   | <i>Lunch</i>   |
| Unit 2: Standard of Care (cont'd)<br>Activity 2.2: Altered Standard of Care  | Unit 5: Organic Chemistry<br>Activity 5.1: Hydrocarbon Derivative Research |

| <b>DAY 3</b>                            | <b>DAY 4</b>   |
|---|--|
| Unit 6: Biochemistry                    | Unit 8: Blood and Blood Components<br>Activity 8.1: Patient Scenario Carbon Monoxide<br>Unit 9: The Nervous System |
| <i>Lunch</i>                            | <i>Lunch</i>   |
| Unit 7: Cellular Anatomy and Physiology | Unit 10: The Respiratory System  |

| DAY 5  | DAY 6   |
|--|---|
| Unit 10: The Respiratory System (cont'd)<br>Activity 10.1: Inhalation Injury (Knock-Down Syndrome)<br>Unit 11: The Cardiovascular System | Unit 13: Biotransformation and Elimination<br>Unit 14: The Skin |
| <i>Lunch</i>   | <i>Lunch</i>  |
| Unit 12: The Digestive System<br>Midterm Exam  | Unit 15: Pesticides   |

| <b>DAY 7</b>  | <b>DAY 8</b>  |
|---|---|
| Unit 15: Pesticides (cont'd)<br>Activity 15.1: Patient Scenario Organophosphate Exposure<br>Unit 16: Industrial Chemicals | Unit 17: Drugs (cont'd)<br>Activity 17.1: Excited Delirium<br>Final Exam Review   |
| <i>Lunch</i>  | <i>Lunch</i>  |
| Unit 16: Industrial Chemicals (cont'd)<br>Activity 16.1: Patient Scenario Chlorine<br>Unit 17: Drugs                      | Unit 18: Initial Patient Care Plan Activity<br>Activity 18.1: Initial Patient Care Plan and Final Exam<br><b>Final Written Exam</b> |

| <b>DAY 9</b>  | <b>DAY 10</b> |
|---|---------------|
| Unit 18: Initial Patient Care Plan (cont'd)<br>Activity 18.1: Initial Patient Care Plan (cont'd)<br>Unit 19: Chronic Sequelae | Graduation    |
| <i>Lunch</i>  | <i>Lunch</i>  |
| Course Wrap-Up  |               |

### **Course Resources (Instructional Materials)**

In order to be fully prepared, obtain a copy of the required textbooks and other instructional materials prior to the first day of class.

### **Required Readings**

The student must complete required readings during the course to be able to thoughtfully participate in discussions and activities.

“Altered Standard of Care in Mass Casualty Incidents.”

“Review of Chemistry and Toxicology.”

Both of these are part of the pre-course assignment.

### **Suggested Reading/Resources**

Suggested readings and resources are not evaluated, but may enhance the student’s understanding, serve as additional sources for citation and promote discussion of course material.

NIOSH Pocket Guide to Chemical Hazards (NIOSH Guide)

The Condensed Chemical Dictionary

### **Required Resources (Course Textbook)**

Student Manual.

## Supplemental Resources (Supplemental Course Textbook)

None.

## Grading Methodology (Evaluation Procedures)

| Graded Items       | Percentage of Final Grade |
|--------------------|---------------------------|
| Midterm Exam       | 30 percent                |
| Final Exam         | 30 percent                |
| Practical exercise | 10 percent                |
| Patient Care Plan  | 30 percent                |
| <b>Total</b>       | 100 percent               |

### EXAMINATION ADMINISTRATION PROCEDURES

Students will be given exams at the end of the class, and only the instructor will grade the exams. While the exams are being graded by the instructor, students will be asked to complete end-of-course evaluations.

Exams are to be completed individually and not as a group or a group activity, unless specifically directed within the instructor guide for the specific course. Students should use pencils to complete answer sheets if bubble sheets and a scoring key overlay are being used.

There should only be one answer for any given question marked by the student. A question with multiple answers is considered incorrect. Please mark number of incorrect answers on completed exam sheets, record score (percentage), and mark the appropriate letter grade.

Transfer the letter grades to the corresponding student name on the course roster.

If a student does not obtain a passing grade on the first attempt, the instructor will provide remediation<sup>1</sup> prior to a retest. Students who do not pass the first exam will be allowed to take one retest of a new exam before departing from the class. A second failure will result in a grade of "F" being recorded on the grade roster.

Once all exams have been graded, instructors should review the exam as a group.

In the event of unusual events (storm, fire response, family emergency) or early departure, the host agency or state representative may be asked to proctor the exam at a later date. The instructor is responsible to notify the Training Specialist as soon as practical of the situation and name of person responsible for the exams and testing process.

## **Required Reading Assignments**

Student completion of reading assignments will be done via evaluation of their class participation and will not be a separately graded activity.

## **Suggested Readings**

Suggested readings are not evaluated, but may enhance the student's understanding and promote discussion of course material.

## **Course Outline**

### **Unit 1: Introduction**

#### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 1.1 Explain the course and their role in Advanced Life Support Response to Hazardous Materials Incidents.

#### **Enabling Objectives**

The students will be able to:

- 1.1 Explain the course goal.
- 1.2 Describe course completion requirements and student responsibilities.
- 1.3 Explain the components of training fundamental to the knowledge required for successful Advanced Life Support Response to Hazardous Materials Incidents.

### **Unit 2: Standard of Care**

#### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 2.1 Summarize the roles of the health care provider in a xenobiotic exposure.

## **Enabling Objectives**

The students will be able to:

- 2.1 Explain the effects of the standard of care on the hazardous materials responder.
- 2.2 Evaluate the effects of standards, regulations and guidance on the standard of care.
- 2.3 Compare the health care provider's responsibilities during the three phases of response.
- 2.4 Evaluate circumstances that would cause a health care provider to alter the standard of care.
- 2.5 Explain the key responsibilities of the health care provider as outlined in National Fire Protection Association (NFPA) 473, Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents.
- 2.6 Define the term toxidrome.
- 2.7 Relate the 12 toxidromes to common xenobiotic exposures.

## **Unit 3: Basics of Chemistry**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 3.1 Interpret a periodic table to identify atoms, types of elements, atomic weights and atomic numbers of elements.

#### **Enabling Objectives**

The students will be able to:

- 3.1 Compare elements from the periodic table using the element's symbol or atomic number.
- 3.2 Using the periodic table, predict whether an element is a metal or a nonmetal.
- 3.3 Using the periodic table, predict the group or period that an element is in.

## **Unit 4: Inorganic Chemistry**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 4.1 Compare salts and inorganic nonsalts, their names and hazards.

#### **Enabling Objectives**

The students will be able to:

- 4.1 Using the periodic table, predict the type of bonding that occurs between two or more elements.
- 4.2 Given a formula and a chemical structure, interpret the type of bonding that occurs in a chemical compound.
- 4.3 Given seven types of salts, explain their hazards.
- 4.4 Given five types of inorganic nonsalts, explain their hazards.

## **Unit 5: Organic Chemistry**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 5.1 Given a name, structure or formula, identify organic compounds and their hazards.

#### **Enabling Objectives**

The students will be able to:

- 5.1 Given a name, structure or formula, contrast four types of hydrocarbon compounds.
- 5.2 Interpret the functional groups of organic compounds and their hazards.
- 5.3 Given an organic compound and a name, structure or formula, evaluate the hazards of that organic compound.

## **Unit 6: Biochemistry**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 6.1 Describe the fundamental biochemical reactions.

#### **Enabling Objectives**

The students will be able to:

- 6.1 Describe the role of water and polarity in biochemical reactions.
- 6.2 Describe the role of pH in biochemical reactions.
- 6.3 Compare and contrast polar and nonpolar molecules.
- 6.4 Estimate the solubility of a substance.
- 6.5 Given the four types of bonding that occur in biochemical reactions, rate their relative strengths.
- 6.6 Compare the functional groups of biochemistry.

## **Unit 7: Cellular Anatomy and Physiology**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 7.1 Interpret the concepts of basic cellular physiology, energy production, and the manufacture of biomolecules.

#### **Enabling Objectives**

The students will be able to:

- 7.1 Compare four types of biomolecules.
- 7.2 Describe the three processes involved in energy production in the cell.
- 7.3 Describe the role of nucleic acids in the cell.

- 7.4 Describe the process of protein synthesis.
- 7.5 Describe the four types of movement of substances across the cell membrane.

## **Unit 8: Blood and Blood Components**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 8.1 Evaluate the effects of hazardous materials on the blood and blood components.

#### **Enabling Objectives**

The students will be able to:

- 8.1 Describe the components of blood.
- 8.2 Describe the role of blood and blood components in homeostasis.
- 8.3 Explain the mechanisms by which selected hazardous materials affect the blood and its components.
- 8.4 Choose the appropriate management options for hazardous materials exposure to the blood and its components.

## **Unit 9: The Nervous System**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 9.1 Evaluate effects of hazardous materials on the nervous systems.

#### **Enabling Objectives**

The students will be able to:

- 9.1 Differentiate between the central and peripheral nervous systems.
- 9.2 Analyze the anatomy and physiology of the central nervous system (CNS).

- 9.3 Analyze the anatomy and physiology of the peripheral nervous system.
- 9.4 Summarize the role of chemical neurotransmitters in the conduction of nerve impulses.
- 9.5 Describe the process of nerve impulse transmission.
- 9.6 Examine the roles of the sympathetic and parasympathetic pathways.
- 9.7 Contrast the processes that affect nerve excitability.
- 9.8 Describe the mechanisms by which selected hazardous materials affect the nervous system.
- 9.9 Choose the appropriate management options for hazardous materials exposure to the nervous system.

## **Unit 10: The Respiratory System**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 10.1 Evaluate the effects of hazardous materials on the respiratory system.

#### **Enabling Objectives**

The students will be able to:

- 10.1 Analyze the anatomy and physiology of the respiratory system.
- 10.2 Describe the processes of gaseous diffusion in the respiratory system.
- 10.3 Describe the mechanism by which selected hazardous materials affect the respiratory system.
- 10.4 Choose the appropriate management options for hazardous materials exposure to the respiratory system.

## **Unit 11: The Cardiovascular System**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 11.1 Evaluate the effects of hazardous materials on the cardiovascular system.

#### **Enabling Objectives**

The students will be able to:

- 11.1 Analyze the anatomy and physiology of the cardiovascular system.
- 11.2 Describe the role of the cardiovascular system in perfusion.
- 11.3 Describe the mechanisms by which selected xenobiotics affect the cardiovascular system.
- 11.4 Choose the appropriate management options for hazardous materials exposure to the cardiovascular system.

## **Unit 12: The Digestive System**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 12.1 Evaluate effects of hazardous materials on the digestive system.

#### **Enabling Objectives**

The students will be able to:

- 12.1 Analyze the anatomy and physiology of the digestive system.
- 12.2 Describe the processes of intake, metabolism and elimination.
- 12.3 Describe the mechanisms by which selected xenobiotics affect the digestive system.
- 12.4 Choose the appropriate management options for hazardous materials exposure to the digestive system.

## **Unit 13: Biotransformation and Elimination**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

13.1 Evaluate effects of hazardous materials on the hepatic and renal systems.

#### **Enabling Objectives**

The students will be able to:

13.1 Analyze the anatomy and physiology of the hepatic system.

13.2 Analyze the anatomy and physiology of the renal system.

13.3 Analyze the role of the hepatic system in biotransformation.

13.4 Analyze the role of the renal system in elimination.

13.5 Describe the mechanisms by which selected hazardous materials affect the renal system.

13.6 Describe the mechanisms by which selected hazardous materials affect the hepatic system.

13.7 Choose the appropriate management options for hazardous materials exposure to the renal system or the hepatic system, or both.

## **Unit 14: The Skin**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

14.1 Evaluate the effects of hazardous materials on the skin.

#### **Enabling Objectives**

The students will be able to:

14.1 Describe the components of the skin.

- 14.2 Describe the physiology of the skin.
- 14.3 Describe the mechanisms by which selected hazardous materials affect the skin.
- 14.4 Choose the appropriate management options for hazardous materials exposure to the skin.

## **Unit 15: Pesticides**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 15.1 Given a category of pesticides, identify the potential target organs and predict the effects on the human body system.

#### **Enabling Objectives**

The students will be able to:

- 15.1 Describe the effects of pesticides on multiple organ systems.
- 15.2 Describe the mechanism of harm of the given pesticide.
- 15.3 Compare the short- and long-term effects of exposure.
- 15.4 Evaluate the need for additional medical monitoring or surveillance.
- 15.5 Choose the appropriate management option for pesticide exposure.

## **Unit 16: Industrial Chemicals**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 16.1 Given a category of selected hazardous materials, identify the potential target organs and predict the effects on the human body system.

### **Enabling Objectives**

The students will be able to:

- 16.1 Describe the effects of selected industrial chemicals on multiple organ systems.
- 16.2 Describe the mechanism of harm of the given hazardous material.
- 16.3 Compare the short- and long-term effects of exposure.
- 16.4 Evaluate the need for additional medical monitoring or surveillance.
- 16.5 Choose the appropriate management option for selected hazardous material exposure.

### **Unit 17: Drugs**

#### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 17.1 Given a category of xenobiotics, identify the potential target organs and predict the effects on the human body system.

#### **Enabling Objectives**

The students will be able to:

- 17.1 Describe the effects of xenobiotics on multiple organ systems.
- 17.2 Describe the mechanism of harm of the given xenobiotics.
- 17.3 Compare the short- and long-term effects of exposure.
- 17.4 Evaluate the need for additional medical monitoring or surveillance.
- 17.5 Choose the appropriate management option for xenobiotic exposure.

## **Unit 18: Initial Patient Care Plan Activity**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 18.1 Given a scenario, analyze the toxicological event presented in the scenario and develop an appropriate Initial Care Plan.

#### **Enabling Objectives**

The students will be able to:

- 18.1 Analyze the signs and symptoms.
- 18.2 Implement appropriate scene precautions.
- 18.3 Select the appropriate level of protective ensemble.
- 18.4 Identify possible differential diagnoses.
- 18.5 Identify possible treatment options.
- 18.6 Select the most appropriate treatment options.
- 18.7 Identify the appropriate notifications and documentation associated with the event.

## **Unit 19: Chronic Sequelae**

### **Objectives**

#### **Terminal Objective**

The students will be able to:

- 19.1 Identify the potential acute or chronic medical sequelae that may result from single or recurring occupational exposures to hazardous materials.

## **Enabling Objectives**

The students will be able to:

### **Cancer**

- 19.1 Recognize potential exposure risks.
- 19.2 Identify the types of cancers and their causes.
- 19.3 Identify the cellular process associated with a cancer's development and growth.
- 19.4 Identify methods to prevent exposure risks to carcinogens.

### **Radiation**

- 19.5 Identify the mechanism of harm to biological tissue from exposure to ionizing radiation.
- 19.6 Identify the expected dose-response relationship, given a specific dose of ionizing radiation.
- 19.7 Identify the principal methods of protecting human tissue from the effects of an exposure to ionizing radiation.

### **Policies**

#### **Class Attendance and Cancellation Policy**

##### **Attendance**

- You are required to attend all sessions of the course. If you do not, you may not receive a certificate.
- If you need to depart the training facility early and miss any portion of the course, you must make the request in writing to the sponsoring agency (e.g., State training director, etc.). The State training director may waive the attendance requirement in order to accommodate you with extraordinary circumstances as long as you complete all course requirements.

##### **Course Failure**

You can reapply for the failed course or any other NFA course and go through the random selection process. You don't have to successfully complete the failed course before attending another NFA course.

## **Student Code of Conduct Policy**

Students, instructors and staff are expected to treat each other with respect at all times. Inappropriate behavior will not be tolerated.

## **Writing Expectations**

Student writing will conform to the generally accepted academic standards for college papers. Papers will reflect the original work of the student and give appropriate credit through citations for ideas belonging to other authors, publications or organizations. Student written work should be free of grammatical and syntax errors, free of profanity or obscene language or ideas, and reflect critical thinking related to the course subject matter.

## **Citation and Reference Style**

Attention Please: Students will follow the APA, Sixth Edition as the sole citation and reference style used in written work submitted as part of coursework to NFA. Assignments completed in a narrative essay, composition format, abstract, and discussion posts must follow the citation style cited in the APA, Sixth Edition.

## **Late Assignments**

All assignments must be turned in by the established deadline. Late submissions could result in a 10 percent decrease in grade.

## **Disclaimer Statement**

Course content may vary from the outline to meet the needs of this particular group.

## **Grading**

Please review the following rubrics that explain how grades will be awarded.

Students who do not complete the entire course will be awarded an Incomplete (I) grade. In accordance with National Fire Academy academic policies, an Incomplete (I) grade must be removed by the end of the next semester following the course, or it automatically becomes a Failing (F) grade.

[https://www.usfa.fema.gov/training/nfa/admissions/student\\_policies.html](https://www.usfa.fema.gov/training/nfa/admissions/student_policies.html)

## **Academic Honesty**

Students are expected to exhibit exemplary ethical behavior and conduct as part of the NFA community and society as a whole. Acts of academic dishonesty including cheating, plagiarism, deliberate falsification, and other unethical behaviors will not be tolerated.

Students are expected to report academic misconduct when they witness a violation. All cases of academic misconduct shall be reported by the instructor to the State training director or host agency and to the NFA Training Specialist.

If a student is found to have engaged in misconduct and the allegations are upheld, the penalties may include, but are not limited to one or a combination of the following:

- expulsion,
- exclusion from future classes for a specified period; depending on the severity it could range from 1-10 years, and/or
- forfeiture of certificate for course(s) enrolled in at NETC.

Refer to NFA-specific Standard Operating Procedure 700.1 – *Academic Code of Conduct and Ethics* for more information.

## Grading Rubrics

**RUBRIC FOR INITIAL PATIENT CARE**

|  | Student did not complete this task.<br>(1 point) | Student attempted the task but did not demonstrate skills necessary to complete it.<br>(2 points) | Student completed the task but did not have the knowledge and skills necessary to make accurate decisions.<br>(3 points) | Student completed the task and made accurate decisions but did not clearly articulate responses.<br>(4 points) | Student completed the task, made accurate decisions, and clearly articulated responses.<br>(5 points) |
|--|--|---|--|--|---|
| Propose appropriate scene precautions and personal protection. Identify appropriate notifications and documentation. |  |   |  |  |   |
| Analyze the signs and symptoms, and identify possible treatment options.   |  |   |  |  |   |
| <b>Total</b>   |  |   |  |  |   |

Note: A total of 10 points are possible using this scoring rubric.