STRANDS AND STANDARDS

FIRE SCIENCE, FIRE BEHAVIOR AND COMBUSTION

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CTE®

Course Description

Explores the theories and fundamentals of how and why fires start, spread and how they are controlled. Addresses the fire problem in America, background of research, and how to approach the study of fire. Provides an overview of various flames, smoldering, and spontaneous combustion.

Intended Grade Level	10-12
Units of Credit	0.5
Core Code	40.06.00.00.020
Concurrent Enrollment Core Code	40.06.00.13.020
Prerequisite	None
Skill Certification Test Number	N/A
Test Weight	N/A
License Area of Concentration	CTE and/or Secondary Education 6-12
Required Endorsement(s)	
Endorsement 1	Fire Science
Endorsement 2	
Endorsement 3	

Strand 1

Students will explore early traditions and history of firefighting operations.

Standard 1

Discuss fire protection in early American history.

Standard 2

Review historical fires in early American history and assess their impact on building and construction standards.

Standard 3

Explain how the growth of the volunteer fire service has changed modern-day fire and emergency medical services.

Standard 4

Examine modern building codes and the challenges faced by modern firefighting agencies.

Standard 5

Explore improvements and standards relating to personal firefighting clothing, equipment and SCBA capabilities.

Standard 6

Indicate how improvements in technology have increased the safety and effectiveness of the modern American fire department.

- Alternative fuels
- Infrared imaging
- GPS
- Suppression techniques
- Personal Protective Equipment (PPE)
- Apparatus

Performance Skill

Submit a case study review of a historical fire and explore its impact on improvements in firefighter safety and building construction standards.

Strand 2

Students will examine fire chemistry as it relates to fire behavior.

Standard 1

Discuss the various states of matter.

- Solid
- Liquid
- Gas

Standard 2

Explore the properties of vapor pressure, density, solubility, and specific gravity.

Standard 3

Examine flash points, fire points, and explosive limits.

Standard 4
Examine the conditions that contribute to a Boiling Liquid Expanding Vapor Explosion (BLEVE).

Standard 5
Illustrate the components of chemical reactions within fire:
- Water Reactive
- Air-Reactive
- Oxidizers

Performance Skill
Present to the class on the properties of fire chemistry.

Strand 3
Students will understand the components of combustion and fire behavior.

Standard 1
Define the fire tetrahedron.
- Fuel
- Heat
- Oxygen
- Chemical reaction

Standard 2
Describe the three types of combustion:
- Pre-Combustion
- Smoldering Combustion
- Flaming Combustion

Standard 3
Classify fires based on the type of substance burning.
- Class A: Ordinary cellulose materials
- Class B: Flammable Liquids
- Class C: Energized Electrical Equipment
- Class D: Combustible Metals
- Class K: Cooking Oils

Standard 4
Classify fires based on stages and events:
- Fire Stages
  - Ignition
  - Growth
  - Fully Developed
  - Decay
- Fire Events
  - Flame over or Rollover
  - Flashover
  - Backdraft
  - Smoke Explosion

Standard 5
Describe the fire ratings of building materials.

Standard 6
Examine weather conditions and their impact on fire behavior.
- Wind effect
- Relative humidity
- Stack effect

Standard 7
Define the four methods of heat transfer.
- Conduction
- Convection
- Radiation
- Direct flame impingement

Standard 8
Define key terms related to fire behavior.
- Rate of spread
- Fire intensity
- Building factors

Standard 9
Explain the impact that products of combustion have on fire behavior.

Standard 10
Recognize the characteristics of specific fire events.
- Liquid fires
- Electrical fires
- Metal fires

Standard 11
Distinguish the skills necessary to read smoke patterns and behavior at structural fires.

Performance Skill
Build a presentation on the different aspects of fire behavior.

Strand 4
Students will examine fire extinguishing agents and the methods of application for each.

Standard 1
Examine the basic components of the fire extinguishment process.
- Temperature reduction
- Fuel removal
- Oxygen depletion
- Chemical flame inhibition

Standard 2
Review the five basic classifications of fire and explain the various types of agents used to extinguish or control fires in these five classifications.

- Class A: Ordinary cellulose materials
- Class B: Flammable Liquids
- Class C: Energized Electrical Equipment
- Class D: Combustible Metals
- Class K: Cooking Oils

Standard 3

Examine the variety of agents used for fire extinguishment and explain the application methods for each of these agents.

- Water
  - Wet water
  - Slippery water
  - Thick water
  - Viscus water
- Foam
- Carbon dioxide
- Dry chemicals
- Halogenated agents

Standard 4

Identify and explain the benefits of using the latest technological advances in fire extinguishing agents.

- Compressed air foam
- Ultrafine water mist systems

Performance Skill

Demonstrate the correct usage of a fire extinguisher.

Strand 5

Students will develop an understanding of firefighting tactics and strategies.

Standard 1

Discuss strategies/tactics for fire ground operations.

- Locate the fire.
- Confine the fire.
- Extinguish the fire.

Standard 2

Define the term “size-up” and explain the steps and factors involved in conducting a size-up at an emergency scene.

- Rescue
- Exposures
- Confinement
- Extinguishment
- Overhaul
- Ventilation
- Salvage

Standard 3

Distinguish the differences in fire construction types.

- Type 1: Fire Resistive
- Type 2: Non-Combustible
- Type 3: Ordinary
- Type 4: Heavy Timber
- Type 5: Lightweight

Standard 4
Identify special concerns that are found at a fire. Discuss how these concerns alter and/or impact strategies, tactics, and overall operations.
- Occupancy or use
- Apparatus and staffing
- Life hazard
- Terrain
- Water supply
- Weather

Standard 5
Explain and provide examples of historical changes in construction type, building codes, and occupancy types and loads.

Performance Skill
Write a capstone paper on a historical fire identifying building construction, fire ground strategies, and changes in codes and/or laws as a result.

Strand 6
Students will explore fire related emergencies in high-rise buildings and the unique challenges they pose to modern fire departments.

Standard 1
Explain why high-rise buildings present a difficult and different fire problem for firefighters, including the unique fire behavior problems that may be encountered in a high-rise fire.

Standard 2
Describe the firefighting strategies and tactics used to locate, confine, and extinguish high-rise fires.

Standard 3
Examine the special problems encountered on high-rise fires.
- Communications issues
- Stack effect
- Evacuation concerns
- Resource management
- Elevator control
- Incident command

Standard 4
Explain the various special fire protection equipment found in high-rise buildings.
- Sprinkler systems
- Standpipe connections
- HVAC systems

- Communications technology
- Fire-alarm notification systems
- Elevator management systems

Standard 5
Discuss the principles of ventilation unique to fighting fires in a high-rise building.
- Stack effect
- Utilization of HVAC systems
- Vertical ventilation

Performance Skill
Submit a pre-incident survey on a high rise structure within the student's jurisdiction or nearest relevant location.

Strand 7
Students will explore fire related emergencies in wildland and urban interface settings.

Standard 1
Discuss the basic fire combustion principles related to a wildland fire emergency.
- Fuel
- Heat
- Oxygen

Standard 2
Describe the method used to classify resources used on wildland fires and how fire behavior impacts the type and number of resources needed to achieve containment and suppression.

Standard 3
Explore the tools unique to wildland firefighting.
- Pulaksi
- Combi-tool
- Mcleod
- Chainsaw
- Flapper

Standard 4
Summarize the five-step decision making process for wildland incident size- up.
- Factors impacting life safety.
- Factors impacting property safety.
- Factors that may harm the environment.
- Factors that harm wildlife.
- The availability of needed firefighting resources.

Standard 5
Explain how weather, fuel types, and topography effects fire behavior.

Standard 6
Distinguish the unique types of resources used to combat a wildfire emergency.
- Engine type

- Hand crew type
- Bulldozers
- Fixed wing aircraft
- Rotary wing aircraft
- Water tenders

Standard 7
Indicate the difference between direct, in-direct, and combination attack methods in wildland fire fighting tactics.

Performance Skill
Submit a case review of a well-documented wildland fire emergency.

Strand 8
Students will explore hazardous material related emergencies and responses within the fire service.

Standard 1
Describe the U.S. Department of Transportation hazardous materials warning system.

Standard 2
Explain the requirements, purposes, and value of Safety Data Sheets (SDS) to firefighters and first responders.

Standard 3
Become familiar with the Emergency Response Guidebook and how it is used in a real-world setting.

Standard 4
Explain the issues that make weapons of mass destruction incidents complex and the reasons for the development of the National Incident Management System.

- Weapons of Mass Destruction Incidents
  - Dirty bombs
  - Economic impact
  - Chemical
  - Biological
- National Incident Management System
  - Inter-agency operations
  - Resource allocation
  - Emergency management planning

Standard 5
Illustrate the four main areas of difficulty regarding terrorism events relating to Weapons of Mass Destruction (WMD).

- Large number of persons needing immediate assistance at the same time.
- Multifunctions conducted simultaneously.
- Immediate involvement of federal and state agencies.
- Overwhelming response of the national media.

Performance Skill
Submit a case study related to a hazardous material response of your local fire agency.

Workplace Skills

- Communication
- Problem Solving
- Teamwork
- Critical Thinking
- Dependability
- Accountability
- Legal Requirements/expectations