|  |
| --- |
| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Law, Public Safety, Corrections, & Security |
| **Course Name** | Firefighter II |
| **Lesson/Unit Title** | Portable Fire Extinguishers  |
| **TEKS Student Expectations** | **130.335. (c) Knowledge and Skills**(4) The student describes the characteristics and applications for the classes of extinguishers.1. The student is expected to identify the classification of types of fires as they relate to the use of portable fire extinguishers and the materials involved in each class of fire
2. The student is expected to identify the appropriate fire extinguisher for each class of fire

(C) The student is expected to identify and describe fire extinguisher characteristics and operations |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** | The student will be able to:1. Select the appropriate extinguisher for the size and type of a fire2. Safely carry portable fire extinguishers3. Approach a fire with a portable fire extinguisher4. Operate portable fire extinguishers5. Describe the characteristics and applications of pump tank water extinguishers, Aqueous Film Forming Foam fire extinguishers, carbon dioxide extinguishers, dry chemical extinguishers, and wet chemical extinguishers |
| **Rationale** | It is necessary for firefighters to understand the operation and use of portable extinguishers, as they are among the most common fire protection devices in use today. Designed to combat incipient fires, extinguishers can be found in business, industry, at homes, and on fire apparatus. Portable extinguishers are intended for use on small fires, and can often control a small fire in less time than would be necessary to deploy a handline. |
| **Duration of Lesson** | 8 hours |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * Full Protective Clothing
* Portable Fire Extinguishers Quiz and Key
* Fire extinguishers (CO2, dry chemical, and stored pressure water)
* Carbon Dioxide (CO2) Extinguisher Checklist
* Dry Chemical (A B C) Extinguisher Checklist
* Stored Pressure Water Extinguisher Checklist
* Discussion Rubric
* Individual Work Rubric
* Computer/projector
 |
| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Engage the students in a discussion about how the use of extinguishers fits into the overall mission of the fire service. Because they are designed for use on incipient fires, and are required in most occupancies, they are available for use by homeowners, business owners, and persons in the general public that know how to use them. At times, they are more practical to use for firefighters in terms of expense, time, and ease. Use the Discussion Rubric for assessment. |
| **Direct Instruction \*** | 1. General information
	1. Portable extinguishers may use a number of different extinguishing agents, depending on what type of fire they are designed to extinguish. Every agent extinguishes fire with at least one of the following methods:
		1. Smothering – oxygen exclusion
		2. Cooling – reducing the fuel to below its ignition temperature
		3. Chain Breaking – interrupting the chemical chain reaction
		4. Saponification – forming oxygen-excluding soapy foam
	2. NFPA 1901, the Standard for Automotive Fire Apparatus, requires that pumping apparatus
		1. Have two approved, portable fire extinguishers with mounting brackets
			1. They must be suitable for use on Class B and Class C fires.
			2. The minimum size requirement for a dry chemical extinguisher is a rating of 80 B:C
			3. The required rating for a Carbon Dioxide (CO2) extinguisher is 10 B:C
		2. Carry at least one 2½ gallon or larger water extinguisher for use on Class A fires.
		3. Be protected from freezing (water-type extinguishers) if they are going to be exposed to temperatures lower than 40 degrees Fahrenheit (F).
	3. Expelling of Agents – all portable extinguishers expel their agent in one of the following ways:
		1. Manual pump (water can)
		2. Stored pressure
		3. Pressure cartridge
	4. Fire Classifications
		1. Classified according to the material that is burning
		2. Some extinguishing agents are most effective on specific fuel types.
		3. The five classifications of fire that dictate which type of portable extinguisher is most effective on that class of fire.
			1. Class A
				1. Ordinary combustibles, extinguished by water or water-based agents such as foam, or multipurpose dry chemicals
				2. Water is the most common agent used by the fire service.
			2. Class B
				1. Flammable and combustible liquids and gases
				2. Agents used are carbon dioxide (CO2), dry chemical, and class B foam.
			3. Class C
				1. Fires created by electrical energy
				2. Water-based agents are not effective or safe to use until the electricity has been eliminated.
				3. Disconnect the electrical source and use the appropriate extinguisher.
			4. Class D
				1. Combustible metals
				2. These fires are often identified by the bright white emissions from the burning process.
				3. Dry powder extinguishers are most effective.
			5. Class K
				1. Combustible cooking oils
				2. Wet chemical extinguishers and extinguishing systems are the most effective.
2. Extinguisher Types
	1. Pump-Type Water Extinguishers
		1. Intended for use on small Class A fires
		2. Equipped with a single- or double-action pump
	2. Stored Pressure Water Extinguishers
		1. Also called air pressurized water (APW) extinguishers, or pressurized water extinguishers
		2. Intended for use on all types of small Class A fires
		3. They are often used for hot spots during overhaul
		4. Water is stored with compressed air or nitrogen
		5. Class A foam concentrate is sometimes added to water extinguishers to increase their effectiveness
		6. Class A foam is also used as a wetting agent to help reach deep- seated fires in upholstered furniture, baled fuels, and wildland fires with dense matted vegetation
	3. Water-Mist Stored Pressure Extinguishers
		1. Intended for use on Class A and C fires
		2. Use deionized water as an agent
		3. The deionized water is non-conductive.
		4. The extinguisher uses a fine spray, as opposed to a solid stream of water.
		5. The fine spray also increases the cooling and soaking characteristics of water.
	4. Wet Chemical Stored-Pressure Extinguishers (Class K)
		1. Similar in appearance to conventional stored-pressure units
		2. Designed to control and extinguish fires in deep fryers found in kitchens
		3. Contain a special potassium-based, low pH agent that is designed to cool and extinguish fires in unsaturated cooking oils
	5. Aqueous Film Forming Foam (AFFF) Extinguishers
		1. Also known as “light water”
		2. Intended for use on Class A and Class B fires
		3. Effective in suppressing vapors from small liquid fuel spills
		4. A highly effective extinguishing and blanketing agent on hydrocarbon fuels
		5. Ineffective on polar solvents
		6. AFFF is corrosive and can remove finishes from tools and apparatus.
	6. Clean Agent Extinguishers
		1. Designed to replace Halon 1211
		2. Discharge a rapidly evaporating liquid that leaves no residue
		3. Agents include:
			1. Hydrochlorofluorocarbon (HCCF)
			2. Hydrofluorocarbon (HFC)
			3. Perfluorocarbon (PFC)
			4. Fluoroidiocarbon (FIC)
		4. Effectively cool and smother fires in Class A and B fuels, and, because the agents are non-conductive, they may be used on Class C fires.
		5. Pressurized with Argon gas
		6. Approved by the U.S. Environmental Protection Agency (EPA)
	7. Carbon Dioxide Extinguishers
		1. Effective on Class B and Class C fires
		2. Come as handheld and wheeled units
		3. Wheeled units are usually found in airports and industry.
		4. Wheeled unit hoses (usually less than 15 feet long) must be unwound before use.
		5. Limited reach because they are discharged as a gas
		6. Do not require freeze protection
		7. Stored under their own pressure
		8. The CO2 gas displaces available oxygen and smothers the fire.
			1. It has little cooling effect, even though it is discharged at subzero temperatures.
			2. Does not produce a vapor-suppressing film, so reignition is always possible
	8. Dry Chemical Extinguishers
		1. For use on Class A:B:C fires and/or Class B:C fires
		2. The most common portable extinguishers in use today
		3. Come as handheld units or wheeled units
		4. Cartridge-type and stored-pressure design
		5. Two basic types:
			1. Regular B:C-rated
			2. Multipurpose A:B:C-rated
		6. Commonly used dry chemicals:
			1. Sodium bicarbonate
			2. Potassium bicarbonate
			3. Potassium chloride
			4. Monoammonium phosphate
			5. Urea-potassium
		7. During manufacturing, chemicals are mixed with an additive to make them moisture resistant. This prevents them from caking inside the extinguisher.
		8. Monoammonium phosphate and sodium bicarbonate agents are not compatible with foam. They will cause a foam blanket to break down.
		9. Dry chemical agents are considered non-toxic.
		10. Upon discharge, chemical clouds can reduce visibility and create respiratory problems as airborne particulates.
		11. Discharge should be directed at whatever is burning, to cover it with the chemical.
		12. When the flames are knocked down, the agent should be applied intermittently on any hot spots.
		13. Many of the agents are corrosive.
		14. On wheeled units, the hose must be extended before use.
3. Extinguishers and Agents for Metal Fires
	1. No single agent can control fires in all combustible metals.
	2. Some powered agents can be applied by extinguishers, while others need to be applied by a shovel or scoop.
	3. Portable extinguishers for Class D fires can be handheld or wheeled units.
	4. Agents must be applied with sufficient depth to completely cover the area that is burning; the agent creates a smothering blanket.
	5. The agents may form a crust over the metal, and if the crust breaks, the fire may reignite.
	6. Avoid scattering the burned metal.
	7. After the metal is extinguished the material should be left undisturbed until it is cooled completely; then it may be disposed of.
4. Fire Extinguisher Rating System
	1. Extinguishers are classified according to their intended use.
	2. Class A ratings
		1. Rated from 1-A through 40-A
		2. Ratings are based on the amount of extinguishing agent, and the duration and range of the discharge used in extinguishing test fires
		3. For a 1-A rating, 1¼ gallons of water is required.
		4. For a 2-A rating, 2½ gallons, or twice the capacity, is required.
		5. Ratings are based on test fires in various sizes of fuel test cribs.
	3. Class B ratings
		1. Classified with numerical ratings from 1-B through 640-B

 * + 1. Ratings are based on the approximate square foot area of flammable liquid fire that a non-expert operator can extinguish.
		2. Non-expert operators are expected to extinguish 1 square foot for each numerical rating.
	1. Class C ratings
		1. There are no number ratings for Class C fires.
		2. Class C fires are Class A and Class B fires involving energized electrical equipment.
		3. Extinguishing agents for Class C extinguishers are tested to make sure they are nonconductive.
		4. The Class C rating is assigned to extinguishers in addition to their Class A or Class B rating or both.
	2. Class D ratings
		1. No numerical rating is given
		2. Test fires for establishing Class D ratings vary with the combustible metal being tested.
		3. The following factors are considered:
			1. Reaction between the metal and the agent
			2. Toxicity of the agent
			3. Toxicity of the fumes produced and the products of combustion
			4. The time needed to allow the metal to burn out without fire suppression efforts, versus the time needed to extinguish the fire
			5. Application instructions for the specific agents are on the faceplate.
	3. Class K ratings
		1. Recognized by Underwriters Laboratories (UL) since 1996
		2. Extinguishers rated for Class K must be capable of saponifying vegetable, peanut, canola, and other oils with little or no fatty acids.
		3. Saponify – reduce fatty acids or fats into a soap or foam
		4. Class K extinguishers work by suppressing vapors and smothering the fire.
		5. Class K agents must be able to extinguish a fire in a deep fryer with a surface area of 2.25 square feet.
	4. Multiple Markings
		1. Extinguishers may be capable of extinguishing more than one class of fire.
		2. The three most common extinguisher combinations are
			1. Class A:B:C
			2. Class A:B
			3. Class B:C
		3. Extinguishers should be properly marked, or not used.
		4. The ratings of each class of fire that an extinguisher can extinguish are independent of each other.
		5. Example: a 4-A 20-B:C extinguisher can extinguish a Class A fire 4 times greater than a 1-A extinguisher can, and a Class B fire 20 times greater than a 1-B:C can
		6. Portable extinguishers are identified in two ways:
			1. Geometric shapes of specific colors with the class letter in the shape
			2. Pictographs to make the selection of the most appropriate extinguisher easier.
				1. An additional pictograph shows the type(s) of fire the extinguisher will not extinguish.
				2. This method is recommended by the NFPA.
1. Proper Extinguisher Selection depends on numerous factors:
	1. Classification of the burning fuel
	2. Rating of the extinguisher
	3. Hazards to be protected
	4. Size and intensity of the fire
	5. Atmospheric conditions
	6. Life hazards or operational concerns
	7. Ease of handling
	8. Availability of trained personnel
2. Using Portable Extinguishers
	1. A. Become familiar with the instructions found on the different types of extinguishers
	2. Make sure that extinguishers are accessible from fire service vehicles and fully operational.
	3. Check it before using it:
		1. External condition – no apparent damage
		2. Hose/nozzle – in place
		3. Weight – feels as though it contains the agent
		4. Pressure gauge (if available) – within the operable range
	4. After choosing the proper extinguisher (size and type) approach the fire from the windward side (wind at your back).
	5. Pull, Aim, Squeeze, Sweep (PASS) method of application
		1. No modern extinguisher needs to be inverted.
		2. All modern extinguishers operate similarly.
		3. Pick up the extinguisher by the handle and carry it to the point of discharge (application).
		4. Use the PASS method:
			1. Pull the pin, breaking the seal.
			2. Aim the nozzle at whatever is burning.
			3. Squeeze the handles together to release the agent.
			4. Sweep the nozzle back and forth to cover the burning material.
		5. Make sure the extinguisher reaches the fire
		6. Operate with enough distance; being too close with an extinguisher can scatter lightweight fuels. Be careful!
		7. Move closer for final extinguishment after the fire is knocked down
3. Inspecting Fire Extinguishers
	1. NFPA 10 requires that portable fire extinguishers be inspected at least once every year, and that they are accessible and operable.
		1. Inspections are the responsibility of the building owner and are usually done by the owner or their designee, such as a licensed extinguisher company.
		2. Firefighters should include extinguisher inspections as part of their annual building inspections.
		3. Fire extinguisher inspections should include:
			1. Location and accessibility
			2. Checking
				1. The discharge nozzle or horn for obstructions
				2. For cracks, dirt, or grease accumulations
				3. The extinguisher shell for damage
				4. The operating instructions for legibility
				5. The locking pin and tamper seal
				6. That the extinguisher is full and pressurized

The weight and pressure gaugeIf the extinguisher is found to be deficient in weight by 10 percent, it should be removed from service.* + - * 1. The inspection tag for date of previous inspection, maintenance, or recharging
				2. The hose and hose fittings
		1. Regularly inspect extinguishers located on fire apparatus
		2. Three factors that determine the value of a portable fire extinguisher:
			1. Its serviceability
			2. Its accessibility
			3. Its simplicity of operation
		3. Damaged extinguishers should be replaced. Do not use them again until they are certified for use.
		4. Obsolete extinguishers should be removed from service.
			1. Inverting-type extinguishers stopped being manufactured in 1969.
			2. Copper and brass shells have been discontinued.
			3. Carbon tetrachloride and chlorobromomethane have been obsolete since 1982.
	1. Halon Fire Extinguishers
		1. Termination and consumption of Halon by the year 2000 because of its ozone depletion material
		2. The only exception is for essential uses where there is no alternative.
		3. The U.S. stopped producing halogens in 1993.
		4. Extinguishes fire by interrupting the chemical chain reaction.
		5. The vapor is non-conductive and effective on surface fires.
		6. Halon 1211was replaced by FE-36 (hexafluoropropane).
		7. Halon 1301was replaced by FE-241 (chlorotetrafluoroethane) and FM-200.
 |
| **Guided Practice \*** | Participate in fire extinguisher training using live fire and/or live fire simulators. Use the Carbon Dioxide (CO2) Extinguisher Checklist, Dry Chemical (A B C) Extinguisher Checklist, and Stored Pressure Water Extinguisher Checklist for assessment. |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Students will map extinguisher locations at their school, checking for inspection tags, size, and types of extinguishers. Use the Individual Work Rubric for assessment. |
| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | * Portable Fire Extinguishers Quiz
* Carbon Dioxide (CO2) Extinguisher Checklist
* Dry Chemical (A B C) Extinguisher Checklist
* Stored Pressure Water Extinguisher Checklist
* Discussion Rubric
* Individual Work Rubric
 |
| **References/Resources/****Teacher Preparation** | * ISBN: 0135151112, *Essentials of Firefighting* (5thEdition), International Fire Service Training Association (IFSTA)
 |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | IV. ListeningB. Listen effectively in informal and formal situations1. Listen critically and respond appropriately to presentations.
2. Listen actively and effectively in one-on-one situations
3. Listen actively and effectively in group discussions.
 |
| **Recommended Strategies** |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy****Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies****Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication****90 Second Speech Topics** |  |
| **Other Essential Lesson Components** |
| **Enrichment Activity**(e.g., homework assignment) | For enrichment, students will participate in an extinguisher demonstration and school inspection program. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)