|  |
| --- |
| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Law, Public Safety, Corrections, and Security |
| **Course Name** | Firefighter I |
| **Lesson/Unit Title** | Utility Services Safety |
| **TEKS Student Expectations** | **130.334. (c) Knowledge and Skills**(18) The student describes the handling of different types of accidents and hazards.(A) The student is expected to describe the procedures for terminating utility services to a building (B) The student is expected to explain hazards that exist and describe procedures to be used in electrical emergencies |
| **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. Describe the procedures for terminating utility services to a building. |
| 2. Explain the hazards that exist and describe the procedures to be |
| used in electrical emergencies. |

 |
| **Rationale** |

|  |
| --- |
| Much of what needs to be done in emergency service responses involving |
| utilities can be beyond the scope of many firefighters’ training and should |
| be left for utility personnel to handle. Establishing mutual aid agreements |
| and coordination with the different utility providers (electric, water, and |
| natural gas) is advised. Cross training with utility personnel can be helpful |
| for both entities to help minimize the dangers to both emergency response |
| and utility personnel. Because of the inherent dangers associated with |
| utilities that can be involved in emergency service responses, it is |
| imperative that firefighters know and understand those dangers and how to |
| respond appropriately. |

 |
| **Duration of Lesson** | 4 hours |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * Utility Services Safety Quiz and Key
* Discontinuation of Building Utilities Checklist
* Discussion Rubric
* Presentation Rubric
* Summary Rubric
* Building with utility services
* Drawing materials
* Computers with Internet access
* Projector
 |
| **Anticipatory Set**(May include pre-assessment for prior knowledge) |  |
| **Direct Instruction \*** |

|  |  |  |
| --- | --- | --- |
| I. Utility Safety |  |  |
| A. Natural gas |
| 1. A pure form of methane gas |
| 2. Flammable but not toxic |
| 3. Classified as an asphyxiate because it can displace air in a |
| confined space, leading to suffocation |
| 4. Lighter than air and tends to rise and disperse when |
| not confined |
| 5. Odorless – receives its odor with the addition of mercaptan in |
| order to aid in leak detection |
| 6. Distributed and transferred from wells through surface and |
| subsurface pipes |
| a) | The range of pressure is from 0.25 psi to 1000 psi |
| b) | Pressures in local distribution lines are usual 50 psi or |
|  | less |
| 7. Has explosive limits in concentrations between 5% and 15% |
| in air |  |  |
| 8. May be compressed, stored, and shipped in pressure cylinders |
| identified and marked as Compressed Natural Gas (CNG) |
| 9. May be shipped and stored as Liquefied Natural Gas (LNG) |
| a) | Subject to Boiling Liquid Expanding Vapor Explosion |
|  | (BLEVE) when it is exposed to fire |
| 10. Emergency response |
| a) | Contact your local utility company and request a utility |
|  | emergency response crew with the following resources: |

1. Non-sparking tools
2. Distribution system maps
3. Prior Training
4. Liquefied Petroleum Gas (LPG)
5. Also sometimes referred to as bottled gas
6. There are two main gases classified as LPG
	* 1. Butane
		2. Propane
7. Primarily used as fuel gas in
	* 1. Camping vehicles
		2. Manufactured homes
		3. Agricultural use
		4. Rural homes and businesses where natural gas is not accessible
8. Can be adapted for use in motor vehicles
9. Odorless – has an odorant added to give it a distinct smell
10. Nontoxic, but considered an asphyxiate for the same reasons as natural gas
11. Different from natural gas because it is one and a half times heavier than air and sinks rather than rises
	1. Propane sinks to the lowest point possible and often finds an ignition source
12. Has an explosive range between 1.5% and 10% in air
13. Shipped and distributed in cylinders and tanks on cargo trucks
14. Emergency response in LPG emergencies
	* 1. The supply of gas can be stopped by shutting off a valve at the tank
		2. LPG leaks produce a visible cloud of vapor that hugs the ground and can be dissipated by using 100 gpm or larger fog streams
		3. LPG tanks and cylinders are subject to BLEVE
		4. Firefighters can prevent BLEVE by cooling the top portion of the tank with water
15. Flammable Gas Incidents
	1. Pipe breaks are often caused by excavation equipment
	2. Emergency response
		1. Call the gas utility company immediately
		2. Approach leaks and gas fires from the windward (upwind) side
		3. Evacuate the areas immediately
			1. Surrounding the incident
			2. Downwind from the incident
		4. Follow the department Standard Operating Procedures (SOPs) regarding the crimping or plugging of leaks
		5. If the gas is burning, protect the exposures but do not extinguish the fire until the leak is controlled\
		6. Locate the CNG gas meters and shut them off if the SOP allows
		7. If the meter is involved in the fire, protect the hose team with a wide-angle fog
		8. In the closed position, the valve is at a right angle (perpendicular) to the supply pipe

D. Electrical Emergencies* 1. Electric substations and transmission lines
		1. Always consider the power lines to be charged until the local utility company verifies that they are not
		2. Transmission lines often break and fall, creating fires in dry grass or vegetation
		3. Whenever you encounter fallen electrical lines cordon off or isolate an area equal to one span between telephone (electrical) poles
		4. With associated fires, wait for the fire to burn an area equal to one span between telephone (electrical) poles before extinguishing it
		5. Many local SOPs require notification of the local electrical utility company when this type of incident occurs (the scene is controlled until the utility company arrives)
		6. Only utility personnel should cut electrical wires (they have the training and the appropriate tools for the job)
		7. When it is necessary to shut off power to a building
			1. The main switch
				1. Can be used
				2. Should be locked and tagged out
	2. Transformer involved fires
		1. This type of fire is fairly common
		2. Older transformers are often cooled with a carcinogenic liquid that contains polychlorinated biphenyls (PCBs)
			1. Firefighters must protect themselves from it
		3. Use a dry chemical or carbon dioxide extinguisher to put these fires out
		4. Transformers located at the top of utility poles can be allowed to burn until utility personnel arrive to extinguish the fire from their aerial device
		5. If there is a danger that the transformer may fall prior to the arrival of utility personnel, local policy may allow firefighters to extinguish it with a fog stream
	3. Underground transmission lines
		1. Often located in below grade conduits and vaults, fire separated rooms that encase transformers or large capacity electric motors
		2. The greatest hazard is and explosion caused by blown fuses that ignite accumulated flammable gases underground
		3. Manhole covers
			1. May be blown over a considerable distance
			2. Could injure emergency response personnel and members of the public
		4. Members of the public should be kept a minimum of 300 feet away from the scene
		5. Extinguishment should be made from outside the vault, and the only time a firefighter should enter a vault is for a rescue
		6. Firefighters should use a pike pole to remove the manhole cover – be aware of a possible back draft situation
		7. Once the cover has been removed, extinguishment can be accomplished by using carbon dioxide or dry chemical extinguishers – not water because of the electrical shock hazard
1. High Voltage Installations (Electrical)
	1. Commercial and industrial electrical equipment
		1. Commonly have capacities of 600 volts or greater
		2. Marked with *High-Voltage* signs on their vaults, fire separated rooms that encase transformers or large capacity electric motors
		3. Water (including fog streams) should not be used because of the shock hazard and damage that it may cause to equipment not involved in the fire
		4. PCB laced coolants and chemicals used in insulating the equipment create very toxic smoke which is another danger for firefighters
		5. Full Personal Protective Equipment (PPE) including Self-Contained Breathing Apparatus (SCBA) must be worn by firefighters
		6. A tag line should be monitored from outside, and a Rapid Intervention Team (RIT) or Rapid Intervention Crew (RIC) should be in place
		7. All searches should be done using clenched fists or the back of the hand to prevent involuntarily grabbing energized equipment as a result of reflex reaction
		8. All firefighters exposed to smoke or other toxins should be properly decontaminated after the incident
2. Securing Electrical Power
	1. Deciding to shut off or leave on the power
		1. It might be recommended to leave the power on at some structural fires to
			1. Provide lighting
			2. Supply fire pumps, ventilation equipment, and other systems in the building
		2. The Incident Commander (IC) will make the call, perhaps after speaking with the Incident Safety Officer (ISO)
		3. Having control over the electrical power is necessary when firefighters are performing emergency operations in a building
		4. It is not always necessary to shut power off to an entire building if the fire is isolated in one area of the building
		5. If the building becomes involved or damaged to the point that electrical power becomes a hazard, the power should be turned off at the main panel or power source
			1. It is preferred that an electric company employee do this
			2. Follow the local SOPs
		6. At some facilities, removing the electrical meter will not entirely shut off the power to a building
			1. Be aware of installations of auxiliary power generators for emergency power
			2. Ask for assistance from electric company employees
		7. Be aware of pirated utilities
			1. Often used in drug labs and marijuana growing operations
			2. Not charged to the meter, so the power companies are not aware of the increase in power at the address
			3. The perpetrators may go undetected by law enforcement for a long time
			4. Firefighters should cautiously watch for
				1. Makeshift wiring
				2. Toxic and or flammable chemicals
				3. Man traps (booby traps) set by the building occupants
3. Electrical Hazards and Injuries
	1. Consequences of electrical shock
		1. Electrocution associated with high-voltage equipment
		2. Electrocution associated with conventional residential current
		3. Cardiac arrest
		4. Ventricular fibrillation – an abnormal, irregular heart rhythm characterized by very rapid, uncoordinated fluttering contractions of the lower chambers (ventricles) of the heart
		5. Respiratory arrest
		6. Muscular contractions
		7. Paralysis
		8. Burns- electrical heat that causes arcing can create temperatures in excess of 2000 degrees Fahrenheit
		9. joint Damage

H. Safety Principles for Electrical Emergencies* 1. Create exclusion zones equal to one span in all directions from the downed power lines
	2. Be watchful for weakened wires that may fall
	3. Wear full PPE
	4. Use tested and approved insulated tools
	5. Guard against shocks, burns, and eye injuries from electrical arcs
	6. Wait for electrical utility employees to cut the power lines
	7. Use lockout/tagout devices to secure electrical power supplies
	8. Check for overhead electrical obstructions when using ladders
	9. Do not touch any vehicle that is in contact with electrical wires
	10. Jump clear of apparatus that may be energized from fallen wires while keeping both feet together
	11. Do not use solid or straight streams on electrical fires
	12. Use fog streams with at least 100 psi nozzle pressure on electrical equipment
	13. Avoid ground gradient hazards by maintaining a safety zone when dealing with downed electrical wires
	14. Remember that voltage drops as it spreads away from the source

Muscular *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
 |
| **Guided Practice \*** | Discontinuation of Utility Services. Have students locate, identify, and shut off the following in a building or residence secured for this skill. Use the Discontinuation of Building Utilities Checklist for assessment.* Electric main panel
* Gas service cutoff
* Water meter valve

*Note*: Students must not manipulate any utility service that they have notbeen trained to shut off, or that would normally be the responsibility of utility personnel. This activity involves shutting off switches and closing valves. Nothing beyond this basic scope of training should be attempted.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
 |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | The students will do a residential home survey and locate the utility service drops for their home. They will draw a site plan of their home showing the location of the following utilities:* Main electric service (commonly located on the outside of the home)
* Main electric fuse box (commonly located in the garage or in the utility room of most homes)
* Natural gas meter (commonly located on the outside of the home)
* Water utility shut off (commonly located between the street and sidewalk)

Have the students make a brief presentation of their site plan. Use the Presentation Rubric for assessment.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
 |
| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | * Utility Services Safety Quiz and Key
* Discontinuation of Building Utilities Checklist
* Discussion Rubric
* Presentation Rubric
* Summary Rubric

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
 |
| **References/Resources/****Teacher Preparation** | 0135151112, *Essentials of Firefighting* (5th Edition), *International Fire* *Service Training Association (IFSTA),* 20081428339825, *Firefighter's Handbook: Firefighter I and Firefighter II* (1st Edition), Delmar Cengage Learning, 2008Do an Internet search for the following: fire fighter close calls |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | English/Language Arts Standards IV. Listening B. Listen Effectively in informal and formal situations 2. Listen Actively and effectively in one-on-one situations |
| **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 visit a website and select a news story about a firefighter or firefighters injured in a structural fire. (To find an article do an Internet search for the following: fire fighter close calls.) They will determine if utilities were a factor in the injury. Use the Summary Rubric for assessment. |
| **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)