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| **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** | Fire Service Ladders |
| **TEKS Student Expectations** | **130.335. (c) Knowledge and Skills**(5) The student explains the purpose of the National Fire Protection Association standards applicable to fire service ground ladders. The student is expected to:(A) identify the materials used in ladder construction and the features(B) describe and demonstrate inspection and maintenance procedures for different types of ground ladders and describe procedures for conducting an annual service test on ground ladders(C) identify the load capacities for ground ladders(D) identify and select a ladder for a given task(E) demonstrate raising and positioning ground ladders(F) describe and demonstrate securing a ladder(G) explain and demonstrate proper ladder climbing techniques while transporting tools and equipment or assisting a person with a simulated injury(H) demonstrate the deployment of a roof ladder on a pitched roof |
| **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:* Identify the parts of a ladder
* Identify different ladder types and their uses
* Explain ladder inspection and maintenance procedures
* Demonstrate the proper handling of ground ladders
* Demonstrate the proper raising and positioning of ground ladders
* Demonstrate proper climbing techniques in various fire service related circumstances
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| **Rationale** | It is necessary for firefighters to understand the design, characteristics and uses of fire service ground ladders. Ladders can be used for rescue purposes as well as for firefighting. They provide access to elevated locations and are often the only means of escape from life-threatening situations. This chapter will discuss the safe and effective use of ground ladders in the fire service. |
| **Duration of Lesson** | This lesson should take 8 lectures, 4 hours skills demonstration. |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * Fire Service Ladder Components Worksheet 1a
* Fire Service Ladder Components Worksheet 1b
* 14-foot straight wall ladder or roof ladder
* 24-foot extension ladder
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Lead the students in a discussion pertaining to fire service tools and equipment, and how ladders fit into the equation. Ask them to list circumstances in which firefighters would need to use ladders, and what would happen if firefighters did not have ladders available at their discretion. Use the Discussion Rubric for assessment. |
| **Direct Instruction \*** | I. Ladder Partsa. Beam – the main structural member(s) of a ladder. They support the rungs, or rung blocks, that the rungs attach to.b. Bed/base/main section – the lowest and widest section of an extension ladder. This section is always in contact with the ground.c. Butt, heel, or base – the bottom of the ladder that is placed on the groundd. Butt spurs – metal plates, spikes, or cleats attached at the butt to prevent the ladder from sliding or slippinge. Dogs, locks, pawls – devices attached to the inside of the beams of extension ladders to hold the fly section in place after it is extendedf. Fly section – the upper section(s) of extension ladders and some combination ladders. Fly sections are the sections that move.g. Footpads/shoes – swivel plates attached to the butt of the ladder. They usually have rubber or neoprene bottomsh. Guides – slots or channels on an extension ladder that hold the fly sections in place while they are being raisedi. Halyard – the rope or cable that is used to hoist and lower the fly sections of extension laddersj. Heat sensor label – attached to the inside of each beam in each ladder section. By changing color, they indicate if the ladder has been exposed to excessive heat, requiring testing before further use.k. Hooks – installed near the top end of a roof ladder to secure the ladder to the highest point on a peaked roofl. Protection plates – pieces of metal attached to a ladder at chafing points, where the ladder may come in contact with the apparatus mounting bracketsm. Pulley – the small grooved wheel that the halyard travels on as an extension ladder is raised or loweredn. Rails – the two lengthwise members of a truss ladder that are separated by truss or separation blockso. Rungs – the cross members of a ladder that the climber steps upon. The rungs extend from one beam to the other, except on pompier ladders, where the rungs run through a single beamp. Stops – wooden or metal pieces of the ladder that prevent the fly section from being overextendedq. Tie rods – metal rods that extend from one beam to the other to hold wooden ladders together. They are located directly beneath the rungs at different levelsr. Tip/top – the extreme tip or top of a ladders. Truss block – spacers set between the top and bottom rails of a trussed ladder. They sometimes support rungsII. Ladder Typesa. Single laddersi. Single ladders1. Consist of one fixed-length section2. Identified by their overall lengtha. 6 to 32 feetb. Most common lengths range from 12 to 24 feet.3. Also calleda. Wall laddersb. Straight (wall) ladders4. Used for quick access to windows and roofs of one and two-story buildingsii. Roof ladders1. Single ladders equipped with folding hooks that can anchor over the ridge of pitched roofs2. When in the proper position, they lie flat on the roof surface so that firefighters may work from the ladder3. The ladder evenly distributes the weight of the firefighter and helps to prevent slipping4. Can be used as single wall ladders5. Range from 12 to 24 feet in lengthiii. Folding ladders (Attic ladders)1. Single ladders that are most often used to access attics2. They have hinged rungs that allow the beams to rest against each other when the ladder is closed3. Folding ladders range from 8 to 16 feet in length4. The most common length is 10 feetb. Extension laddersi. Extension ladders1. Have a bed or base section and one or more fly sections that extend the ladder’s length2. Are adjustable to the length needed to access roofs and windows3. Range in length from 12 to 39 feetii. Pole ladders1. Extension ladders with poles attached to swivels at the top of the bed section that add leverage and stability when the ladder is being raised2. NFPA 1931 requires that ladders 40 feet or longer be equipped with staypoles3. Pole ladders are constructed with two to four sections and most modern pole ladders are no longer than 50 feetc. Combination laddersi. Are designed to be a self-supporting step ladder (A-frame), a single ladder, or an extension ladderii. Range from 8 to 14 feet in lengthiii. The most popular length is 10 feetiv. Must be equipped with positive locking devices to secure the ladder when in the open positiond. Pompier laddersi. Often referred to as scaling laddersii. They are single beam ladders with rungs extending through the beam, and projecting from both sidesiii. They have large metal “goosenecks” that are used to hook onto window sills or other openingsiv. Are used to climb from floor to floor, through the use of exterior windows or openingsv. Range from 10 to 16 feet in lengthIII. Ladder Construction (advantages and disadvantages)a. Metali. A good conductor of heat, cold, and electricityii. Easy to repairiii. May fail suddenly when exposed to heat or flameiv. Metal ladders come in the widest range of sizesb. Woodi. The most expensive of all ladder typesii. Also the heaviest per footiii. Retain strength when exposed to heat or flameiv. They are very durablec. Fiberglassi. Are generally poor conductors of electricityii. May suddenly crack or fail when overloadediii. May burn when exposed to flameIV. Ladder Inspection and Maintenancea. Ladders must conform to NFPA 1931: they are required to have a certification label (applied by the manufacturer) verifying that the ladder meets NFPA standardsb. Maintenancei. The difference between maintenance and repair1. Maintenance – keeping in a state of usefulness or readiness2. Repair – restore or replace what is damaged or worn outii. Ladders must be serviced and tested1. Before being put into use2. Annually3. After exposure to high heat4. After exposure to rough treatmentiii. General maintenance requirements1. Keep ladders free from moisture2. Do not expose ladders to vehicle exhaust or engine heat3. Do not store ladders where they will be exposed to the elements4. Do not paint ladders, except for the top and bottom 18 inches of the beams for the purpose of identification or visibilityV. Cleaning Laddersa. Dirt and debris on ladders can cause them to malfunctionb. A soft bristle brush and running water are the most effective method of cleaning accumulated dirt from a ladderc. Tar, oil, and greasy residue should be removed with mild soap and water, or solvents that are safe for the environmentd. Always wipe wet ladders dry when you finish cleaning theme. As ladders are being cleaned, firefighters should look for damage or wear, and any defects should be dealt with according to department Standard Operating Procedures (SOPs)f. Lubricants should be applied according to manufacturer’s specifications to allow for the proper operation of the ladderVI. Inspection and Service Testing Laddersa. NFPA 1932 is the standard for ground ladder testing; it requires ladders to be inspected monthly, and after each useb. All ground ladders should be tested prior to being put into servicec. Ladder testing should be done by approved testing organizations or approved fire service personneld. Inspections should include:i. Verification of heat sensing labels (look for a change in color, indicating heat exposure)ii. Rungs for damage and weariii. Rungs for tightnessiv. Bolts and rivets for tightnessv. Welds for cracks and/or defectsvi. Beams and rungs for cracks, splintering, breaks, gouges, checks, wavy conditions, or deformatione. Inspection of wooden ladders and ladders with wooden componentsi. Ladder finishes that are chafed or scrapedii. Darkened varnish (indicates exposure to heat)iii. Dark streaks in the wood (indicates deterioration of the wood)iv. Marred, worn, cracked, or splintered partsv. Rounded or smooth shoesvi. Water damagef. Roof laddersi. Make sure the roof hook assemblies operate smoothlyii. Look for signs of rustiii. Deformed hooksiv. Parts firmly attached with no signs of being looseg. Extension laddersi. Check the following:1. Pawl assemblies (hooks and fingers should move in and out freely)2. Halyard should be replaced if damaged3. Halyard cables should be taut when the ladder is bedded4. Make sure pulleys spin freely5. Make sure ladder guides are in place and that the ladder can move freely6. Staypole toggles and the mechanisms used for detachable staypoles should be checked to make sure that they move and operate freelyh. If any repairs are necessary, the ladder should be removed from service until it can be repaired and testedi. Ladders that cannot be repaired need to be destroyed or scrapped for partsVII. NFPA Requirementsa. NFPA 1901, Standard for Automotive Fire Apparatus, specifies the minimum length and types of ladders to be carried on pumpers/engine companies:i. One roof ladderii. One extension ladder (recommended to be 35 feet in areas where no ladder trucks are in service)iii. One attic ladderb. NFPA 1901, Standard for Automotive Fire Apparatus, specifies that aerial ladders must carry the following:i. One10-foot or longer attic ladderii. Two roof ladders that are at least 16 feet longiii. One combination ladder at least 14 feet longiv. One 24-foot or longer extension ladderv. One 35-foot extension ladderc. Ladder safetyi. Choose the proper ladder for the jobii. Wear appropriate Personal Protective Equipment (PPE) when working on a ladderiii. Use your leg muscles when lifting ladders below the waistiv. Do not raise ladders within 10 feet of electrical linesv. Place the ladder at the proper climbing angle (approximately 75 degrees)vi. Do not overload the ladder (one firefighter every 10 feet, or one per section)vii. Tie in with a leg lock or a ladder belt when working from a ladderviii. Use ladders for their intended purposesix. Inspect ladders for damage or wear after each used. Selecting the proper ladder for the jobi. Residential stories average about 10 feet, and the distance between the floor and the window averages about 3 feetii. Commercial stories average about 12 feet from floor to floor, and the distance between the floor and the windowsill averages 4 feetiii. The base of the ladder should be able to be placed 1/4 of the vertical distance from the ground to where the ladder comes in contact with the walliv. The optimum climbing angle is approximately 75 degreesv. Ladders should extend three to five rungs beyond the roof edge to provide safe footing and handholds to step off the ladder.vi. The tip of the ladder should be placed even with the top of the window and on the windward side (upwind), to gain access into narrow windows or to ventilatevii. The ladder tip should be placed just below the windowsill to facilitate rescuesVIII. Proper Lifting and Lowering Methodsa. Have the proper number of personnel for the jobb. When raising a ladder bend your knees, keeping your back as straight as possible, and lift with your legsc. When 2 or more firefighters are lifting, the firefighter at the butt end should give the ladder commandsd. When lowering a ladder use your leg musclesIX. Ladder Carriesa. One Firefighter Low-Shoulder Carryi. Rest the ladder’s upper beam on your shoulder, while your arm goes between two rungs (Single or Roof Ladder)ii. Carry the butt end of the ladder in front, slightly loweredb. Two Firefighter Low-Shoulder Carryi. Most commonly used for 24-, 28-, and 35-foot extension laddersii. Allows for excellent control of the ladderiii. The forward firefighter (at the butt) places his or her free hand over the upper butt spur, in order to prevent injury if there is a collision while the ladder is being carriedc. Three Firefighter Flat-Shoulder Carryi. Usually used on extension ladders up to 35 feet in lengthii. There are two firefighters on one side of the ladder (one on each end), and a single firefighter on the opposite side of the ladder in the middled. Four Firefighter Flat-Shoulder Carryi. The ladder is carried on the flat, as in the three firefighter flat-shoulder carry, except for the positioningii. There are two firefighters on each end of the ladder, opposite each othere. Two Firefighter Arm’s Length On-Edge Carryi. Best performed with lightweight laddersii. The firefighters are positioned on the bed-section of the ladder while the ladder is in a vertical position (on-edge)f. Special Procedures for Carrying Roof Laddersi. In some cases, a firefighter may have to carry a roof ladder tip forward, as opposed to butt forward. The firefighters will use the low-shoulder method with the hooks or tip forwardii. This occurs if the firefighters intend on climbing another ground ladder to allow them to place the roof ladder, with the hooks deployed, on a sloped roofX. Positioning Ground Laddersa. Responsibility for positioningi. Officers usually choose the general location on which a ladder is to be raisedii. Personnel carrying the ladder most often decide on the exact location where the ladder will be raisediii. The firefighter at the butt end makes the decision about where to raise the ladder (If there are two firefighters at the butt end, the firefighter on the right side is responsible for choosing its placement)iv. This procedure changes from department to department. Check your department’s protocolsb. Factors affecting ladder placementi. Ladders should always be placed properly for their intended useii. Make sure the butt is the proper distance from the buildingiii. To break a window for ventilation1. Place the ladder alongside the window on the windward side2. The tip of the ladder should be even with the top of the window3. The same method can be used to climb in and out of narrow windows, or to direct hose streams into themiv. For entry or rescue from a window1. Place the ladder tip slightly below the sill2. If the window is wide enough to permit the ladder tip to project into it, and allow entry and exit for firefighters to perform a rescue, place the ladder so that two or three rungs extend above the sillv. Miscellaneous guidelines1. Place ladders at a minimum of two points on different sides of the building to allow for emergency egress if necessary2. Try not to place ladders over windows, doors, or other openings where the ladder may be exposed to heat or flame3. Take advantage of the building’s construction when placing a ladder (such as the corners)4. Raise the ladder directly in front of the window if you are going to use the ladder to support a smoke ejector. Place the ladder tip on the wall directly above the window opening5. Don’t place ladders where there are overhead obstructions6. Try not to place ladders on uneven terrain7. Avoid placing ladders in avenues of egress; attempt to place ladders to the side of openings where firefighters need to gain entry, or where evacuation may occur8. Avoid heat and flames whenever possible9. Don’t place ladders on top of trapdoors, grates, or manholes that are located on sidewalks or streets10. The desired angle of inclination is approximately 75 degrees11. Proper distance between the heel of the ladder and the building can be determined by dividing the length of the ladder used by 4XI. Securing the Laddera. For safety, ladders must be secure before firefighters climb or work on themi. On extension ladders1. Make sure the ladder locks are locked2. Tie the halyard with a clove hitch and an overhand safety knotii. Prevent movement of the ladder by tying the ladder in, or by heeling the ladderb. Several methods for heeling a ladderi. Underneath the ladder method1. Stand beneath the ladder with feet shoulder’s width apart, and one foot slightly in front of the other2. Grasp the beams at about eye level and then pull backward, pulling the ladder against the building3. Wear head and eye protection4. Do not look up as someone climbs the ladder5. Grasp the beams and not the rungs6. Be aware of the potential for falling objectsii. Outside the ladder method1. Stand on the outside of the ladder and chock or secure the ladder with one foot placed against the beam at the butt or on the bottom rung2. Grasp the beams with your hands and press the ladder against the building3. Stay alert for firefighters coming down the ladderiii. Tying in1. Tie the ladder securely to an object whenever possible, to prevent it from slipping or pulling away from the building2. Use a hose, rope, tool, or strap to secure it3. This frees you from having to stay with the ladder to secure itXII. Climbing and descending laddersa. Should be done smoothly, with as little bounce or sway as possibleb. Keep knees bent to ease the weight onto each rung and aid in making the climb or descent smoothc. Keep your body perpendicular to the ground to help maintain balanced. Keep your eyes focused forward, occasionally looking at the tip of the laddere. Keep your arms straight (horizontal) during the climb to keep your body away from the ladder and allow for freedom of movementf. Keep your hands on the rungs, palms down with thumbs under the rung, when not carrying equipmentg. Grasp alternate rungs while climbingh. Coordinate your hand and foot movements so that your right hand and left foot are in contact with the ladder as you move your left hand and right foot to the next rungsi. Use your leg muscles to push yourself upwardj. Do not reach your arms and hands above your head while climbing, to maintain adequate space between your body and the ladderk. Develop form as you practice; speed comes with repetitionl. If you are required to carry equipment as you climb, slide your free hand under a beam as you climb maintaining constant contact with the ladder, and hoist tools and equipment whenever possibleXIII. Working from a Laddera. Firefighters must work with both hands while working from a ladderb. Use a ladder belt or leg lock to make sure both hands are free to workc. If a ladder belt is used, it should be securely tightened around the waist and attached to a rungd. A leg lock can be used to secure a firefighter to a ladder, with the leg opposite the side of the ladder your hands are working onXIV. Assisting Victims Down Laddersa. Ladder placementi. Rescue from a window requires the ladder to be placed just below the sillii. To bring victims down a ladder, at least four firefighters are needed:1. Two inside the building2. One or two on the ladder3. One heeling the ladderb. Conscious victims can be lowered feet-first (facing the building) onto the ladderc. An unconscious victim can be held on the ladder the same way as a conscious victim, with the victim’s weight resting on the rescuer’s kneei. The victim’s feet are placed outside the railsii. The rescuer must grasp the rungs to provide a secure hold on the ladder, and to help prevent the victim’s head from hitting the ladderiii. The unconscious victim can also be turned around, facing the rescuer to reduce the chance of the victim’s limbs catching on the rungsiv. The victim’s weight is supported at the crotch by one of the rescuer’s arms and at the chest by the other armv. Extraordinarily heavy victims will require two rescuers:1. Two ground ladders are placed side-by-side2. One rescuer supports the victim’s waist and legs3. The second rescuer supports the victims head and upper torsod. Small children may be brought down a ladder cradled across the rescuer’s arms |
| **Guided Practice \*** | Provide a ladder, for demonstration purposes, to complete the following activities:* Review all parts of a ladder using the Ladder Components Worksheets
* Demonstrate the following skills and have the students use skills sheets for practice:
	+ Tying a halyard
	+ One firefighter low-shoulder carry
	+ Heeling a ladder from the outside and underneath
	+ Raise and lower a ladder
	+ Deploy a roof ladder
	+ Assist a conscious victim down the ladder
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| **Independent Practice/Laboratory Experience/Differentiated Activities \*** |  |
| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | * Fire Service Ladders Quiz and Key
* Assist a Conscious Victim Method Checklist
* Deploy a Roof Ladder One Firefighter Method Checklist
* Heeling the Ladder from the Outside Checklist
* Heeling the Ladder from Underneath Checklist
* One Firefighter Low-Shoulder Carry Checklist
* Raise and Lower a Ladder One Firefighter Method Checklist
* Tie a Halyard Checklist
* Discussion Rubric
 |
| **References/Resources/****Teacher Preparation** | * ISBN: 1418001775, *Introduction to Fire Protection* (3rd Edition)*,* Klinoff, Robert
* 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)** | English Language ArtsIV. ListeningB. Listen effectively in informal and formal situations1. Listen critically and respond appropriately to presentations.2. Listen actively and effectively in one-on-one situations3. 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) | Students will practice additional ladder methods. |
| **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)