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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 |
| **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 |
| **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 Parts  a. 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 ground  d. Butt spurs – metal plates, spikes, or cleats attached at the butt to prevent the ladder from sliding or slipping  e. Dogs, locks, pawls – devices attached to the inside of the beams of extension ladders to hold the fly section in place after it is extended  f. 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 bottoms  h. Guides – slots or channels on an extension ladder that hold the fly sections in place while they are being raised  i. Halyard – the rope or cable that is used to hoist and lower the fly sections of extension ladders  j. 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 roof  l. Protection plates – pieces of metal attached to a ladder at chafing points, where the ladder may come in contact with the apparatus mounting brackets  m. Pulley – the small grooved wheel that the halyard travels on as an extension ladder is raised or lowered  n. Rails – the two lengthwise members of a truss ladder that are separated by truss or separation blocks  o. 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 beam  p. Stops – wooden or metal pieces of the ladder that prevent the fly section from being overextended  q. 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 levels  r. Tip/top – the extreme tip or top of a ladder  s. Truss block – spacers set between the top and bottom rails of a trussed ladder. They sometimes support rungs  II. Ladder Types  a. Single ladders  i. Single ladders  1. Consist of one fixed-length section  2. Identified by their overall length  a. 6 to 32 feet  b. Most common lengths range from 12 to 24 feet.  3. Also called  a. Wall ladders  b. Straight (wall) ladders  4. Used for quick access to windows and roofs of one and two-story buildings  ii. Roof ladders  1. Single ladders equipped with folding hooks that can anchor over the ridge of pitched roofs  2. When in the proper position, they lie flat on the roof surface so that firefighters may work from the ladder  3. The ladder evenly distributes the weight of the firefighter and helps to prevent slipping  4. Can be used as single wall ladders  5. Range from 12 to 24 feet in length  iii. Folding ladders (Attic ladders)  1. Single ladders that are most often used to access attics  2. They have hinged rungs that allow the beams to rest against each other when the ladder is closed  3. Folding ladders range from 8 to 16 feet in length  4. The most common length is 10 feet  b. Extension ladders  i. Extension ladders  1. Have a bed or base section and one or more fly sections that extend the ladder’s length  2. Are adjustable to the length needed to access roofs and windows  3. Range in length from 12 to 39 feet  ii. Pole ladders  1. Extension ladders with poles attached to swivels at the top of the bed section that add leverage and stability when the ladder is being raised  2. NFPA 1931 requires that ladders 40 feet or longer be equipped with staypoles  3. Pole ladders are constructed with two to four sections and most modern pole ladders are no longer than 50 feet  c. Combination ladders  i. Are designed to be a self-supporting step ladder (A-frame), a single ladder, or an extension ladder  ii. Range from 8 to 14 feet in length  iii. The most popular length is 10 feet  iv. Must be equipped with positive locking devices to secure the ladder when in the open position  d. Pompier ladders  i. Often referred to as scaling ladders  ii. They are single beam ladders with rungs extending through the beam, and projecting from both sides  iii. They have large metal “goosenecks” that are used to hook onto window sills or other openings  iv. Are used to climb from floor to floor, through the use of exterior windows or openings  v. Range from 10 to 16 feet in length  III. Ladder Construction (advantages and disadvantages)  a. Metal  i. A good conductor of heat, cold, and electricity  ii. Easy to repair  iii. May fail suddenly when exposed to heat or flame  iv. Metal ladders come in the widest range of sizes  b. Wood  i. The most expensive of all ladder types  ii. Also the heaviest per foot  iii. Retain strength when exposed to heat or flame  iv. They are very durable  c. Fiberglass  i. Are generally poor conductors of electricity  ii. May suddenly crack or fail when overloaded  iii. May burn when exposed to flame  IV. Ladder Inspection and Maintenance  a. Ladders must conform to NFPA 1931: they are required to have a certification label (applied by the manufacturer) verifying that the ladder meets NFPA standards  b. Maintenance  i. The difference between maintenance and repair  1. Maintenance – keeping in a state of usefulness or readiness  2. Repair – restore or replace what is damaged or worn out  ii. Ladders must be serviced and tested  1. Before being put into use  2. Annually  3. After exposure to high heat  4. After exposure to rough treatment  iii. General maintenance requirements  1. Keep ladders free from moisture  2. Do not expose ladders to vehicle exhaust or engine heat  3. Do not store ladders where they will be exposed to the elements  4. Do not paint ladders, except for the top and bottom 18 inches of the beams for the purpose of identification or visibility  V. Cleaning Ladders  a. Dirt and debris on ladders can cause them to malfunction  b. A soft bristle brush and running water are the most effective method of cleaning accumulated dirt from a ladder  c. Tar, oil, and greasy residue should be removed with mild soap and water, or solvents that are safe for the environment  d. Always wipe wet ladders dry when you finish cleaning them  e. 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 ladder  VI. Inspection and Service Testing Ladders  a. NFPA 1932 is the standard for ground ladder testing; it requires ladders to be inspected monthly, and after each use  b. All ground ladders should be tested prior to being put into service  c. Ladder testing should be done by approved testing organizations or approved fire service personnel  d. Inspections should include:  i. Verification of heat sensing labels (look for a change in color, indicating heat exposure)  ii. Rungs for damage and wear  iii. Rungs for tightness  iv. Bolts and rivets for tightness  v. Welds for cracks and/or defects  vi. Beams and rungs for cracks, splintering, breaks, gouges, checks, wavy conditions, or deformation  e. Inspection of wooden ladders and ladders with wooden components  i. Ladder finishes that are chafed or scraped  ii. Darkened varnish (indicates exposure to heat)  iii. Dark streaks in the wood (indicates deterioration of the wood)  iv. Marred, worn, cracked, or splintered parts  v. Rounded or smooth shoes  vi. Water damage  f. Roof ladders  i. Make sure the roof hook assemblies operate smoothly  ii. Look for signs of rust  iii. Deformed hooks  iv. Parts firmly attached with no signs of being loose  g. Extension ladders  i. Check the following:  1. Pawl assemblies (hooks and fingers should move in and out freely)  2. Halyard should be replaced if damaged  3. Halyard cables should be taut when the ladder is bedded  4. Make sure pulleys spin freely  5. Make sure ladder guides are in place and that the ladder can move freely  6. Staypole toggles and the mechanisms used for detachable staypoles should be checked to make sure that they move and operate freely  h. If any repairs are necessary, the ladder should be removed from service until it can be repaired and tested  i. Ladders that cannot be repaired need to be destroyed or scrapped for parts  VII. NFPA Requirements  a. 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 ladder  ii. One extension ladder (recommended to be 35 feet in areas where no ladder trucks are in service)  iii. One attic ladder  b. NFPA 1901, Standard for Automotive Fire Apparatus, specifies that aerial ladders must carry the following:  i. One10-foot or longer attic ladder  ii. Two roof ladders that are at least 16 feet long  iii. One combination ladder at least 14 feet long  iv. One 24-foot or longer extension ladder  v. One 35-foot extension ladder  c. Ladder safety  i. Choose the proper ladder for the job  ii. Wear appropriate Personal Protective Equipment (PPE) when working on a ladder  iii. Use your leg muscles when lifting ladders below the waist  iv. Do not raise ladders within 10 feet of electrical lines  v. 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 ladder  viii. Use ladders for their intended purposes  ix. Inspect ladders for damage or wear after each use  d. Selecting the proper ladder for the job  i. Residential stories average about 10 feet, and the distance between the floor and the window averages about 3 feet  ii. Commercial stories average about 12 feet from floor to floor, and the distance between the floor and the windowsill averages 4 feet  iii. 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 wall  iv. The optimum climbing angle is approximately 75 degrees  v. 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 ventilate  vii. The ladder tip should be placed just below the windowsill to facilitate rescues  VIII. Proper Lifting and Lowering Methods  a. Have the proper number of personnel for the job  b. When raising a ladder bend your knees, keeping your back as straight as possible, and lift with your legs  c. When 2 or more firefighters are lifting, the firefighter at the butt end should give the ladder commands  d. When lowering a ladder use your leg muscles  IX. Ladder Carries  a. One Firefighter Low-Shoulder Carry  i. 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 lowered  b. Two Firefighter Low-Shoulder Carry  i. Most commonly used for 24-, 28-, and 35-foot extension ladders  ii. Allows for excellent control of the ladder  iii. 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 carried  c. Three Firefighter Flat-Shoulder Carry  i. Usually used on extension ladders up to 35 feet in length  ii. 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 middle  d. Four Firefighter Flat-Shoulder Carry  i. The ladder is carried on the flat, as in the three firefighter flat-shoulder carry, except for the positioning  ii. There are two firefighters on each end of the ladder, opposite each other  e. Two Firefighter Arm’s Length On-Edge Carry  i. Best performed with lightweight ladders  ii. 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 Ladders  i. 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 forward  ii. 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 roof  X. Positioning Ground Ladders  a. Responsibility for positioning  i. Officers usually choose the general location on which a ladder is to be raised  ii. Personnel carrying the ladder most often decide on the exact location where the ladder will be raised  iii. 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 protocols  b. Factors affecting ladder placement  i. Ladders should always be placed properly for their intended use  ii. Make sure the butt is the proper distance from the building  iii. To break a window for ventilation  1. Place the ladder alongside the window on the windward side  2. The tip of the ladder should be even with the top of the window  3. The same method can be used to climb in and out of narrow windows, or to direct hose streams into them  iv. For entry or rescue from a window  1. Place the ladder tip slightly below the sill  2. 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 sill  v. Miscellaneous guidelines  1. Place ladders at a minimum of two points on different sides of the building to allow for emergency egress if necessary  2. Try not to place ladders over windows, doors, or other openings where the ladder may be exposed to heat or flame  3. 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 opening  5. Don’t place ladders where there are overhead obstructions  6. Try not to place ladders on uneven terrain  7. 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 occur  8. Avoid heat and flames whenever possible  9. Don’t place ladders on top of trapdoors, grates, or manholes that are located on sidewalks or streets  10. The desired angle of inclination is approximately 75 degrees  11. Proper distance between the heel of the ladder and the building can be determined by dividing the length of the ladder used by 4  XI. Securing the Ladder  a. For safety, ladders must be secure before firefighters climb or work on them  i. On extension ladders  1. Make sure the ladder locks are locked  2. Tie the halyard with a clove hitch and an overhand safety knot  ii. Prevent movement of the ladder by tying the ladder in, or by heeling the ladder  b. Several methods for heeling a ladder  i. Underneath the ladder method  1. Stand beneath the ladder with feet shoulder’s width apart, and one foot slightly in front of the other  2. Grasp the beams at about eye level and then pull backward, pulling the ladder against the building  3. Wear head and eye protection  4. Do not look up as someone climbs the ladder  5. Grasp the beams and not the rungs  6. Be aware of the potential for falling objects  ii. Outside the ladder method  1. 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 rung  2. Grasp the beams with your hands and press the ladder against the building  3. Stay alert for firefighters coming down the ladder  iii. Tying in  1. Tie the ladder securely to an object whenever possible, to prevent it from slipping or pulling away from the building  2. Use a hose, rope, tool, or strap to secure it  3. This frees you from having to stay with the ladder to secure it  XII. Climbing and descending ladders  a. Should be done smoothly, with as little bounce or sway as possible  b. Keep knees bent to ease the weight onto each rung and aid in making the climb or descent smooth  c. Keep your body perpendicular to the ground to help maintain balance  d. Keep your eyes focused forward, occasionally looking at the tip of the ladder  e. Keep your arms straight (horizontal) during the climb to keep your body away from the ladder and allow for freedom of movement  f. Keep your hands on the rungs, palms down with thumbs under the rung, when not carrying equipment  g. Grasp alternate rungs while climbing  h. 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 rungs  i. Use your leg muscles to push yourself upward  j. Do not reach your arms and hands above your head while climbing, to maintain adequate space between your body and the ladder  k. Develop form as you practice; speed comes with repetition  l. 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 possible  XIII. Working from a Ladder  a. Firefighters must work with both hands while working from a ladder  b. Use a ladder belt or leg lock to make sure both hands are free to work  c. If a ladder belt is used, it should be securely tightened around the waist and attached to a rung  d. 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 on  XIV. Assisting Victims Down Ladders  a. Ladder placement  i. Rescue from a window requires the ladder to be placed just below the sill  ii. To bring victims down a ladder, at least four firefighters are needed:  1. Two inside the building  2. One or two on the ladder  3. One heeling the ladder  b. Conscious victims can be lowered feet-first (facing the building) onto the ladder  c. 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 knee  i. The victim’s feet are placed outside the rails  ii. 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 ladder  iii. The unconscious victim can also be turned around, facing the rescuer to reduce the chance of the victim’s limbs catching on the rungs  iv. The victim’s weight is supported at the crotch by one of the rescuer’s arms and at the chest by the other arm  v. Extraordinarily heavy victims will require two rescuers:  1. Two ground ladders are placed side-by-side  2. One rescuer supports the victim’s waist and legs  3. The second rescuer supports the victims head and upper torso  d. 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 |
| **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 Arts  IV. Listening  B. Listen effectively in informal and formal situations  1. 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) | 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)