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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, and Security |
| **Course Name** | Firefighter I |
| **Lesson/Unit Title** | Self-Contained Breathing Apparatus (SCBA) Types and Uses |
| **TEKS Student Expectations** | **130.334. (c) Knowledge and Skills**(11) The student analyzes the internal systems that sustain life in the human body and identifies the physical requirements of a self-contained breathing apparatus wearer.(D) The student is expected to identify respiratory hazards during firefighting that require the use of respiratory protection(E) The student is expected to identify the different types of self-contained breathing apparatus (F) The student is expected to describe the safety features and function of the open circuit self-contained breathing apparatus(14) The student identifies the types and components of fire service protective clothing and personal protective equipment.(F) The student is expected to demonstrate the donning and doffing of personal protective equipment such as helmet with eye protection, hood, boots, gloves, protective coat and trousers, self-contained breathing apparatus, and personal alert safety system device |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** |

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| The students will be able to: |
| Describe the hazardous environments that require the use of |
| respiratory protection |
| Identify the types of self-contained breathing apparatus |
| Describe the safety features and the function of the open circuit self- |
| contained breathing apparatus |
| Describe the operational check of a SCBA and a (personal alert safety |
| system) PASS device |
| Demonstrate an operational check of SCBA and a PASS device |

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| **Rationale** | Wearing SCBA protects the firefighter’s respiratory system from superheated atmospheres, toxic gases, and other hazards associated with atmospheres that are Immediately Dangerous to Life and Health (IDLH). Firefighters can suffer from the immediate short-term effects of not wearing SCBA and the long-term effects from repeatedly exposing themselves to IDLH atmospheres. With over 4,000 incidents of smoke inhalation suffered by firefighters each year, it is imperative that firefighters understand the reasons for wearing SCBA while performing their job. In this lesson, students will demonstrate and describe the "operational check" of a SCBA and a PASS device. |
| **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** | * Open-Circuit SCBA used by local jurisdiction
* PASS alarm
* SCBA Types and Uses Quiz
* SCBA Types and Uses Quiz Key
* Operational Check of SCBA for Emergency Use Checklist
* Discussion Rubric
* Research Rubric
* Writing Rubric
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Lead students in a discussion about the respiratory hazards present in common fire service responses including potentially fatal short- and long- term effects. Some examples of respiratory hazards that may be discussed are:* Oxygen deficient atmospheres (hypoxia)
* Elevated temperatures that can cause injuries such as pulmonary edema
* Smoke and other toxic atmospheres such as irritants and toxicants that can injure or kill firefighters

Use the Discussion Rubric for assessment. |
| **Direct Instruction \*** | 1. Respiratory Hazards

A. Oxygen Deficient Atmospheres* + 1. Occur when the fire consumes the oxygen in a compartment fire
		2. Can occur in
			1. Below-grade confined spaces
			2. Chemical storage tanks
			3. Grain bins and silos
			4. Rooms protected by total flooding extinguishing systems
		3. The Occupational Safety and Health Administration (OSHA) and the National Fire Protective Association (NFPA) define oxygen deficient atmospheres as containing less than 19.5% oxygen
	1. When the oxygen level in an atmosphere reaches
		1. 18% – the body will adjust by increasing its respiratory rate (breathing more rapidly)
		2. 17% – impairment of muscular coordination
		3. 12% – dizziness, headache, tiring rapidly
		4. 9% – unconsciousness
		5. 6% – death within a short period of time from heart and respiratory failure
	2. Departments that are equipped to monitor atmospheres should do so
	3. Departments should remind firefighters to wear SCBA whenever they are unsure of the oxygen level of the atmosphere in which they are working
1. Elevated Temperatures (Respiratory Hazard)
	1. Can cause severe damage to a firefighter’s respiratory tract by causing
		1. Burns
		2. Decreased blood pressure
		3. Circulatory system failure
		4. Example – pulmonary edema is an accumulation of fluids in the lungs which causes death through asphyxiation
	2. The tissue damage caused by inhaling superheated gases cannot be reversed immediately by just breathing fresh cool air
	3. Oxygen therapy and other prompt medical treatment are needed
2. Smoke (Respiratory Hazard)
	1. Smoke typical in a compartment fire includes a mixture of the following
		1. Oxygen
		2. Nitrogen
		3. Carbon monoxide
		4. Carbon dioxide
		5. Soot (carbon particles)
	2. Suspended smoke particles
		1. Often contain aldehydes and organic acids that are formed from carbon
		2. Some may only be irritating to the respiratory tract, others may have deadly affects
	3. The size of the suspended particles determines how deep into the lungs they travel
	4. They may burn the respiratory tract as well
3. Toxic Atmospheres Associated with Fire
	1. Gases commonly found in fire
		1. Carbon monoxide
			1. Causes most fire deaths
			2. A product of incomplete combustion
			3. Combines with blood hemoglobin 200 times more readily than does oxygen
				1. Excludes oxygen from the blood, causing victims to experience hypoxia of the brain and body that is followed by death
			4. Carbon dioxide is the end product of complete combustion
			5. Hydrogen chloride irritates eyes and the respiratory tract
			6. Hydrogen cyanide is a chemical asphyxiate
			7. Nitrogen dioxide irritates the nose and the throat
			8. Phosgene forms hydrochloric acid in the lungs due to moisture
		2. All the gases listed above can be IDLH, producing immediate, irreversible, debilitating effects on a firefighter’s health
		3. This depends upon how many parts per million (ppm) there are of the gas compared to the volume of air ppm
	2. Toxic Atmospheres Not Associated with Fire
		1. Usually associated with industrial processes that use dangerous chemicals
		2. Some of these chemicals include
			1. Ammonia
				1. Irritates the respiratory tract and eyes
			2. Sulfur Dioxide
				1. Irritates the respiratory tract and eyes
				2. Reacts with moisture from the lungs to form sulfuric acid
			3. Chlorine
				1. Used to manufacture plastic, rubber compounds, and synthetic textiles
				2. Used to treat water
		3. Transportation leaks can occur from traffic accidents, train derailments, etc.
			1. Natural gas leaks
			2. Chemical leaks
		4. The Department of Transportation (DOT) defines hazardous materials as
			1. “Any substance which may pose unreasonable risk to health and safety of operating or emergency personnel, the public, and/or the environment if it is not properly controlled during handling, storage, manufacture, processing, packaging, use, disposal, or transportation”
			2. May include biologically hazardous materials such as etiologic agents which are living microorganisms that can cause human disease
4. Types of SCBA
	1. Open-Circuit SCBA
		1. Discharges the wearer’s air directly into the atmosphere
	2. Four basic components
		1. Backpack harness assembly – rigid frame with straps that hold the air cylinder to the firefighter’s back
		2. Air Cylinder
			1. Includes the cylinder, cylinder valve, main pressure gauge, and in some units the integrated Personal Alert Safety System (PASS) alarm
			2. Must be strong enough to contain the pressure – on some units as high as 4,500 psi
			3. 30-minute cylinders hold 2216 psi
			4. A cylinder must be at least 90% full (2000 psi) before donning it at an emergency scene
		3. Regulator Assembly
			1. Includes a high-pressure hose, pressure reducing device, low pressure regulator, and bypass valve
			2. Reduces pressure to slightly above the atmospheric pressure for use by the wearer
			3. There is also a remote gauge positioned for the wearer to see how much air remains
			4. The cylinder gauge and the main gauge must read within 100 psi of each other, or be the same if the gauges read in larger increments
		4. Facepiece Assembly
			1. Includes a facepiece lens and exhalation valve, and on some units a low pressure breathing tube, voice amplifier, head harness, or helmet mounting bracket
			2. External fogging of the facepiece can be prevented or eliminated by using a nose cup, or by applying an anti-fogging chemical to the interior of the facepiece
	3. Open-Circuit Airline Equipment
		1. Used when first responders may be forced to remain in a contaminated atmosphere for extended periods of time
		2. Supply hoses are used from a large supply source and run directly to the open-circuit SCBA
			1. These units are often called Supplied Air Respirators (SARs)
		3. Emergency Breathing Support Systems (EBSS) use a 5-10 minute emergency egress cylinder
		4. Airline systems allow emergency service personnel to operate as far as 300 feet from their supply source
5. Closed-Circuit Breathing Apparatus
	1. Systems in which the wearer’s exhalation is recycled and rebreathed after the carbon dioxide has been removed and replaced with oxygen
	2. Used for long-duration operations
	3. Restore oxygen to the system using
		* 1. Compressed oxygen
			2. Chemical oxygen
			3. Liquid oxygen

III. Safety Features and Functions of the Open-Circuit SCBA* 1. Personal Alert Safety System (PASS) alarm
		1. Sometimes referred to as a Personal Alert Device (PAD)
		2. Used to find lost, disoriented, or incapacitated firefighters
			1. Many newer generation SCBA
				1. Have the PASS alarm integrated into the air supply system
				2. Activate when the main air valve is opened
			2. Detachable PASS alarms
				1. Are worn on the SCBA harness or on the turnout coat
				2. Must be manually turned on with a switch
		3. Both types of units will automatically sound an alarm if the firefighter wearing the unit remains motionless for approximately 30 seconds
		4. Both types of units can be activated manually by the wearer if he or she is conscious and senses the need for assistance
		5. Rescuers follow the sound of the alarm to find the firefighter that is in need
	2. Bypass valve – controls the direct airflow from the cylinder in the event of a regulator malfunction
	3. Remote pressure gauge – shows the wearer what air pressure remains in the cylinder
		1. The remote pressure gauge should read within 100 psi of the main gauge if the increments are in psi
		2. If the measurements are shown as percentages or fractions, the gauges should read the same
	4. Low pressure alarm – designed to activate when the cylinder pressure drops below ¼ of its rated capacity (between 500 and 600 psi)
	5. Facepiece seal – designed to maintain positive air pressure within the facepiece to prevent toxic smoke and gases from being inhaled by the wearer

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
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| **Guided Practice \*** | *Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** NONE
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| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Operational Check of SCBA for Emergency Use. Have students demonstrate and describe the “operational check” of a SCBA and a PASS device. Use the Operational Check of SCBA for Emergency Use Checklist for the activity and for assessment.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:** Students will imagine that they are a firefighter preparing to entire a burning structure. They will write down what they must know about SCBA prior to entry. They will describe and outline the operational check they will do prior to coming on duty, and describe and explain the safety features and functions of an open-circuit SCBA. Use the Writing Rubric for assessment.
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| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | SCBA Types and Uses Quiz and KeyOperational Check of SCBA for Emergency Use ChecklistDiscussion RubricResearch RubricWriting Rubric*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:***Accommodations for Learning Differences:** For reinforcement, students will imagine that they are a firefighter preparing to entire a burning structure. They will write down what they must know about SCBA prior to entry. They will describe and outline the operational check they will do prior to coming on duty, and describe and explain the safety features and functions of an open-circuit SCBA. Use the Writing Rubric for assessment.  |
| **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, 2008 |
| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** | English/Language Arts StandardsIV. ListeningB. Listen effectively in informal and formal situations.1. Listen critically and respond appropriately to presentations.

2. Listen actively and effectively in one-on-one communication 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 research and describe the different types and uses of SCBA used in the fire service. Use the Research 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)