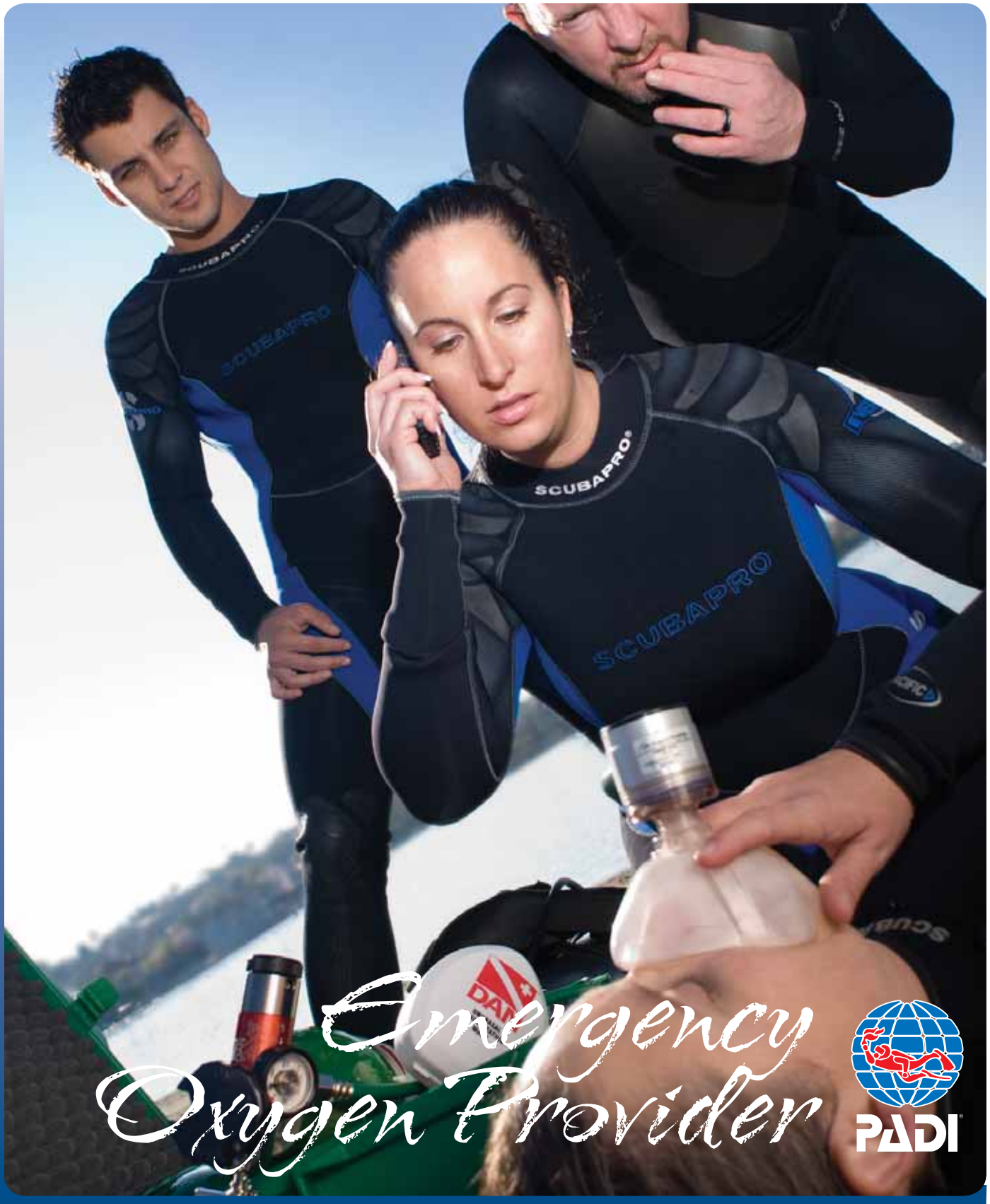

Emergency Oxygen Provider

PADI

Specialty Course Instructor Guide

Product No. 79118 (Rev. 4/11) Version 1.02

PADI Emergency Oxygen Provider Specialty Course Instructor Guide

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Introduction

This section includes suggestions on how to use this guide, an overview of course philosophy and goals, a flow chart to show you how course components and materials work together for success, and ways you can organize and integrate student learning.

How to Use this Guide

This guide speaks to *you,* the PADI Emergency Oxygen Provider Specialty Instructor. The guide contains three sections – the first contains standards specific to this course, the second contains knowledge development presentations, the third outlines skill development for students. All required standards, learning objectives, activities, and performance requirements specific to the PADI Emergency Oxygen Provider course appear in **boldface** print. **The boldface assists you in easily identifying those requirements that you *must* adhere to when you conduct the course.** Items not in boldface print are recommendations for your information and consideration. General course standards applicable to *all* PADI courses are located in the General Standards and Procedures section of your PADI *Instructor Manual.*

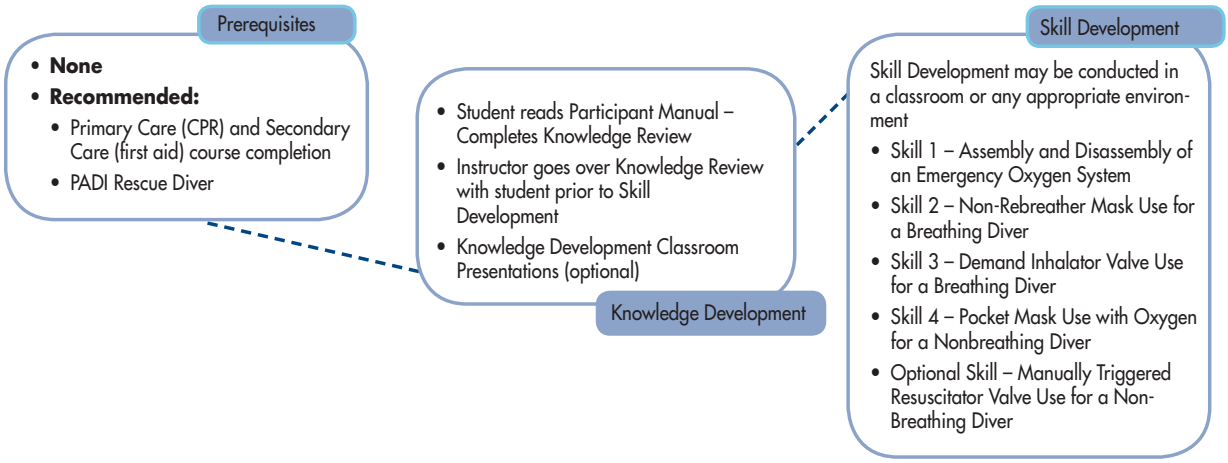
Course Philosophy and Goals

Oxygen, water, and food are fundamentally important to all animals. Of these three basic essentials for the maintenance of life, the lack of oxygen leads to death most rapidly. First aid with emergency oxygen is useful or necessary as a treatment for many injuries, diseases and intoxications that interfere with oxygen reaching the blood or tissues. For recreational scuba divers, emergency oxygen is the primary first aid given to individuals suffering from a near drowning or decompression illness (lung overexpansion injuries and decompression sickness). Providing emergency oxygen has become the standard of practice for treating injured scuba divers since it provides oxygen to starved tissues and aids in bubble reduction. Having emergency oxygen immediately available at dive locations is especially important to divers suffering from these maladies. Along with the availability of oxygen at dive sites, first responders must know how to provide oxygen in an emergency.

It is the goal of this course to train all divers (PADI Junior Open Water Divers and above) and those in a position to help divers (boat captains, lifeguards, etc.) in the proper use of emergency oxygen. This entry-level emergency oxygen course also teaches the recognition of diving illnesses treatable by emergency oxygen, but the specific details of dive accident response and management are left to the PADI Rescue Diver course. The PADI Emergency Oxygen Provider Specialty course may be used as an enhanced substitute for the emergency oxygen training provided in the PADI Rescue Diver course.

Beginning recreational divers completing this course are also encouraged to become PADI Rescue Divers. For those supervising recreational divers, it is highly recommended that those individuals achieve a PADI Divemaster rating.

Course Flow at a Glance



Course Flow at a Glance provides a visual representation of how recommended prerequisites, knowledge development and skill development leads students to completion of course goals. For course efficiency, it is preferable to have students read their PADI *Emergency Oxygen Provider Manual* and complete the Knowledge Review before participating in the skill development session.

When the manual isn't available in a language understood by your students, or when otherwise needed (i.e., to meet required, local workplace training hours), you have the option of conducting knowledge development classroom presentations.

Skill development may be conducted in a classroom or any appropriate environment (boat deck, beach, pool side, etc.). Because the skills (one through four) build on one another, it's best to conduct them in sequence.

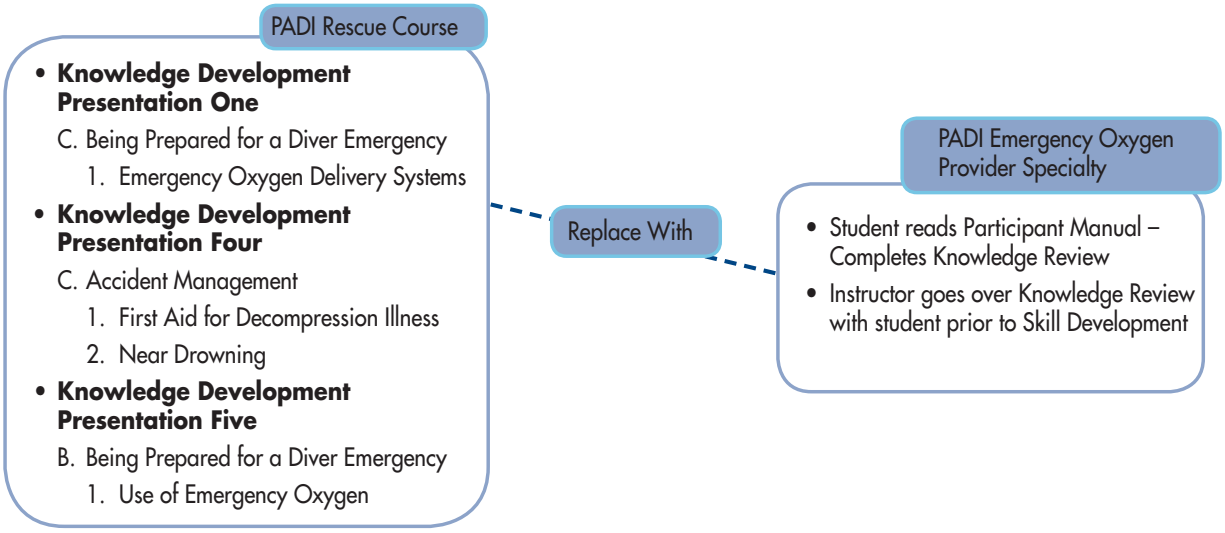
Rescue Diver Course Integration

It is recommended, but not required that you integrate the PADI Emergency Oxygen Provider course with the PADI Rescue Diver course. **When you teach the PADI Emergency Oxygen Provider Specialty course as outlined in this guide, you may substitute the appropriate knowledge development topics and skills within the Rescue Diver course.** The Rescue Diver sections noted below may be replaced with the PADI Emergency Oxygen Provider Specialty course, so students earn both a PADI Rescue Diver and PADI Specialty course. Use the Knowledge Development and Skill Development charts below to assist you in integrating the PADI Emergency Oxygen provider course into your PADI Rescue Diver course. These are the knowledge development topics and skills that may be substituted within the PADI Rescue Diver course for those within the PADI Emergency Oxygen Provider course.

When you teach the PADI Emergency Oxygen Provider Specialty course during a PADI Rescue Diver course, you may issue a separate PADI Specialty certification. See the following charts for clarification of course integration.

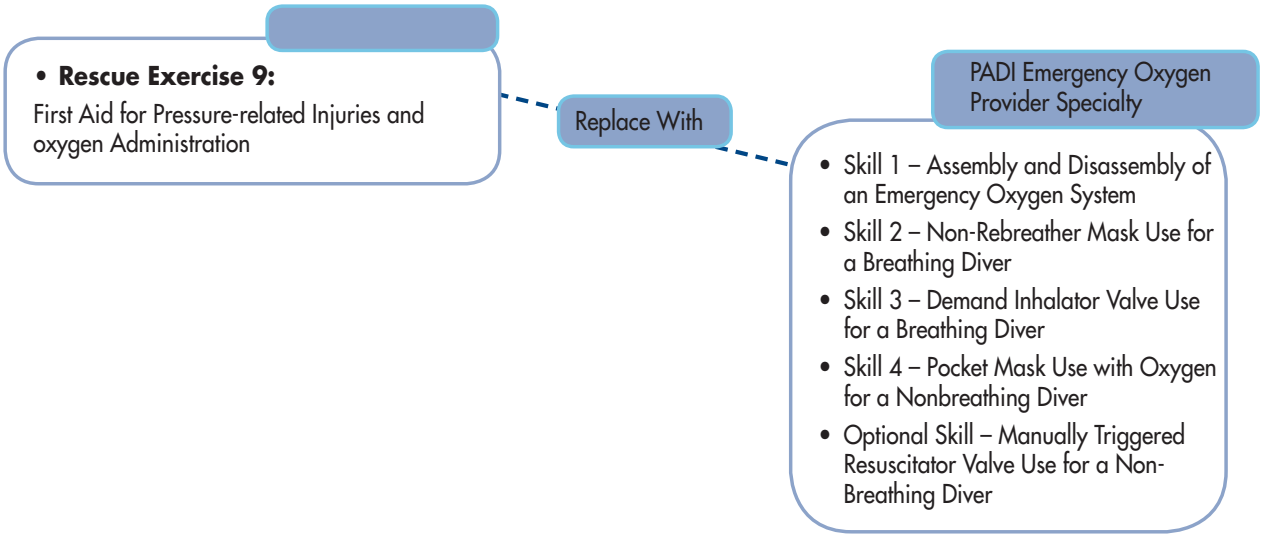
Using the PADI Emergency Oxygen Provider Specialty Course with the PADI Rescue Diver Course

Knowledge Development



Using the PADI Emergency Oxygen Provider Specialty Course with the PADI Rescue Diver Course

Skill Development



Program Options

Step	Student Conduct	Rescue Diver Integration	Instructor-Led
1	Complete independent study with PADI *Emergency Oxygen Provider Manual*	Students read *PADI Emergency Oxygen Provider Manual* in lieu of: Rescue Diver Knowledge Development Presentation 1: C. Being Prepared for a Diver Emergency 2. Emergency Oxygen Delivery Systems Rescue Diver Knowledge Development Presentation 4 C. Accident management 1. First Aid for Decompression Illness 2. Near Drowning Rescue Diver Knowledge Development Presentation 5 B. Being Prepared for Diver Emergency 1. Use of Emergency Oxygen	*Knowledge Development Classroom Presentations* (optional)
2	Complete Knowledge Review in manual		Review Knowledge Review with students
3	Attend PADI Emergency Oxygen Provider course skill development session	Students attend PADI Emergency Oxygen Provider skill development session in lieu of: Rescue Exercise 9 – First Aid for Pressure-related Injuries and Oxygen Administration	Conduct PADI Emergency Oxygen Provider course skills 1, 2, 3 and 4 Emergency Oxygen Provider Optional Skill – Manually Triggered Resuscitator Valve Use for a Nonbreathing Diver is optional

Section One:
Course Standards

This section includes the course standards, recommendations, and suggestions for conducting the PADI Emergency Oxygen Provider course.

Standards at a Glance

Topic	Course Standard
Minimum Instructor Rating	**PADI Emergency Oxygen Provider Specialty Instructor**
Prerequisites	**None**
Minimum Age	**None** (must be capable of completing all performance requirements)
Ratios	**12:1 Instructor**
Hours	Hours Recommended: two - three
Materials and Equipment	**Instructor:** • **PADI *Emergency Oxygen Provider Course Instructor Guide*** • **Emergency oxygen delivery system consisting of oxygen cylinder, cylinder valve, multifunction regulator, non-rebreather mask, pocket mask, demand inhalator valve with mask** • **Filled oxygen cylinder for students to breathe from during the course** • **PADI Emergency Oxygen Care at a Glance reference** • **Manually triggered resuscitator valve (only required when teaching Optional Skill)** • Resuscitation manikins (adult) **Student:** • **PADI *Emergency Oxygen Provider Manual*** • **Non-rebreather mask**

Instructor Prerequisites

To qualify to teach the PADI Emergency Oxygen Provider course, an individual must be a Teaching status PADI Open Water Scuba Instructor (or higher), PADI Assistant Instructor or an active status PADI Divemaster.

PADI Instructors may apply for the PADI Emergency Oxygen Provider Specialty Instructor rating after completing a Specialty Instructor Training course with a PADI Course Director, or by providing proof of experience (PADI Emergency Oxygen Provider Specialty or other qualifying certification) **and applying directly to PADI.** For further detail, reference the Professional Ratings section in the Professional Membership Guide of your PADI *Instructor Manual.*

PADI Assistant Instructors and Divemasters may become PADI Emergency Oxygen Provider Instructors by completing a PADI Emergency Oxygen Provider Specialty Instructor Training course offered through a PADI Course Director.

A PADI Emergency Oxygen Provider Instructor may teach the Optional Skill – *Manually Triggered Resuscitator use for a Nonbreathing Diver* if they have this type of equipment available for student practice.

Student Prerequisites

None. Students must be old enough to successfully complete all stated performance requirement. First aid and CPR training is recommended.

Supervision and Ratios

Supervision

A Teaching status PADI Emergency Oxygen Provider Specialty Instructor must directly supervise all skill development activities. The Specialty Instructor must ensure that all performance requirements are met.

Student-to-Instructor Ratio

The ratio for skill development is 12 students per instructor (12:1). Student-to-equipment ratios should be as low as possible.

Materials and Equipment

Instructor Materials and Equipment

Use the PADI Emergency Oxygen Provider course materials prescriptively to accommodate various sequencing preferences and teaching and learning styles.

Required

- **PADI *Emergency Oxygen Provider Specialty Course Instructor Guide***
- **PADI *Emergency Oxygen Provider Manual***
- **PADI Emergency Oxygen Care at a Glance reference**
- **Specialty equipment**
  - **Refillable, variable rate emergency oxygen unit that includes the following:**
  - **Oxygen cylinder and valve**
  - **Filled oxygen cylinder for students to breathe from during the course**
  - **Multifunction regulator capable of delivering at least 15 litres-per-minute (lpm) of oxygen**
  - **Non-rebreather mask**
  - **Pocket mask with oxygen inlet**
  - **Demand inhalator valve with mask**
  - **Manually triggered resuscitator valve (only required when teaching Optional Skill)**

Recommended

- Resuscitation manikins (adult). It's recommended that resuscitation manikins be used for all nonbreathing diver skills (Skill 4 – pocket mask use and the Optional Skill – manually triggered resuscitator valve use).

Student Materials and Equipment

Required

- **PADI *Emergency Oxygen Provider Manual***
- **Non-rebreather mask** (disposable item)

Recommended

- PADI Emergency Oxygen Care at a Glance reference
- Gloves - bloodborne pathogen barrier

Assessment Standards

To assess knowledge, review the Knowledge Reviews from the student's manual with the diver. **The student diver must demonstrate accurate and adequate knowledge during skill development and must perform all skills (procedures and motor skills) fluidly, with little difficulty, in a manner that demonstrates minimal or no stress.**

Certification Requirements and Procedures

To qualify for certification, by completion of the course, students must complete *all* performance requirements for Emergency Oxygen Provider required skills one through four. The instructor certifying the student must ensure that all certification requirements have been met. Reference Administrative Procedures of the General Standards and Procedures section of your PADI *Instructor Manual* for detailed information on Referral.

Links to Other Courses

Students completing the PADI Emergency Oxygen Provider course may credit the specialty certification toward the PADI Master Scuba Diver rating if they are also PADI Advanced Open Water and Rescue Diver certified (or qualifying certification from another training organization) with certification in four other PADI Specialty ratings, and have 50 logged dives. The PADI Emergency Oxygen Provider course does not include open water dives; therefore, it does not have a link to the PADI Adventures in Diving program.

Section Two:
Knowledge Development
Conduct

Oxygen, water, and food are of fundamental importance to life. Of these three basic essentials for the maintenance of life, the deprivation of oxygen leads to death most rapidly. Oxygen therapy is useful or necessary to treat many injuries, diseases and intoxications that interfere with normal oxygenation of the blood or tissues.

Knowing how to activate the local Emergency Medical Service (EMS) and provide emergency oxygen are the two most important first aid steps for treating a diver suspected of suffering a near drowning or decompression illness (lung overexpansion injuries and decompression sickness). Emergency oxygen given to divers suffering from decompression illness may reduce damage to oxygen starved tissues and bubble size. Medical case histories show repeatedly that prompt oxygen first aid can make a dramatic difference in the diver's immediate condition and in the effectiveness of subsequent treatment.

Within the dive community, statistics show that fewer than 50 percent of all injured divers receive emergency oxygen in the field. Of that 50 percent, still fewer receive oxygen concentrations approaching the recommended 100 percent.

This course represents entry-level training designed to educate the public to provide emergency oxygen first aid to scuba divers while activating the local Emergency Medical Service (EMS) and arranging for evacuation to the nearest medical facility. The course goal is to train all divers and those in a position to help divers (boat captains, lifeguards, etc.) in the proper use of emergency oxygen. This entry-level emergency oxygen course also outlines the recognition of diving illnesses treatable by emergency oxygen, but the specific details of dive accident response

and management are left to the PADI Rescue Diver course. The PADI Emergency Oxygen Provider Specialty course may be used as an enhanced substitute for the emergency oxygen training provided in the PADI Rescue Diver course.

Beginning recreational divers completing this course are also encouraged to become PADI Rescue Divers. For those supervising recreational divers, it is highly recommended that those individuals achieve a PADI Divemaster rating. At the very least, all students completing this course are encouraged to take a general CPR and first aid course, such as the Emergency First Response *Primary and Secondary Care* course.

Students complete independent study of the course by reading the PADI *Emergency Oxygen Provider Manual.* Work hand-in-hand with the student manual to address prescriptively student misconceptions or for clarification on certain points of interest. If there is a need for instructor-led presentations, use the following teaching outline, which appears in point form, as a road map of the conduct, content, sequence and structure for the PADI Emergency Oxygen Provider course.

The result should be students with theoretical knowledge and practice who can adapt what they've learned to provide divers with emergency oxygen who may have had a near drowning or have decompression illness. **Regardless of how you conduct knowledge development (independent study, instructor-led or a combination of these instructional approaches), students must be able to explain the following learning objectives.**

Knowledge Development

Learning Objectives

By the end of knowledge development, students will be able to answer the following questions:

Uses of Emergency Oxygen

- **What is oxygen?**
- **Why is oxygen important for life?**
- **What percent of oxygen is contained in room air?**
- **What percent of oxygen is contained in expired air?**
- **How does rescue breathing help treat nonbreathing injured divers?**
- **How is rescue-breathing efficiency increased with the addition of emergency oxygen?**
- **Why is oxygen used to treat scuba diving maladies?**
- **For what seven life-threatening problems can the use of emergency oxygen help to make a positive difference in a patient's outcome?**

Diving Injuries

- **What is the difference between drowning and near drowning?**
- **What is the primary first aid for a near drowning accident?**
- **Why is medical evaluation important for a diver after a near drowning incident?**
- **What is the most common cause of lung overexpansion injuries?**
- **What is the cause and what are nine signs/symptoms of air embolism?**
- **What is the cause and what are two signs/symptoms of pneumothorax.**
- **What is the cause and what are four signs/symptoms of mediastinal emphysema?**
- **What is the cause and what are three signs/symptoms of subcutaneous emphysema.**
- **What is the most common cause of decompression sickness (DCS)?**
- **What are the eleven signs/symptoms of decompression sickness?**
- **What is meant by decompression illness?**
- **What first aid steps should you take for a diver with suspected decompression illness?**
- **Why should a diver with suspected decompression illness remain lying down?**
- **Why should a diver suspected of having decompression illness always be transported as soon as possible to the nearest medical facility?**
- **How much oxygen should be available to treat decompression illness?**

Emergency Oxygen Equipment

- **What are the two basic types of emergency oxygen equipment?**
- **What are the six primary components of emergency oxygen equipment and the function of each?**
- **On an emergency oxygen system, where can the following parts be found?**
  1) Cylinder; 2) Valve; 3) Valve Orifice; 4) Valve Indexing Holes; 5) Valve Hand Wheel, Wrench or Lever; 6) Multifunction Regulator; 7) Indexing Pins; 8) Sealing Washer; 9) Flowmeter and flow controller; 10) Cylinder Pressure Gauge; 11) Barbed Constant-Flow Outlet; 12) Demand/Resuscitator Valve Outlet; 13) "T"-Handle
- **What is a *nasal cannula* and when is it used to deliver emergency oxygen?**
- **What are the three basic styles of emergency oxygen masks and how do they differ?**
- **What is a *demand inhalator* valve and when is it used to deliver emergency oxygen?**
- **What is a *manually triggered resuscitator valve* and when is it used to deliver emergency oxygen?**

Safety Considerations When Using Oxygen

- **What are seven safety procedures to follow when handling oxygen and oxygen equipment?**
- **What is a *compression fire*?**

Maintaining Emergency Oxygen Equipment

- **How often must an emergency oxygen cylinder be tested?**
- **How do you determine if an emergency oxygen cylinder needs testing?**
- **Where and how do you fill emergency oxygen cylinders?**
- **What regular maintenance must be performed on emergency oxygen systems?**

Knowledge Development Teaching Outline

Suggestions to *you,* the PADI Emergency Oxygen Provider Specialty Course Instructor, *appear in note boxes.*

A. Course Introduction

1. Staff and student introductions

Note:
Introduce yourself and assistants. Explain your background with emergency oxygen training or experience if your students are not familiar with you.

Have students introduce themselves and explain why they are interested in emergency oxygen training. Break the ice and encourage a relaxed atmosphere.

Give times, dates and locations as appropriate for classroom presentations and skill development session(s).

Review with students other skills they'll want as a PADI Emergency Oxygen Provider. *These opportunities, through additional training, may include PADI* Rescue Diver and Divemaster. *Also encourage students to complete the Emergency First Response* Primary and Secondary Care *course.*

2. Course goals – this course will help:
    a. Develop your practical knowledge of oxygen equipment use and the two primary diving maladies treatable with emergency oxygen – near drowning and decompression illness.
    b. Increase your emergency first responder abilities.
    c. You assist divers suffering from a near drowning or decompression illness.
    d. Encourage you to participate in other related PADI courses, specifically Rescue Diver and Divemaster.
    e. Encourage you to complete the Emergency First Response *Primary and Secondary Care* course.

3. Course overview
    a. Knowledge Development presentation(s).
    b. Skill development session(s).
4. Certification
    a. Upon successfully completing the course, you will receive the PADI Emergency Oxygen Provider Specialty certification.
    b. Certification means that you will be qualified to:
        1. Administer emergency oxygen to divers suspected of near drowning or decompression illness.

Note:
Like all emergency first responder skills, Emergency Oxygen Provider skills deteriorate over time if unused or not practiced. Encourage students to retrain every two years by retaking the skill development portion of this Specialty course.

2. Apply for the Master Scuba Diver rating if you are a PADI Advanced Open Water Diver and a PADI Rescue Diver (or qualifying certification from another training organization) with certification in four other PADI Specialties, and you have 50-logged dives.

Note:
Explain all course costs and materials, and what the costs do and do not include, including equipment use, etc. Explain what equipment students must have for the course, and what you will provide. Cover and review points about scheduling and attendance.

5. Class requirements
    a. Complete paperwork.
    b. Course costs.
    c. Material requirements
    d. Equipment needs – if any.
    e. Schedule and attendance.

B. Uses of Emergency Oxygen

- ***What is oxygen?***

1. Contact
    a. Understanding what oxygen is and how it's used will help you use it appropriately as a first aid treatment.
    b. Here are the questions you'll be able to answer at the conclusion of this segment of the presentation:
        - What is oxygen?
        - Why is oxygen important for life?
        - What percent of oxygen is contained in room air?
        - What percent of oxygen is contained in expired air?
        - How does rescue breathing help treat nonbreathing injured divers?
        - How is rescue-breathing efficiency increased with the addition of emergency oxygen?
        - Why is oxygen used to treat scuba diving maladies?
        - For what seven life-threatening problems can the use of emergency oxygen help make a positive difference in a patient's outcome?
2. At the elemental level, oxygen:
    a. Is a gas.
    b. Is colorless, odorless and tasteless.
    c. As a gas, two oxygen atoms join to form a single oxygen molecule – hence the term "O_2."

- ***Why is oxygen important for life?***

3. In terms of human physiology, oxygen:
    a. Is carried to our cells and organs by our breathing (respiratory) system and the blood circulation (circulatory) system.
    b. Is the fuel of the body. Oxygen is essential for animal respiration, allowing the body to "burn" fuel (food molecules) – much like a car engine needs oxygen and fuel.
    c. Animals take in oxygen when inhaling and give off carbon dioxide when exhaling.

- ***What percent of oxygen is contained in room air?***

4. Atmospheric oxygen makes up about 21 percent of the total. Most of the remaining gas is physiologically inert nitrogen.

- ***What percent of oxygen is contained in expired air?***
- ***How does rescue breathing help treat nonbreathing injured divers?***

5. A person's exhaled breath contains less oxygen than air. As we learned air contains about 21 percent oxygen, whereas an exhaled breath contains about 16 to 17 percent.
    a. This means that the human body only uses about a quarter of the oxygen inhaled, leaving about 75 percent available for rescue breaths.
    b. This is why rescue breathing works – it can supply a nonbreathing injured diver with enough oxygen to support life.

- ***How is rescue-breathing efficiency increased with the addition of emergency oxygen?***

6. The efficiency of rescue breathing can be greatly increased with the addition of emergency oxygen.
    a. By using a pocket mask with additional emergency oxygen flow during rescue breathing (a skill you'll practice in this course), available oxygen for the injured diver increases from 17 percent to over 40 percent.
    b. If a manually triggered oxygen resuscitator valve is used on a nonbreathing injured diver (an optional skill in this course), oxygen availability rises to approximately 99 percent.
    c. Important point: *The greater the oxygen concentration, the more efficient rescue breathing becomes.*

- ***Why is oxygen used to treat scuba diving maladies?***

7. In general, maladies specific to scuba diving interrupt the amount of oxygen in the blood and the rate of blood flow.
8. Often, these maladies impair the performance of the lungs in delivering oxygen to the blood, leading to an overall reduction of available oxygen to tissues.
9. Increasing the oxygen concentration breathed by a diver suffering from a scuba diving specific malady increases the saturation of oxygen in the blood. Natural circulation of this hyper-oxygenated blood may increase the chances of survival of damaged tissues or tissues with a poor blood supply.
10. As you'll learn in the next presentation, tissues that are supersaturated with nitrogen (and other inert gas) in a diver's body are the primary culprit in decompression sickness. Giving the injured diver 100 percent oxygen (or as close to 100 percent as possible):

- Keeps the injured diver from breathing more nitrogen when on the surface.
- Accelerates the elimination of nitrogen from the body. The added concentration of oxygen creates a greater pressure difference between the nitrogen bubble and the nitrogen dissolved in the tissues. This pressure difference speeds nitrogen dissolving from the tissues, helping reduce the bubble size or, in ideal circumstances, cause bubbles to disappear. Reducing or eliminating bubbles reduces or eliminates the primary injury mechanism of DCI.

- ***For what seven life-threatening problems can the use of emergency oxygen help to make a positive difference in a patient's outcome?***

11. First aid with emergency oxygen is useful or necessary as a treatment for many injuries, diseases and intoxications that interfere with normal oxygenation of the blood or tissues. Providing emergency oxygen to an injured or ill person may reduce possible tissue damage due to lack of oxygen and increase the patient's chances of survival. Emergency oxygen can make a positive difference in a patient's outcome if he is suffering from any of the following seven life-threatening problems:
    a. Traumatic injury leading to excessive blood loss or airway/breathing interference.
        - Any injury involving massive blood loss means that some tissues may suffer from lack of oxygen due to reduced blood flow.
        - Any injury that interferes with airway or breathing.
    b. Shock
        - Any injury or illness, serious or minor, which stresses the body, may result in shock. In reaction to a medical condition, the body pools blood into one or more vital organs. This reduces normal blood flow to other body tissues depriving cells of oxygen.
    c. Cardiac arrest
        - Cardiac arrest occurs when a heart artery becomes blocked and the heart stops receiving oxygen. When the heart is oxygen deprived, it may begin to quiver – called ventricular fibrillation – or the heart may just stop beating.
    d. Respiratory arrest
        - Respiratory arrest occurs when the lungs stop functioning due to paralysis of the diaphragm, collapse of the lung or any number of respiratory failures. Respiratory arrest is a medical emergency and it usually is related to or coincides with a cardiac arrest.

e. Stroke
   - A stroke occurs when a blood vessel is blocked or ruptures in the patient's brain. Blockage or rupture deprives the brain of oxygen and causes cell death.

f. Near drowning
   - *Drowning* is defined as death caused by asphyxiation (suffocation) in water.
   - *Near Drowning* is when a person suffers asphyxiation in water but is revived. More on scuba-related near drowning in the next section.

g. Decompression illness
   - Decompression illness (DCI) is the term used to describe two diving maladies – lung overexpansion injuries and decompression sickness. More on decompression illness in the next section.
   - DCI can also cause shock, respiratory and/or cardiac arrest – all needing emergency oxygen treatment.

Note:
This is an excellent place to encourage students to complete CPR and first aid training (such as the Emergency First Response Primary and Secondary Care *course). Emphasize that the delivery of emergency oxygen is but one step in an entire first responder protocol. First aid and CPR training gives context to emergency oxygen use, and familiarizes students with scene assessment, barrier use, activating the local Emergency Medical System (EMS), and the ABCD'S of emergency care.*
A – Open Airway
B – Check Breathing
C – Circulation – Chest Compressions
D – Defibrillation
S – Serious Bleeding, Shock, Spinal Injury

C. Diving Injuries

1. Contact
   a. Helping an injured diver is more than removing him from the water. Once on the boat or shore it is important to provide the diver with the appropriate primary (CPR) and secondary care (first aid). Appropriate care depends on the diver's injury. Nevertheless, emergency care specific to diving related maladies always includes providing oxygen.

Knowing about these specific diver maladies – near drowning and decompression illness (over-expansion lung injuries and decompression sickness) – will help guide the care you provide.

b. Here are the questions you'll be able to answer at the conclusion of this segment of the presentation:
   - What is the difference between drowning and near drowning?
   - What is the primary first aid for a near drowning accident?
   - Why is medical evaluation important for a diver after a near drowning incident?
   - What is the most common cause of lung overexpansion injuries?
   - What is the cause and what are nine signs/symptoms of air embolism?
   - What is the cause and what are two signs/symptoms of pneumothorax.
   - What is the cause and what are four signs/symptoms of mediastinal emphysema?
   - What is the cause and what are three signs/symptoms of subcutaneous emphysema.
   - What is the most common cause of decompression sickness (DCS)?
   - What are the eleven signs/symptoms of decompression sickness?
   - What is meant by decompression illness (DCI)?
   - What are the eleven signs/symptoms of decompression illness?
   - Why should a diver suspected of having decompression illness always be transported as soon as possible to the nearest medical facility?
   - What is the primary first aid protocol for a diver with suspected decompression illness?
   - Why is administering emergency oxygen to a diver with suspected decompression illness crucial?

- ***What is the difference between drowning and near drowning?***
- ***What is the primary first aid for a near drowning accident?***
- ***Why is medical evaluation important for a diver after a near drowning incident?***

2. Near drowning
    a. A drowning victim is someone who suffocates (or is asphyxiated) underwater and cannot be revived. Near drowning, on the other hand, occurs when some suffers asphyxiation underwater, but is revived.
        - A near drowning victim may display coughing, shortness of breath, rapid breathing, cyanosis (blueness) of lips, convulsions, unconsciousness, vomiting, cessation of breathing or cardiac arrest.
        - Regardless of the length of submersion, begin emergency care immediately.
    b. The steps for near drowning first aid are:
        - Begin your first aid with a primary assessment.
            - Stop – Assess scene.
            - Think – Consider your safety and form action plan.
            - Act – begin first aid.
        - If nonbreathing, begin CPR. (The rescue breaths portion of CPR for a nonbreathing diver will be practiced in Oxygen Skill Four - Pocket Mask Use with Oxygen for Nonbreathing Diver)
        - If breathing, administer oxygen; keep the injured diver lying down. (practiced in Emergency Oxygen Skill Two – Non-Rebreather Mask Use for a Breathing Diver and Emergency Oxygen Skill Three – Demand Inhalator Valve Use for a Breathing Diver).
        - Treat for shock and continue to monitor the diver's lifeline – ABCD'S – **A**irway, **B**reathing, **C**irculation/**C**hest Compressions, **D**efibrillation, **S**erious Bleeding, **S**hock, **S**pinal Injury.
        - Transport as soon as possible to nearest medical facility – even if the diver appears fully recovered.
    c. Medical evaluation after near drowning is important because water may have entered the diver's lungs. The water can cause slow damage that, if left untreated, will eventually cause the lungs to fill with fluid and lose their ability to obtain oxygen. This is called secondary drowning and can be fatal. For this reason, a near drowning injured diver should always be professionally examined, even if the diver appears completely recovered.

- ***What is the most common cause of lung overexpansion injuries?***
- ***What is the cause and what are nine signs/symptoms of air embolism?***

3. Lung overexpansion injuries
    a. Over-expansion lung injuries result from breath-holding during ascent while on scuba. They can also occur (though rarely) during ascent when a physiological condition traps air in a part of the lung. The most common cause of a breath-hold ascent is a panicked bolt to the surface as a result of running out of air.
    b. Lung overexpansion can result in four distinct injuries either independently or together – air embolism, pneumothorax, mediastinal emphysema, subcutaneous emphysema.
    c. Air embolism. Cause: results when expanding air forces through the walls of the lungs into the circulatory system. Bubbles go to the heart and then on to the body, with the most serious injuries blocking blood flow to the brain. Signs and symptoms are usually sudden and rapid. They include stroke-like symptoms:
        - Sudden unconsciousness
        - Paralysis (usually one side of the body)
        - Blurred vision
        - Dizziness
        - Bloody froth from the mouth
        - Coughing
        - Personality changes
        - Cardiac arrest
        - Death

- ***What is the cause and what are two signs/symptoms of pneumothorax?***
    d. Pneumothorax. Cause: results when expanding air forces its way between the lung and the chest wall (pleural cavity), partially or completely collapsing the lung. Signs and symptoms include:
        - Severe chest pain
        - Extreme difficulty breathing

- ***What is the cause and what are four signs/symptoms of mediastinal emphysema?***
    e. Mediastinal emphysema. Cause: results when expanding air from the lungs finds its way into the chest cavity, constricting the heart and lungs. Signs and symptoms include:
        - Difficulty breathing

- Fainting
- Shock
- Cyanosis (blueness of the skin)

- ***What is the cause and what are three signs/symptoms of subcutaneous emphysema?***

f. Subcutaneous emphysema. Cause: results when expanding air from the lungs accumulates under the skin around the neck and collarbone. Signs and symptoms include:

- Neck swelling
- Voice changes
- Difficulty swallowing

- ***What is the most common cause of decompression sickness (DCS)?***
- ***What are the eleven signs/symptoms of decompression sickness?***

4. Decompression sickness

a. Decompression sickness (DCS) results when nitrogen (or other inert gas, such as helium in technical diving) dissolved into the tissues comes out of solution and forms bubbles during ascent. The bubbles can block blood flow (mechanical problems) and cause clotting activation and tissue inflammation (biochemical problems).

b. The most common causes of DCS are rapid ascent, or when divers fail to use their dive computers or tables conservatively. Much less commonly, divers get DCS when they do everything correctly because there is always a minute risk of DCS.

c. Bubbles can come out of solution almost anywhere in the body, therefore symptoms tend to be variable and range in seriousness. The more serious cases affect the nervous system. Typically, DCS symptoms manifest themselves more slowly than lung overexpansion injuries. Over one-half of DCS symptoms appear more than 30 minutes after a dive. Symptoms appear within three hours in about 95 percent of the cases.

d. Signs and symptoms of decompression sickness include:

- Pain, typically in joints
- Fatigue
- Inability to urinate

- Blurred vision, vertigo, hearing or speech impairment
- Paralysis
- Loss of sensation
- Unconsciousness
- Breathing difficulties
  - Chest pain
  - Uncontrollable coughing
  - Death

- ***What is meant by decompression illness?***
- ***What first aid steps should you take for a diver with suspected decompression illness?***
- ***Why should a diver with suspected decompression illness remain lying down?***
- ***Why should a diver suspected of having decompression illness always be transported as soon as possible to the nearest medical facility?***
- ***How much oxygen should be available to treat decompression illness?***

5. Decompression illness (DCI)

   a. For the emergency rescuer, it doesn't really matter whether the diver suffers from an lung overexpansion injury or DCS. Review the symptoms carefully. In the field, it could be hard to differentiate between the two since many of the signs and symptoms overlap. Fortunately, it's not important to distinguish between the two to provide first aid because the first aid is the same. This is why we call a lung overexpansion injury and DCS *decompression illness* (DCI). DCI is a clinical term used to describe both diving maladies in the context of first aid and therapy.

   b. Begin your first aid with a primary assessment.
      - Stop – Assess scene.
      - Think – Consider your safety and form action plan.
      - Act – Begin first aid.

   c. To begin your first aid you must determine if the injured diver is conscious or unconscious, breathing or nonbreathing. Regardless, you need to begin arranging for immediate medical evacuation and provide CPR if necessary. If needed, give rescue breaths with additional 100 percent oxygen added. More on this later.

   d. If the injured diver is conscious and responsive, ask him the following questions:

- Were you scuba diving today or breathing compressed air?
- Did you make a forced or rapid ascent?
- How deep did you go?
- What was your bottom time?
- Do you feel excessively tired?
- Where do you hurt?
- Do you feel dizzy?
- Does any part of your body feel numb or tingle?
- Are you having trouble breathing?

e. Based on the diver's answers to these questions, if you believe he may have DCI continue first aid:

- Have the injured diver lay down. Field experience has shown that some divers' symptoms worsen significantly after sitting up or standing. Remaining lying down is believed to assist blood flow to the brain and to minimize bubbles migrating to the brain.
- Arrange for immediate emergency medical transport. Evacuation will involve advanced medical care and often treatment in a hyperbaric chamber.
- Continually monitor the diver's lifeline – the ABCD'S.
- Provide the diver with 100 percent emergency oxygen until diver is transported by emergency medical services.
- Ideally, you want to have enough oxygen available to supply an injured diver with pure oxygen until emergency medical personnel arrive. When diving in remote locations, this may not always be possible.

Note:
If you find yourself in a situation where you won't have enough oxygen, give the highest concentration possible for as long as it lasts. Avoid reducing the flow rate or turning the oxygen on and off. If you run out of oxygen, but have enriched air nitrox available, give that to a responsive injured diver with a scuba regulator.

- Protect the diver from excess heat or cold – manage shock.

Note:
Never attempt to recompress a diver suspected of DCI by putting the injured diver back underwater. Proper recompression therapy takes hours. Even if you had sufficient air supply to do this, you wouldn't be able to keep the diver adequately warm, or administer necessary drugs and fluids. Without the proper equipment and training, attempts to recompress an injured diver in the water invariably lead to worsening symptoms and delays in proper treatment.

f. It can't be emphasized enough, a diver suspected of having DCI must always be transported as soon as possible to the nearest medical facility. Emergency care and first aid for decompression illness may reduce or eliminate symptoms, but not the cause. Only advanced medical care that includes drug administration and hyperbaric treatment in a recompression chamber can actually treat the causes of DCI.

D. Emergency Oxygen Equipment

Note:
Provide students access to different types of emergency oxygen equipment and the manufacturers' literature. If possible, provide additional copies of manufacturers' literature to students. Most manufacturers will provide additional information upon request.

1. Contact
   a. Knowing how to use the appropriate type of oxygen equipment and their specific components to treat diving injuries will assist you in providing appropriate first aid.
   b. Here are the questions you'll be able to answer at the conclusion of this segment of the presentation:
      - What are the two basic types of emergency oxygen equipment?
      - What are the six primary components of emergency oxygen equipment and the function of each?
      - On an emergency oxygen system, where can the following parts be found? 1) Cylinder; 2) Valve; 3) Valve Orifice; 4) Valve Indexing Holes; 5) Valve Hand wheel/Wrench or Lever; 6) Multifunction Regulator; 7) Indexing Pins; 8) Sealing Washer; 9) Flowmeter and flow controller; 10) Cylinder Pressure Gauge; 11) Barbed Constant-Flow Outlet; 12) Demand/Resuscitator Valve Outlet; 13) "T"-Handle

- What is a *nasal cannula* and when is it used to deliver emergency oxygen?
- What are the three basic styles of emergency oxygen masks and how do they differ?
- What is a *demand inhalator* valve and when is it used to deliver emergency oxygen?
- What is a *manually triggered resuscitator valve* and when is it used to deliver emergency oxygen?

- ***What are the two basic types of emergency oxygen equipment?***

2. Basically, all emergency oxygen units can be divided into two distinct types:
   a. Disposable, fixed rate emergency oxygen units. These units:
      - Are inexpensive with disposable cylinders – meaning they cannot be refilled. The tanks are generally small and designed to be thrown away once used.
      - Come with preset regulators that can only provide a fixed amount of oxygen to an injured diver – about 6 litres-per-minute (lpm).
      - Include the type of mask that can only deliver between 35 and 60 percent oxygen at 6 lpm.
      - Are better than nothing for scuba diving injuries. However, they cannot provide the concentration of oxygen needed to provide optimal first aid for scuba diving injuries.
   b. Refillable, variable rate emergency oxygen units. These units have refillable, high-pressure cylinders with adjustable oxygen regulators. These units are capable of delivering 100 percent oxygen and are the units of choice when treating injured divers. These are the type of units covered in the PADI Emergency Oxygen Provider course.

Note

Rebreather Style Emergency Oxygen Units

There is a third, less common type of emergency oxygen unit that is able to extend the duration of a limited oxygen supply by recycling the injured diver's exhaled oxygen. These units are capable of chemically removing the carbon dioxide (CO_2) from the injured diver's exhaled breath, recycling the usable oxygen and adding fresh oxygen to the system as needed. Duration and percentage of inspired oxygen with these units vary depending on a variety of circumstances. For divers operating far from emergency medical services and hyperbaric chambers, these systems can be valuable.

- ***What are the six primary components of emergency oxygen equipment and the function of each?***

3. Refillable, variable rate emergency oxygen units generally all have six primary components.

   a. Cylinders:

      - Cylinders hold the oxygen under pressure, ready for emergency use. They are refillable, scuba-like cylinders made from either aluminum or steel.
      - Internationally, these bottles are painted *white* (Europe and Canada), *black and white shoulder* (UK, Australia, New Zealand) and *green* (United States). Regardless of the cylinder color, the only acceptable method for determining the contents should be the label. They should be labeled as *medical oxygen.* Label coloring in your local area is:_____.
      - Cylinders come in many sizes. Depending on the remoteness of your diving operations, the ideal is to have enough oxygen to supply an injured diver until in the care of emergency medical personnel. Your PADI Instructor can advise you regarding the size cylinder or cylinders you may need. In general, to estimate how long an oxygen cylinder may last, use this formula: Litre size of cylinder divided by lpm flow rate = How many minutes a cylinder will last.

   b. Medical valve

      - Connected to the top of the cylinder. Functions as the cylinder's on/off valve.
      - Valve is turned on/off with a wheel, wrench, knob, or *lever*.

- Often, emergency oxygen valves have *indexing holes* (to match pins on medical regulators) so that only medical regulators may be attached to an oxygen cylinder.

c. Pressure regulator

- Like scuba regulators, emergency oxygen regulators reduce and control the pressure from the cylinder.
- Most emergency oxygen regulators attach to the cylinder valve using a T-handle and *indexing pins.* The T-handle tightens the oxygen regulator to the valve while the indexing pins keep emergency oxygen regulators from being used on cylinders that contain other gases.
- Some emergency oxygen regulators have screw-in mounting threads that attach to oxygen cylinders. Adaptors between the two types of regulator mounts – screw-in and indexed – are available.
- Between the oxygen regulator and the valve is a single *gasket* or *washer* recommended by the manufacturer. This seal keeps the oxygen from leaking.
- Most emergency oxygen regulators have a *pressure gauge* indicating the amount of pressure in the cylinder.
- Many emergency oxygen regulators have one or both types of outlets for hoses to connect to – barbed and screw-in outlets. Some have multiple outlets of each type allowing more than one injured diver to be treated at the same time. The barbed outlet works with the regulator's constant-flow feature, while the screw-in feature works with demand and resuscitator valves.

d. Flowmeters and flow controllers

- Emergency oxygen pressure regulators typically have *flowmeters* and *flow controllers* built in.
- Flowmeters measure and indicate the amount of oxygen released by the regulator at the *barbed outlet* in litres per minute (lpm). Note the barbed outlet on the regulator (demonstrate).
- Flowmeters are set by turning the flow controller; typically a rotary dial on the end of the regulator. The flow controller dial allows the user to adjust the lpm delivered to the injured diver.

e. Hoses/Tubing

- Low pressure, clear plastic tubing attaches to the regulator's barbed outlet(s). This tubing attaches to constant flow masks.

- Higher-pressure hoses connect to the regulator's threaded outlet(s). These hoses (often green in color) attach to demand valves and manually triggered resuscitator valves. (These are discussed shortly.)

f. Delivery devices – masks and valves

- Masks come in a variety of styles and sizes. (These are discussed shortly.) To treat scuba diving injuries effectively, you want to provide the highest concentration of oxygen possible over an extended period. Use secure fitting masks when treating scuba diving injuries to minimize the dilution of oxygen with air.
- Valves (not to be confused with the medical valve on the cylinder) are like the second stage of a scuba regulator – they fit on a mask that covers the nose and mouth. There are two types of emergency oxygen valves – demand inhalator valves and *manually triggered resuscitator valves.* (These are discussed shortly.)

- ***On an emergency oxygen system, where can the following parts be found? 1) Cylinder; 2) Valve; 3) Valve Orifice; 4) Valve Indexing Holes; 5) Valve Hand Wheel, Wrench or Lever; 6) Multifunction Regulator; 7) Indexing Pins; 8) Sealing Washer; 9) Flowmeter and flow controller; 10) Cylinder Pressure Gauge; 11) Barbed Constant-Flow Outlet; 12) Demand/Resuscitator Valve Outlet; 13) "T"-Handle***

4. Oxygen system components

Note:
Use an actual emergency oxygen system common in your local as a visual aid. Point out all of its components for students.

- ***What is a nasal cannula and when is it used to deliver emergency oxygen?***
- ***What are the three basic styles of emergency oxygen masks and how do they differ?***

5. Nasal cannulas and masks

a. Nasal cannulas deliver emergency oxygen through the nose.

b. Nasal cannulas are used to deliver emergency oxygen to patients that cannot tolerate a mask, when the required oxygen concentration to be delivered is no more than 40 percent, and when long-term oxygen delivery is required.

c. Nasal cannulas are not typically used to treat scuba diving injuries, unless a diver cannot tolerate wearing a mask.

6. Emergency oxygen masks
   a. There are three basic styles of emergency oxygen masks:
      - Simple masks
      - Non-rebreather masks
      - Resuscitation masks (also called pocket masks)
   b. Simple masks
      - Can be connected to either a constant flow regulator or to demand and resuscitator valves. (More on these valves shortly.)
      - Can be used on breathing and nonbreathing injured divers.
      - These masks can be easily cleaned for reuse.
   c. Non-rebreather masks
      - *Non-rebreather* means that the diver does not "rebreathe" his exhaled breath. Low oxygen concentration, exhaled air is dumped out of the mask.
      - These masks are excellent for delivering between 80 and 100 percent oxygen to injured, *breathing* divers. Second only in choice to demand valves. (More on these valves shortly.)
      - Masks feature an attached reservoir bag and three non-return valves. The bag fills with oxygen in between breaths. Two of the non-return valves on the sides of the mask keep air from entering the mask when the injured diver breathes in (the air would dilute the concentration of oxygen being breathed by the diver). The third non-return valve is located at the top of the reservoir bag to keep exhaled air from entering the bag containing 100 percent oxygen.
      - To keep the mask from leaking air, it needs to have a firm fit on the diver's face.
      - These masks use the constant-flow feature of oxygen regulators – the barbed outlet on most regulators.
      - To use this mask appropriately, the regulator flow-controller knob should be set to deliver between 12 and 15 lpm of oxygen (or enough to keep the reservoir bag inflated).
      - These masks are disposable.
      - You will learn how to use these masks during skill development.
   d. Resuscitation masks (Pocket Masks)

- These masks are used to deliver higher concentrations of oxygen to *nonbreathing* divers when the mask has a supplemental oxygen inlet.
- These masks are used when giving mouth-to-mask resuscitation (rescue breaths).
- Supplemental oxygen from an emergency oxygen regulator flows to the mask via a hose attached to a barbed inlet on the mask. With the addition of oxygen, these masks can deliver a concentration of oxygen over 40 percent (as opposed to the 17 percent of oxygen with mouth-to-mouth or mouth-to-mask rescue breathing only).
- These masks use the constant-flow feature of oxygen regulators – the barbed outlet on most regulators.
- To use this mask appropriately, the regulator flow-controller knob should be set to deliver at least 15 lpm of oxygen.
- These masks can be easily cleaned for reuse.
- You will learn how to use these masks during skill development.

- ***What is a demand inhalator valve and when is it used to deliver emergency oxygen?***

7. Demand inhalator valve
    a. Demand inhalator valves are the first choice in treating injured, breathing divers. They are the easiest and fastest way to deliver 100 percent emergency oxygen to injured divers.
    b. The demand inhalator valve is like the second stage of a scuba regulator – it delivers oxygen only when an injured diver inhales. It takes reduced pressure oxygen supplied by the pressure regulator and reduces it further to a breathable pressure.
    c. These valves deliver 100 percent emergency oxygen to injured , breathing divers and since oxygen only flows when the diver takes a breath, they conserve the amount of oxygen in a given cylinder. This valve generally allows a given supply of oxygen to last longer than constant-flow delivery masks.
    d. Demand inhalator valves use high-pressure hoses connected to the regulator's threaded outlet(s). These hoses are often green in color.
    e. The simple masks attached to these valves are easily cleaned for reuse.
    f. You will learn how to use a demand inhalator valve during skill development.

- ***What is a manually triggered resuscitator valve and when is it used to deliver emergency oxygen?***

8. Manually triggered resuscitator valve
    a. These valves may be used on breathing and nonbreathing, injured divers.
    b. Many manually triggered resuscitator valves may also function as a demand inhalator valve.
    c. For nonbreathing, injured divers they provide a fast, relatively simple and effective means to resuscitate an individual – rather than using mouth-to-mouth or mouth-to-mask resuscitation which is more exhausting.
    d. On these units, a ventilation button is manually pushed by the rescuer to provide an injured, nonbreathing diver with a pressurized rescue breath of 100 percent oxygen.
    e. Many newer models incorporate an internal safety feature that prevents over pressurization of the injured, nonbreathing diver's lungs. This feature prevents lung damage during resuscitation and is why trained, lay rescuers may now use this type of resuscitator.
    f. Lay rescuers should not, however, use a manually triggered resuscitator valve unless specifically trained on that unit. All manually triggered resuscitator valves should be used with great care. They should not be use on infants or small children.
    g. Manually triggered resuscitator valves use high-pressure hoses connected to the regulator's threaded outlet(s). These hoses are often colored green.
    h. The simple masks attached to these valves are easily cleaned for reuse.
    i. Skill development on these valves is optional during this course.

E. Safety Considerations when Using Oxygen and Emergency Oxygen Equipment

1. Contact
    a. Oxygen is an element that can sustain life and support combustion. The first is desirable; the second can be deadly in the wrong circumstances. By itself, oxygen will not burn but it is a highly reactive gas. All substances require oxygen to burn and aggressive combustion can occur in the presence of pure oxygen. Heat, fuel and oxygen are all needed to start a fire. Although problems with oxygen fires are rare, they can occur if oxygen and oxygen equipment is not handled correctly.

b. Here are the questions you'll be able to answer at the conclusion of this segment of the presentation:
   - What are seven general safety procedures to follow when handling oxygen and oxygen equipment?
   - What is a compression fire?

- ***What are seven general safety procedures to follow when handling oxygen and oxygen equipment?***

2. Oxygen safe handling tips
   a. Avoid open flames. Do not use oxygen within 3 metres/10 feet of open flames or cigarettes.
   b. Keep oxygen away from electrical equipment that may spark and use only in well-ventilated areas. In closed areas, oxygen concentration can build up, resulting in a more combustible atmosphere.
   c. Keep all petroleum and hydrocarbon products (e.g., grease, oil, etc.) away from direct contact with oxygen. Never use petroleum or silicone grease or oil on oxygen cylinders or regulators. Oxygen equipment requires special lubricants.
   d. Keep oxygen cylinders away from heat and open flames. Avoid exposing cylinders to direct sunlight or storage in hot vehicles.
   e. Like scuba cylinders, keep oxygen cylinders properly secured during transport and use. Compressed gas cylinders with oxygen are pressurized to 140 bar/2000 psi or higher. Although engineered to withstand normal handling and rigors, the high pressure presents a risk if the cylinder or valve is damaged. It is always best to keep cylinders in protective cases when not in use or being transported. Even when in use, position the cylinder for access and stability.
   f. When carrying cylinders, use both hands around the cylinder. Avoid grabbing the tank by the valve as this can leave behind potentially combustible contaminates, including dirt and skin oil.
   g. Only use oxygen high-pressure cylinders that are within the hydrostatic test date.

Note:
Use of Automated External Defibrillators (AED's) around oxygen equipment is safe. No need to worry about hazards when using this equipment together on a diver.

- ***What is a compression fire?***

3. When an oxygen cylinder is opened quickly, releasing a burst of gas into the regulator, compression can result causing heat. In rare instances, this heat can cause a fire by igniting any contaminants or particles within the regulator. To avoid this problem:
    - Have regulators serviced on schedule, following manufacturers' recommendations.
    - Inspect regulators and valves prior to assembling.
    - Open cylinder valve slowly to turn on the flow.
    - Test oxygen flow prior to giving to an injured diver.

F. Maintaining Emergency Oxygen Equipment

1. Contact
    a. Proper maintenance of emergency oxygen equipment is necessary and easy. There are few user serviceable components on emergency oxygen systems; however, there are a few maintenance details you need to know.
    b. Here are the questions you'll be able to answer at the conclusion of this segment of the presentation:
        - How often must an emergency oxygen cylinder be tested?
        - How do you determine if an emergency oxygen cylinder needs testing?
        - Where and how do you fill emergency oxygen cylinders?
        - What regular maintenance must be performed on emergency oxygen systems?

- ***How often must an emergency oxygen cylinder be tested?***
- ***How do you determine if an emergency oxygen cylinder needs testing?***

2. Emergency oxygen cylinders are like scuba cylinders, made from either steel or aluminum. As such, they must undergo periodic high-pressure testing.
    a. Generally, emergency oxygen cylinders must be tested every five to ten years depending on the laws of your country. Locally, emergency oxygen cylinders must be tested every: _____ years.

b. The test date is stamped on the neck of the emergency oxygen cylinder. Typically, the original test date of the cylinder is given by month (example: "02"), separated by "*" the Independent Inspection Agency (IIA) symbol, followed by the year (example: "08"). Using the example date of 02 * 08, a tank that is empty on 02 * 13 would be out of test date and could not be refilled until the cylinder underwent another pressure test and passed.

- ***Where and how do you fill emergency oxygen cylinders?***

3. Where to fill emergency oxygen cylinders.
   a. Medical supply and medical gas companies.
   b. In some areas, a doctor's prescription may be required to obtain a fill for an emergency oxygen cylinder.
   c. Often, certified emergency first responders trained to use oxygen can obtain cylinder refills. Take your PADI Emergency Oxygen Provider certification card with you when attempting to refill a cylinder.
   d. Refill the cylinder only at authorized and reputable dealers.
   e. Locally, you can refill your cylinder at:_____
4. How cylinders are filled.
   a. Typically, emergency oxygen cylinders are transfilled from larger containers.

- ***What regular maintenance must be performed on emergency oxygen systems?***

5. Disposable items.
   a. Some masks and tubing are used once and then disposed. These items include non-rebreather masks, one-way valves for pocket masks and all plastic tubing.
   b. Replace disposed of items before repacking a kit for storage.
6. General maintenance.
   a. Make sure all used, non-disposable masks are disinfected and rinsed before storage.
   b. Secure spare sealing gaskets/washers.
   c. Check the cylinder for the need to refill.
   d. Follow the manufacturers' instructions exactly regarding maintenance procedures.

Section Three:
Skill Development
Conduct

This section provides information about teaching all four of the required PADI Emergency Oxygen Provider course skills. It also includes guidelines for introducing the Emergency Oxygen Optional Skill – Manually Triggered Resuscitator Valve use for Nonbreathing Divers.

Consider teaching the PADI Emergency Oxygen Provider Skills in a variety of venues – classroom, beach, boat or pool deck, etc. Different venues provide realism and context to skills. Also, consider dividing students into small practice groups. This will provide them with a comfortable learning environment and continually engage them in skill practice. Ideal practice groups consist of a guide, a simulated injured diver and an emergency oxygen provider. Group members alternate roles until all students have the opportunity to play each role. This approach allows students to perform not only a skill, but also to see someone else practice the skill and to feel what an injured diver may experience.

When acting as a guide, the student helps the Emergency Oxygen Provider through the skill by reading the "How It's Done" steps outlined using their student manual or the Care at a Glance reference. Having to direct a peer helps each student understand the skill steps and increases overall confidence.

Practicing the skill as the Emergency Oxygen Provider, especially the first attempt, becomes less stressful when students know that a peer is available to guide them. Making initial mistakes in front of other students, instead of the instructor, can be less intimidating for many people. Practicing in a group also strongly promotes self-discovery and self-correction.

Having students act as a simulated injured diver serves two important purposes. First, it adds realism by requiring the Emergency Oxygen Provider to approach, touch and interact with another person. Secondly, it allows students to examine emergency care from an injured diver's perspective. This heightens awareness and reinforces the need to help others whenever possible.

The ideal practice group is made up of three students, but, if the class size doesn't allow this division, place four students in a group or use smaller groups with you or an assistant filling in as necessary.

Scenario practice is not required during the course. However, if additional time is needed to meet local training requirements or you simply wish to provide your students with additional practice, scenario practice is encouraged.

Students must demonstrate the following performance requirements to qualify for certification. Because the skills (one through four) build on one another, it's best to conduct them in sequence.

Emergency Oxygen Provider Skills

Performance Requirements

Emergency Oxygen Provider Skill One

Assembly and Disassembly of an Emergency Oxygen System

- **Students will demonstrate how to assemble emergency oxygen equipment safely so that it can be used on breathing and nonbreathing injured divers. Students will be able to: 1) attach the multifunction regulator, 2) attach a pocket mask to the regulator, 3) attach a non-rebreather mask to the regulator, and 4) attach a demand inhalator valve to the oxygen regulator.**
- **Students will demonstrate how to assemble emergency oxygen equipment so that two injured divers can breathe from one system.**
- **Students will demonstrate how to disassemble and safely store emergency oxygen equipment.**

Emergency Oxygen Provider Skill Two

Non-Rebreather Mask Use for Breathing Injured Diver

Students will be able to demonstrate how to use a non-rebreather mask on a breathing injured diver by:

- **Turning on the oxygen cylinder valve and adjusting the flowmeter on the multifunction regulator to at least 15 litres per minute.**
- **Filling the reservoir bag.**
- **Delivering the oxygen use statement and self-testing the system.**
- **Placing the mask on an injured diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.**
- **Positioning unresponsive, breathing injured divers appropriately.**

Emergency Oxygen Provider Skill Three

Demand Inhalator Valve Use for Breathing Injured Diver

Students will demonstrate how to use a demand inhalator valve on a breathing diver by:

- **Turning on the oxygen cylinder valve.**
- **Delivering the oxygen use statement and self-testing the system.**
- **Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.**
- **Positioning a responsive and unresponsive, breathing injured diver appropriately.**

Emergency Oxygen Provider Skill Four

Pocket Mask Use with Oxygen for a Nonbreathing Diver

Students will demonstrate how to use a pocket mask on a nonbreathing diver by:

- **Connecting an emergency oxygen source to a pocket mask via the mask's supplemental oxygen inlet.**
- **Turning on the oxygen cylinder valve and adjusting the flowmeter on the multifunction regulator to 15 litres per minute.**
- **Delivering the oxygen use statement and self-testing the system.**
- **Opening the diver's airway.**
- **Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.**
- **Delivering mouth-to-mask rescue breathing with each breath lasting approximately one second.**

Emergency Oxygen Provider Optional Skill

Manually Triggered Resuscitator Valve Use for a Nonbreathing Diver

Students will demonstrate how to use a manually triggered resuscitator valve on a nonbreathing diver by:

- **Turning on the oxygen cylinder valve.**
- **Checking the safety valve to ensure it functions properly by blocking the oxygen outlet.**
- **Delivering the oxygen use statement and self-testing the system.**
- **Opening the diver's airway.**
- **Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.**
- **Triggering the resuscitator valve manually to provide the diver with oxygen and rescue breaths.**

Skill Guidelines for Emergency Oxygen Provider Course

A. General Skill Development Guidelines

1. For practice, have all students prepare and clean emergency oxygen equipment for use and storage.
2. Before the course, familiarize yourself with the specific emergency oxygen system you will use during skill development.
3. With larger classes, use certified assistants to work closely with individual practice groups. Certified assistants include other PADI Emergency Oxygen Provider Instructors,
4. Review with students the Key Points at the beginning of each skill.
5. Demonstrate the techniques included in each skill by reviewing the critical steps. Always allow ample time for student practice.
6. The skill development session should not last much more than two hours (depending on number of students and available emergency oxygen equipment).
7. Consider how you will provide students with clean masks for skill development. Since non-rebreather masks cannot be cleaned between student use, each student must have their own during training. Simple masks and pocket masks can be cleaned between student use. To clean these masks between students, during class, rinse them in two solutions – a disinfecting solution and a solution of clean water. The disinfecting solution can be made with common household bleach at a concentration of 1:100 bleach-to-water. This concentration is approximately: a) 60 millilitres of bleach in 4 litres of water, or b) 1/4 cup bleach in one gallon of water or mix one tablespoon bleach in one quart of water. Between courses, masks can also be washed in a dishwasher on the hot cycle. Other disinfecting solutions can be of industrial types mixed according to the manufacturer instructions. One such solution is Simple Green Pro 5®. Note that household bleach damages fabric and corrodes many metals. Cleaning masks with alcohol-based products can make them hard and brittle, and some people are allergic to alcohol.
8. Always have students wash their hands before skill training. Train students to protect themselves from disease transmission by using gloves and barriers. Consider having students practice skills with gloves on.
9. Conduct training in a well-ventilated area away from any source of flame or heat.
10. Consider using manikins for Emergency Oxygen Provider Skill Four – Pocket Mask Use.

B. Emergency Oxygen Provider Skills

Emergency Oxygen Provider

Skill One

Assembly and Disassembly of an Emergency Oxygen System

Performance Requirements

1. ***Students will be able to assemble emergency oxygen equipment safely so that it can be used on breathing and nonbreathing injured divers. Students will be able to***
   - ***Attach the multifunction regulator.***
   - ***Attach a pocket mask to the regulator.***
   - ***Attach a non-rebreather mask to the regulator.***
   - ***Attach a demand inhalator valve to the oxygen regulator.***
2. ***Students will be able to assemble emergency oxygen equipment so that two injured divers can breathe from one system.***
3. ***Students will be able to disassemble and safely store emergency oxygen equipment.***

Value

Before you can provide an injured diver with emergency oxygen, you need to be able to assemble available emergency oxygen equipment quickly and correctly. This skill will teach you how to assemble the equipment available for this course. Although emergency oxygen equipment does vary, most equipment assembles in a like manner. If you do not own your equipment or do not have it on scene, consider evaluating any styles of emergency oxygen equipment that might be at the dive site (if appropriate). Doing this prior to an emergency will make your deployment of emergency oxygen equipment efficient.

Key Points

- Wash your hands prior to practice.
- Always give the emergency oxygen responder statement to a responsive, injured diver prior to helping. Say, "This is oxygen, may I help you?"
- Always examine the cylinder for the oxygen label and expiration date.

- If the cylinder is new, remove any protective covering on the cylinder valve. Avoid handling the valve with your hands.
- Always clear away any debris that may be present in the valve outlet before connecting the pressure regulator. To do this, locate the on/off wheel, lever or wrench. Turn the valve on gently – often counter-clock-wise – to remove debris. A very small burst of gas will do.
- Always check to make sure the gasket/washer is attached to the oxygen entrance port on the regulator.
- Make sure the index holes on the cylinder valve match up with the pins on the regulator. If they do not match, do not use the equipment.
- Each of you should have your own non-rebreather masks. Do not share masks, as they cannot be cleaned.

Critical Steps – Assembly

- **Remove the equipment from any carrying case** (if appropriate; some equipment is designed to stay in its container). For safety, consider keeping the cylinder in its case so it can't fall over.
- **Connect the regulator.** Hand-tighten it to the cylinder (if appropriate; some cylinders are stored attached to their regulators). At this point, do not turn on the oxygen cylinder.
- **Remove the various masks from any bag or container.** Non-rebreather mask, pocket mask and simple mask for demand valve. Assemble the masks if needed.
- **Connect a pocket mask to the regulator.** Pocket masks have a small inlet on the mask itself. Attach one end of the clear tubing to the pocket mask, the other (larger end) to the barbed outlet on the regulator. On most oxygen systems, the end of the tubing that fits on the regulator is designed for the barbed outlet. If available, attach the one-way valve to the pocket mask. This mask is now ready to use.
- **Turn on emergency oxygen flow.** Using the unit's wheel, lever or wrench, slowly turn on the oxygen cylinder. To begin the flow of emergency oxygen to the pocket mask, adjust the flow controller on the regulator to the lowest flow rate. Note the flow of oxygen to the pocket mask. Check the pressure in the oxygen cylinder by looking at the gauge. Next, turn the oxygen cylinder off – allow the regulator to depressurize. To continue, remove the pocket mask from the tubing.
- **Connect a non-rebreather mask to the regulator.** Attach the Non-rebreather mask to the clear tubing (in place of the removed pocket mask). Like the pocket mask, the other end of the tubing is attached to the barbed outlet on the oxygen regulator. This mask is now ready for use. Leave this mask attached to the regulator.

- **Connect a demand inhalator valve to the oxygen regulator.** Attach the appropriately sized simple mask to the demand inhalator valve. Next, attach the demand inhalator valve to the high-pressure threaded hose. Finally, attach the high-pressure threaded hose to the oxygen regulator. Note that both threaded ends of the high-pressure hose are identical. The demand valve is now ready for use.
- **Ready for two injured divers.** At this point (depending on the emergency oxygen system used), emergency oxygen may be delivered to two injured divers from the same cylinder and regulator. Using the unit's wheel, lever or wrench, turn on the oxygen cylinder. Note the flow of oxygen to the demand valve. To begin the flow of emergency oxygen to the non-rebreather mask, adjust the flow controller on the regulator to the lowest flow rate. Note the flow of oxygen to the non-rebreather mask.

Critical Steps – Disassembly

- **Turn off emergency oxygen flow.** Using the unit's wheel, lever or wrench, turn off the oxygen cylinder. Allow the system to drain and the regulator to depressurize. Adjust the regulator's flow controller to zero. Check the pressure gauge – it should read zero.
- **Remove regulator from cylinder.**
- **Remove regulator gasket/washer.** Secure appropriately.
- **Remove non-rebreather mask and tubing from regulator.**
- **Remove demand valve and high-pressure hose from regulator and mask.**
- **Remove simple mask from demand valve.**
- **Secure system appropriately.** Place cylinder, regulator and components in carrying case.

Emergency Oxygen Provider

Skill Two
Non-Rebreather Mask Use for a Breathing Diver

Performance Requirements

1. ***Students will be able to demonstrate how to use a non-rebreather mask on a breathing injured diver by:***
    - ***Turning on the oxygen cylinder valve and adjusting the flowmeter on an oxygen regulator to at least 15 litres per minute.***
    - ***Filling the reservoir bag.***
    - ***Delivering the oxygen use statement and self-testing the system.***
    - ***Placing the mask on an injured diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.***
    - ***Positioning an unresponsive, breathing injured diver appropriately.***

Value

Receiving adequate oxygen is crucial to an injured diver. You can decrease diver stress and support the respiratory system by administering emergency oxygen. The non-rebreather mask can deliver close to 100 percent oxygen for appropriate treatment of breathing divers suffering from near drowning and DCI.

Key Points

- Wash your hands prior to practice. Use gloves as appropriate.
- Use the non-rebreather mask given to you for this skill. Do not switch masks between students as these masks cannot be disinfected.
- Use this mask when a diver cannot tolerate a demand inhalator valve mask.
- When helping an injured diver, always:
    - Stop, think and then act.
    - Alert local Emergency Medical Services (EMS) as soon as possible and coordinate transport to the nearest hyperbaric facility.

- Give the emergency oxygen responder statement to a responsive, injured diver prior to helping. Say, "This is oxygen, may I help you?" If the injured diver does not respond, assume permission is granted.

- Monitor the injured diver's lifeline – The ABCD'S. **A**irway, **B**reathing, **C**irculation/**C**hest **C**ompressions, **D**efibrillation, **S**hock, **S**pinal Injury and **S**erious Bleeding.
- Treat for shock by maintaining a diver's body temperature – mostly by covering and keeping the diver warm. Also, consider elevating the diver's legs.
- Write down or try to remember the time you began to provide an injured diver with emergency oxygen. Give this information to the EMS.

Critical Steps – Non-Rebreather Mask

- **Assemble the emergency oxygen system with a non-rebreather mask as previously practiced.**
  - Start the flow of emergency oxygen by slowly opening the cylinder valve.
  - Check the cylinder pressure gauge.
  - Check for system leaks.
- **Position an injured, responsive breathing diver lying face up.**
- **Position an unresponsive, breathing injured diver in the recovery position.**
  - Put diver on his left side, lateral position. This would allow fluid to drain from his mouth and mask should this occur.
  - Stabilize the diver by bringing the top leg over the other. Place the leg on ground in a bent position.
  - Place the diver's lower arm near or under the head for stabilization, ensuring the airway remains open and unobstructed.
- **Set the flow controller to 15 lpm.**
- **Listen for the flow of oxygen.**
- **Fill the bag with oxygen.** Look inside the mask and find the non-return valve positioned on top of the reservoir bag. With a finger, block the valve inside the mask. Manually blocking the valve will fill the reservoir bag.
- **Test the flow of oxygen.** Loosely place the mask on your own face, take a breath and then exhale away from the mask. This test also shows conscious, responsive divers that the oxygen is flowing and it is

safe.

- **Place the mask on the injured diver.** Adjust the mask's elastic band around the diver's head. Position the mask so it fits comfortably over the diver's nose and mouth. Try to eliminate leaks due to a poor fit. Squeeze the metal nose-clip together to obtain a firm fit. If the diver is responsive, have the diver hold the mask in place for a tight fit. Note the diver's exhalations – mask fogs – and inhalations – mask clears. Watch the diver's chest rise and fall.
- **Check the breathing rate of the injured diver.** If the non-rebreather mask reservoir bag does not remain at least partially inflated, increase the flow rate by adjusting the flow controller to 25 lpm.
- **Attend to the injured diver.** Monitor the diver's lifeline and reassure him – helping him relax and breathe normally. Check for shock; keep the diver warm. Keep an eye on the diver's use of oxygen by checking the pressure gauge regularly.

Emergency Oxygen Provider

Skill Three
Demand Inhalator Valve Use for a Breathing Diver

Performance Requirements

1. ***Students will be able to demonstrate how to use a demand inhalator valve on a breathing diver by:***
   - ***Turning on the oxygen cylinder valve.***
   - ***Delivering the oxygen use statement and self-testing the system.***
   - ***Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.***
   - ***Positioning a responsive and unresponsive, breathing injured diver appropriately.***

Value

Demand inhalator valves are the first choice in treating injured divers. They are the easiest and fastest way to deliver 100 percent emergency oxygen to breathing, responsive or unresponsive injured divers. The demand inhalator valve is like the second stage of a scuba regulator – it delivers oxygen only when an injured diver breathes in. Since oxygen only flows when the diver takes a breath, demand inhalator valves conserve the amount of oxygen in a given cylinder. This valve generally allows a given supply of oxygen to last longer than constant-flow delivery masks.

Key Points

- Wash your hands prior to practice. Use gloves as appropriate.
- Disinfect the mask portion of the demand inhalator valve after each student's use.
- When helping an injured diver, always:
  - Stop, think and then act.
  - Alert local Emergency Medical Services (EMS) as soon as possible and coordinate transport to the nearest hyperbaric facility.
  - Give the emergency oxygen responder statement to a responsive, injured diver prior to helping. Say, "This is oxygen, may I help you?" If the injured diver does not respond, assume permission is granted.
- Monitor the injured diver's lifeline – The ABCD'S. **A**irway, **B**reathing,

Circulation/**C**hest **C**ompressions, **D**efibrillation, **S**hock, **S**pinal Injury and **S**erious Bleeding.

- Treat for shock by maintaining a diver's body temperature – mostly by covering and keeping the diver warm. Also, consider elevating the diver's legs.
- Write down or try to remember the time you began to provide an injured diver with emergency oxygen. Give this information to the EMS.

Critical Steps – Demand Inhalator Mask

- **Assemble the emergency oxygen system with a demand inhalator valve as previously practiced.**
  - Start the flow of emergency oxygen by slowly opening the cylinder valve.
  - Check the cylinder pressure gauge.
  - Check for system leaks.
  - Make sure the flow controller is set at the "0" or off position.
- **Position an injured, responsive breathing diver lying face up.**
- **Position an unresponsive, breathing injured diver in the recovery position.**
  - Put diver on his left side, lateral position. This would allow fluid to drain from his mouth and mask should this occur.
  - Stabilize the diver by bringing the top leg over the other. Place the leg on ground in a bent position.
  - Place the diver's lower arm near or under the head for stabilization, ensuring the airway remains open and unobstructed.
- **Test the flow of oxygen.** Loosely place the mask on your own face, take a breath, and then exhale away from the mask. This test also shows conscious, responsive divers that the oxygen is flowing and it is safe.
- **Place the demand valve mask on the injured diver.** Adjust the mask so it fits comfortably over the diver's nose and mouth. Try to eliminate leaks due to a poor fit. If the diver is responsive, have the diver hold the mask in place for a tight fit. Note the diver's exhalations – mask fogs – and inhalations – mask clears. Watch the diver's chest rise and fall.
- **Attend to the injured diver.** Monitor the diver's lifeline and reassure him – helping him relax and breathe normally. Check for shock; keep the diver warm. Keep an eye on the diver's use of oxygen by checking the pressure gauge regularly.

Emergency Oxygen Provider

Skill Four
Pocket Mask Use with Oxygen for a Nonbreathing Diver

Performance Requirements

1. ***Students will be able to demonstrate how to use a pocket mask on a nonbreathing diver by:***
   - ***Turning on the valve and adjusting the flowmeter on the multi-function regulator to 15 litres per minute.***
   - ***Delivering the oxygen use statement and listening for oxygen flow.***
   - ***Opening the diver's airway.***
   - ***Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.***
   - ***Delivering mouth-to-mask rescue breathing with each breath lasting approximately one second.***

Value

Near drowning, DCI and other injuries and illnesses may cause a diver to stop breathing. In this case, you need to breathe for the diver and provide him with supplemental emergency oxygen. One way to give a nonbreathing diver rescue breaths (mouth-to-mask resuscitation) and supplemental oxygen is with a pocket mask. Learning how to use the pocket mask will help you appropriately aid a non-breathing, injured diver while still providing emergency oxygen.

Key Points

- Wash your hands prior to practice. Use gloves as appropriate.
- Disinfect the pocket mask after each students use.
- When helping an injured diver, always:
  - Stop, think and then act.
  - Alert local Emergency Medical Services (EMS) as soon as possible and coordinate transport to the nearest hyperbaric facility.
  - Give the emergency oxygen responder statement to a responsive, injured diver prior to helping. Say, "This is oxygen, may I help you?" If the injured diver does not respond, assume permission is granted.
- Monitor the injured diver's lifeline – The ABCD'S. **A**irway, **B**reathing,

Circulation/**C**hest **C**ompressions, **D**efibrillation, **S**hock, **S**pinal Injury and **S**erious Bleeding.

- Treat for shock by maintaining a diver's body temperature – mostly by covering and keeping the diver warm. Also, consider elevating the diver's legs.

Note:
If an injured diver is not breathing, he will need chest compressions (CPR). While one rescuer sets up the emergency oxygen equipment, another can begin CPR. To learn more about CPR and AED use, take a Primary and Secondary Care or CPR and AED course offered by Emergency First Response.

Critical Steps – Pocket Mask

- **Assemble the emergency oxygen system with a pocket mask as previously practiced.**
  - Start the flow of emergency oxygen by slowly opening the cylinder valve.
  - Check the cylinder pressure gauge.
  - Check for system leaks.
- **Set the flow controller to 15 lpm.**
- **Listen for the flow of oxygen.**
- **Position yourself at the top of the diver's head.**
- **Place the pocket mask on the injured diver.** (At this point, you may need to interrupt CPR being given by a second rescuer.) Adjust the mask's elastic band around the diver's head or just hold it firmly in place. Position the mask so it fits comfortably over the diver's nose and mouth. Try to eliminate leaks due to a poor fit.
- **Open the diver's airway with both hands by lifting the chin.** At this point, the emergency oxygen provider can take over CPR if needed.
- **Give the diver two rescue breaths, each over one second.**
  - Provide the diver with just enough air to make the chest rise. This means giving a normal (not deep) breath.
  - If you can't make the diver's chest rise with the first breath, repeat the head tilt-chin lift to open the airway before attempting another breath.
- **Attend to the injured diver.** Monitor the diver's lifeline and continue

CPR. Check for shock; keep the diver warm. Keep an eye on the diver's use of oxygen by checking the pressure gauge regularly.

Emergency Oxygen Provider

Optional Skill

Manually Triggered Resuscitator Valve Use for a Nonbreathing Diver

1. **Students will be able to demonstrate how to use a manually triggered resuscitator valve on a nonbreathing diver by:**
   - **Turning on the oxygen cylinder valve.**
   - **Checking the safety valve to ensure it functions properly by blocking the oxygen outlet.**
   - **Delivering the oxygen use statement and self-testing the system,**
   - **Opening the diver's airway.**
   - **Placing the mask on a diver's face/head so it is comfortable, has a proper seal, and delivers a high concentration of emergency oxygen.**
   - **Triggering the resuscitator manually to provide the diver with oxygen and rescue breaths.**

Value

Near drowning, DCI and other injuries or illnesses may cause a diver to stop breathing. In this case, you need to breathe for the diver and provide him with supplemental emergency oxygen. For nonbreathing injured divers, manually triggered resuscitator valves provide a fast, relatively simple and effective means to resuscitate an individual with 100 percent oxygen (rather than using mouth-to-mouth or mouth-to-mask resuscitation). Since these valves replace the need for mouth-to-mouth or mouth-to-mask resuscitation, their use is less exhausting for the emergency oxygen provider.

Key Points

- Wash your hands prior to practice. Use gloves as appropriate.
- Disinfect the simple mask and the outlet adaptor/exhalation valve assembly after each student's use. First, unscrew the outlet adaptor from the valve. Next, use the same disinfecting solution and rinse water for both the mask and the outlet adaptor/exhalation valve assembly. Once the outlet adaptor has been reconnected to the valve, depress the resuscitation button to blow out residual rinse water.

WARNING: *Do not submerge the remaining portion of the manually triggered resuscitation valve in the disinfecting solution or water. Some manually triggered resuscitation valves may vary in their design. Clean as per manufacturer's instructions after each student's use.*

- When helping an injured diver, always:
  - Stop, think and then act.
  - Alert local Emergency Medical Services (EMS) as soon as possible and coordinate transport to the nearest hyperbaric facility.
  - Give the emergency oxygen responder statement to a responsive, injured diver prior to helping. Say, "This is oxygen, may I help you?" If the injured diver does not respond, assume permission is granted.
  - Monitor the injured diver's lifeline – The ABCD'S. **A**irway, **B**reathing, **C**irculation/**C**hest **C**ompressions, **D**efibrillation, **S**hock, **S**pinal Injury and **S**erious Bleeding.
  - Treat for shock by maintaining a diver's body temperature – mostly by covering and keeping the diver warm. Also, consider elevating the diver's legs.

Note:
If an injured diver is not breathing, he may also need chest compressions (CPR).

Note:
While one rescuer sets up the emergency oxygen equipment, another can begin CPR. With some manually triggered resuscitator valves, it is best to have two rescuers work the resuscitator valve – one rescuer holds the mask firmly on the injured diver, while the second rescuer pushes the manual resuscitation button. The person pushing the manual resuscitator button can also provide the diver with chest compressions.

Note:
Regular and repeated practice with manually triggered resuscitator valves is advised to assure competence. If you have not practiced with this valve recently and you find yourself in a position of having to treat a nonbreathing injured diver, provide rescue breaths with supplemental oxygen and a pocket mask.

Critical Steps – Manually Triggered Resuscitator Valve

- **Assemble the emergency oxygen system with a manually triggered resuscitator valve.**
  - Attach the valve itself to one end of the high-pressure threaded hose.
  - Attach the other end of high-pressure threaded hose to the oxygen regulator. Note that both threaded ends of the high-pressure hose are identical.
  - Attach the appropriately sized simple mask to the valve. The valve is now ready for use.
  - Start the flow of emergency oxygen by slowly opening the cylinder valve.
  - Make sure the flow controller is set at the "0" or off position.
  - Check the cylinder pressure gauge.
  - Check for system leaks.
- **Push the manual resuscitator button on the valve. Listen for the flow of oxygen.**
- **Check the resuscitator valve's safety feature.** Press the manual resuscitator button again, but this time block the valve's outlet with your hand or thumb. If the safety feature is working, blocking the outlet will stop the flow of oxygen.
- **Position yourself at the top of the diver's head.**
- **Place the mask on the injured diver.** At this point, the emergency oxygen provider can take over CPR if needed. Position the mask so it fits comfortably over the diver's nose and mouth. With two hands, hold the mask firmly on the face to maintain a tight seal.
- **Open the diver's airway with both hands by lifting the chin.**
- **Carefully give the diver two rescue breaths, by depressing the manual resuscitator button on the valve with your thumb. Release the button once the injured diver's chest begins to rise.**
  - Ventilations should be about one second each.
  - If you can't make the diver's chest rise with the first manual ventilation, repeat the head tilt-chin lift to open the airway before attempting another manual ventilation.

Note:
Be aware of the flow rate delivered by your manually triggered resuscitator valve. Some units provide more than two litres of oxygen per second. Holding the button for two seconds can overinflate the lungs and cause the diver additional injury. Newer models shut off at lower pressures; however, caution is advised with using these valves.

- **Attend to the injured diver.** Monitor the diver's lifeline and continue CPR. Check for shock; keep the diver warm. Keep an eye on the diver's use of oxygen by checking the pressure gauge regularly.

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Emergency Oxygen Provider
Knowledge Review Answer Key

1. Summarize why oxygen is important for life.
   For animals, the most important use of oxygen is for breathing. In terms of human physiology, our breathing (respiratory) system and the blood circulation (circulatory) system carry oxygen to the cells and organs. Oxygen is essential for respiration because the body uses it to "burn" fuel (food molecules) – much like a car engine needs oxygen to run by combusting gasoline or diesel.

2. The addition of emergency oxygen greatly increases the efficiency of rescue breathing. By using a pocket mask with additional emergency oxygen flow during rescue breathing, available oxygen for the injured diver increases from 17 percent to over __40____ percent. If a manually triggered oxygen resuscitator valve is used on a nonbreathing injured diver, oxygen availability rises to approximately ___99___ percent.

3. Briefly describe why oxygen is used to treat scuba diving maladies.
   Giving oxygen to an injured diver:
   1. *Increases the oxygen concentration breathed by a diver suffering from a scuba diving specific illness increases the saturation of oxygen in the blood. Natural circulation of this hyperoxygenated blood may increase the chances of survival of damaged tissues or tissues with a poor blood supply.*
   2. *Keeps the injured diver from breathing more nitrogen when on the surface.*
   3. *Accelerates the elimination of nitrogen from the body. The added concentration of oxygen creates a greater pressure difference between the nitrogen bubble and the nitrogen dissolved in the tissues. This pressure difference speeds nitrogen dissolving from the tissues, helping reduce the bubble size or, in ideal circumstances, causes bubbles to disappear. Reducing or eliminating bubbles reduces or eliminates the primary injury mechanism of DCI.*

4. List seven life-threatening problems that the use of emergency oxygen helps to make a positive difference in a patient's outcome.
   1. *Traumatic injury leading to excessive blood loss or airway/breathing interference.*
   2. *Shock*
   3. *Cardiac arrest*
   4. *Respiratory arrest*
   5. *Stroke*
   6. *Near drowning*
   7. *Decompression illness*

5. A diver suffering from a near drowning incident is not breathing. What mask should you select that will enable you to provide the diver with rescue breaths and supplemental, emergency oxygen?
   Pocket mask

6. State the most common cause of lung overexpansion injuries.
   Over-expansion lung injuries result from breath-holding during ascent while on scuba. The most common cause of a breath-hold ascent is a panicked bolt to the surface as a result of running out of air.

7. State the cause of decompression sickness (DCS).
   Decompression sickness (DCS) results when nitrogen (or other inert gas, such as helium in technical diving) dissolved into the tissues comes out of solution and forms bubbles during ascent. The bubbles can block blood flow (mechanical problems) and cause clotting activation and tissue inflammation (biochemical problems).

8. Explain what is meant by decompression illness.
   Decompression illness is a clinical term used to describe the signs and symptoms of both lung overexpansion and decompression sickness maladies in the context of first aid and therapy.

9. List fifteen possible signs/symptoms of decompression illness.
   [Answers could be any of the following:]

   Pain, typically in joints
   Fatigue
   Inability to urinate
   Blurred vision
   Vertigo
   Hearing Impairment
   Speech impairment
   Paralysis
   Loss of sensation
   Unconsciousness
   Breathing difficulties
   Chest pain or severe chest pain
   Uncontrollable coughing
   Death
   Fainting
   Shock
   Cyanosis (blueness of the skin)
   Neck swelling
   Voice changes
   Difficulty swallowing
   Sudden unconsciousness
   Coughing
   Personality changes
   Cardiac arrest
   Dizziness
   Bloody froth from the mouth
   Extreme difficulty breathing

10. Explain why a diver with suspected decompression illness be treated while lying down.
    Field experience has shown that some divers' symptoms worsen significantly after sitting up or standing.

11. Summarize why a diver suspected of having decompression illness must always be transported as soon as possible to the nearest medical facility.
    Emergency care and first aid for decompression illness may reduce or eliminate symptoms, but not the underlying cause. Only advanced medical care that includes drug administration and hyperbaric treatment in a recompression chamber can actually treat the causes of DCI.

12. Explain why non-rebreather masks are often used to treat injured scuba divers.
    As their name implies, non-rebreather means that the diver does not "rebreathe" his exhaled breath. Low oxygen concentration, exhaled air is dumped out of the mask. These masks are excellent for delivering between 80 and 100 percent oxygen to injured, breathing divers.

13. Identify two reasons why demand inhalator valves are the first choice in treating injured, breathing divers.
    These valves deliver 100 percent emergency oxygen to injured divers. Also, since oxygen only flows when the diver takes a breath, they can serve the oxygen supply.

14. Outline the general maintenance of all emergency oxygen equipment.
    Disinfecting and rinsing all non-disposable masks before storage.

    Securing spare sealing gaskets/washers from regulators.

    Checking the cylinder for the need to refill.

    Following the manufacturers' instructions exactly regarding maintenance procedures.