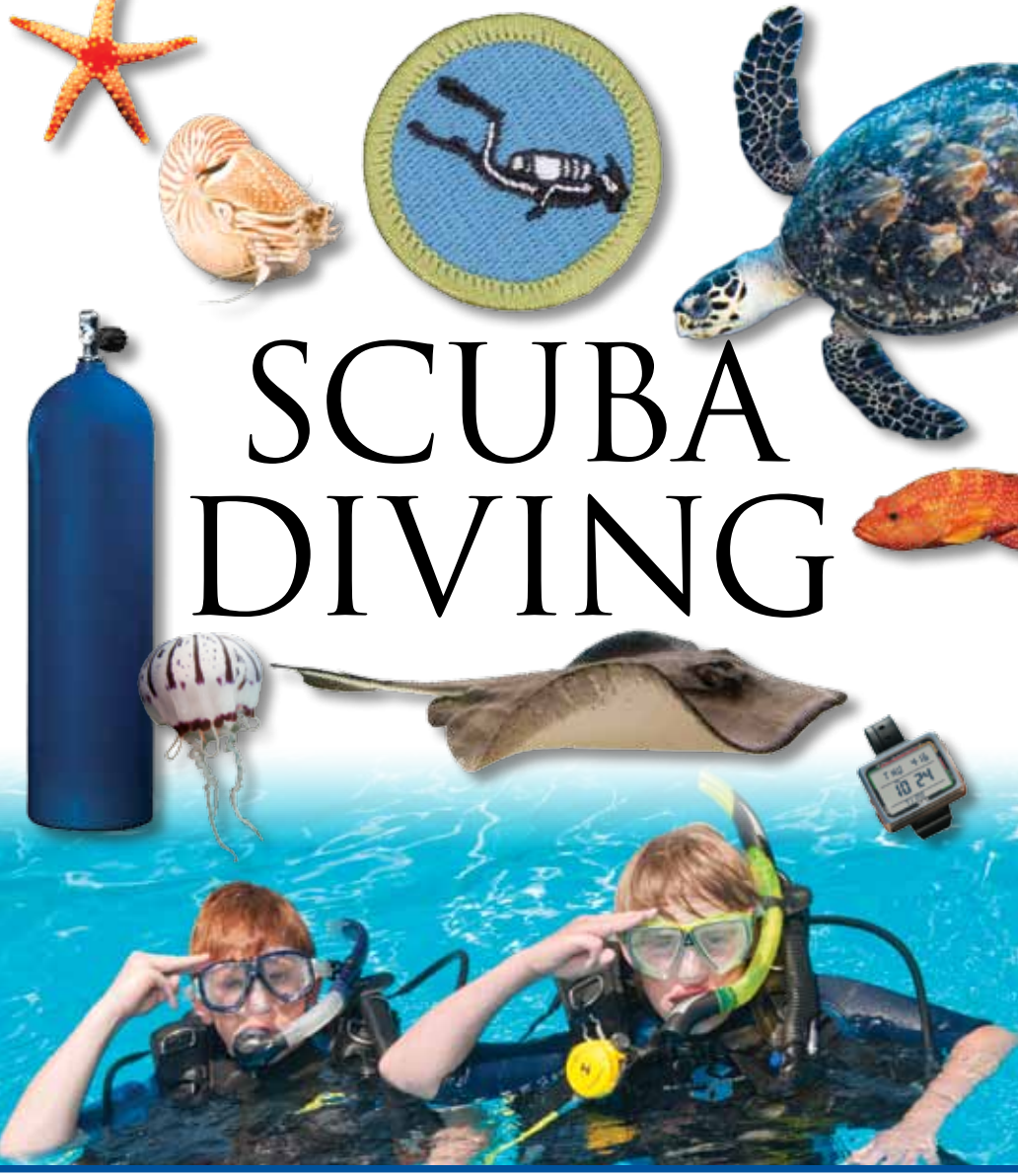
MERIT BADGE SERIES



SCUBA DIVING

BOY SCOUTS OF AMERICA®

How to Use This Pamphlet

The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

Your counselor can be as important to you as a coach is to an athlete. Use all of the resources your counselor can make available to you. This may be the best chance you will have to learn about this particular subject. Make it count.

If you or your counselor feels that any information in this pamphlet is incorrect, please let us know. Please state your source of information.

Merit badge pamphlets are reprinted annually and requirements updated regularly. Your suggestions for improvement are welcome.

Send comments along with a brief statement about yourself to Youth Development, S209 • Boy Scouts of America • 1325 West Walnut Hill Lane • P.O. Box 152079 • Irving, TX 75015-2079.

Who Pays for This Pamphlet?

This merit badge pamphlet is one in a series of more than 100 covering all kinds of hobby and career subjects. It is made available for you to buy as a service of the national and local councils, Boy Scouts of America. The costs of the development, writing, and editing of the merit badge pamphlets are paid for by the Boy Scouts of America in order to bring you the best book at a reasonable price.

BOY SCOUTS OF AMERICA
MERIT BADGE SERIES

SCUBA DIVING

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Note to the Counselor

All scuba instruction must be conducted by recreational diving instructors in good standing with a scuba agency recognized by the Boy Scouts of America and approved by the BSA local council.

Counselors for the Scuba Diving merit badge must be registered with the Boy Scouts of America and be approved by the district/council advancement committee.

Like other merit badges, the Scuba Diving merit badge has been developed to teach and train youth in a manner consistent with the overall goals and values of the Boy Scouts of America. The merit badge counselor should be fair and consistent when presenting and evaluating the knowledge and skills specified by the requirements. None of the requirements may be modified or omitted.

Unlike many other merit badges, the Scuba Diving critical prerequisites, knowledge, and skills are not itemized in the requirements nor adequately covered in this pamphlet. The requirement to earn Open Water Diver Certification means the Scout must meet training requirements set by outside agencies and must supplement the material in this pamphlet with an entry-level scuba diver manual.

All phases of scuba instruction—classroom, pool, and open water training—must comply with the minimum training standards for entry-level scuba certification adopted by the American National Standards Institute (ANSI) or the U.S. Recreational Scuba Training Council (RSTC). The RSTC is recognized as the ANSI Accredited Standards Developer for recreational diving instructional standards. The BSA acknowledges those standards by limiting scuba instruction only to instructors trained and sanctioned by recognized scuba agencies.

35969DIG/35969SKU
ISBN 978-0-8395-0301-9

2011 Digital Edition of the 2009 Printing

Agencies recognized by the BSA for scuba training are **PADI** (Professional Association of Diving Instructors); **NAUI** (National Association of Underwater Instructors); **SSI** (Scuba Schools International); **IDEA** (International Diving Educators Association); **PDIC** (Professional Diving Instructors Corporation); and **SDI** (Scuba Diving International). In addition to the agencies listed by name, any current member of the World Recreational Scuba Training Council (WRSTC) is also recognized.

Each approved instructor must follow the training protocols established by his or her authorizing agency, including limitations and special provisions based on medical conditions and age. For Scout divers under age 15, this will include restrictions for maximum depth, buddies, and supervision ratios.

Scuba industry standards for Open Water Diver Certification require the student to be at least 15 years of age. Students under the minimum age who meet open water scuba performance requirements may qualify for a special certification that allows them to dive with an adult buddy who has, as a minimum, an open water scuba certification. Several of the scuba organizations recognized by the BSA offer "junior" open water certifications for those as young as 10; others have a minimum age of 12. Such junior open water diver certifications satisfy Scuba Diving merit badge requirement 4.

When scuba diving is taught in connection with any local council program, such as offering the Scuba Diving merit badge at summer camp, instructors should provide the training on a contract basis. Such instructors should have dive store or other commercial affiliation that provides liability coverage. Direct employment of scuba instructors is not recommended.

Local council programs may not compress or sell air for scuba use, or sell, rent, or loan scuba equipment (scuba cylinders, regulators, gauges, dive computers, weights, BCDs).

All air and scuba equipment for local council use must be obtained from professional sources (dive stores, resorts, dive boats, etc.) affiliated with a scuba agency recognized by the BSA.

Information on merit badge counselors and BSA scuba policies, including restrictions and protocols for divers under 15 years of age, may be found at *www.scouting.org*.

Requirements

1. Do the following:
   a. Show that you know first aid for injuries or illnesses that could occur while scuba diving, including hypothermia, hyperventilation, squeezes, decompression illness, nitrogen narcosis, motion sickness, fatigue, overexertion, heat reactions, dehydration, injuries by aquatic life, and cuts and scrapes.
   b. Identify the conditions that must exist before performing CPR on a person, and explain how to recognize such conditions. Demonstrate the proper technique for performing CPR using a training device approved by your counselor.
2. Before completing requirements 3 through 6, earn the Swimming merit badge.
3. Discuss the Scuba Diver's Code with your merit badge counselor, and explain the importance of each guideline to a scuba diver's safety.
4. Earn an Open Water Diver Certification from a scuba organization recognized by the Boy Scouts of America scuba policy.

The Boy Scouts of America is not a dive certification agency. Your merit badge counselor can help you find a scuba agency recognized by the Boy Scouts of America scuba policy so that you can fulfill requirement 4.

Scouts who have already earned an Open Water Diver Certification outside of a BSA activity from a scuba agency recognized by the Boy Scouts of America scuba policy may still earn the Scuba Diving merit badge by earning the Swimming merit badge and completing all other listed requirements.

5. Explain what an ecosystem is, and describe four aquatic ecosystems a diver might experience.
6. Find out about three career opportunities in the scuba industry. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

Minimum Course Content for Open Water Diver Certification

The following abbreviated list represents the RSTC "Minimum Course Content for Open Water Diver Certification." It is not intended as a complete outline of learning objectives for an Open Water Diver course. Development of learning objectives is left to the respective training agencies.

During the Open Water Diver course you can look forward to learning basic scuba theory and developing entry-level scuba skills required for certification. All scuba instruction must meet the minimum training standards for Entry-Level Scuba Certification set by the Recreational Scuba Training Council (RSTC). Your course will consist of the topics and scuba skills required by the training organization and as outlined in this section.

At a minimum, the following will be covered.

1. **Equipment.** Learn the physical description, operating principles, maintenance, and use of the following equipment items—face mask, fins, snorkel, BCD, exposure suit, weights and weight system, float and flag, cylinders, valves, regulators/air-delivery system, submersible pressure gauge, alternate air source, timing device, compass, depth gauge, dive table or dive computers, knife.
2. **Physics of Diving.** Learn the physical principles of matter and their application to diving activities and hazards.

3. **Medical Problems Related to Diving.** Learn the causes, symptoms, prevention, and first-aid and treatment of diving medical problems.
4. **Decompression Theory and Use of Dive Tables and/or Dive Computers.** Learn how to determine no-decompression limits for single and repetitive dives, plus how to use dive tables and/or dive computers to properly plan and execute a dive.
5. **Dive Environment.** Learn information on the local and general conditions of the diving environment and their possible effects on the diver.
6. **General Topics.** Learn information on dive planning, underwater and surface communications, diver assistance, recommended diving practices (including safety stops), procedures for diving from boats, proper use of personal diving logbook, and local dive regulations and protocols.

7. **Pool/Confined Water Scuba Skills.** Learn and practice the following scuba skills in a pool or confined water.
   - Diving system assembly and disassembly
   - Equipment inspection (at water's edge)
   - Entries and exits
   - Proper weighting
   - Mouthpiece clearing—snorkel and regulator
   - Regulator/snorkel exchanges at the surface
   - Controlled descents and ascents
   - Underwater swimming
   - Mask-clearing, including removal and replacement
   - Underwater exercises—with and without mask
   - Buddy-system techniques
   - Underwater and surface buoyancy control
   - Underwater problem-solving (regulator recovery/retrieval, etc.)
   - Surface-snorkel swimming with full diving system
   - Surface operation of the quick release/emergency function of the weight system

- Underwater removal and replacement of scuba system
- Underwater removal and replacement of the weight/ballast system
- Out-of-air emergency alternatives, including at least one dependent procedure and one independent procedure
- Equipment care and maintenance (at water's edge)

8. **Open Water Scuba Skills.** Perform the following scuba skills while diving in open water.
   - Equipment inspection (at water's edge)
   - Entries and exits
   - Proper Weighting
   - Mouthpiece clearing—snorkel and regulator
   - Regulator/snorkel exchanges at the surface
   - Controlled descents and ascents
   - Underwater swimming
   - Mask-clearing
   - Buddy-system techniques
   - Underwater and surface buoyancy control
   - Diver assistance techniques (self/buddy)
   - Surface-snorkel swimming with full diving system
   - Removal and replacement of weight/ballast system
   - Removal and replacement of scuba system
   - Out-of-air emergency alternatives
   - Equipment care and maintenance (at water's edge)
   - Underwater navigation

Scuba BSA is an introductory scuba experience. It introduces qualified Boy Scout, Venturing, and registered adult participants to the special skills, equipment, and safety precautions associated with scuba diving. The Scuba BSA experience consists of two parts—knowledge development and water skills development. There are no open water training dives included in Scuba BSA.

A scuba instructor teaching through a BSA-recognized scuba agency conducts water skills development in a clear, confined water environment. Certain portions of the Scuba BSA experience may apply to the Scuba Diving merit badge at the discretion of the merit badge counselor and open water scuba instructor.

Contents

Safe Scuba Diving

Safe scuba diving demands respect—respect for the potential power of the aquatic realm, your abilities, and your dive buddy's safety. Scuba diving safely is a matter of learning the important knowledge of safe diving, practicing your skills, and using good judgment. You will learn how to become a safe scuba diver by reading this pamphlet and completing your Open Water Diver Scuba Certification course.

Swimming Skills

To be a safe diver, you must have good swimming skills. The BSA swimmer test evaluates the skills needed for the minimum level of swimming ability required for safe deep-water swimming, a safety factor necessary for scuba diving.

Safe Scuba Diving

Safe scuba diving demands respect—respect for the aquatic realm's power, your abilities, and your dive buddy's safety. Scuba diving safely is a matter of learning the important knowledge of safe diving, practicing your skills, and using good judgment. You will learn how to become a safe diver by reading this pamphlet and completing your Open Water Diver scuba certification course.

The BSA Swimmer Test

Jump feetfirst into water over your head in depth. Level off and swim 75 yards in a strong manner using one or more of the following strokes: sidestroke, breaststroke, trudgen, or crawl. Then swim 25 yards using an easy resting backstroke. The 100 yards must be completed without any stops and must include at least one sharp turn. After completing the swim, rest by floating. This qualification test should be renewed annually.

Safe Swim Defense Applied to Scuba Diving

You should recall the BSA's Safe Swim Defense from Second Class and Swimming merit badge requirements. Scuba diving is an advanced swimming activity, so the basic safety rules for swimming still apply. However, the greater freedom that comes from carrying your own air supply also adds more risks, so you will learn additional safety rules and skills during your scuba training. To get you started, here is how Safe Swim Defense points apply to scuba diving.

The complete text of Safety Afloat can be found in the BSA publication *Guide to Safe Scouting,* available online at *www.scouting.org.*

1. **Qualified Supervision.** All swimming and scuba activities must be supervised by a mature and conscientious adult who is trained in planning and conducting a safe activity, including how to reduce risk and respond during emergencies. Your instructor will provide this supervision during your Scuba Diving merit badge training. After you complete your Open Water Diver Certification, you can participate in dives with similarly trained Scouts provided the activity is supervised by a Divemaster or Instructor.
2. **Personal Health Review.** You will be required to complete a special health history. Some conditions may require additional review by a physician beyond your normal BSA health exam to ensure that you can safely participate in scuba training. After certification, you may need to restrict diving activities depending on changes in your health, for example, if you have sinus congestion.
3. **Safe Area.** Your Scuba Diving merit badge instruction will cover items such as water clarity, depth, temperature, currents, and marine life that provide a safe diving environment. Your Open Water Diver Certification will not prepare you for special situations that require more training, such as extended deep diving, wreck diving, cave diving, or ice diving.
4. **Response Personnel (lifeguards).** Lifeguards are expected to stop unsafe activities and to perform rescues if necessary. The instructor serves those functions during your scuba training. However, consider a swimming activity where all the swimmers are also lifeguards. That situation applies to scuba diving. Your scuba training will include accident prevention and emergency response, so there typically is no need for additional "lifeguards." Since each member of a dive group provides backup for the others, especially his buddy, you should never dive with anyone who is not certified.

All Scouts working toward the Scuba Diving merit badge must earn the Swimming merit badge prior to fulfilling requirements 3 through 6. Once you have presented proof of having earned your Swimming merit badge to your Scuba Diving merit badge counselor, you may begin working on requirements 3 through 6.

5. **Lookout (surface support personnel).** If you take a dive boat to a remote diving location, then it is a good idea to leave personnel on the boat to watch the weather and boat traffic and to respond during a dive emergency. During a drift dive, divers follow a current and may finish the dive a considerable distance from where they started. Either a single dive boat, or small tenders from a live-aboard vessel, may follow the group and be ready to quickly pick up divers who may end the dive before others.
6. **Ability (skill proficiency).** The standard 100-yard BSA swimmer test defines the minimum ability needed for safe swimming in deep water. However, the in-water comfort level demonstrated by those who earn the Swimming merit badge is a better starting level for scuba training.

   Your Scuba Diving merit badge instructor will specify what your Open Water Diver Certification prepares you for, and what it does not. Additional training is available for more demanding environments. Note that there is no expiration date for your scuba certification. Some recreational divers will take several dives during and just after their certification course and not dive again for a long time. Those divers may need a refresher course to make sure their skills are current.
7. **Buddy System.** Every scuba diver must have a certified buddy underwater at all times. Buddies check each other's equipment prior to a dive and continuously monitor each other while underwater.

8. **Discipline.** All participants should know, understand, and respect the rules and procedures for safe scuba diving. It is important to have a "tailgate" review just prior to each dive to review basics, such as underwater signals, entry techniques, and procedures for reuniting in case of separation, as well as the specifics of the current dive plan and emergency procedures for the site.

Additional Considerations for Safe Scuba Diving

9. **Equipment.** During swimming, you rely mainly on skill in a safe swim environment to keep yourself safe. During scuba diving, you must also rely on complicated equipment. Your regulator reduces the very high pressure in your tank to the pressure you need to breathe at a given depth. Your dive computer monitors your time and depth to avoid the need for decompression. Your pressure gauge indicates how much air you have left. Your mask makes it easier to see. Failure of any of these items, plus others, can range from inconvenience to dangerous. It is important that you understand how to check your equipment, and that of your buddy, prior to each and every dive. Your instructor will check equipment for you during training and show you how to check your own prior to your open water training dives.

10. **Maturity.** BSA policies encourage Tiger Cubs to learn to swim, but they may not take Open Water Scuba Certification courses. Why not? The answer lies in the maturity that comes with age.

    You don't have to worry that scuba diving will stunt your physical growth. However, a person's ability to recognize risk and handle stress generally improves with age. Buddies rely on those qualities in each other. Because of concerns about emotional maturity, scuba agencies recognized by the BSA place restrictions on open water certifications for those from 10 through 14 years of age.

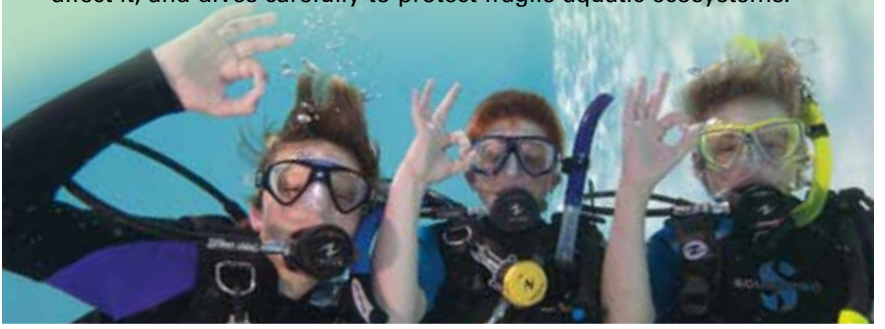
    If you fall in the 10- to 14-year-old age group, you are still encouraged to follow your interest and complete the Scuba Diving merit badge. The skills you learn and experiences you gain will help you obtain the confidence and poise that mark your transition to an adult. Learning to dive is great fun and a lifelong opportunity. However, you need to understand that your certification card will have restrictions, such as a limited depth range and the need to dive with a certified parent or other certified adult as a buddy. (During BSA scuba diving activities, BSA Youth Protection rules will apply.) For safety's sake, you need to honor such restrictions, but you should consider them as steppingstones toward safe and enjoyable adventures rather than stumbling blocks.

    You may face similar situations as you get older, such as driving restrictions based on age in states that have graduated driving license programs. That doesn't mean you should delay learning to drive, or to scuba dive.

The Scuba Diver's Code

A Scout:

- Maintains good mental and physical fitness for scuba diving.
- Keeps his dive skills sharp through continuing education.
- Seeks professional orientation prior to diving at unfamiliar dive locations.
- Seeks training prior to attempting specialized types of diving—such as night diving, cavern and cave diving, wreck diving, and deep diving.
- Adheres to the buddy system throughout every dive.
- Uses complete, well-maintained, and reliable equipment with which he is familiar.
- Always dives no deeper than the recommended depth for his certification level and experience.
- Always follows the time limits listed by special dive tables or a dive computer for a particular depth.
- Is a S.A.F.E. diver—**S**lowly **A**scends **F**rom **E**very dive—and makes a safety stop at 15 feet for three minutes at the end of each dive prior to surfacing.
- Breathes properly while diving, never holding his breath or skipping breathing.
- Knows and obeys local diving laws and regulations, including fish and game laws and dive-flag laws.
- Understands and respects aquatic life, considers how his interactions affect it, and dives carefully to protect fragile aquatic ecosystems.



Scuba Diving First Aid

Following the 10 points of Safe Swim Defense (as applied to Scuba Diving) and the Scuba Diver's Code will help prevent many accidents in your diving activities, but some injuries could still occur. Take appropriate precautions and become familiar with first-aid techniques and steps to follow if health concerns arise while you are out on the water. Below are some of the most common first-aid situations that might occur while scuba diving.

Hypothermia

Hypothermia occurs when the body's core temperature falls below the normal range. Exposure to cold, or even cool, water can lower your core temperature dangerously, especially when combined with wind, exhaustion, or hunger. Early signals of heat loss include shivering and bluish lips. Further cooling may result in loss of muscle strength and coordination. It may become difficult to think clearly or do simple tasks. In severe stages, shivering will stop and unconsciousness will follow. At this stage, death is possible unless treatment is received.

Anyone who starts to shiver or shows discoloration around the lips or cheeks should immediately be taken out of the water, thoroughly dried, put in dry clothing or wrapped in blankets, and moved to a warm place. If no warm shelter or other heat sources are available, press the victim close to one or more persons to transfer heat through direct skin contact. Minimize the victim's movement and call for medical aid.

Hyperventilation

Hyperventilation is the result of overbreathing—either deliberately or because of panic. The likely result of hyperventilation is dizziness and fainting, and victims will feel as if they are being suffocated. Such a condition is unlikely in diving if the participants are properly prepared for each new skill level. If a diver shows signs of panic at any time, bring that person back into the boat or onto shore, calm the person, and encourage slow breathing. Make sure the person rests in a comfortable position and has plenty of open, fresh air. Before resuming any activity, find out and resolve the cause of the panic.

Avoid forceful equalization. If you feel sinus pain while descending, stop your descent and end the dive.

Never dive with a cold, allergy, or even mild congestion.

Squeezes

Natural air spaces such as the body's sinuses and ears or artificial air spaces (e.g., diving masks) respond readily to the underwater environment, as long as you equalize them to the surrounding pressure. A scuba diver may be injured if he fails to equalize these air spaces, either while descending or ascending.

Any air space can suffer a pressure injury during ascent or descent. Descending pressure injuries are called *squeezes*. Ascending pressure injuries are called *reverse squeezes, reverse blocks,* or *expansion injuries.* You easily can avoid these pressure injuries by equalizing early and often while descending. (See the chapter "Adjusting to the Underwater World" for a discussion of specific techniques to use to avoid squeezes.) If you get a sinus squeeze, see a doctor if you experience significant pain, pain over a long period of time, or complications in healing.

Decompression Illness

Decompression illness refers to both decompression sickness and lung overexpansion injuries as a single condition. Primarily, decompression sickness may occur when a diver exceeds time limits for specific depths as set forth by dive tables or a dive computer. When present, these secondary factors can contribute to decompression sickness: fatigue, dehydration, vigorous exercise (before, during, or after the dive), coldness, age, illness, injuries, and being overweight. Lung overexpansion injuries may result if a diver fails to breathe normally or exhale during an ascent.

A diver with decompression illness may experience symptoms such as unusual fatigue, dizziness, vertigo, shortness of breath, tingling of the skin, numbness, and pain or paralysis in the muscles and/or joints of the arms, legs, or torso. Itchy skin, difficulty urinating, and ringing in the ears also can be symptoms of decompression illness. If one of your diving buddies has decompression illness, you may observe a blotchy rash on his skin. He also might be confused or behaving oddly. Other signs include muscle weakness or paralysis, tremors, staggering, and coughing up blood. A diver with decompression illness may even collapse or become unconscious.

See the chapter "Adjusting to the Underwater World" for further discussion of decompression illness.

First aid for decompression illness includes immediately calling for assistance and getting the victim to a hospital and recompression chamber. Immediate care by a doctor is most important. While waiting for medical assistance, monitor the diver's airway, breathing, and circulation (ABCs). Your counselor/dive instructor will be trained in oxygen administration and will have the appropriate equipment. He or she will administer as close to 100 percent oxygen to the patient as possible.

To prevent decompression illness, **never** hold your breath when using any form of underwater scuba equipment. Further, ascend slowly after every dive, never exceeding 60 feet per minute, or the maximum allowed by a dive computer. Always use dive tables and dive computers to plan your dives conservatively, well within depth and time limits.

Nitrogen Narcosis

Deeper diving can cause a problem that relates to gases dissolving into a diver's blood and reaching the nervous system. This can trigger an anesthetic effect called *nitrogen narcosis* that may cause a diver to make poor judgments and decisions.

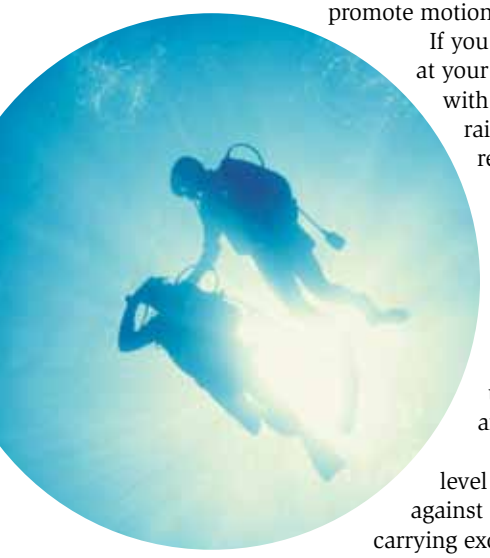
To avoid this problem, beginning divers should stay within safe diving depths of 60 feet or less. More advanced divers should never descend deeper than 130 feet. If you begin to feel the effects of nitrogen narcosis, simply ascend until the feeling goes away.

Motion Sickness

You need to think about motion sickness (seasickness) before it happens. If you are prone to motion sickness, avoid it by taking motion sickness medication (as advised by your physician or pharmacist) before boarding the boat. Follow all manufacturer's instructions for taking any motion sickness medication. Prior to boarding, avoid greasy foods, which can further irritate an already weak stomach.

Once on the boat, stay in the fresh air on deck and out of the boat exhaust. It helps to stay in the center of the boat, which moves the least, and watch the horizon. Try to stay busy setting up your equipment so you will be prepared to enter the water as soon as possible. Reading and intricate tasks tend to promote motion sickness, so avoid these types of activities.

If you do get sick, go to the leeward side (wind at your back) of the boat and have someone come with you. Be careful when you lean over the railing of the boat. Stay out of the boat's restroom (the *head*) and try to relax.



Fatigue and Overexertion

Scuba diving can be a strenuous activity. Water's density makes it harder to move through than air. Moving slowly and steadily underwater will help you conserve energy. Avoid rapid or jerky movements that waste energy and cause you to use air faster.

If you try to maintain a high activity level while diving by, for example, swimming against a current, swimming long distances, or carrying excessive weight, you may experience *fatigue* or *overexertion.* The symptoms include tiredness, labored breathing, a feeling of suffocation, weakness, anxiety, headache, muscle cramping, or a tendency to panic.

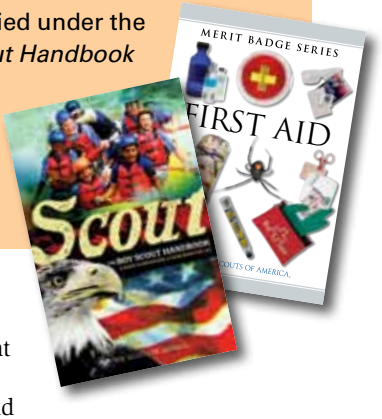
If you experience fatigue or overexertion at the surface, establish buoyancy (by dropping weights if necessary) and stop moving. Rest and catch your breath. Signal for help if you need it. Once you recover, continue at a slower pace. If you experience fatigue or overexertion underwater, stop all activity, breathe deeply, and rest. It may help to hold on to an object for support.

Take your time, and you will stay underwater longer and go farther.

Cardiac Emergencies and CPR

Cardiopulmonary resuscitation (CPR) is the important first response in the event of a cardiac emergency. CPR is used in near-drownings when a victim's breathing and heartbeat have stopped. Include individuals trained in CPR at every diving outing. Complete CPR should be attempted only by persons trained and qualified under the supervision of a trained instructor. *The Boy Scout Handbook* and *First Aid* merit badge pamphlet further explain CPR and when it should be used.

To receive full and proper CPR training, contact the American Red Cross, the American Heart Association, or an equivalent agency.



Heat Reactions

Heat exhaustion and heatstroke result when the body can't keep itself cool enough. Typical symptoms for heat exhaustion include dizziness, nausea, muscle cramps, and a rapid pulse. A person with heat exhaustion should lie down in a cool, shady place and raise the feet. Loosen or remove your diving exposure suit and cool off with a damp cloth or fan. Heatstroke is much more serious than heat exhaustion. Symptoms include hot, sweaty, red skin, confusion, and disorientation. A person suffering from heatstroke must be cooled immediately. Loosen clothing, fan the person, and apply wet towels and ice packs. Heat exhaustion and heatstroke are covered more completely in the *Swimming* merit badge pamphlet.

Sunburn is a common injury among those who enjoy the outdoors. Scuba divers should always prevent sunburn by using plenty of sunscreen with a sun protection factor (SPF) of at least 15. Apply sunscreen liberally about 30 minutes before sunlight exposure. Reapply every two hours, especially if you have been in the water.

Dehydration

When you are scuba diving, it is easy to forget the importance of staying well-hydrated. You are, after all, surrounded by water, and you may not feel as though you need to take a drink. Whether it is hot or cool out, drink plenty of fluids and eat enough throughout the day to keep your body well-balanced.

Injuries Caused by Aquatic Life

As a diver you will interact with underwater organisms. Nearly all injuries involving *aquatic life* or plants and animals that live in water, result from human carelessness. Most injuries are minor. It takes only a little bit of understanding and care to avoid potential problems.


Sea urchin


Jellyfish

Most injuries result from an encounter with an unaggressive organism. For example, a diver may suffer a puncture wound from a sea urchin or a sting from a jellyfish. To avoid these, watch what you touch while in the water, and wear an exposure suit as protection from accidental contact. To avoid potential problems with aquatic life, practice the following precautions.

- Treat all organisms with respect. Never tease or intentionally disturb them.
- Be cautious in extremely murky water where you may have trouble seeing where you place your hands.
- Avoid wearing shiny, dangling jewelry that resembles baitfish or other small prey.
- Wear an exposure suit.
- Maintain buoyancy and stay off the bottom.
- Watch where you are going and where you are placing your hands and your body.
- Avoid contact with animals.
- Be aware of local advisories, which may issue warnings such as those about jellyfish along the shoreline.

Treat venomous wounds such as stings by first focusing on the victim's airway, breathing, and circulation (ABCs). Next, manage bleeding and shock. If possible and safe, remove spines or stingers with forceps or other tools. Soak the affected area with hot water for 30 to 90 minutes and keep the area still. After flushing the wound with running water, dry the area and apply a triple antibiotic ointment (if the person has no known allergies or sensitivities to the medication). Cover the wound with a dry, sterile bandage. For more serious injuries, see a doctor.

Never touch spines or stingers from venomous aquatic animals.

Cuts and Scrapes

Simple first-aid care will take care of most minor cuts and scrapes. As with treating stings and puncture wounds, flush the area with clean water, apply a triple antibiotic ointment (if the person has no known allergies or sensitivities to the medication), and cover with a dry, sterile bandage. See a doctor for more serious injuries.

If you have cuts or scrapes from contact with corals, be sure to clean the area carefully or infection may develop. Keep a close eye on your injuries as they heal, and see a doctor if your injuries worsen or do not seem to be healing.

Astronauts and scuba divers use almost the same kind of equipment to be comfortable in space and underwater. Both have air supply equipment, an exposure suit for protection, and something to look through—a helmet or mask.

The Adventure of Boy Scout Scuba Diving

Perhaps you have dreamed of being able to fly. When you watch astronauts work on the International Space Station during a space walk, you might have thought, "Boy, I wish I could do that." The good news is you don't have to be an astronaut to experience a similar weightless feeling. Similar experiences and adventures are available to you when you learn to dive with *s*elf-contained *u*nderwater *b*reathing *a*pparatus—or *scuba*—equipment.

Once you venture underwater, your life will be changed. You will gain new confidence about your abilities and learn about the underwater world.

Being an astronaut and a scuba diver is not all that different. All U.S. astronauts train for their space walks in NASA's gigantic practice pool called the Neutral Buoyancy Laboratory. Perhaps earning this merit badge will place you on the path to becoming an astronaut.

Whether you dive in freshwater or the ocean, there is always something new to see, learn, and do underwater.

If you like making discoveries, then welcome to the Scuba Diving merit badge. Once you earn your merit badge and scuba certification, you will be on your way to exploring "inner space." As a Boy Scout scuba diver, prepare to be an adventurer.

If you love nature, you will see plenty of it underwater. No other environment approaches the abundance, diversity, and excitement to be found while exploring underwater reefs. On most shallow water reefs, you can easily see hundreds of different species during a single dive. With time, you will even discover that underwater areas that seem empty—like a lake or flooded quarry—are home to unique and interesting life-forms as well as artifacts and shipwrecks.

Go Diving, and See Critters!

Scuba diving allows you to get up close and personal with those living things you would normally only get to see at an aquarium.


Grouper


Angelfish

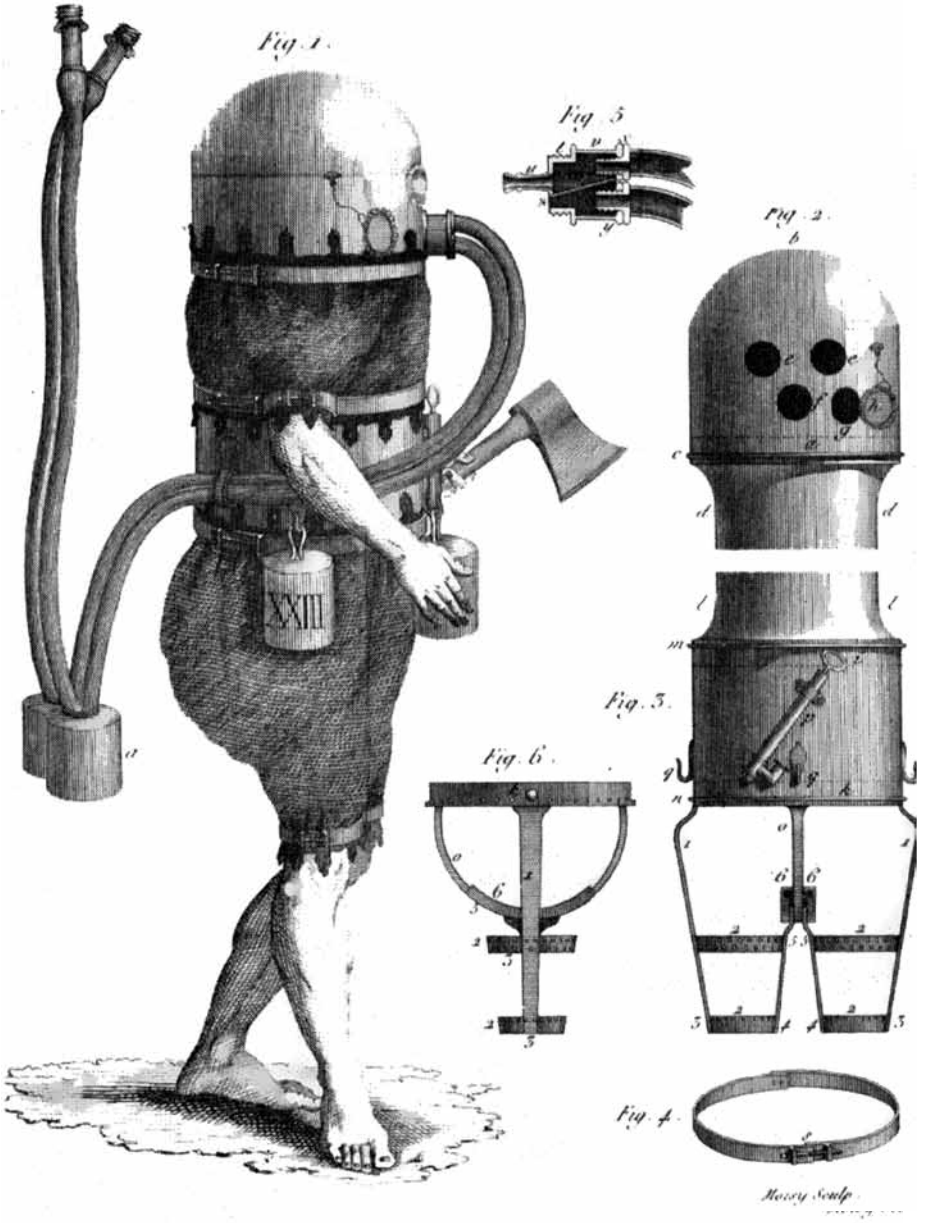

Sea anemone


Sea turtle


Squirrelfish


Dolphins

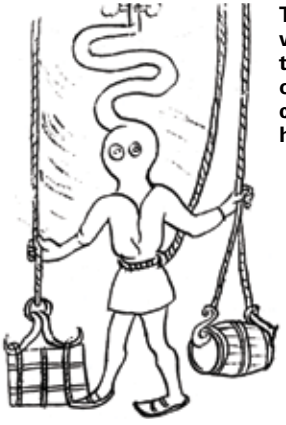

Octopus



The History of Scuba

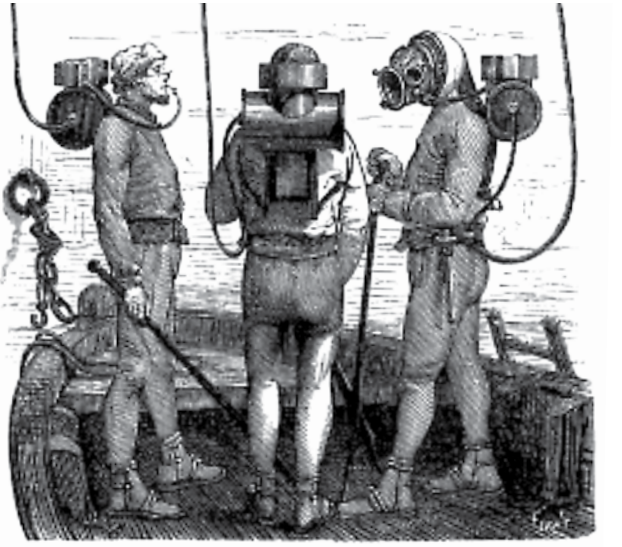
Humans have been experimenting for centuries with ways to stay underwater for longer than a single breath. Crude diving apparatus dates back as far as A.D. 375.

Many of these early efforts and designs failed when tried underwater, or were never fully developed. By the 1800s, however, equipment had been developed that allowed divers to explore the deep using a long hose that connected them to a surface air supply. These "hard-hat" divers wore very heavy helmets and lead shoes to walk (not swim) on the bottom. The hose and heavy equipment greatly limited their ability to move freely underwater. It was not until the mid-20th century that the first practical self-contained dive equipment emerged.

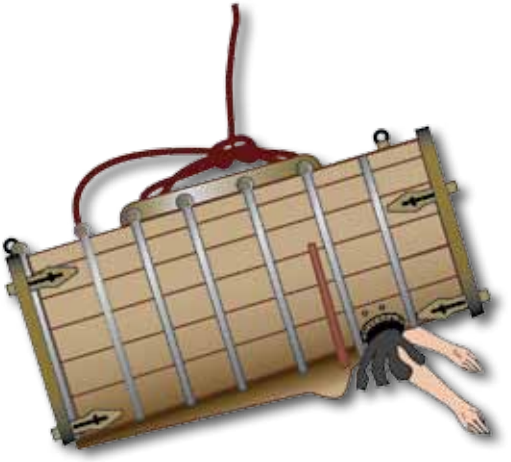


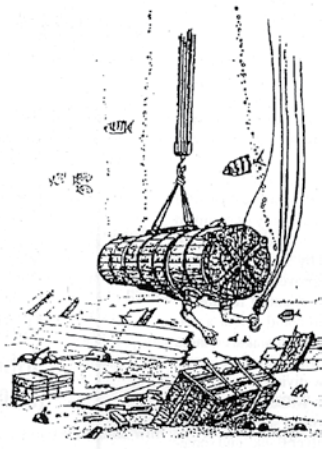
This German print from 1511 shows the dream of walking underwater and recovering lost items on the seafloor. This is possibly the first printed design of a diver in equipment. It is doubtful that a diver could survive this apparatus for much longer than he could hold his breath.

Hard-hat diving equipment



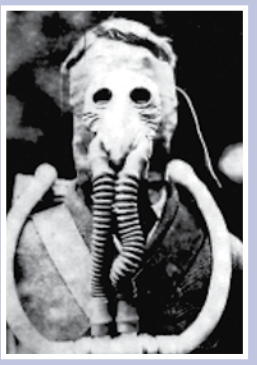
In 1860, Benoit Rouquayrol and Auguste Denayrouze introduced self-contained diving equipment that was essentially the same as that developed by Jacques-Yves Cousteau in the mid-20th century.





During the 1700s, people experimented with different diving-apparatus designs. Some designs had partial success, while many failed when tested underwater or were never built. Most were initially designed to help salvage wrecked sailing vessels and their cargo.

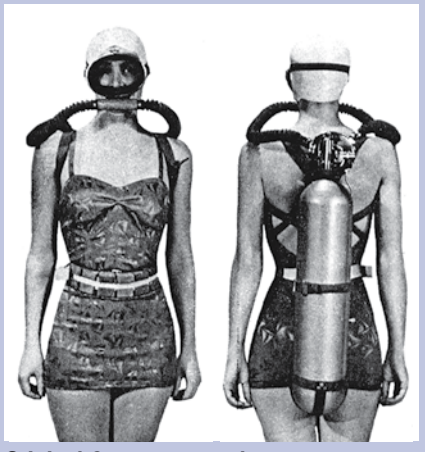
The First Rebreather Scuba



Englishman Henry Fleuss designed the first rebreather scuba in 1878. His unit recirculated and purified oxygen by removing the diver's exhaled carbon dioxide. (Carbon dioxide is the waste gas humans exhale.) Although his system worked, its use was limited. The biggest obstacle to Fleuss' unit was that divers cannot use pure oxygen deeper than about 20 to 30 feet—oxygen becomes toxic beyond this depth.

In 1943 French ocean explorer Jacques-Yves Cousteau designed the first practical scuba equipment, known as the *aqualung*. Working with an engineer named Emile Gagnan, Cousteau developed a scuba system that delivers compressed air (not pure oxygen) to a diver. By automatically adjusting the breathing air pressure and providing air only when the diver inhaled, this new, self-contained equipment was easy to operate, reliable, and allowed a diver to remain underwater for a reasonable amount of time.

Within 20 years of the invention of scuba, the military, underwater scientists, and recreational divers were using the scuba system. In fact, the equipment you will be using to obtain your Scuba Diving merit badge is basically the same design invented by Cousteau and Gagnan.



Original Cousteau aqualung

Modern scuba equipment

Essential Scuba Equipment

As with any outdoor activity, scuba diving requires that you understand how to use certain equipment. For many Scouts, assembling and using the equipment is a big part of the fun.

You will learn a lot about scuba equipment in your course, but here is a quick overview of the essential pieces of equipment you will need to safely dive as well as explanations of the purpose of each. Your counselor and local dive center or resort can show you the different types and models that best suit your needs and your body.

Masks—A Window to the Underwater World

If you have ever opened your eyes underwater, it's not news to you that you need a mask to be able to see clearly while diving. The reason you need the mask is that light behaves differently in water than in air, and your eyes focus according to how light behaves in air. That is why water makes everything blurry. The mask creates an air space so your eyes can focus.

Mask features

A mask is designed to be equalized. When a mask is *equalized,* the pressure of the water pushing on the outside of the mask is the same as the pressure of the air inside the mask. A scuba mask covers your nose. This allows you to add air to the space between the glass and your face by exhaling air through your nose into the space. This process is called *equalization.*

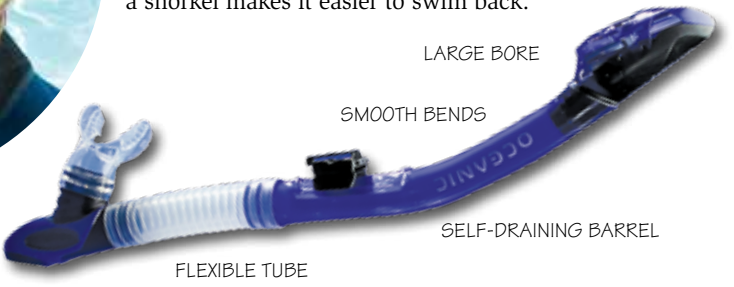
Scuba divers don't wear goggles, because goggles cannot be equalized. Attempting to dive too deep while wearing goggles causes water pressure to push the goggles uncomfortably against the face. Because goggles do not cover the nose, a diver cannot make any adjustments to equalize the air space inside the goggles.

Typical scuba-diving masks

Tempered glass, wraparound design

Snorkels—Helping You Breathe on the Surface

Since you will scuba dive with an air cylinder on your back, you may wonder why a snorkel is a standard piece of scuba gear. You need a snorkel for a few reasons when you scuba dive. First, it lets you rest or swim with your face in the water without wasting cylinder air. For example, you might use your snorkel when you are looking for something below. Second, when there is a bit of surface chop, splashing waves can get in your mouth if you do not have a snorkel. The snorkel is usually high enough to let you breathe without getting any water. Third, if you run low on air away from the boat or shore, a snorkel makes it easier to swim back.



A snorkel is standard equipment for scuba diving. It is positioned on the mask's left side.

Fins—Foot Power Underwater

Fins provide a large surface area so your powerful leg muscles can move you through the water more effectively than swimming with only your arms. Fins come in two basic styles: the adjustable-strap design and the full-foot design. Adjustable fins have open-heel foot pockets and adjustable heel straps. Divers use this type of fin with wet suit boots that keep the feet warm. Full-foot fins enclose the heel and fit like rubber slippers. Divers use this type of fin in warm water.

Divers with limited leg mobility sometimes use special hand fins.

Adjustable fin

Full-foot fin

Fins are often made of both rubber and plastic.

Exposure Suits—Keeping You Warm and Protected

You will use an exposure suit in virtually all diving activities. An exposure suit has two basic purposes: to reduce heat loss and to protect you from minor scrapes, stings, and cuts. Wet suits are by far the most common form of exposure suit. They come in many styles, patterns, and thicknesses, making them suitable for insulation in water as cold as 50° F to as warm as 86° F.

Exposure suits

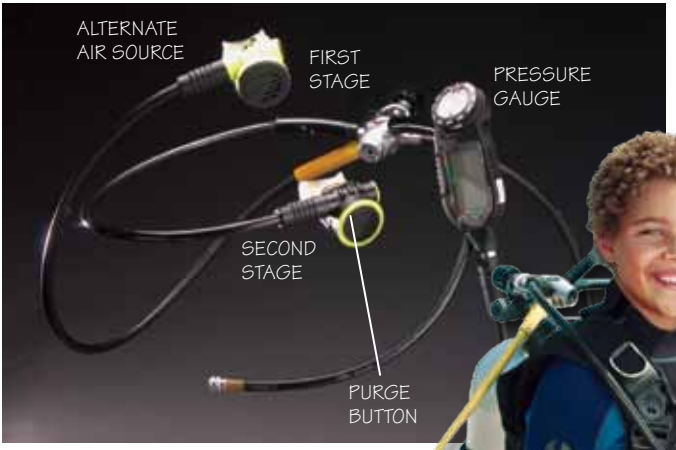
Scuba cylinders

Scuba Cylinders—Your Underwater Air Supply

A scuba cylinder is a cylindrical metal container. It safely stores the high-pressure air divers use so that they can breathe underwater. Scuba cylinders come in different sizes. Selecting a scuba cylinder size mainly depends on a diver's height and weight.

Regulators—Delivering Air When You Need It

A regulator makes it possible for you to use the air in your cylinder. It reduces the pressure of the air in the scuba cylinder to match the surrounding water pressure. It delivers air only when you want it, that is, when you inhale. It controls, or *regulates,* the air flow, which is why it is called a regulator.



Regulators have multiple features and two *stages.* The *first stage* attaches to your scuba cylinder and the *second stage* is placed in your mouth. The *pressure gauge* (typically called a submersible pressure gauge, or SPG) tells you how much air you have left in your cylinder, while the *alternate air source* is used in an emergency to give to a buddy who is out of air.

Dive Instruments—Time, Depth, and Direction

Pilots, astronauts, and outdoor enthusiasts use instruments to guide them during their work and adventures. Scuba divers also need accurate information to dive safely. These instruments include a dive timer, compass, depth gauge, and a submersible pressure gauge (SPG). Often the timer and depth gauge are combined in one instrument called a dive computer. Some diving instruments are attached to the regulator, while others are worn on the wrist.

Divers use a depth gauge to keep track of how far they are below the surface. Because it is important not to dive too deep, using a depth gauge is a crucial safety measure.

You cannot stay underwater an unlimited time, even if you have enough air. Every dive has a time limit, which changes with depth, so you need to keep track of how long you have been underwater. This is why divers wear either dive watches or special underwater timers that are pressure-activated stopwatches.

A compass helps divers know where they are and where they are going.

Scuba divers need accurate information to dive safely. This is especially true of the air supply, since no one wants to run out of air underwater. A submersible pressure gauge like this one shows how much air is available during a dive. The red zone indicates that the air supply is running very low.

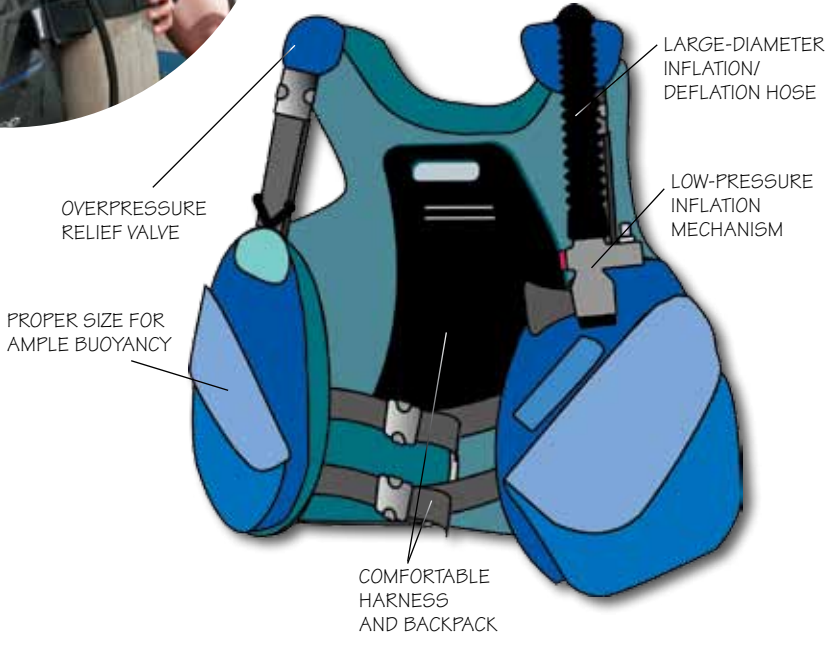
The photo on the *left* shows a cluster of dive instruments attached to a regulator. These consoles may include a depth gauge, timer, compass, and air-supply gauge. It is also possible to wear some dive instruments on your wrist.

Buoyancy Control Devices—Helping Control the Ups and Downs

A buoyancy control device, or BCD, is an expandable bladder that you inflate or deflate to regulate your *buoyancy,* that is, your ability to float. You can inflate a BCD by blowing it up as you would blow up a balloon. Most of the time, however, you will use an inflator that easily inflates the BCD with air directly from your cylinder. To decrease buoyancy, you deflate the BCD through a hose or valve.

In addition to allowing you to control your buoyancy underwater—letting you remain neutral, sink down, or float up—the BCD provides positive buoyancy for resting, swimming, or helping other divers. The most common style of BCD is worn like a sleeveless jacket. It holds your cylinder in place as well as helps provide buoyancy control.

Of the various types of buoyancy control devices, the jacket-style BCD is by far the most common. Pictured here is a Scout connecting his jacket-style BCD to his scuba cylinder.



Weight Systems—A Sinking Feeling

Scuba divers often wear a weight system to help them sink and easily get underwater. All weight systems use lead. You may find that you can sink underwater without lead weight, but if you are wearing a wet suit you probably will need some additional weight to get down.

Scuba divers use two basic weight-system types: (1) a weight belt worn around the waist or (2) an integrated weight system. Integrated weight systems carry lead weight in special quick-release pockets designed into a BCD. The blue pouch in the photo *below* contains small lead shot for weight. Divers call these "soft" weights.

Complete scuba system

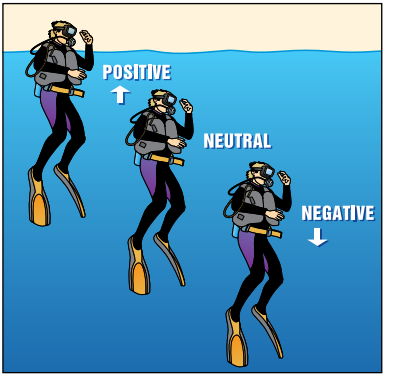
Weight belt

Integrated weight system

Adjusting to the Underwater World

When scuba diving you will experience some new and different sensations related to being underwater. Differences include buoyancy, pressure and temperature differences, and changes in the way you see and hear. Becoming a diver depends on understanding how these differences affect you.

Buoyancy—Up, Down, or Level



Have you ever wondered why a large steel ship floats, but a small steel nail sinks? The answer is surprisingly simple. The ship's steel hull forms a shape that displaces—pushes aside—a great deal of water. The same amount of steel reshaped into a giant nail would sink, like the small steel nail. This demonstrates that whether an object floats depends on both its weight and how much water it displaces.

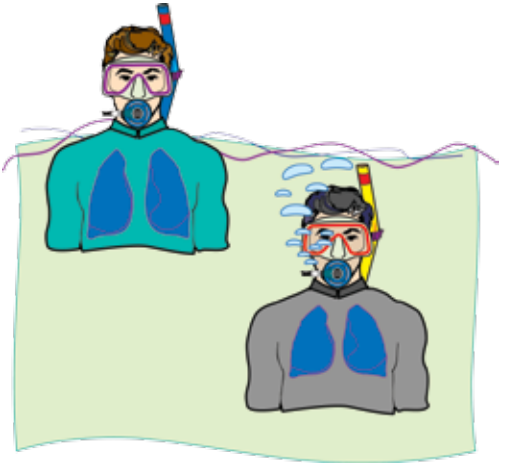
While scuba diving you will either want to comfortably stay on the surface with your equipment on, descend or ascend underwater, or remain neutral. All these situations require you to either have *positive, negative,* or *neutral buoyancy.* If you are resting comfortably on the surface without moving your arms and legs, you have *positive buoyancy.* If at depth you are safely touching the bottom, then you have *negative buoyancy.* When you remain *neutral* underwater you are effectively "flying" above the bottom.

While scuba diving, you will control your buoyancy with your lungs and breath control. For example, if you exhale you will descend, and if you inhale you will ascend. Your buoyancy control device and the amount of lead weight you place in your weight system also will help you adjust buoyancy underwater.

Pressure—The Force of Water

As a scuba diver, you will descend and ascend regularly underwater. During this activity your body will need to adjust to either increasing pressure as you go down or decreasing pressure as you go up. You will feel pressure on your body's small air spaces (sinuses, ears), which hold compressible air. If you don't equalize the pressure in these air spaces with the surrounding pressure, you will feel pain in these air spaces.

At any given time while scuba diving underwater, you will either have positive, neutral, or negative buoyancy. This Scout is hovering above the bottom demonstrating neutral buoyancy.

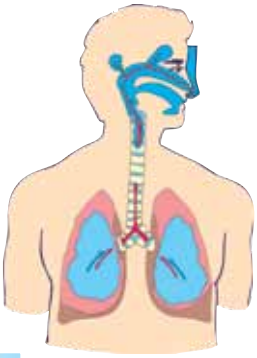


When you exhale you release air from your lungs, which makes you less buoyant and helps you descend at the beginning of a dive. Underwater you can use lung volume and breath control to fine-tune your neutral buoyancy.

The pressure-change sensation you feel while diving is similar to what you may feel in your ears when you fly in a plane or drive up into the mountains.

As you dive deeper, the pressure on your body increases. This pressure pushes in on your body's air spaces. The two major air spaces in your body most noticeably affected by increasing pressure are your ears and sinuses. The major artificial air space most affected by increasing pressure is the one created by your mask.

Solving the Pressure Problem When Going Down



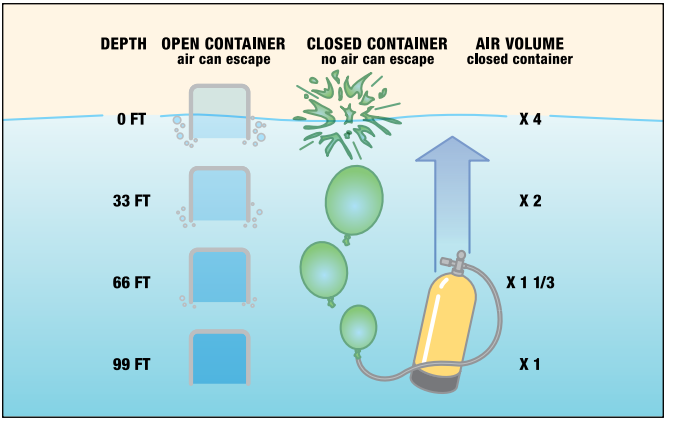
You can easily equalize the pressure within the air spaces created by your ears and sinuses. To do this, pinch your nose shut and gently blow against it with your mouth closed; this directs air from your throat into your ears and sinus air spaces. Another technique is swallowing and wiggling the jaw from side to side. A third technique combines these—swallow and wiggle your jaw while blowing gently against your pinched nose. To equalize the pressure in your mask so that it does not press too hard against your face, simply exhale through your nose.

Equalizing pressure when descending *(left)* and releasing excess air when ascending *(right)*

Going Up—Getting Rid of Excess Air

Scuba equipment allows you to breathe underwater by delivering air at a pressure equal to the surrounding water pressure. This means your lungs will be at their normal volume while at depth. However, when you head up toward the surface, the air in your lungs will expand, that is, the air will take up more space in your lungs. To release the excess air, you must either breathe normally while ascending or exhale. **Never hold your breath when diving.**

Never hold your breath when scuba diving.



If you were to hold your breath while going up, your lungs would overexpand, much like the sealed bag in the illustration. With an open container such as the upside-down glass in the illustration the excess expanding air simply bubbles out into the surrounding water. Why is this expansion of air a problem for divers? If you don't exhale this expanding air when you are going up, it can cause lung overexpansion, or a lung rupture in which the lung tissue tears. This is the most serious injury that can occur to a diver. For this reason, the most important rule in scuba diving is to breathe continuously and **never, never hold your breath.**

Pressure and Air Supply

Your Scouting friends who don't dive may ask you, "Hey, how long does your air last underwater?" This is a good question. The correct answer is that it depends on how deep a diver dives and the size of the scuba cylinder. The deeper a diver dives the more air will be used because of increasing pressure. At shallow depths with a standard size cylinder you would typically expect to be able to dive for about one hour. But the deeper you go and the more energy you expend, the more air you will use.

Decompression—The Importance of Going Up Slow

As you dive, your time underwater has limits. These limits are affected by depth, your air supply, the cold, and fatigue.

Decompression sickness is usually very easily avoided by following proper diving techniques.

Depth-Related Limitations

The pressure on a diver's body increases with depth. This increase in pressure causes nitrogen (the gas that makes up 79 percent of the air we breathe) to be absorbed into the body's tissues. The deeper a diver dives and the longer the diver stays underwater, the more nitrogen the body absorbs.

The nitrogen that dissolves into a diver's tissues must leave the body as the diver exhales while ascending to the surface, or the diver could experience serious problems. To make sure that the excess nitrogen is properly and slowly released, divers should always do the following.

1. **Ascend very slowly**—no faster than 60 feet per minute (a dive computer may require an even slower ascent).
2. **Make a safety stop** at a depth of 15 feet for three minutes while ascending to the surface at the end of every dive.
3. **Follow special tables or a dive computer** to limit depth and time underwater.
4. **Follow special procedures when flying** after making scuba dives. (Many divers travel on airplanes to get to diving destinations. When they return home on the plane, they must end their diving activities up to 18 hours prior to flying.)

This set of procedures is called *decompression,* which means "releasing pressure." If you do not make a safety stop at the end of each dive or if you ignore the special tables or dive computer by staying longer than a prescribed time at a particular depth, you may get *decompression sickness.* Decompression sickness occurs when tiny bubbles of nitrogen gas form in the tissues of the body.

Because nitrogen bubbles can form in different places in the body, decompression sickness symptoms can vary. As discussed in the chapter "Safe Scuba Diving," symptoms and signs include paralysis, shock, weakness, dizziness, numbness, tingling, difficulty breathing, and joint pain.

Staying Warm

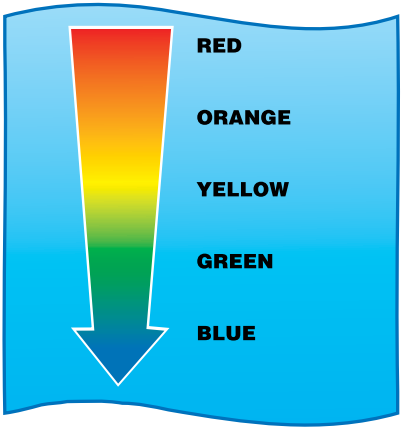
It is easy to stay relatively warm underwater with the right exposure suit. Since water cools you much faster than air, you will almost always need to wear some type of exposure suit when diving. Divers often wear *wet suits* to slow their heat loss.

The most important point to remember about body temperature and diving is that if you begin to shiver continuously underwater, get out, immediately dry off, and seek warmth.

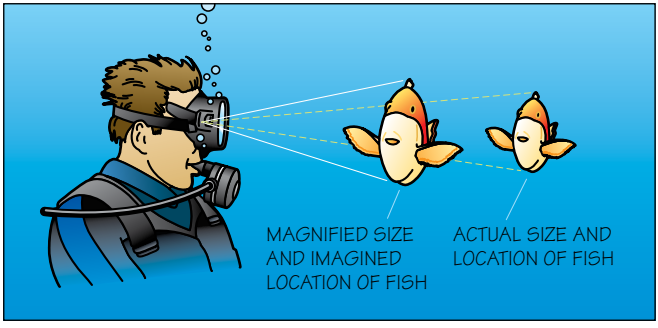
In all but very warm pools and tropical water, you will need to wear an exposure suit to slow down your heat loss underwater. For extra warmth and protection, divers wear thick wet suits, a hood for the head, and boots for the feet.

Underwater Vision—Bigger and Closer but Less Colorful

Water changes how light behaves. First, the optical effect of light traveling through water and air *magnifies* objects underwater. This makes things look closer and larger than they really are. Also, water *absorbs* the colors in sunlight the deeper you go. If you dive deep enough, all you will see is dark blue. Reds disappear in shallow water, followed by shades of orange, yellow, and then green.



If you want to see the underwater world in full color, stick to fairly shallow water. As you dive deeper, shades of red begin to disappear followed by orange, yellow, and then green.



When you are underwater, fish and other objects will look closer and larger than they really are.

Hearing Underwater— You Can Listen But You Can't Talk

Sound travels well through water, so you will be able to hear underwater. However, sound travels about four times faster in water than in air. This makes it difficult to tell where a sound is coming from.

You will not be doing much talking underwater. You can attract attention vocally by yelling into a regulator, but you cannot speak clearly, so you will need to use other methods of communication. For example, you can rap your knife on your tank to get your buddy's attention, write on a slate, and use hand signals. Many scuba divers "talk" with their hands through standardized hand signals that most divers recognize.

Hand signals may vary somewhat, so be sure to review the signals you will be using when planning a dive with a new buddy.

Essential Diving Skills

You will be able to perform the essential diving skills discussed in this chapter after you have successfully completed your skills development sessions in a pool or confined water. *Confined water* refers to a body of water much like a pool, with similar pool-like conditions, such as a clear and shallow pond, a lake, or a ocean lagoon or bay.

After you practice these skills in confined water, you will apply them during open water dives under the supervision of your scuba instructor in order to achieve your dive certification and earn this merit badge. *Open water* refers to a natural, non pool-like aquatic area such as a lake, quarry, or an ocean environment. Open water environments are deeper than confined water areas with natural contours and features.

Assembling, Inspecting, and Testing Equipment

Before you can use scuba equipment, you have to be able to put together your cylinder, regulator, and buoyancy control device, or BCD. Putting your equipment together carefully allows it to function correctly underwater. In addition, you will learn how to inspect and test your equipment before using it. Inspection and testing help make sure all the pieces of equipment function properly *before* you venture underwater.

Proper Weighting

Weight belt

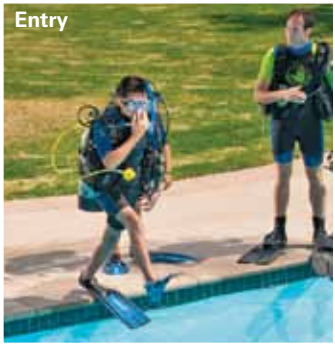
Before putting your equipment on, you will learn how to add or subtract weights from your weight belt or weight pockets in your BCD (collectively, these two places where you can place lead weight are called a *weight system*). This allows you to adjust your buoyancy so you can descend underwater but not be too heavy on the dive bottom. On the bottom, you may practice achieving neutral buoyancy by doing a *fin pivot*.

A fin pivot is a training skill to help you practice attaining neutral buoyancy. If you are properly weighted on the bottom, you will pivot *up* on your fins when you inhale and pivot *down* when you exhale. More often than not, you will want to dive with neutral buoyancy, neither descending nor ascending. Neutral buoyancy keeps you under control and off the bottom so you don't stir up debris or harm aquatic life on the bottom.

Fin pivot

Entries and Exits

Depending on the dive site where you learn your essential diving skills, you will practice a variety of water entries and exits. Different types of dive sites require different types of entries and exits. In general, the best entry and exit is usually the easiest. If you can wade or lower yourself into the water, that is usually better than a long drop. To exit, if you can use a ladder or simply walk out of the water, that is usually best.



Emergency Function of the Weight System

In an emergency at the surface, your first reaction should be to inflate your BCD. However, if your BCD does not support you, your next option would be to drop your weights.

Snorkel/Regulator Exchanges at the Surface

Quite often you will snorkel on the surface directly over the place where you want to dive so that you do not waste cylinder air on the way. When you get there, you will exchange your snorkel for your regulator and then descend. Since there may be waves or chop in the ocean or lake, you might have to do this with your face in the water.

Mouthpiece Clearing—Snorkel and Regulator

Both snorkels and regulators can get water in them. To clear water from your snorkel or regulator, simply exhale forcefully and sharply into the mouthpiece. This "blasts" the water out of the equipment. Typically, you will need to do this when you surface and switch from your regulator to your snorkel.

Regulator Recovery and Retrieval

If your regulator should accidentally drop from your mouth, you can recover it by sweeping your arm forward and placing it back into your mouth.

You will want to practice your regulator recovery and retrieval skills.

Controlled Descents and Ascents

Every diver needs to descend (go down) at the beginning of a dive and then ascend (go up) at the end. In your certification course, you will learn the specific steps for appropriate descents and ascents.

Descents

The descent has five steps that you will practice in your open water diver course.

1. Signal that you and your buddy are both ready to descend.
2. Orient yourself to something at the surface that will help you find out where you are when you resurface.
3. Switch from your snorkel to your regulator. Do this with your face in the water.
4. Check the time, set your watch bezel (the movable timer dial on the outer area of some traditional dive watches), or start your underwater timer. If you don't have an underwater watch or timer, for practice look at your wrist where you would wear your watch to simulate noting the time.
5. Slowly deflate your BCD and exhale to initiate a head-up descent. Equalize your ears immediately upon submerging and do so frequently during descent. You do not need to be straight up and down, but staying in a generally head-up position helps you stay oriented and makes it easier to equalize.

Ascents

A proper ascent has five steps that you will learn and practice in your open water diver course.

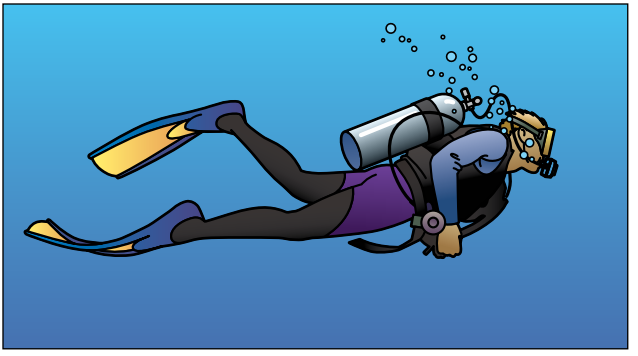
1. You and your buddy signal each other and agree to ascend.
2. Note the time of your ascent. Again, if you do not have a watch for this dive, simulate checking the time by looking at your wrist.
3. Hold your right hand over your head (so you do not run into anything) and hold up the buoyancy control device hose with exhaust control using your left hand. Air expanding in your BCD during ascent will increase your buoyancy. You need to release air as you rise to keep your ascent under control.
4. Look up and around, slowly rotating to make sure the area above you is clear.
5. Swim up slowly, at a rate no faster than 60 feet (18 meters) per minute (slower is fine), while breathing normally.

Surface Snorkel Swimming With a Full Scuba System

Quite often you will snorkel on the surface to the place where you want to dive, which means that you won't waste cylinder air on the way. During confined water development, you will practice snorkel swimming on the surface with scuba equipment.

Underwater Swimming

After you have practiced a few skills, you will be ready to swim around a bit. The standard kick for diving is the flutter kick. If you use the flutter kick appropriately you will save energy, because the flutter kick is quite efficient.



Flutter kick

Mask Removal, Replacement, and Clearing

Water sometimes leaks into your mask while diving—especially if you smile or laugh. In addition, you may need to take your mask off underwater to adjust it, so it is essential to become comfortable with taking it off and then putting it back on. Once your mask is back on, you will clear the water from it by exhaling through your nose. This pushes the water out of the mask, allowing you to see again.

Buddy-System Techniques

During your confined water skills development, you will practice the buddy system—always diving with a buddy who stays nearby at all times. Dive buddies help each other with things such as putting on and checking each other's equipment before the dive; reminding each other to check depth, time, and air-supply limits; and providing emergency assistance in the unlikely event it is necessary. Remember, the buddy system is part of Safe Swim Defense training.

Underwater and Surface Buoyancy Control

Achieving neutral buoyancy underwater is a skill you will use often while diving. During confined water skill development, you will practice hovering above the bottom, demonstrating your ability to maintain neutral buoyancy. You need to maintain neutral buoyancy while diving for the following reasons.

- To avoid inappropriate contact with the bottom that could possibly harm bottom-dwelling animals
- To be able to relax and maneuver easily
- To prevent rapid, uncontrolled ascents and descents

Underwater Removal and Replacement of Scuba System

There may be times when you need to remove and replace your scuba unit. Underwater, your scuba unit may need adjustment or may be slightly entangled and need to be freed. On the surface, you may put your scuba unit on after entering the water and remove it before exiting.

Out-of-Air Emergency Alternatives

If you pay attention to your air-supply gauge and plan your dive conservatively, it is unlikely that you will ever run out of air underwater. Even so, you need to be able to handle such an emergency, and you will practice a few responses during your confined water dives.

Equipment Care and Maintenance

Like all outdoor equipment, diving equipment needs to be cleaned, maintained, and stored after each use. Rinse all equipment with freshwater and allow it to dry in a place that is out of the sun.

Be sure to follow the manufacturer's directions for the proper cleaning, care, and storage of all your scuba equipment.

Dive Equipment for Adventurers

Divers love working with their equipment and trying new devices. Some divers use specialty equipment to get more out of their underwater adventures. This chapter outlines what is possible as you increase your diving experience and skills.

Diver Propulsion Vehicles

If you want to travel farther, save time, and save air on a dive, diver propulsion vehicles (DPVs, or "scooters") are one answer. DPVs tow (or push in some cases) you through the water, making them excellent tools for a variety of diving situations. It is also thrilling to zoom over a reef or through a kelp forest like you are flying a jet or racing a motorcycle. You might find you love DPVs simply because they are so much fun.

DPVs, or "scooters," can be a valuable tool for explorers who want to cover a lot of territory underwater in a short period of time.

Boats and Kayaks

Many divers also are boat owners. Boats allow divers to reach underwater destinations beyond a beach or shoreline. How much a boat can extend your dive-location opportunities depends on the size of the boat and how well it is equipped.

Boats allow divers to reach dive destinations beyond a shoreline. Dive kayaking has become a popular, yet inexpensive way to dive offshore.

Digital Underwater Cameras

Digital photography has revolutionized taking pictures underwater just as much as it has on dry land. Compact, easy-to-use underwater camera systems have become so simple that some people begin taking underwater photos on their very first dive. Professional underwater photographers use expensive cameras in watertight housings to take their photos. As a result, digital underwater photography suits itself to practically all levels of interest, whether you simply want fun snapshots or whether you plan to pursue it as a dedicated artist.

One activity you may want to try once you become a certified diver is underwater photography. You can even take underwater photos of your fellow Scouts.

Technical Diving Equipment

Technical diving—"tec diving" for short—is a relative newcomer to the world of underwater exploration. Tec diving is a very specialized form of diving that uses extensive equipment and procedures to dive beyond the limits of recreational diving. Tec diving requires more elaborate and intense training, plus ample experience and the willingness to accept the risks. As a Scout, you will have to wait until you are at least 18 to enroll in a technical diving course.

Technical divers explore the ocean to deeper depths and for longer periods than recreational divers, so they need specialized training and equipment. Extra scuba cylinders, special breathing gases, multiple regulators, dive computers, and extremely warm exposure suits are just some of the special equipment tec divers use.

Look, No Bubbles!

Rebreathers allow divers to stay underwater longer. In addition, they give off few or no bubbles, so divers are much less noticeable. Aquatic animals cannot detect rebreather divers as easily as divers using conventional scuba equipment that release noisy bubbles.

Closed Circuit Rebreathers (CCRs)

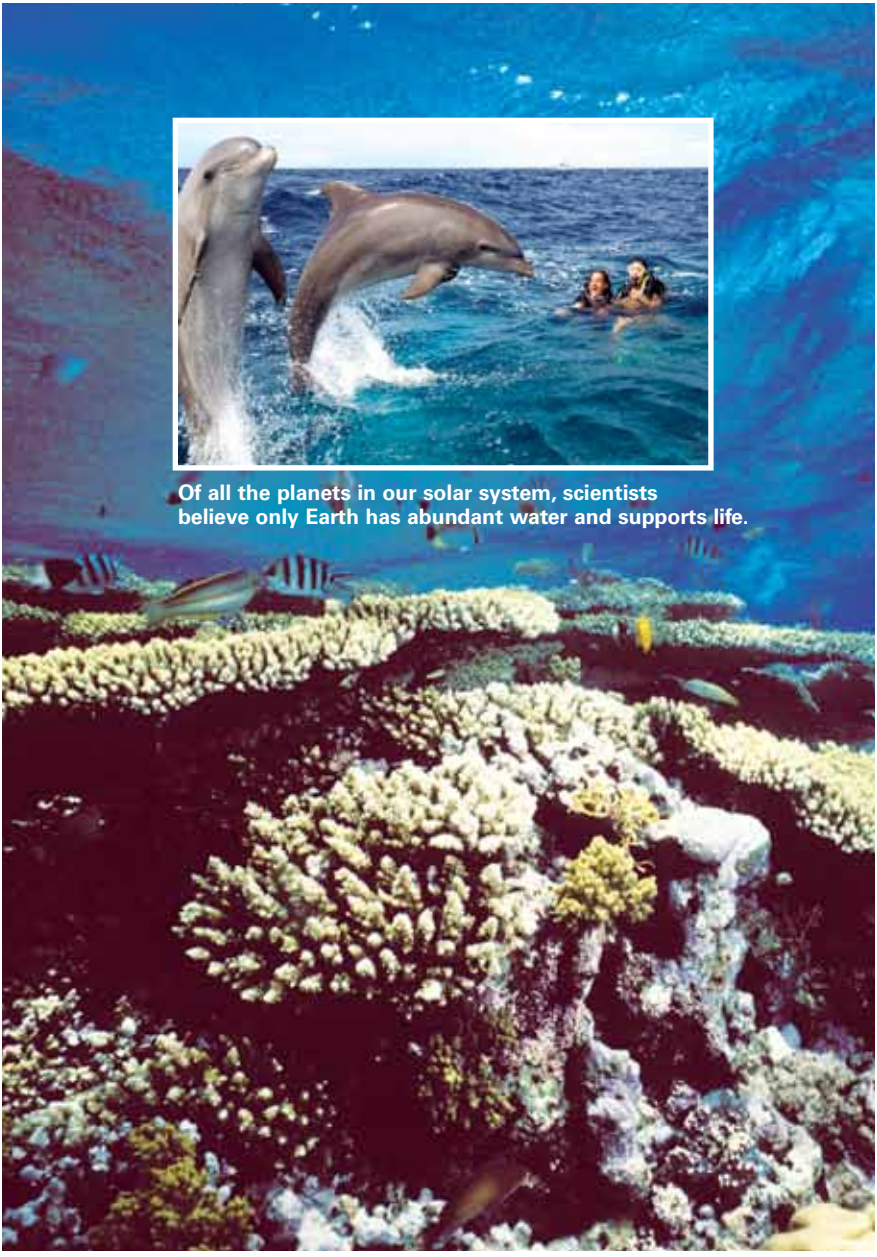
Divers who use conventional scuba equipment breathe in air from a cylinder using a regulator. When a diver exhales using this equipment, bubbles exit the regulator and rise to the surface. The exhaled air contains a higher percentage of carbon dioxide than the air inhaled. However, the exhaled air also contains quite a bit of usable oxygen, but it is not used again with this type of scuba equipment.

Rebreathers are scuba devices that allow divers to breathe their own air over and over again so exhaled oxygen is not wasted. Rebreathers have several advantages over conventional scuba equipment.

- Rebreathers are silent. They produce few or no bubbles and do not disturb marine life or reveal the diver's presence. Many underwater photographers use rebreathers to get close to marine animals.
- Rebreathers allow divers to spend a longer time underwater than do conventional cylinders.
- Rebreathers are often lighter in weight.
- Rebreathers allow for less decompression time than when diving using a conventional cylinder.

Rebreathers are considered to be advanced scuba equipment and require extra, specialized training. Even so, more and more recreational divers are beginning to use rebreathers.

Military divers, such as the U.S. Navy SEALs, use rebreathers to keep from being detected underwater.



Of all the planets in our solar system, scientists believe only Earth has abundant water and supports life.

Exploring the Ocean Planet

Imagine a planet where approximately 70 percent of its living space is water and more than half of this area measures deeper than 9,800 feet deep. This is planet Earth—and is the reason why it is sometimes called the "ocean planet." Of all the planets in our solar system, Earth is unique. It is the only planet known to have liquid water. Life as we know it depends on water. Without water, life simply cannot exist.

This NASA photograph shows that we truly live on an "ocean planet." Water covers more than 70 percent of Earth's surface. About 97 percent of the water on Earth is saltwater contained in the oceans.

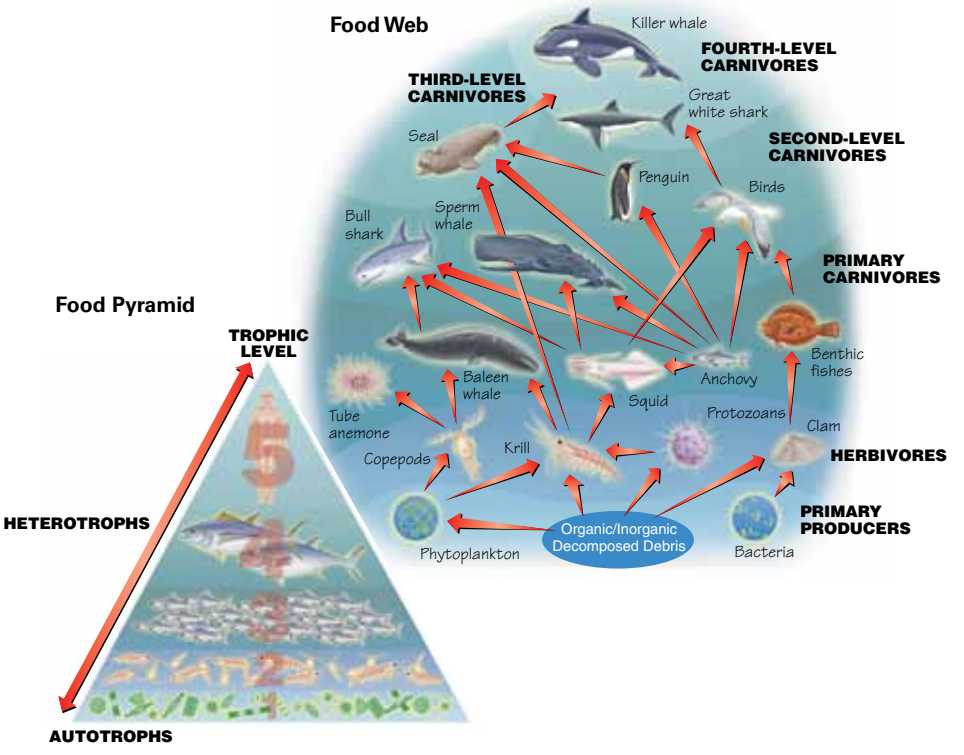
Marine scientists use scuba and small deep-diving submarines called submersibles to explore the ocean. With this technology they can see firsthand what's beneath the waves and collect specimens for research. Even with this technology, they've been able to explore less than 5 percent of the ocean.

When you focus on our water planet, think exploration. Very little of the underwater world has been explored. In fact, less than 5 percent of the ocean has been explored.

Underwater Ecosystems to Explore

The ocean is vast. Throughout the world's oceans, there are many different environments, or *ecosystems.* An *aquatic ecosystem* is a specific underwater environment with a clearly defined physical boundary, distinct physical conditions (temperature of the water, depth, etc.), at least one energy source (such as sunlight), and a community of plants, animals, and other organisms that interact with one another and through which energy is transferred.

Food webs and food pyramids illustrate the flow of energy. For example, algae use energy from sunlight to carry out photosynthesis—a process that converts carbon dioxide into food compounds. The algae are then eaten by other organisms. Nutrients from the algae provide energy to these organisms that in turn are eaten by other organisms. In this way, the sun's energy is passed from organism to organism in the ecosystem.



Freshwater Ecosystems

Inland, away from the ocean, divers may explore freshwater ecosystems, both natural and human-made bodies of water. These include reservoirs, mountain lakes, flooded rock quarries, springs, caves, and rivers. Visibility can range from a couple of feet to clearer than the clearest ocean water. Such dive places are often very popular.

Although freshwater ecosystems account for only a tiny portion of Earth's aquatic environment, they are vitally important to life on Earth. These ecosystems also can be very diverse, that is, they support a large number of different types of animals and plants. For example, the Amazon River is believed to contain almost as many fish species as found in all the world's coral reefs.

You could scuba dive in a different place, every week for an entire lifetime and there would still be new wonders to see.

Some inland bodies of water, such as the Great Lakes, are actually freshwater seas that have had the same roles in culture and shipping commerce as large seas. These lakes offer good opportunities for shipwreck diving. Wrecks are often far better preserved in these bodies of water than are wrecks in saltwater. This is because rust forms more slowly in freshwater than in saltwater. In addition, freshwater supports fewer organisms that contribute to the deterioration of the wreck. This is particularly true of wooden-hulled craft, which deteriorate and collapse in only a couple of decades in tropical seas but that can last well over a century in the cold depths of a lake.

Rivers have their own personalities. In many rivers, divers will enter upstream, drift with the current, and exit downstream. Other rivers flow slowly enough that divers can dive them as they would dive a lake, without being overly concerned about currents.

Marine Ecosystems

Marine ecosystems are saltwater ecosystems.

CORAL REEFS

The entire tropical zone receives the sun's rays more directly than areas in higher latitudes, so the average annual temperature of the tropics is higher. Seasonal temperatures vary less than in other places on Earth.

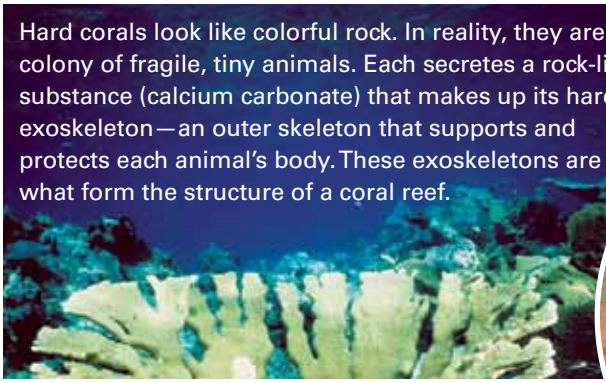
Of all Earth's ecosystems, few compare to the coral reef. A *coral reef* consists of the hard outer skeletons of tiny animals called corals. Most scientists believe that coral reefs are the most diverse ecosystems in the ocean. The Central-South Pacific area between Asia and Australia has the world's highest diversity of marine species. In this area, more than 2,000 species of fish are known, with new species discovered every year.

Coral reefs exist in many parts of the world, including coastal areas near southeastern Asia, southeastern Africa, northeastern Australia, eastern Brazil, and near Florida and Hawaii. These are all tropical or subtropical areas. The tropics lie within a narrow band of water and land on each side of the equator. They include all the land and water situated between the Tropic of Cancer and the Tropic of Capricorn.

Coral reef ecosystems are fragile. Scientists, divers, and others familiar with coral are concerned about the health of these ecosystems. The conditions corals require for life are narrow and specific. Corals need a lot of light and clear water that is free of sand and debris that could clog, smother, and kill the corals.

The Central–South Pacific area between Asia and Australia has the world's highest marine species diversity.

Hard corals look like colorful rock. In reality, they are a colony of fragile, tiny animals. Each secretes a rock-like substance (calcium carbonate) that makes up its hard exoskeleton—an outer skeleton that supports and protects each animal's body. These exoskeletons are what form the structure of a coral reef.



Soft corals form colonies but don't secrete a hard, rock-like exoskeleton.

A healthy coral ecosystem requires water that is relatively free of nutrients. This may seem odd. However, coral ecosystems efficiently pass on and preserve organic material. The lack of nutrients in the water actually protects the corals from organisms that need more nutrients (such as species of algae) and that would otherwise compete with the corals for food and other resources.

One of the first things you will notice about tropical coral reef ecosystems is that they are colorful. Many reef creatures are quite delicate as well.

When you scuba dive around corals, never touch them with your fingers, body, or fin tips. Most corals break off easily. Carefully control your buoyancy with your buoyancy control device (BCD) to remain neutral and off the bottom.

TEMPERATE KELP FORESTS

Temperate marine ecosystems—cooler, but still mild, environments—are wonderful places to dive, but they do require that you wear a warm exposure suit to stay comfortable. The west coast of the United States and areas along the northeastern coast of North America can be considered temperate.

Of these temperate areas, the kelp forest ecosystem is one of the more unique. Giant kelps, a type of algae, can grow up to 12 inches a day and reach a total length of 80 feet, as long as they are in clear water with ample sunlight and nutrients. Kelp forests provide a safe living environment for a substantial number of temperate fish and reef-dwelling creatures.

Kelp forests are fascinating ecosystems for divers to explore. The fastest-growing algae is giant kelp. Forests of this algae provide a lush environment for many underwater creatures.

Kelp is important because it is the foundation for many temperate coastal ecosystems, much as coral is the foundation for many tropical marine ecosystems.

POLAR ECOSYSTEMS

Because of their nutrient-rich water, the oceans at both the North Pole and the South Pole are home to some of the largest organisms on the planet. Every species of great whale—including humpback and gray whales and many other marine mammals—feed in the polar regions, mainly during the warm, long days of summer. These are the only seas rich enough in nutrients to support large populations of these hungry giants.

While coral reefs are characterized by having lots of different species with relatively small populations, the polar seas are the opposite. They have a low number of types of animals, but large populations. For these reasons, a growing number of divers are visiting polar ecosystems for adventure, thrills, and the chance to see very clear water and large animals.

Ice diving requires special training from experienced instructors. Divers certified as ice divers have the opportunity to dive year-round in clear water and to see unique cold-water creatures.

Cave Diving

Cave diver exploring Mexico's Yucatan Peninsula

Highly trained cave divers explore underground aquatic ecosystems. In the Mexican Yucatan (south of the city of Cancun), exploratory cave divers have mapped submerged caves with more than 461 miles of passages. The longest single passage has been mapped to 74 miles. More than 20 years since the first serious cave exploration began in the Yucatan, divers are still discovering new caves and unexplored passages. Specialized cave-diving training is always required before entering underwater caverns (the lighted entrance area of a cave) and actual cave passages. Nevertheless, those well-trained divers who have completed cave-diving courses find the adventure an incredible experience.

Being a Good Steward of Our Ocean Planet

No matter where you live, you are connected to the ocean. It supplies you with oxygen and freshwater. Most of the oxygen in the atmosphere originally came from the activities of photosynthesizing organisms in the ocean. Much of Earth's freshwater is water that evaporates from the ocean and then condenses and falls as rain.

The ocean also moderates Earth's climate, influences our weather, and affects our health. We get food, medicine, minerals, and energy resources from the ocean. In addition, the ocean serves as a global highway for ships and navies.

The ocean may someday provide you with a career. See the chapter "Diving-Related Career Opportunities" for a discussion of diving professions.

Helping to Protect the Ocean

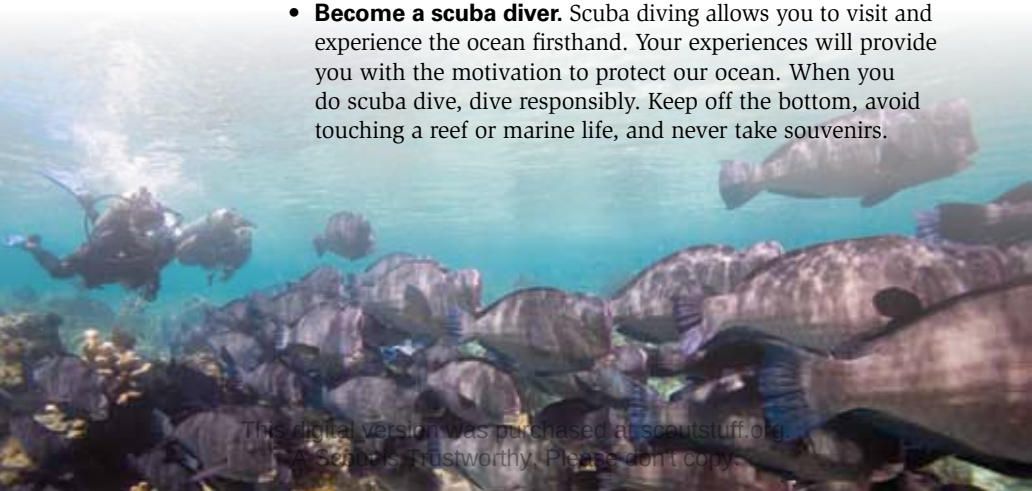
Because you depend on the ocean, you need to become a good steward of this largely unexplored portion of our planet. Even if you live miles from the ocean, you can participate in its protection. Here are some general principles to help you become a good steward of any environment.

- **Take responsibility for your actions in all things.** It sounds simple, but being accountable to yourself will help you do what is necessary to become a good steward of the oceans.

- **Stop to consider the consequences of your actions.** Ask, "If I choose to do this, what will be the result?" Remember the Outdoor Code: "As an American, I will do my best to be clean in my outdoor manners, be careful with fire, be considerate in the outdoors, and be conservation-minded."
- **Lead by example.** If you become a good steward of the ocean, it will inspire your family and friends to act similarly.
- **Remember that one person can make a difference.** Small accomplishments add up faster than you might think.

Here are some ideas of what you can do to protect the ocean, regardless of where you live.

- **Learn.** The more you know about the ocean, the better caretaker you will be.
- **Be a voice for the ocean.** Share with your fellow Scouts, parents, other family members, and neighbors what you have learned about protecting our ocean.
- **Become a scuba diver.** Scuba diving allows you to visit and experience the ocean firsthand. Your experiences will provide you with the motivation to protect our ocean. When you do scuba dive, dive responsibly. Keep off the bottom, avoid touching a reef or marine life, and never take souvenirs.



- **Practice the appropriate principles of Leave No Trace while you dive.** In particular, practice the following: (1) Plan ahead and prepare. Watch for hazards and follow all the rules of the park, outdoor facility, marine park, or boat. (2) Leave what you find. (3) Respect wildlife. (4) Be considerate of other visitors. Remember that other divers or visitors may be nearby. (5) Dispose of waste properly. Stash your trash. Do not throw trash into the ocean.

- **Choose your home detergents and cleaning products carefully.** The household chemicals you use may end up in our waterways and be carried to the oceans, so be sure to use naturally derived and biodegradable detergents and cleaning products.
- **Eat only sustainable seafood.** Certain types of seafood sold in markets are endangered and overfished. Being careful about which kinds of seafood you eat is important, both at home and in restaurants. Some species to avoid eating include Chilean sea bass, Atlantic cod, Atlantic flounder, grouper, halibut, rockfish, snapper, imported swordfish, bluefin tuna, shark, turtle, Caribbean spiny lobster, and conch.

- **Fish responsibly.** If you enjoy recreational fishing, obey regulations and consider catch-and-release style fishing.
- **Be "water-wise" at home.** Have your parents install a water-saving toilet or add a water saver bag or brick to your toilet. Take shorter showers and add water-saving or low-flow showerheads and faucets in your home. Run your dishwasher and washing machine only with a full load. Using less freshwater at home means that less polluted runoff makes its ways into streams and rivers that ultimately flow into the ocean.
- **Avoid using harmful pesticides and weed killers around your home.** Some yard chemicals can be harmful to ocean inhabitants. Rain can wash the chemicals off your yard, into rivers, and ultimately into the ocean.
- **Refuse to buy ornaments made from dead marine life.** Coral jewelry and home decorations made from dead marine life cannot compare to their living beauty in the ocean.
- **Refuse to buy wild marine life for home aquariums.** If you keep a saltwater tank, buy only marine life that have been certified as being sustainably caught or reared in captivity.

Gaining Diving Experience

Once you earn your Scuba Diving merit badge and become a certified diver, go diving with your fellow Scouts. Dive often and build your experience. Dive different locations and explore new areas. There is no need to limit yourself just to swimming around underwater and sightseeing—although that can be a lot of fun. Try new challenges such as underwater digital photography or exploring wrecks. Recognize that scuba diving is more than just a recreational activity, it is a door through which you reach hundreds of underwater pursuits and maybe even a lifelong career.

At the national Scout jamboree, you can try diving and begin your Scuba Diving merit badge adventure. The scuba diving pools at the jamboree are very popular.

Boy Scout Continuing Education

As an activity, scuba diving relates to many Scouting adventures and other merit badge accomplishments. For example, if you are age 14 or older you can go to the Florida Sea Base and continue your diving in the Florida Keys. In fact, you could earn your Scuba Diving merit badge in just one week at the Florida Sea Base. Under the guidance of your merit badge counselor and PADI instructor there, you may earn your Open Water Diver Certification. As a certified Scout diver, you can experience the underwater wilderness as you have never seen it before.

Diver Continuing Education

Once you become certified, you will be a beginning diver, and you can start expanding your diving knowledge and skills immediately by taking other scuba courses.

First, set your sights on completing an advanced open water diver course. The course title does not mean you have to be *advanced* to take the course, it simply means you will advance your underwater abilities by taking the course.

Typically, advanced courses include a series of supervised dives taught by a professional instructor. Advanced courses introduce you to the basics of special underwater activities. It is a great way to see what kinds of diving interest you. Advanced dives include training in underwater navigation and deep diving, plus other specialty-oriented dives such as night diving, boat diving, altitude diving, search-and-recovery diving, and wreck diving.

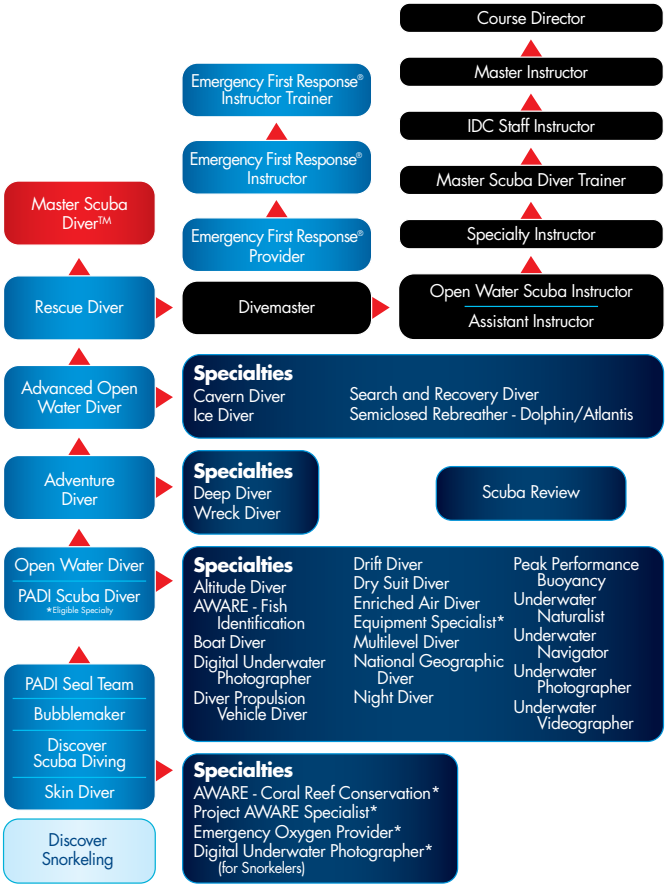
By completing an advanced open water diver course, you may find one specialty activity that really excites you. If that happens you can take an entire course specific to that activity. Specialty diver courses focus on just one underwater activity and refine your knowledge and skills in that area.

If you discover that you are really interested in one particular underwater activity, there is probably a course for it. In diving, these are called specialty courses. Wreck diving and underwater digital photography are two of the most popular courses.

Rescue divers assist other divers in need. As a rescue diver, you will learn how to deal with diving emergencies. You may never need to use these skills, but the challenges of this course will provide you with the confidence to handle many emergencies.

After completing a rescue course, you can either continue your training and become a Master Scuba Diver or a Divemaster. The Master Scuba Diver rating is the highest nonprofessional rating in recreational diving. During a Divemaster-style course you will sharpen your dive skills to demonstration quality, develop a professional-level understanding of dive knowledge, learn to organize and conduct diving activities, and learn how to assist professional scuba instructors while they train beginning divers.

Completing a rescue diver course is a real confidence builder, because you will begin to learn how to assist other divers in need.



Diving-Related Career Opportunities

As a Scout, you will first visit the underwater world as a recreational scuba diver. If you catch the scuba diving "bug" and become hooked on diving, you may ask yourself, "When I become an adult, can I make diving my career?"

There are thousands of careers that involve underwater exploration and adventure. Some involve many years of college and university training to earn degrees, while some require "trade school" type accomplishments such as learning to weld, repair machinery, become a boat captain and other similar skills.

Careers to Explore

Here are some diving professions worth exploring.

Recreational Scuba Instructor

Imagine a career where you look forward to heading off to work in the morning. As a professional recreational scuba instructor, you might work at a local dive center, at a resort, or on a dive boat. Sailing out into the ocean to dive every day could be the rule, not the exception—especially if you work in a tropical dive destination. Your commute to work could be as easy as a 10-minute boat ride to an exotic reef. One of the best things about being a recreational scuba instructor is that you will get to help others by teaching them a new recreational activity and enriching their lives by helping them experience the adventure of diving.

Regardless of the diving-related career you might train for, most people who have chosen an occupation that makes use of their scuba skills agree that it is a life filled with variety and adventure.

Even though there are other ways to do work underwater (such as using small submersibles and remotely operated vehicles), commercial divers remain the most cost-effective way of accomplishing many tasks down to a depth of approximately 1,000 feet.

Expect to work long days as a recreational scuba instructor, especially if you work at a popular dive resort. It can be demanding work, but this exciting profession can be lots of fun and very rewarding. In addition, becoming a recreational scuba instructor is an excellent starting point for many of the other diving-related occupations you will read about next.

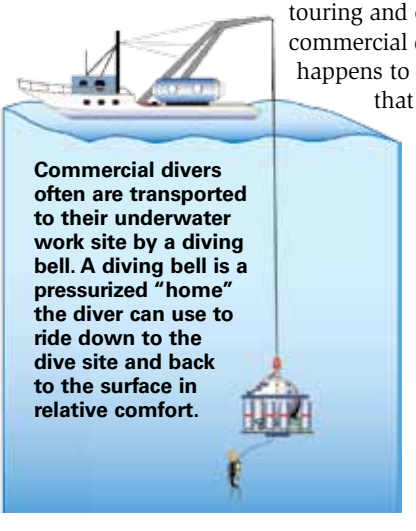
To become a recreational scuba instructor, you will need to become a great diver. To become a great diver, you will need to take more scuba courses and go diving. After you earn your Scuba Diving merit badge and receive your Open Water Diver Certification, you may enroll in the following courses: Advanced Diver, Rescue Diver, and then Divemaster.

These diver ratings were discussed in the chapter called "Gaining Diving Experience."

Some scuba instructors continue their training to become instructor trainers. This position allows them to train others to become instructors. Other scuba instructors become owners of professional dive stores and dive resorts on tropical islands.

Commercial Diver

In recreational diving, the emphasis is on the sport—underwater touring and enjoying the aquatic environment. In commercial diving, the emphasis is on work that happens to be underwater. Commercial diving is a trade that includes inspections, repairs, construction, cleaning, and other forms of labor.



Commercial divers often are transported to their underwater work site by a diving bell. A diving bell is a pressurized "home" the diver can use to ride down to the dive site and back to the surface in relative comfort.

To succeed as a commercial diver, you must have good mechanical ability and have been trained in skills such as welding. Commercial divers go where there is work. This rarely means warm, tropical places. More typically, a commercial diver works in a cold harbor with little or no underwater visibility. The offshore oil industry is one of the major sources of work for commercial divers.

Commercial divers often use full helmets, lines that extend to the surface for their air supply, very warm exposure suits, and a variety of backup safety equipment. A commercial diver's equipment is very much like the space suits NASA astronauts wear.

Public safety divers often use equipment similar to commercial divers. However, instead of using air delivered by a hose from the surface, public safety divers often use standard scuba cylinders and full-face masks.

Public Safety Diver

Public safety diving is a broad term for professions related to underwater crime and accident investigations or to other community needs, such as inspecting dams or waterways. A public safety diver also is usually a police officer, firefighter, sheriff, paramedic, emergency medical technician (EMT), or some other kind of public service agent. However, in some areas, public safety divers are specialized volunteers who work closely with police and fire services.

As with commercial diving, public safety diving is about the work, not the diving. Accidents occur everywhere—not necessarily where you want to dive. Consequently, public safety diving often takes place in bodies of water that are less than desirable to visit.

Scientific Diver

Scuba diving has become an important scientific tool. Biologists, oceanographers, archaeologists, geologists, ecologists, and other scientists rely on scientific diving to gather underwater data about their fields. In addition to pure research, scientific scuba diving has become an important tool in applied sciences related to fisheries management, environmental damage assessments, and energy development.

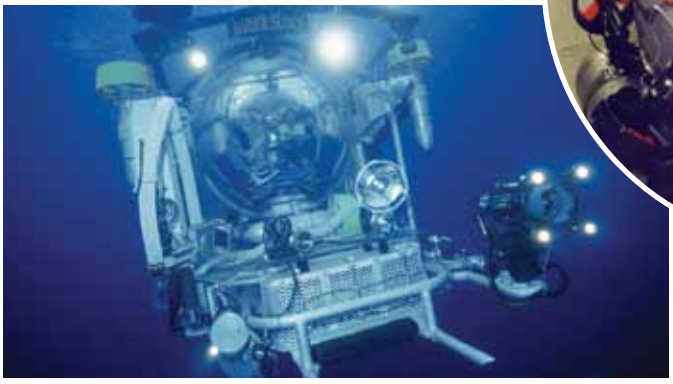
To conduct scientific investigations at any depth and location, scientific diving borrows tools and techniques from virtually every other type of diving. Although most scientific divers use standard recreational scuba gear, some scientific divers also are technical divers or commercial divers. They may use full-face masks and wireless communication devices.

Scientific divers may work for the government, universities, private institutions, or environmental groups. Often, scientific divers have advanced degrees in such fields as marine biology, oceanography, geology, or archaeology.

Diving has become an important part of scientific research. Here we see diving scientists conducting a fish survey underwater, taking underwater measurements, and using a microscope to examine collected specimens.

Submersible Pilot or ROV Pilot

Diving is a relatively inexpensive, portable, and versatile way to explore and study the underwater world. However, diving does have its limitations, which is where deep-diving submersibles—small submarines—come in. Even using the most sophisticated diving system, humans exposed to pressure cannot (so far) perform much meaningful work deeper than about 1,000 feet. The stresses on the body related to pressure and other factors become overwhelming. Yet, 1,000 feet does not even represent 10 percent of the ocean's average depth. Many deep-diving submersibles and remotely operated vehicles (ROVs), on the other hand, can easily reach depths of 10,000 feet. Their capabilities greatly assist in scientific endeavors and other kinds of ocean exploration.

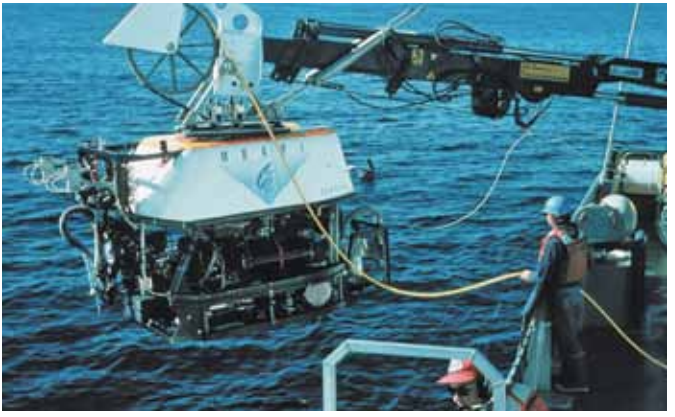


Submersibles are small, very deep-diving submarines that scientists use to explore ocean depths beyond the capabilities of scuba diving. Submersibles require a human pilot to guide them safely underwater.

A submersible pilot is much like an airline pilot, except the submersible pilot goes down, rather than up. Submersible pilots not only "drive" the submersible underwater, but they are often responsible for the care and maintenance of the submersible while at its home base, in the field, or while it is being transported. In addition, most submersible pilots are trained marine biologists or oceanographers. As they pilot the submersible underwater, they often assist other scientists onboard (if the submersible holds more than one person) in doing a survey or study.

A remotely operated vehicle (ROV) combines much of the portability and affordability of diving with the depth and duration capabilities of submersibles. A ROV dives without a human at the helm. ROV pilots work onboard ships, guiding their vehicles underwater by various switches and joy sticks and receiving images from the ROV via a television. In a way, operating a ROV is much like playing a video game!

As a submersible or ROV pilot, you may spend many days and months at sea. However, these expeditions are often filled with wonderful discoveries of new species of animals, deep shipwrecks, and undersea geological formations. You may be the first person to see sights never before seen by another human.



Operating a ROV is much like playing a video game.

Military Diver

When you think of military diving, you may think of groups such as the U.S. Navy SEALS, stealthily slipping behind enemy lines from underwater. In reality, this is only one type of several diver roles you can experience as a military diver.

In most countries, the majority of military divers have long, distinguished careers and perform valuable—often risky—services for their countries that do not relate directly to combat situations. Military divers may perform the following tasks.

- **Combat swimming.** Many operations fall into the category of combat swimming. These include antiterrorism, hostage/prisoner rescue, raids, reconnaissance, and other incursions into enemy territory.

- **Construction.** Military divers using equipment and procedures similar to those used by commercial divers work in the construction, maintenance, or removal of submerged or partially submerged structures such as piers, docks, and bridges.
- **Rescue.** Military rescue divers and swimmers, such as those in the U.S. Coast Guard, train to aid mariners, trapped submariners, and downed pilots.
- **Search and salvage.** Military salvage divers recover practice weapons and military vessels or aircraft that have sunk.
- **EOD and demolition.** Explosive Ordnance Disposal diving is one of the most hazardous duties in military diving. EOD divers must render harmless enemy mines (explosive devices) or live weapons that have failed to detonate and then dispose of them.
- **Security swims.** These are inspections of vessels and structures for explosives, sabotage, or other signs of tampering. Military divers conducting this task are not necessarily trained to disarm explosives; they may simply locate the explosives.
- **Vessel maintenance, repair, and inspection.** These duties are similar to those carried out in the civilian world by commercial divers and include hull inspections, cleaning, welding, and other maintenance or repair tasks.

This diver is a military combat swimmer. Many types of operations fall into the category of combat swimming. These include antiterrorism, hostage/prisoner rescue, raids, reconnaissance, and other incursions into enemy territory.

Glossary

alternate air source. A piece of diving equipment used in an emergency to give to a buddy who is out of air.

assistant instructor. A leadership certification level in diving that can include limited teaching duties. May assist fully certified instructors while preparing for instructor training.

aquatic ecosystem. A specific underwater environment with a clearly defined physical boundary, distinct physical conditions (temperature of the water, depth, etc.), at least one energy source (such as sunlight), and a community of plants, animals, and other organisms that interact with one another and through which energy is transferred.

buddy system. When two scuba divers assist each other. A set of safety procedures that improve divers' chances of avoiding or surviving accidents underwater.

buoyancy control device (BCD). An inflatable vest worn by the diver that can be automatically or orally inflated to help control buoyancy; also known as a buoyancy compensator.

certification card (C-card). Proof of completed diver training and evidence of experience.

closed circuit rebreathers (CCRs). Breathing equipment that captures, cleanses and re-oxygenates exhaled breath so that it can be re-inhaled.

commercial diver. A professional diver doing such tasks as underwater hunting, welding, recovery, inspection, and construction.

Buoyancy control device (BCD)

confined water. Refers to a body of water such as a pool, or an environment with similar pool-like conditions, such as a clear and shallow pond, a lake, or a ocean lagoon or bay.

coral reef. Consists of the hard outer skeletons of tiny animals called corals.

cylinder. The metal container that holds pressurized air for breathing. Also called a scuba tank.

decompression. Means "releasing pressure." Any change from one ambient pressure to a lower ambient pressure always results in a reduction of gas pressure within the body.

decompression illness (DCI). Refers to both decompression sickness and lung overexpansion injuries as a single condition, resulting in overlapping sets of symptoms.

Depth gauge

depth gauge. A device that indicates how far a diver is below the surface.

Divemaster. A professional level diver who leads a group of less experienced divers underwater. It is also, in some cases, a certification level that denotes a leadership role in diving, on a pathway to becoming a recreational scuba instructor.

dive computer. Device that constantly measures depth and time. Using this information and a preprogrammed algorithm, the computer calculates and displays the decompression status of a diver.

Exposure suits

dive flag. Special flag used by a boat or on a buoy to indicate "divers down."

dive tables. Printed tables that provide divers with a way of avoiding decompression sickness by giving the maximum times that can be spent at depth, and by indicating the decompression stops and surface intervals needed for a particular depth and time profile to be carried out safely.

diver certification. A general statement meaning an individual is taking formal scuba training from a qualified instructor.

diver propulsion vehicles (DPVs). Motorized, underwater vehicle used by divers to cover long distances underwater without having to kick. Also known as a dive "scooter."

exposure suit. A specific diving garment used to reduce heat loss and to protect a diver from minor scrapes, stings, and abrasions. Examples are wet suits, dry suits, and rash guards.

ecosystem. A specific environment with a clearly defined physical boundary, distinct physical conditions (temperature of the water, depth, etc.), at least one energy source (such as sunlight), and a community of plants, animals, and other organisms that interact with one another and through which energy is transferred.

equalization. The act of forcing air into an air space (in the body or created by equipment like a dive mask) to offset increasing water pressure.

face mask. A skirted glass window constructed to provide an air space between the eyes and nose from the water. Masks permit divers to see underwater and equalize the air space created by the mask.

Face mask

Full-foot fin

fins. Adjustable-strap or full-foot design that allow a diver's powerful leg muscles to move them through the water.

fin pivot. A training skill to help divers practice attaining neutral buoyancy.

hand signals. A standardized form of sign system used by scuba divers to communicate underwater.

Adjustable fin

military diver. Divers that venture underwater for the military. May include those that use diving for war, construction, rescue, search and salvage, demolition, security swims, vessel maintenance, repair, and inspection.

nitrogen narcosis. A condition caused by breathing nitrogen at high pressure at depth. Causes an anesthetic effect that may result in a diver making poor judgments and decisions.

open water. A natural, nonpool-like aquatic area such as a lake, quarry, or an ocean environment.

Open Water Certification. A beginning level of recreational diver training. Certification allows the holder to purchase diving equipment and air for scuba cylinders.

polar ecosystem. An ecosystem around the north and south poles; in the polar seas.

public safety diver. A broad term for professions related to underwater crime and accident investigations or to other community needs, such as inspecting dams or waterways. A public safety diver also is usually a police officer, firefighter, sheriff, paramedic, emergency medical technician (EMT), or some other kind of public service agent.

recreational scuba diving. Diving for fun and to prescribed limits, including a depth no greater than 130 fsw, using only compressed air, and never requiring a decompression stop.

recreational scuba instructor. An individual that teaches recreational diving to others as a career.

Recreational Scuba Training Council (RSTC). A council of recreational diving certification organizations that regulate the standards of scuba diver training. Member organizations include International Diving Educators Association, Professional Diving Instructors Corporation, Professional Association of Diving Instructors, Scuba Diving International, and Scuba Schools International.

regulator. The piece of dive equipment that makes it possible for divers to use the air in their cylinder. It reduces the pressure of the air in the scuba cylinder to match the surrounding water pressure. It delivers air only when a diver wants it.

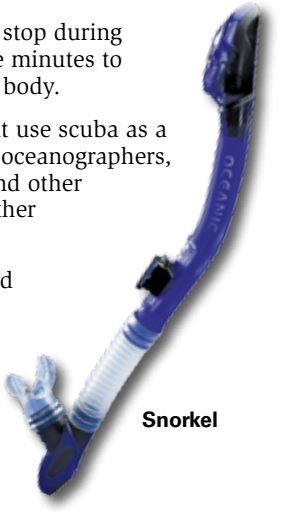
ROV pilot. An individual that guides a remotely operated vehicle (ROV) underwater by various switches and joy sticks, while receiving images from the ROV via a television.

safety stop. At the end of each dive, a stop during ascent to the surface at 15 feet for three minutes to allow excess nitrogen to leave a diver's body.

scientific diver. Professional divers that use scuba as a scientific tool. Examples are biologists, oceanographers, archaeologists, geologists, ecologists, and other scientists rely on scientific diving to gather underwater data about their fields.

scuba. Acronym meaning self-contained underwater breathing apparatus.

snorkel. A piece of equipment that allows divers to rest or swim with their face in the water.



Snorkel

specialized diving. Diving beyond an entry-level (beginner) that requires more training. Examples include night diving, cavern and cave diving, wreck diving, and deep diving.

squeezes. A response by an enclosed air space (sinuses, middle ear, inside a mask) to increasing underwater pressure during descent. A scuba diver may be injured if he or she fails to equalize these air spaces, either while descending or ascending.

submersible. Small deep-diving submarines.

submersible pressure gauge (SPG). Gauge attached to the regulator, used to monitor pressure (the amount of air) remaining in the scuba cylinder.

technical diving. A form of SCUBA diving that exceeds the scope of recreational diving, allowing deeper and longer dives.

temperate marine ecosystem. A cooler, but still mild, marine environment. The west coast of the United States and areas along the northeastern coast of North America can be considered temperate.

timing device. Dive equipment such as dive watches or special underwater timers that are pressure-activated stopwatches, used to determine dive time at depth.

visibility. The vertical distance a diver can see underwater measured in feet.

weight system. A piece of diving equipment helps divers to overcome the buoyancy of their body and equipment. May be a weight belt or lead weight integrated into a BCD.

Weight system

Scuba Diving Resources

Scouting Literature

Archaeology, First Aid, Lifesaving, Oceanography, Swimming, Water Sports, and *Weather* merit badge pamphlets

Visit the Boy Scouts of America's official retail Web site (with your parent's permission) at *http://www.scoutstuff.org* for a complete listing of all merit badge pamphlets and other helpful Scouting materials and supplies.

Books

Shreeves, Karl. *Open Water Diver Manual.* PADI, 2007.

Shreeves, Karl. *Adventures in Diving Manual.* PADI, 2007.

PADI. *Encyclopedia of Recreational Diving* (third edition). PADI, 2005.

Wohlers, Robert. *Life on an Ocean Planet.* Current Publishing, 2010.

Periodicals

Dive Training
Web site: *http://www.dtmag.com*

Scuba Diving
Web site: *http://www.scubadiving.com*

Sport Diver Magazine
Web site: *http://www.sportdiver.com*

Organizations and Web Sites

Historical Diving Society
Web site: *http://www.hds.org*

International Diving Educators Association (IDEA)
Web site: *http://www.ideascuba.com*

National Association of Underwater Instructors (NAUI)
Web site: *http://www.naui.org*

Professional Association of Diving Instructors (PADI)
Web sites: *http://www.padi.com*
http://www.projectaware.org
http://www.currentpublishingcorp.com
http://www.emergencyfirstresponse.com

Professional Diving Instructors Corporation (PDIC)
Web site: *http://www.pdic-intl.com*

Scuba Diving International (SDI)
Web site: *http://www.tdisdi.com*

Scuba Schools International (SSI)
Web site: *http://www.divessi.com*

(World) Recreational Scuba Training Council (RSTC)
Web site: *http://www.wrstc.com*

Acknowledgments

The Boy Scouts of America thanks PADI Americas for its assistance with the development of the Scuba Diving merit badge and its support in the production of this first edition of the merit badge pamphlet. The Boy Scouts of America has long appreciated a mutual and supportive relationship with this highly regarded diving agency. That collaboration continues today through a memorandum of understanding between the BSA and PADI.

Special thanks to PADI's Brad Smith, Emergency First Response director, Business Development and Education, who was instrumental in the development of the merit badge and pamphlet from beginning to end. We appreciate Robert Wohlers, instructional design and development executive, for writing the manuscript, for his technical expertise, and for allowing the BSA to use so many of his wonderful photographs that depict the underwater world. Thanks also to Janelle Hamm, marketing manager; Dawn Azua, supervisor, Media Productions; Karl Shreeves, technical development executive; Kimberly Sickel, graphic designer; and Brooke Schnetz, media production coordinator.

The BSA is grateful to Steve Willis, associate director, Program, Florida National High Adventure Sea Base, and volunteers Jay Fox and Bob Tallent. These dedicated Scouters provided substantial input. Thanks to members of the BSA Aquatics Task Force (Pat Noack, chair) for their crucial input, so integral in keeping our participants safe in and on the water.

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If a Scout has already started working on a merit badge when a new edition for that pamphlet is introduced, *he may continue to use the same merit badge pamphlet to earn the badge and fulfill the requirements therein.* In other words, the Scout need not start over again with the new pamphlet and possibly revised requirements.

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American Business	2002
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American Labor	2006
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Automotive Maintenance	2008
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