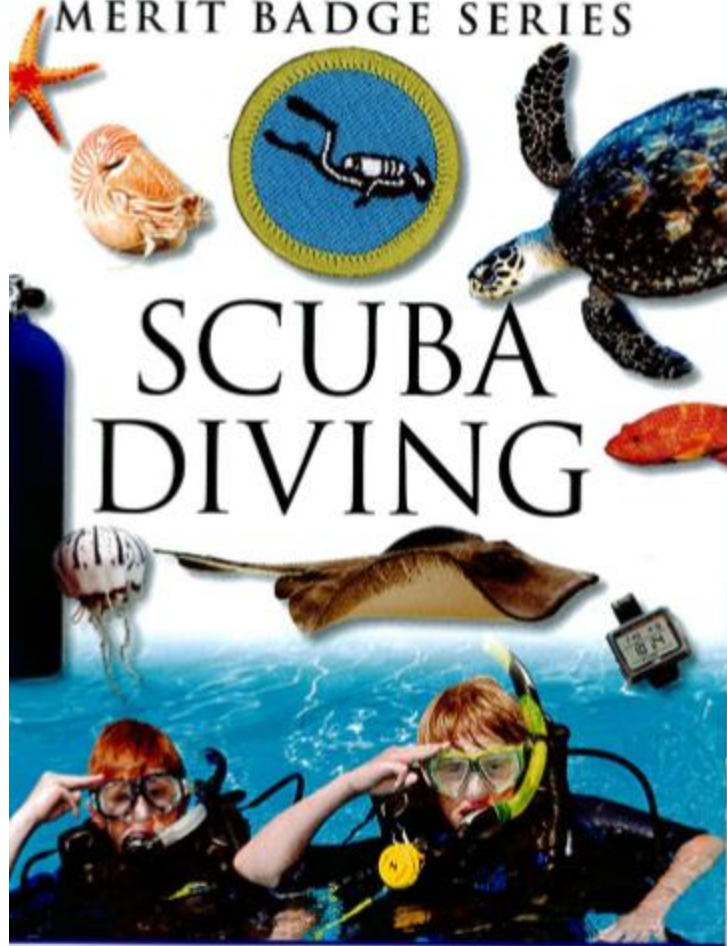


MERIT BADGE SERIES



# SCUBA DIVING



BOY SCOUTS OF AMERICA

## 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.

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.



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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](http://www.scouting.org).

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## 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.

The image shows a 'DECOMPRESSION DIVE PLANNER' table. It is a grid with columns for 'DEPTH (m)', 'DEPTH (ft)', 'TIME (min)', 'NO. OF DIVES', 'DIVE TYPE', 'DIVE TIME', 'DIVE DEPTH', 'DIVE DATE', 'DIVE TIME', 'DIVE DEPTH', 'DIVE DATE', 'DIVE TIME', 'DIVE DEPTH', 'DIVE DATE'. The table is filled with data for various dive profiles, including single and repetitive dives at different depths and durations. It also includes a section for 'DECOMPRESSION STOPS' with columns for 'DEPTH (m)', 'DEPTH (ft)', 'TIME (min)', and 'DIVE TYPE'.

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.





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## 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

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### 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.

- 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.

The complete text of *Safety Afloat* can be found in the BSA publication *Guide to Safe Scouting*, available online at [www.scouting.org](http://www.scouting.org).

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.

### 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.

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.

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.

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.

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

### 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.

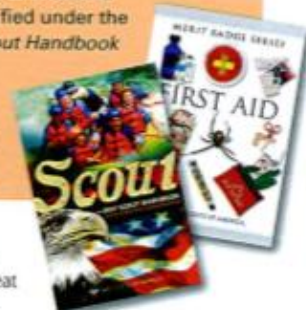


Take your time,  
and you will stay  
underwater longer  
and go farther.

## 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.



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.

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Never touch  
spines or stingers  
from venomous  
aquatic animals.

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### 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 self-contained underwater breathing apparatus—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.



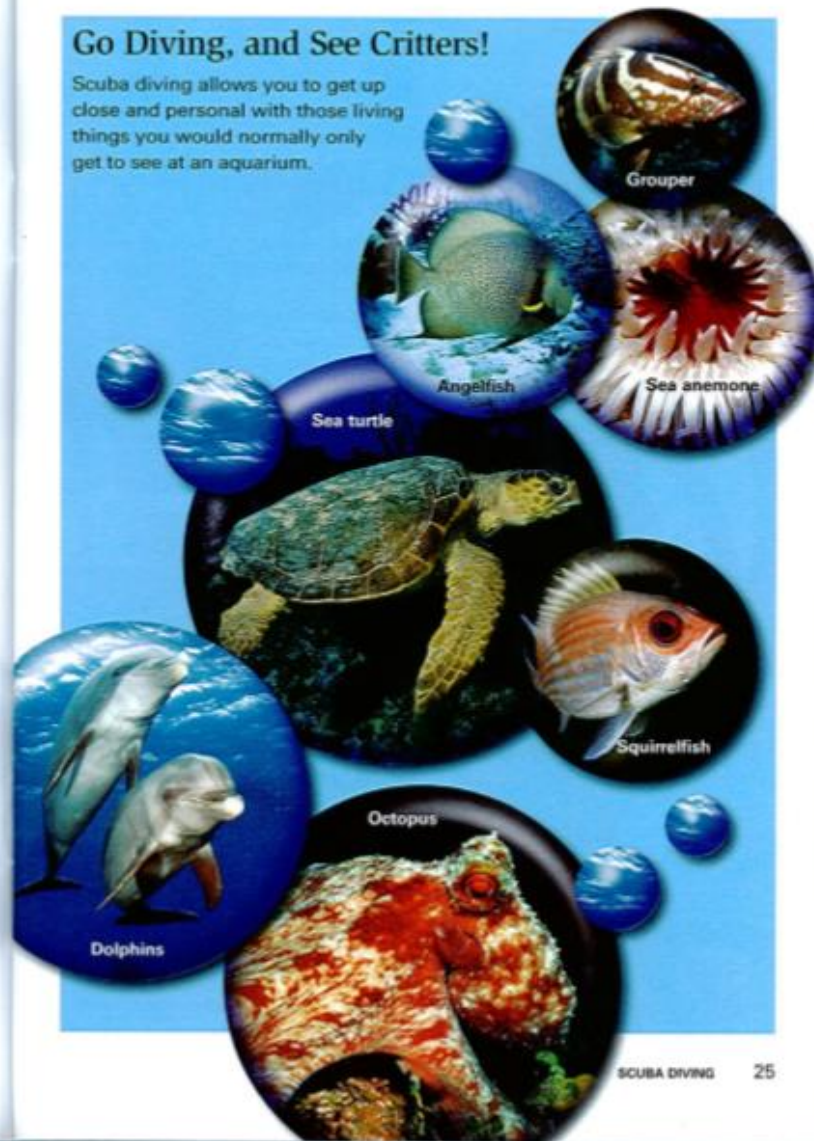
If you like making discoveries, then welcome to the Scuba Diving merit badge. Once you earn your merit badge and scuba certification, you will be on your way to exploring "inner space." As a Boy Scout scuba diver, prepare to be an adventurer.

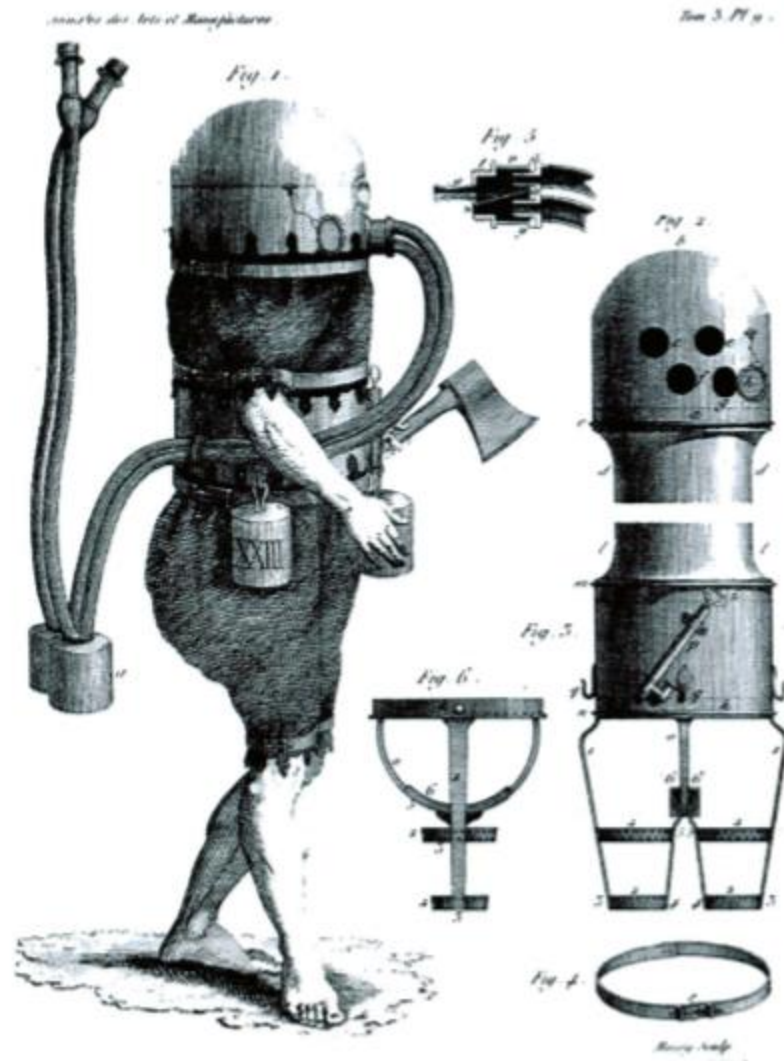


If you love nature, you will see plenty of it underwater. No other environment approaches the abundance, diversity, and excitement to be found while exploring underwater reefs. On most shallow water reefs, you can easily see hundreds of different species during a single dive. With time, you will even 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.





## 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.

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*.



**Mask features**



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

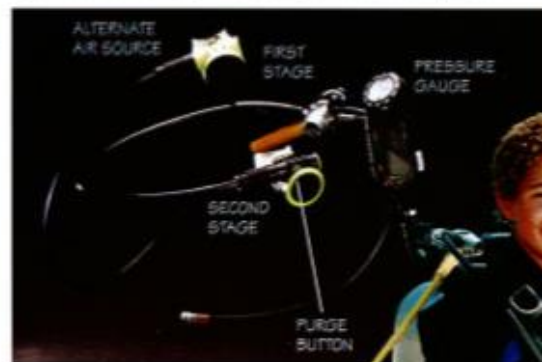
Scuba cylinders

### 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.



DIVE  
COMPUTERS

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.



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.

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.

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.



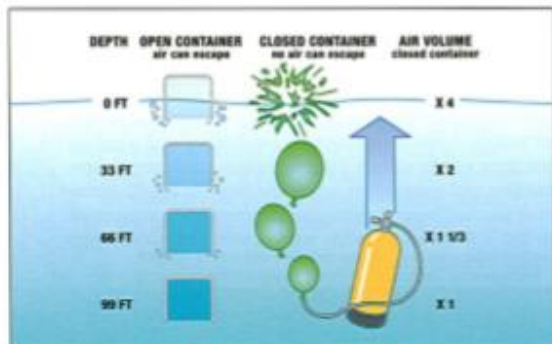
Equalizing pressure when descending (left) and releasing excess air when ascending (right)

### 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.

### 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.

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



## 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.

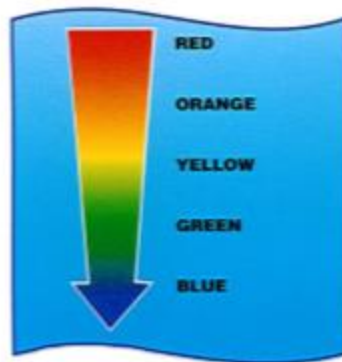


In all but very warm pools and tropical water, you will need to wear an exposure suit to slow down your heat loss underwater. For extra warmth and protection, divers wear thick wet suits, a hood for the head, and boots for the feet.

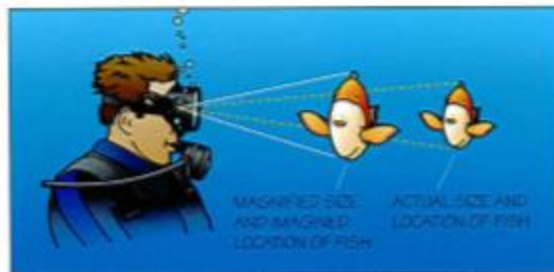


## Underwater Vision— Bigger and Closer but Less Colorful

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.

