OPEN WATER DIVER Manual

PADI

Open Water

DIVER MANUAL

PADI

Student Diver

Address

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Instructor Date

PADI
Open Water
Diver Manual

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Introduction

It feels strange the first time. Your mask. Your awkward gear, a bit heavy. You ease into the water and your face slips below the surface. Inhale; the air comes with a reassuring hiss, and for the first time, you breathe underwater. In moments, you forget your mask. Your equipment transforms to light and agile, and you're free like you've never experienced before. With that first underwater breath, the door opens to a different world. Not a world apart, but different nonetheless.

Go through that door. Your life will never be the same.

No one but you can say what calls you to scuba diving. If you seek adventure, you'll find plenty, whether it's in a sunken ship as you uncover its secrets, in a far corner of the world amid other peoples and cultures, or in your backyard — closer than you imagined possible.

If you love nature, you've come to the right place. No other environment approaches the abundance, diversity and vibrance of a pristine coral reef. You can see more different species in ten minutes there than in ten hours in the most unspoiled wildernesses above water. But with time, you'll discover that even unlikely places that seem empty and

INTRO

sterile to the inexperienced eye — like a lake or flooded quarry — teem with intriguing organisms — a reminder that nature's imagination exceeds ours.

If discovery drives you, welcome to inner space. It's somewhat cliché, yet true, that we know the surface of the moon better than we know the bottoms of the oceans. Even at the most popular dive sites, you'll see things most people never see and go where most people never go. Even with hundreds of dives under your belt, visiting a new dive site thrills you with discovery, and visiting a familiar site is a bit like coming home.

And scuba diving means rising to new challenges. It's one of those rare activities that delivers adrenaline and intensity, or serenity and peace. You can take on challenges that require training, planning, equipment and focus: searching for and recovering lost objects, descending to 30 metres/100 feet (if your diving level permits) or exploring your favorite dive site after sunset. Or you can drift along in some of the world's most tranquil and beautiful settings, with your biggest immediate worry whether you want to stop and photograph that starfish or not. Either way, diving grows with you — there's always something new to see, somewhere new to explore, some new way to enjoy the experience. No other endeavour so easily matches exactly what you're up for, right now, tomorrow and ten years from now. You cannot outgrow it.

You've probably seen photos, television and films about diving, but until you do it yourself, you can't really understand what it's like. Nothing on earth matches the sensations you experience — the thrill of breathing underwater, the freedom of "weightlessness," and unique sights and sounds.

PADI Open Water Diver and Scuba Diver Certification

The PADI Open Water Diver course leads to two possible certifications: PADI Scuba Diver and PADI Open Water Diver.

Open Water Diver certification is a *full entry* level certification you earn by successfully completing the entire Open Water Diver course. The PADI Open Water Diver certification qualifies you to:

- Dive independently while applying the knowledge and skills you learn in this course, within the limits of your training and experience.
- Procure air fills, scuba equipment and other services.
- Plan, conduct and log open water no stop (no decompression) dives when equipped properly and accompanied by a buddy in conditions with which you have training and/or experience.
- Continue your diver training with a specialty dive in the PADI Adventures in Diving program, and/or in PADI Specialty courses.

You earn the PADI Scuba Diver certification by completing only a portion of the Open Water Diver course. The Scuba Diver certification is a *pre-entry* level certification and qualifies you to:

- Dive under the inwater supervision of a PADI Divemaster (or someone with a higher level professional rating) while applying the knowledge and skills you learn in this course, within the limits of your training and experience.
- Procure air fills, scuba equipment and other services for use while diving supervised.
- Plan under supervision, conduct and log open water no stop (no decompression) dives when equipped properly and accompanied in water by a certified divemaster, assistant instructor or instructor in conditions with which you have training and/or experience.
- Continue your diver training to complete the PADI Open Water Diver certification and some select specialty courses.

For your safety.

The information you put on the Medical Form will remain confidential. Because it identifies medical conditions that may be affected by diving, for your safety and health it's important that you complete it completely and accurately.

The PADI Open Water Diver course opens this world for you. During this course, you'll learn what you need to know to explore the underwater world, whether simply snorkeling in the shallows with mask, fins and snorkel, or visiting longer and deeper using scuba (a word derived from self contained underwater breathing apparatus). Most people find learning to dive a fun challenge that's neither effortless nor overly arduous.

Welcome to a world of discovery and adventure. This course is only the beginning.

Course Prerequisites

To become a scuba diver, you need to demonstrate that you're comfortable in water and have some basic swimming skills. Your instructor will have you float/tread water for 10 minutes and swim 200 metres/yards (no time limit) or swim 300 metres/yards in mask, fins and snorkel (no time limit) – nothing extreme, just enough to determine you

All Walks

Marks of distinction.

The professionalism of PADI Instructors, Dive Centers and Resorts has made PADI certifications the world's most respected and requested dive credentials. You can be confident that your certification will be recognized virtually any place you go diving, and that PADI's reputation stands behind it.

As the world's largest diver training organization, PADI enjoys the most diverse professional membership in the entire dive community. This is the world's most culturally and ethnically diverse group of recreational dive professionals. At this writing, more than 130,000 PADI Instructors, Assistant Instructors and Divemasters teach diving and offer dive services in more than 183 countries and territories. You can find PADI diver materials in more than 24 languages. Today, virtually anyone who wants to learn to dive can find a PADI Instructor nearby who speaks the same language and who comes from the same culture.

What does this mean for you? It means wherever your dive travels take you, you can be confident that the local dive community will recognize your diver credentials – even if "PADI" is the only word you can speak in the local language.

have basic swimming abilities. You don't need to be an athlete, but you should be in good overall health, particularly your respiratory and circulatory systems. Mentally, you need a mature attitude, good judgment and the self-discipline to follow the guidelines and principles required for safe diving.

Before any confined water dives or water skills, your instructor will have you complete a medical statement. The information you put on it will remain confidential. Because the statement identifies medical conditions that may be affected by diving, for your safety and health it's important that you complete it completely and accurately. If any of the conditions listed apply to you, as a prudent precaution, your instructor will ask you to consult a physician before participating in any water activities. Also, in some areas local regulations or laws require that all prospective scuba divers receive medical clearance prior to diving.

The minimum ages for scuba certification are 10 for the Junior Open Water Diver or Junior Scuba Diver certification (adult supervised diving), and 15 for the Open Water Diver or Scuba Diver certification. These certifications show that you successfully completed the course according to the training standards and requirements established by PADI. Dive centers and resorts require a person to be a certified diver or in training before they will rent or sell you scuba equipment, fill scuba tanks for you, or let you participate in scuba diving activities.

PADI

PADI is the Professional Association of Diving Instructors, the world's largest diver training organization. PADI establishes training programs, materials and standards, monitors their quality, certifies instructors, and provides support services for PADI professional members. The professionalism of PADI Instructors, Dive Centers and Resorts has made PADI certifications the world's most respected and sought-after dive credentials. You can be confident

Dive today!

You'll become comfortable handling your equipment and maneuvering underwater by diving with your instructor in a pool or confined water and also in open water. You'll learn the basic dive concepts and principles by interacting with the course materials and through review with your instructor.

Authorized Instruction

The worldwide PADI Offices work constantly to prevent individuals from misrepresenting themselves as authorized to teach PADI courses when, in fact, they are not. How do you verify that the individual conducting your program is an authorized PADI Instructor? Easy. First, when you take your PADI Open Water Diver course through an authorized PADI Resort and Dive Center (see padi.com for a complete list), it's highly likely your instructor is an authorized PADI Instructor. Second, to be sure, you may ask to see your instructor's certification card. Check the photo and note the instructor number. For further verification, you may call your local PADI Office, or visit www.padi.com to verify that the individual is authorized to conduct the PADI program you're taking. If at any time during your program you have questions about the instructor conducting your program, please contact your local PADI Office. You can find contact information for the PADI Office nearest you on padi.com.

that your certification will be recognized virtually any place you go diving, and that PADI's reputation stands behind it.

Open Water Diver Course Structure

The PADI Open Water Diver course consists of three segments: Confined water dives, knowledge development, and open water dives. Each plays an important role in learning to dive and in meeting the performance objectives you need to qualify as a diver.

The fun begins in the confined water dives, during which you apply dive principles, and learn and practice dive procedures and skills. You'll do this in either a swimming pool, or a body of water with pool-like conditions, under your instructor's guidance and supervision. There are five confined water dives that correspond with five knowledge development sections (three of each for Scuba Diver).

Knowledge development establishes the principles and basic information all divers need to have fun diving safely. It's divided into five segments that you'll complete primarily on your own time at your convenience using this manual and the PADI *Open Water Diver Video*. (In some instances you may view or review the video in a classroom setting.) For each segment, your instructor reviews and elaborates on the material, applying what you're learning to your specific needs, interests and the local dive environment. A short quiz confirms that you've picked up the information you need from that section.

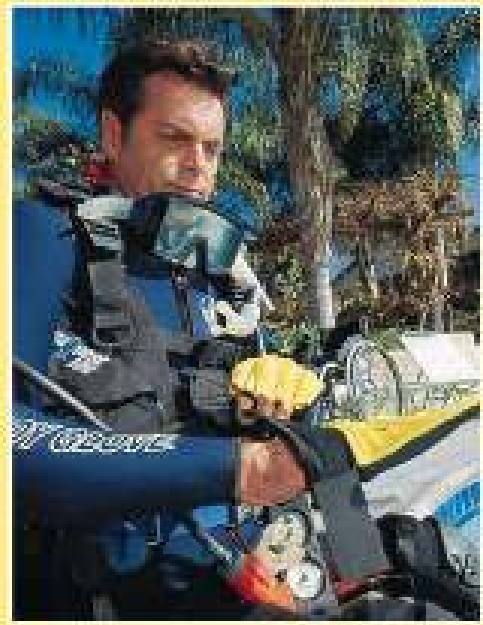
The open water dives complete your training as an entry-level diver by applying and further developing your knowledge and dive skills in a dive environment under your instructor's supervision and guidance. You'll make at least four scuba dives, and perhaps an optional skin dive, during this part of the Open Water Diver course. Prior to certification, you'll meet specific

Performance Based Learning and a Philosophy of Access

Learning to dive means meeting specific performance requirements necessary for enjoyable and safe diving. Your instructor, this manual and the *Open Water Diver Video* suggest methods for meeting those performance requirements, but they're not the *only* methods.

People differ in their talents and strengths, limits and weaknesses, and PADI courses flex to accommodate these differences, including those caused by physical and intellectual challenges. This makes diving accessible to the widest range of people without compromising the requirements necessary to dive safely.

For example, while most divers might enter the water by stepping in, an individual with limited leg use may not have that option. But there are many ways to enter the water that meet the performance requirements; such an individual might enter the water by rolling in backward.



Challenges limited, not limited by challenges.
Learning to dive the PADI way empowers people to meet their goals.

So if a suggested technique for meeting a performance requirement doesn't work because of your personal situation, ask your instructor to help you attain your goal to become a diver by adapting or developing techniques that meet the requirements some other way. You need to meet the performance requirements to receive a PADI certification, but there are many ways besides those listed in this manual.

learning objectives that you'll read about in this manual, and that your instructor will discuss with you.

You'll be learning in a sequence that establishes skills and knowledge from the simple to the complex, with later skills and knowledge building on what you learn first. For this reason, it's important to successfully complete each section before moving on to the next. For example, you need to successfully com-

plete Knowledge Development Section Two before you complete Knowledge Development Section Three, and you must successfully complete Confined Water Dive 2 before you begin Confined Water Dive 3.

Nonetheless, your instructor has tremendous flexibility to accommodate differing schedules and still meet course requirements. Your instructor will review the schedule and reading requirements for your course.

All PADI courses apply the concept of *performance based learning*, which means that you progress based on meeting specific performance requirements under your instructor's guidance. If you have difficulty, you don't "fail" — you just keep working until you meet them — but likewise, you won't get certified just because you show up. Your PADI Instructor is a trained professional committed to helping you attain your goal of becoming a scuba diver by guiding you in meeting the course performance requirements.

How to Use This Manual and Succeed in the Course

You'll find learning to dive fun and exciting, but it *is* a learning experience and you are taking a *course*. This means a bit of independent study and preparation with this manual, the PADI *Open Water Diver Video* or the *CD-ROM*. It's very necessary that you prepare adequately for each session with your instructor; failure to do so makes it difficult or impossible to progress, usually requiring some rescheduling until you can complete the needed learning. What you need to accomplish isn't especially complex or excessively long — and hopefully you'll get a smile or chuckle along the way. But it *is* important: as you'll see, in scuba diving what you don't know *can* hurt you, but don't worry – when you're properly informed and follow what you've learned, you can avoid or minimize the risks of diving.

Dive Today

The emphasis in the Open Water Diver course is to learn to dive by diving. Your

instructor will get you in the water diving as quickly as possible because that's what diving's all about. Nonetheless, diving involves learning some basic principles and guidelines. You'll normally cover these through independent learning and reviews with your instructor.

Independent Learning

Depending on your course schedule, you may complete your independent learning by completing a section, meeting with your instructor for a review and a confined water dive, and then going on to the next one.

Alternatively, you may complete independent learning for all sections prior to your first meeting with your instructor. Either way, use the following steps to prepare:

Independent Learning

1. Begin by skimming the headings in Section One of this manual. This quick scan aids learning by giving you a basic idea of what you'll be studying. You'll also notice that this manual isn't simply a text, but an interactive tool that guides and confirms your learning with objectives, quick quizzes and knowledge reviews. More about these shortly.

2. Next, read Section One and watch the corresponding first section of the PADI *Open Water Diver Video*. It really doesn't matter which you do first, so take your choice. People differ in how they learn, so whichever way you like best is probably best for you.

3. At the beginning of each subsection in Section One, notice the study *objectives*, each stated as a question. To succeed in this course, you need to be able to answer all of these questions. So as you read, guide your learning by looking for the answers. When you find the answers, highlight or underline them. It's important that you *actually* highlight/underline in the manual to do this — not just mentally note it — because the action of stopping and writing reinforces your learning.

4. Following each subsection you'll find a Quick Quiz, which checks and reinforces what you've read. Again (important!) actually writing in the book, answer each question, then check the answers supplied at the bottom of the quiz. If you missed any and don't understand why, flip back to that section and review it until you do.

5. At the end of Section One, you'll find a Knowledge Review. Fill it out to turn in to your instructor when you meet for that section's review and elaboration session. If

Watch for these symbols

As you read the *Open Water Diver Manual*, you'll notice this symbol. It alerts you to important safety information. Pay close attention when you see this symbol and consult your instructor if you do not understand the material.

This Project AWARE symbol highlights information or a specific diving technique that allows you to harmoniously interact with the aquatic environment.

Success is in the details.
During your instructor's demonstrations, pay attention to the details – especially those that your instructor exaggerates or emphasizes. The faster you pick these up, the faster you'll master the skill.

there's a question you can't answer, review that portion of Section One until you can. If there's something you don't understand even after rereading, you may understand it better after watching the video (if you haven't already) or by reviewing the video (if you have). If you still don't get it, ask your instructor to explain the material until you're *both* satisified that you do.

If you're completing all your independent learning ahead of time (or just like getting ahead), repeat Steps 1-5 for Sections Two through Five. If your course schedule distributes your study throughout the course, you can start on the next section after you complete the section One elaboration and review and Confined Water Dive One. Be sure to complete the next section's video, reading, Quick Quizzes and Knowledge Reviews *before* the elaboration and review session.

Confined Water Dives

You'll find the confined water dives a lot of fun. A few tips will help you get the most out of your practice:

1. Think of confined water dives as simulations of open water dives; use them to develop good open water habits. For instance, an ocean or quarry won't have sides you can hang onto, so don't hang onto the pool sides. A dive boat rocks and an unattended scuba tank will fall over, so get in the habit of laying your tank down when preparing for your confined water dives. Your instructor will ask you to develop habits for quite a few things that aren't necessary for confined water dives, but are for open water dives.

2. If you wear contact lenses, be sure to let your instructor know. If you can see adequately to read gauges and watch your instructor, it's best if you can practice without them. But if you need your contacts, wear them. Your instructor will simply have you close your eyes when you're underwater with your mask off.

3. Your instructor will demonstrate skills you need to learn before you practice them. During the demonstration, pay attention to the details — especially those that your instructor exaggerates or emphasizes. The faster you pick these up, the faster you'll master the skill.

4. If you don't understand why you're practicing or doing something, be sure to ask your instructor. **There are no arbitrary skills in the PADI Open Water Diver course — everything you learn has a real, practical purpose.** So, it's important that you understand when and why you would use a skill you're learning.

5. Remember that throughout the course, there are no silly questions. If you have a question, ask it.

Open Water Dives

During the open water dives you learn by applying the knowledge and skills you pick up during your independent learning and in the confined water dives, plus you'll develop some new abilities that you can't practically learn in confined water. You'll also have time to explore and get to know the underwater world with your instructor guiding you.

1. Your instructor will probably make recommendations about preparing for your open water dives, such as what to wear, whether you need sunscreen, etc. Ask the PADI Professionals at your local dive centers and resorts for assistance when purchasing equipment. Pay attention to these details – your instructor knows your local dive environment well and is trying to help you avoid problems and have an enjoyable experience. Diving with your own equipment is much easier and more fun due to fit and familiarity.

Leading Edge Education

What does it take to create a diver training program? PADI believes it requires applying established instructional system design theory, educational psychology and cognitive psychology to create valid, state-of-the-art courses and materials. Apparently, mainstream bodies in higher education agree. Increasingly, institutions in international governments and education recognize the instructional quality of PADI training. For example, the American Council on Education's College Credit Recommendation Service (ACE Credit) independently evaluated PADI courses, and recommended many of them for college credit. Similar authoritative bodies in Australia, Canada, England, Wales, Northern Ireland, Japan and New Zealand recognize PADI courses for academic credit, or for educational credits for competency that can be transferred to other fields. See "Get Credit for your PADI Education," in the appendix section of this manual for more information. These acknowledgments corroborate the educational validity of PADI courses, and the PADI organization's ability to meet its educational goals. As a diver training organization, PADI stands out in receiving such a broad range of academic recognition internationally.

Optimum condition for diving.
You don't have to be an athlete to dive, but it is a physical activity. You'll have a lot more fun if you've rested and eaten adequately before your open water dives.

2. If you're prone to seasickness and will be diving from a boat, consult your physician as necessary regarding an appropriate seasickness medication. Seasickness can ruin an otherwise fabulous outing — but for most people it is easy to prevent. You don't have to let seasickness come between you and enjoying your first underwater adventure.

3. You don't have to be an athlete to dive, but it *is* a physical activity. You'll have a lot more fun if you've rested and eaten adequately before your open water dives.

The PADI Scuba Diver Course

The PADI Scuba Diver certification is a *limited* certification intended for those who will only dive accompanied by a PADI professional-level diver to a maximum depth of 12 metres/40 feet. The Scuba Diver course is a subcourse within the Open Water Diver course. Scuba Divers follow the Open Water Diver course structure and sequence, but complete only:

- Knowledge Development Sections 1-3
- Confined Water Dives 1-3
- Open Water Dives 1-2

It's easy to upgrade to PADI Open Water Diver any time after completing your Scuba Diver course simply by completing the remaining course sections.

Learn to dive anytime. anywhere. with **PADI eLearning®**

The following new PADI Courses are available Online:

- *Open Water Diver Course (available in English, Spanish, German, Japanese, Italian, Dutch and French)*
- *Advanced Open Water Diver Course*
- *Enriched Air Diver Course*
- *Digital Underwater Photographer Course*
- *Scuba Tune Up*

Visit padi.com/eLearning to view all PADI online course offerings!

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Join Us. See Life.

Whether you're a beginner or pro - join the PADI Diving Society, your passport to discovering an active dive lifestyle.

Take advantage of Society Membership and enjoy:

- Equipment rebates and incentives
- Exclusive dive trips, travel specials and local Society events
- Personalized membership card
- Subscription to a membership publication
- Membership supports Project AWARE environmental initiatives

The PADI Diving Society makes it easy to discover more opportunities and discover your dive life! Join today at your local PADI Dive Center or Resort, **or visit padidivingsociety.com.**

*PADI Diving Society offices are located in the US, UK, and Asia Pacific. Benefits differ by region, please contact your local Society office for a full list of benefits in your area. Residents of the US and Canada call 888.333.7234 or + 386.447.2535. UK residents please phone 0117 300 7371. Asia Pacific residents call +65 62983241 or +61 2 9454 2915.

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Join us. See life.

ONE

The Underwater World

If this is the first time you've used scuba to venture into the underwater world, you're going to love it. Immediately, you'll experience new sensations as you venture into a realm where everything looks, sounds and feels a bit different. This is part of what makes diving so special; at first

MAIN Objectives

Underline/highlight the answers to these questions as you read:

1. What will the buoyancy of an object be (positive, neutral or negative) if it displaces an amount of water:
   - more than its own weight?
   - less than its own weight?
   - equal to its own weight?

2. Why is buoyancy control, both at the surface and underwater, one of the most important skills a diver can master?

3. What two items control a diver's buoyancy?

4. How does the buoyancy of an object differ in fresh water compared to salt water?

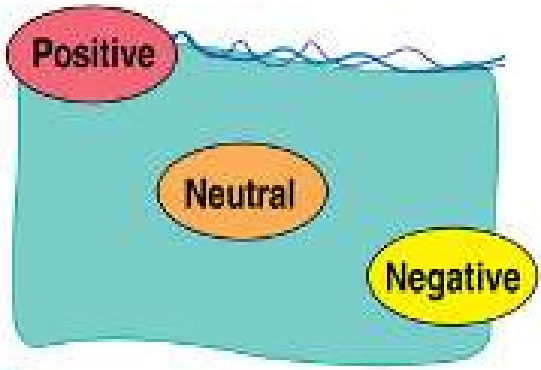
5. How does lung volume affect buoyancy?

you'll enjoy these sensations because they're new, but even after you've made hundreds of dives, you'll find them an important part of the diving experience.

The new sensations you have underwater result from physical differences that arise from being underwater. Becoming a diver depends on understanding how these principles affect you. In this section, you'll begin learning about these by looking at *buoyancy* and *pressure*. (And, you'll be learning some extremely impressive words you can use to impress your friends.)

Buoyancy

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



Buoyancy.
If an object floats, we call it positively buoyant; if it sinks, we call it negatively buoyant; and if it neither floats nor sinks, we call it neutrally buoyant.

You can state the principle of buoyancy this way: *An object placed in water is buoyed up by a force equal to the weight of the quantity of water it displaces.*

This means that if an object displaces an amount of water weighing *more* than its own weight, it will float. If an object displaces an amount of water weighing *less* than its own weight, it will sink. If an object displaces an amount of water *equal* to its own weight, it will neither float nor sink, but remain suspended in the water. If an object floats, we call it *positively buoyant;* if it sinks, we call it *negatively buoyant*; and if it neither floats nor sinks, we call it *neutrally buoyant*. A buoyancy change that makes something more likely to float is called having "more" buoyancy; a change that makes something more likely to sink is called having "less" buoyancy.

Built in buoyancy control.
When you exhale, you decrease the volume of your lungs and the amount of water you displace, which makes you less buoyant.

As a diver, it's important to learn to control your buoyancy at the surface and underwater because

it lets you control where you are in the water. For instance, you'll learn to establish positive buoyancy at the surface so you can save energy and rest. Underwater, you'll remain neutrally buoyant most of the time — almost weightless, like an astronaut — so you can swim effortlessly and move freely in all directions. Staying neutrally buoyant keeps you off the bottom so you avoid injuring delicate aquatic life.

You control your buoyancy using two pieces of equipment. These are lead weights and a buoyancy control device (BCD). You will want to purchase these items as soon as possible. You use lead weight in a weight system (such as a weight belt or in a weight integrated BCD) to adjust your *weight*. The BCD is a device that you inflate (increases your volume) or deflate (reduces your volume) thereby changing your buoyancy at any time during a dive. During the confined water dives, you'll learn how to start a dive with the right amount of lead weight, and how to adjust your buoyancy as you need to using your BCD.

Since buoyancy results from the weight of water volume displaced, the heavier the water, the greater the buoyancy for a given displacement. Salt water (due to its dissolved salts) weighs more than fresh water, so you're more buoyant in salt water than in fresh. Without any gear on, most people float in either fresh or salt water. When floating motionless at the surface, most people need to exhale to sink. When you exhale, you decrease the volume of your lungs and the amount of water you displace, which makes you less buoyant. You'll discover during the confined water dives that in addition to using lead and your BCD to control your buoyancy, you can fine-tune your buoyancy by breathing more deeply or more shallowly.

Pressure and Your Body

Although you don't usually notice it, air constantly exerts pressure on you. If you've walked against a strong wind, though, you've felt its force, demonstrating that air can exert pressure.

Quick Quiz

Self Assessment 1

1. An object is positively buoyant when:
   - ☐ a. it displaces a volume of water weighing less than its own weight.
   - ☐ b. it displaces a volume of water weighing more than its own weight.
   - ☐ c. it displaces a volume of water weighing equal to its own weight.

2. What two pieces of equipment do you use to control your buoyancy?
   - ☐ a. BCD
   - ☐ b. fins
   - ☐ c. lead weight

3. Buoyancy control is one of the most important skills you can master because it allows you to control where you are in the water.
   - ☐ True ☐ False

4. An object will be more buoyant in _____than it would be in _____.
   - ☐ a. fresh water, salt water
   - ☐ b. salt water, fresh water

5. When you exhale, your lung volume decreases. This means you have _____ buoyancy.
   - ☐ a. more
   - ☐ b. less

How'd you do?
1. b 2. a, c 3. True 4. b 5. b.

Feel the pressure.

You don't usually feel pressure because your body is primarily liquid, which is incompressible and distributes pressure equally throughout your entire body. The exception is your body air spaces, which feel pressure due to compression of the air inside them.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

6. **Why do you usually only feel changing pressure in your body air spaces?**

7. **Why are pressure changes while ascending or descending underwater much more substantial than pressure changes when ascending or descending the same distance in air?**

The air pressure that surrounds you now is simply the air's weight — the result of gravity holding the atmosphere against the earth. You don't usually feel pressure, though, because your body is primarily liquid, which is incompressible and distributes pressure equally throughout your entire body. The few air spaces your body does have — in your ears, sinuses and lungs — have air inside them equal in pressure to the external air pressure. Although air is compressible, you don't notice pressure in body air spaces as long as the pressure's the same inside and outside. But if the pressure changes, such as when you ascend to and from a higher altitude by flying or driving through mountains, the air in body air spaces changes volume, and you feel it in your ears, and sometimes in your sinuses.

Just as air exerts pressure on you, so does water when you submerge. But because water is much denser and heavier than air, pressure changes much more significantly for a given distance ascent or descent. As with air pressure, you don't feel water pressure except in your body air spaces, and one of the first things you'll notice is that you'll feel changes

Quick Quiz

Self Assessment 2

1. You usually feel pressure only in body air spaces because:

☐ a. your body is mostly made of incompressible liquid, but air is compressible and changes volume with pressure changes.

☐ b. water is denser than air, which resists pressure better.

2. Pressure changes in water for a given ascent or descent are much more substantial than the same distance ascent or descent in air because water weighs more.

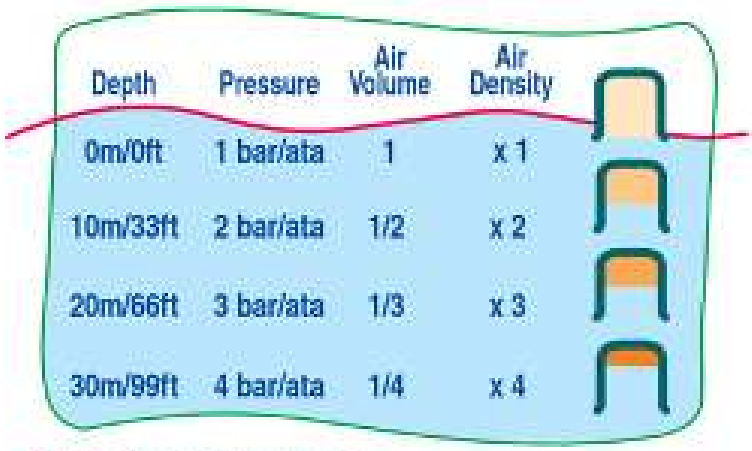
☐ True ☐ False

How'd you do?
1. a. 2. True.

quickly, even when you ascend or descend only a metre or few feet. These changes have some associated problems that you'll learn to avoid later in this section and during your confined water dives.

Pressure, Volume and Density Relationships

At sea level, the surrounding air pressure remains relatively constant. This pressure is a standard reference called one *atmosphere* (ata) because it is the weight/pressure of (but of course) the atmosphere. It's also called one *bar*; there's a slight technical difference between an ata and a bar, but it's so minor that for diving applications, we disregard it.



Same air, smaller space.
If you take an air volume underwater with you in a flexible container or an inverted jar, the volume changes proportionately with pressure.

Ten metres/33 feet of water (sea water, to be precise) exerts the same pressure as the atmosphere, or one ata/bar. Therefore, add one ata/bar pressure for every 10 metres/33 feet you descend. At 10 m/33 ft, you're under two ata/bar — one from air and one from water. At 20 m/66 ft, you're under three ata/bar, and so on.

If you take an air volume underwater with you in a flexible container or an inverted jar, the volume changes proportionately with pressure. If you descend to 10 m/33 ft, you double the pressure (two ata/bar) and halve the volume. At 20 m/66 ft — three ata/bar — you have one third the volume, and so on.

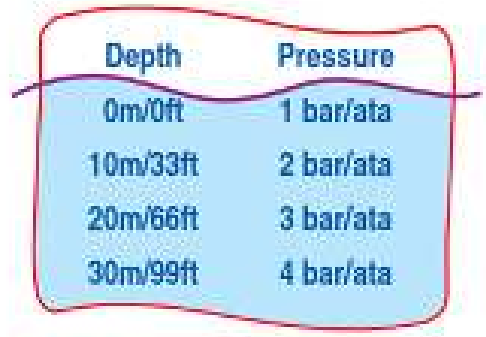
MAIN Objectives

Underline/highlight the answers to these questions as you read:

8. **What is the relationship between increasing and decreasing depth and water pressure?**

9. **What are the absolute pressures, in atmospheres or bar, for:**
   - **10 metres/33 feet?**
   - **20 metres/66 feet?**
   - **30 metres/99 feet?**
   - **40 metres/132 feet?**

10. **What is the relationship between air volume and density, and how do they vary according to this relationship when pressure increases or decreases?**

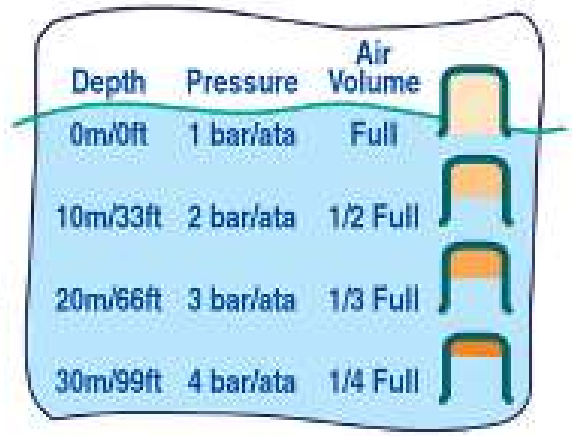


Air and water.
Ten metres/33 feet of sea water exerts the same pressure as one atmosphere, or one bar/ata. Therefore, you add one bar/ata pressure for every 10 metres/33 feet you descend.

Twice the pressure, half the volume.
An inverted open bottle of air taken from the surface to 10 metres/33 feet shows the effects of pressure. The pressure compresses the air volume to half what it was at the surface. Because the same number of air molecules take up half the space, the air density doubles.

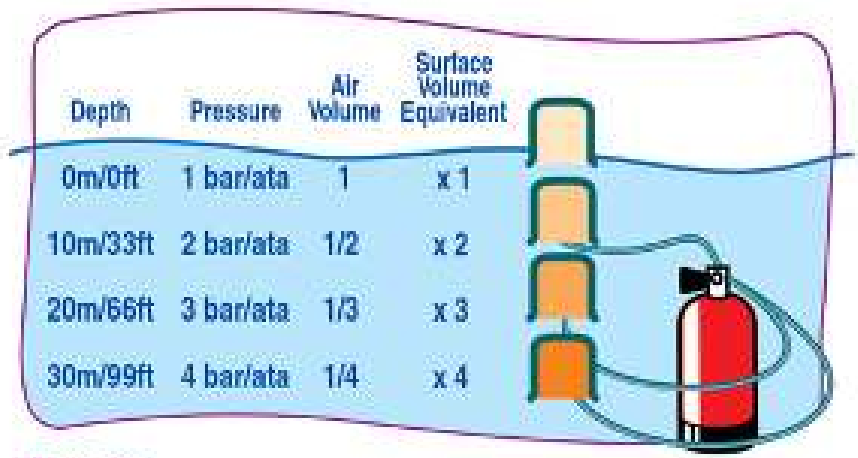
Density also changes proportionately when pressure changes. When you double the pressure and halve the air volume, the volume reduction comes from squeezing the same number of air molecules into half the space. So, the density doubles. When you triple the pressure (20 m/66 ft), you triple the density. Hope you're picking up a pattern here.

To maintain the air volume as you descend, you need to add air to the space to keep up with the volume reduction. This is the concept behind equalization (more about this in a moment); the air you need to add is proportional to the pressure increase.



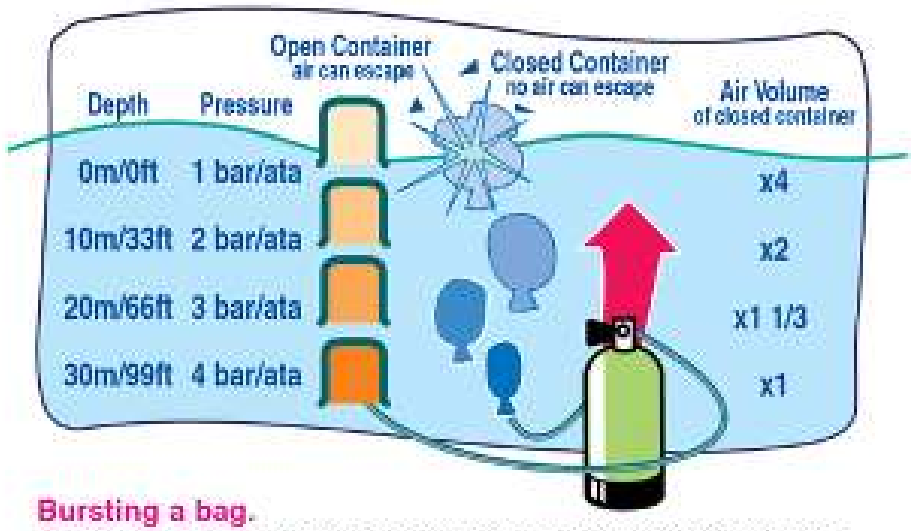
Think thicker.
Air density also changes proportionately when pressure changes.

As you've probably already figured out, air expands proportionately as you ascend and the pressure decreases. If you take an air volume to 30 m/99 ft — four ata/bar — it compresses to one fourth its surface volume. When you return to the surface, the air expands to its original volume.



More air.
To maintain the air volume as you descend, you need to add air to the space to keep up with the volume reduction.

If you added air to the space to maintain its volume, the air you added expands when you reduce the pressure as well. If the air is in an open container, the expanding air simply bubbles out into the surrounding water. In a closed, flexible container like a plastic bag or a balloon inflated at depth, the air volume grows proportionately with the decreasing pressure. If you inflated the bag at 30 m/99 ft, it will be four times as big at the surface — provided it can stretch that much! Otherwise, the bag will burst during ascent; this has important implications regarding your body air spaces that we'll look at shortly.



Bursting a bag.
Air added to an air space to maintain volume expands when you reduce the pressure. With an open container, the excess expanding air simply bubbles out into the surrounding water. In a closed, flexible container the air volume grows proportionately with the decreasing pressure. If you inflated a sealed bag at 30 m/99 ft, it will expand to four times the volume on the way to the surface, or burst during ascent if it cannot stretch that much.

The Effects of Increasing Pressure

Based on what you've just learned, we can look at how the relationships between pressure, volume and density affect your body air spaces while diving. The air spaces that concern you as a diver are the natural ones in your body, and those artificially created by wearing dive equipment. The two major air spaces within 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.

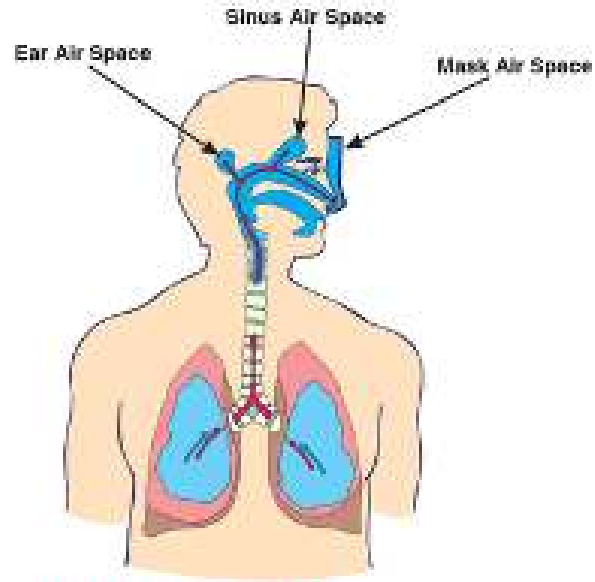
During descent, water pressure increases and compresses the air in your body air spaces. As the volume decreases, the pressure pushes body tissues in, toward the air space, which you feel in your ears, sinuses and mask. If you continue to descend, this becomes uncomfortable, and with continuing descent, possibly even painful. This is called a *squeeze* on the air space. You may have felt a squeeze in your ears when diving to the bottom of a swimming pool. A squeeze, then, is a pressure imbalance in which pressure outside an air space

exceeds pressure inside an air space, resulting in pain or discomfort. Besides the ears, sinuses and mask, it's possible to experience a squeeze in the lungs, teeth or any other air space. Fortunately, you can easily avoid squeezes.

To avoid discomfort, you keep the volume in an air space normal by adding air to it during descent, keeping the air space pressure equal to the water pressure outside. This is called *equalization*. Your ear and the sinus air spaces connect to the throat, allowing you to use air from your lungs to equalize them. You equalize the air space in your mask through your nose.

Although very rare, it's possible for an air space to develop in filled teeth where the tooth or filling has continued to erode. During descent, the increasing pressure pushing in on this small air space causes a tooth squeeze. In most cases, the discomfort will cause you to stop descending. You can't equalize an air space under a tooth filling, but your dentist can eliminate the space, and regular dental checkups help avoid the problem altogether.

Although an air space, your lungs are large and flexible and not very prone to a squeeze. As a scuba diver, you automatically equalize your lungs as you breathe continuously from your scuba equipment. When you skin dive, holding your breath, the pressure compressing your lungs has no effect, provided you started with a good breath. They drop in volume during descent



Mainly in your head.
The two major air spaces within 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.

Quick Quiz

Self Assessment 3

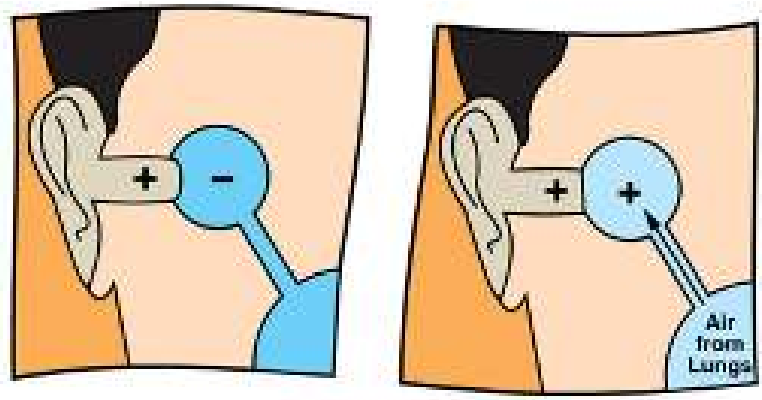
Complete the following chart for a sealed flexible bag full of air at the surface.

Depth	Pressure	Volume	Density
0m/0ft		x 1	x 1
10m/33ft	2 bar/ata		
30m/99ft		1/4	
40m/132ft	5 bar/ata		x 5

How did you do? (Answers appear in bold type)
0m/0ft Depth: **1 bar/ata**, x 1, x 1.
10m/33ft Depth: 2 bar/ata, **1/2**, **x 2**.
30m/99ft Depth: **4 bar/ata**, 1/4, **x 4**.
40m/132ft Depth: 5 bar/ata, **1/5**, x 5.

and re-expand during ascent to nearly their original volume when you reach the surface, having used an inconsequential amount to equalize other air spaces.

If you were to breath hold dive starting with *empty* lungs (you exhale, then dive) several metres/feet, or descend really deep (like 60 metres/200 feet) holding your breath, there's a theoretical possibility that you could squeeze your lungs – but these are rather unlikely situations for most divers.



Equalize to stop the squeeze.
Pressure pushes body tissues in toward the air space, which you feel in your ears, sinuses and mask. If you continue to descend, this causes a squeeze on the air space. To avoid discomfort, you keep the volume in an air space normal by adding air to it during descent. This is called equalization. Your ear and the sinus air spaces connect to the throat, allowing you to use air from your lungs to equalize them.

Another air space you might need to equalize is a dry suit, which holds a layer of air around your body for maximum warmth. If you're going to use a dry suit as part of this course, your instructor will show you how to equalize it. If you're not familiar with them, Section Two describes dry suits in more detail.

Equalization techniques.

The air spaces in your ears are the most sensitive to increasing pressure, but assuming you're in good health (no head cold or allergy congestion) you can easily equalize them. 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.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

11. What are the three major air spaces affected by pressure?

12. What is a "squeeze?"

13. What is "equalization?"

14. What are three ways you can equalize air spaces during descent?

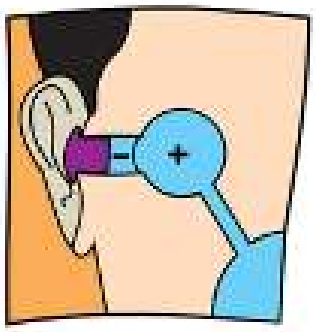
15. How often should you equalize during descent?

16. What three steps should you take if you feel discomfort in an air space while descending?

Prevention is the ticket.
Equalize every metre/few feet while descending, before you feel discomfort. If you feel discomfort in an air space, ascend until the discomfort eases, equalize and continue a slow descent equalizing more frequently.

Signal if you Can't Equalize!

If you have ear discomfort or other equalization problems, *be sure* to signal your buddy or instructor immediately. Your buddy or instructor have *no way* of knowing that you have a problem ***unless you signal.***



Unequalizable.
Conventional ear plugs or a too-tight wet suit hood can create an air space between your ear drum and the plug/ hood that you can't equalize.

Equalize every metre/few feet while descending, *before* you feel discomfort. If you wait until you feel discomfort, you may not be able to equalize because water pressure may be great enough to hold the air passages shut. Instead, if you feel discomfort in an air space, ascend until the discomfort eases, equalize and continue a slow descent equalizing more frequently. You'll find it easier to equalize with experience.

If you can't equalize, discontinue the dive. Continuing to descend with an unequalized air space may result in a ruptured ear drum or similar injuries. **Never attempt a forceful or extended equalization** — that can also cause serious ear injuries, including a ruptured ear drum, which can cause vertigo. Should this occur, abort the dive. If ascending a metre/few feet and trying again doesn't permit you to equalize, don't force it. Be patient and gentle, or end the dive and try another day.

Congestion (due to colds or allergies) can plug air passages, making equalization difficult or impossible. Medications, such as sprays and decongestants, may clear the openings, but you shouldn't do this and dive because the medication may have undesirable side effects (such as drowsiness) and may wear off while you're diving, creating equalization problems when you try to ascend.

You can also create an unequalizable space in your ear canal, either by wearing a too-tight wet suit hood that inadvertently seals against your ears, or by wearing conventional ear plugs. In either case, you end up with an air space between your ear drum and the plug/hood that you can't equalize. To prevent this, pull your hood away from your ears momentarily to allow the pressure to equalize, and *never* wear conventional ear plugs while diving. The only exceptions are special ear protectors and vented ear plugs made specifically for scuba diving that allow for pressure equalization.

You equalize the air space in your mask by simply exhaling into it through your nose. If you forget to

Quick Quiz

Self Assessment 4

1. The three major air spaces affected by pressure when you descend are:
☐ a. sinuses, lungs, stomach
☐ b. mask, ears and sinuses
☐ c. lungs, mask and ears

2. A squeeze is:
☐ a. a pressure imbalance in which pressure inside an air space exceeds pressure outside an air space, resulting in pain or discomfort.
☐ b. a pressure imbalance in which pressure outside an air space exceeds pressure inside an air space, resulting in pain or discomfort.

3. Equalization is adding air to an air space as you descend so the pressure in an air space equals the surrounding water pressure.
☐ True ☐ False

4. Which are techniques for equalizing your ears? (Check all that apply.)
☐ a. Pinch your nose and blow gently against it.
☐ b. Swallow and wiggle your jaw from side to side
☐ c. Make a loud noise.
☐ d. None of the above.

5. You want to equalize your ears:
☐ a. when you feel discomfort.
☐ b. every metre/few feet before you feel discomfort.
☐ c. only if they hurt enough to bother you.

6. If you feel discomfort and can't equalize, ascend until you relieve the discomfort and try again. Don't be forceful in equalizing. If you can't equalize, discontinue the dive.
☐ True ☐ False

How'd you do?
1 b. 2. b. 3. True. 4. a, b. 5. b. 6. True.

equalize your mask, you'll feel a mask squeeze, which is a pulling sensation on your face and eyes. You'll probably find that mask equalization becomes something you do automatically. Note that since your nose has to be inside the mask to equalize it, you can't use swimmer goggles for scuba diving – they don't enclose your nose and cannot be equalized. When you buy a mask, keep these considerations in mind.

The Effects of Decreasing Pressure

As you read in the discussion on squeezes, your lungs experience no harmful effects from changes in pressure when you're holding your breath while skin diving. You take a breath and descend and the increasing water pressure compresses the air in your lungs. During ascent, this air re-expands so when you reach the surface, your lungs return to approximately their original volume.

When you scuba dive, however, the situation differs dramatically. 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. This air will expand when you ascend.

If you breathe normally, keeping the airway to your lungs open, no problem. Expanding air escapes during ascent and your lungs maintain their normal volume. But, if you were to hold your breath, blocking your airway while ascending, your lungs would overexpand, much like the sealed bag or balloon filled at depth and taken to the surface.

Expanding air can cause lung over ex-pansion (lung rupture), 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.** Lung over pressurization

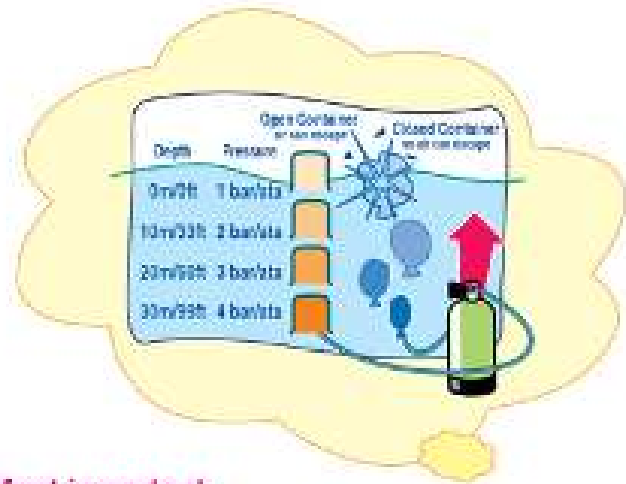
MAIN Objectives

Underline/highlight the answers to these questions as you read:

17. **What is the most important rule in scuba diving?**

18. **What are the consequences of breaking the most important rule in scuba diving?**
19. **What is a "reverse block?"**

20. **What should you do if you feel discomfort during ascent due to air expansion in the ears, sinuses, stomach, intestines or teeth?**



Most important rule of scuba diving!

The lungs can be injured by even slight pressure changes if you hold your breath — even as little as a metre/two or three feet. So, it's important to always breathe continuously when using scuba, even in shallow water.

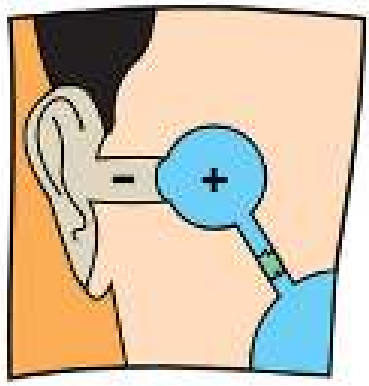
will occur unless you permit the pressure to equalize by breathing normally at all times. *Lung over expansion* can force air into the bloodstream and chest cavity, which can lead to severe injuries including paralysis and death.

Some people find they have a natural tendency to hold their breath when they first begin learning to use scuba, but this tendency must be changed. The lungs can be injured by even *slight* pressure changes if you hold your breath — even as little as a metre/two or three feet. So, it's important to *always* breathe continuously when using scuba, even in shallow water.

Although lung overexpansion injuries are very serious and among the most difficult diving injuries to treat, they are also among the easiest to avoid: Simply breathe at all times and do not hold your breath when using scuba. During your confined water dives you'll practice some skills during which you take the scuba regulator out of your mouth, but even then you don't hold your breath. Instead, you'll learn to exhale a slow, steady stream of bubbles any time the regulator isn't in your mouth.

Your other air spaces generally pose no problems during ascent. Normally, expanding air releases from these without any conscious effort. It is possible, though, to feel pain and discomfort in your ear and sinuses while ascending due to a *reverse block*, sometimes called a "reverse squeeze." A reverse block occurs when expanding air cannot escape from an air space during ascent. In this case, you feel discomfort because the pressure inside the air space exceeds the surrounding water pressure.

Read my lips.
During your confined water dives you'll practice skills during which you take the regulator out of your mouth. So you don't hold your breath, you exhale a slow, steady stream of bubbles.



Won't come out.
A reverse block occurs when expanding air cannot escape from an air space during ascent. In this case, you feel discomfort because the pressure inside the air space exceeds the surrounding water pressure.

Reverse blocks are uncommon and generally result from diving with congestion cleared by medication, and having the medication wear off while underwater. To avoid this, don't dive with a cold or allergy congestion, even if you use decongestants or other medication.

Gas forming in the stomach or intestines during diving can also expand during ascent and cause discomfort if it doesn't pass. This isn't very common, and you can usually prevent it by avoiding gas-producing foods prior to diving. Some people tend to swallow air when breathing through their mouths at depth; this can also expand during ascent and cause some discomfort. If you find this applies to you, paying attention to your breathing and swallowing will usually break the habit.

It is possible, though very rare like a tooth squeeze, for a reverse block to occur in an air space under an inadequate tooth filling or a tooth filling with secondary erosion. Air slowly seeps into the space during the dive, and can't escape quickly enough when you begin to ascend. You avoid this reverse block, like tooth squeeze, through regular dental checkups.

If you feel any reverse block discomfort — whether in your ears, sinuses, stomach, intestines or teeth — slow or stop your ascent, descend a metre/few feet and give the trapped air time to work its way out. If you experience severe or frequent reverse blocks, see a physician knowledgeable about dive medicine.

The Effects of Increased Air Density

Tell your friends that you're learning to scuba dive, and at least one will ask you how long you can stay underwater with a scuba cylinder. A polite answer is, "Oh, around an hour, give or take," but as you'll see, the technically

Quick Quiz

Self Assessment 5

1. The most important rule in scuba diving is: **Breathe continuously and never hold your breath.**
☐ True ☐ False

2. Ascending while holding your breath (check all that apply):
☐ a. can cause lung over expansion injuries.
☐ b. can cause serious injuries, including paralysis and death.
☐ c. causes injuries that are easy to avoid by not holding your breath.

3. A reverse block is:
☐ a. pain and discomfort caused by expanding air trapped inside an air space during ascent.
☐ b. pain and discomfort caused by outside pressure on an air space.

4. If you feel discomfort during ascent due to a reverse block, you should:
☐ a. slow or stop your ascent and give the trapped air time to work its way out.
☐ b. descend to compress the air and allow it to shift to some other area of the body.
☐ c. None of the above.

How'd you do?
1. True. 2. a, b, c. 3. a. 4. a.

Main Objectives

Underline/highlight the answers to these questions as you read:

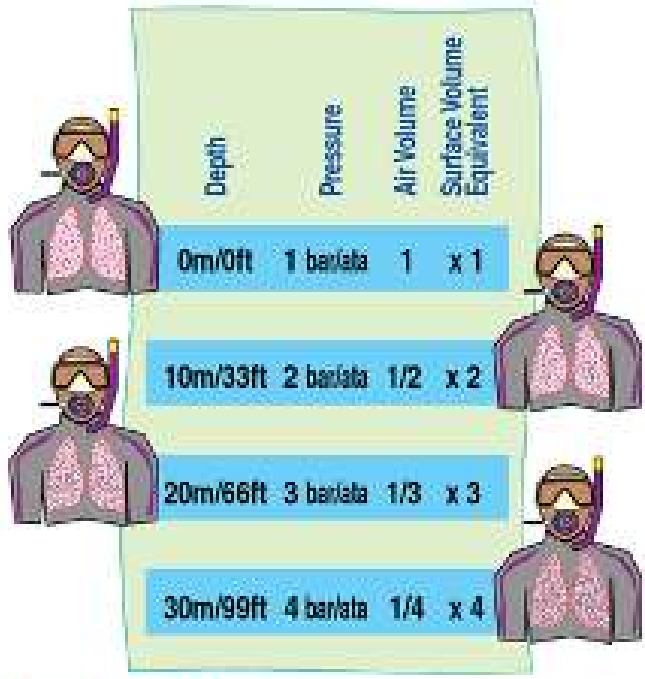
21. How does increasing depth affect how long your air supply lasts?

22. What's the most efficient way to breathe dense air underwater?

correct answer is, "It depends." That is, it depends on how deep you dive (as well as your breathing rate).

Scuba gear supplies air equal to the surrounding pressure. So apply what you learned earlier about pressure and an air volume, and you'll see that you consume your air faster as you go deeper. For example, the pressure at 20 metres/66 feet equals three bar/ata, so for each breath you need three times the number of air molecules to fill your lungs to the same volume. Therefore, all other factors equal, your air supply lasts only one third as long at 20 m/66 ft as it does at the surface.

Likewise as you've learned, the deeper you descend, the denser the air becomes. Dense air is harder to inhale and exhale than air at normal surface pressure and density, with the effort increasing exponentially the faster you try to breathe it. That is, it takes about four times the effort to breathe twice as fast. So, you want to take deep, slow breaths while breathing dense air while diving. For maximum air conservation, save energy and don't over exert yourself. Pace yourself so that you breathe normally through your entire dive. Relax. You should



Deeper = faster.
Scuba gear supplies air equal to the surrounding pressure. This means you use your air faster as you go deeper.

never be out of breath while diving — diving is exciting and adventurous, but its not supposed to get you winded underwater.

Dive Equipment

By this point you realize you need equipment to dive. You may be well on your way to owning a complete set. So, you're probably already familiar with basic types of dive equipment. But you may not be as familiar with some of the specific features or options that apply to each type, or what separates equipment aimed primarily at snorkeling from equipment intended for scuba diving. Also, you may not yet be aware of some equipment you'll use. This subsection looks at equipment basics for masks, snorkels, fins, BCDs, scuba cylinders, regulators and submersible pressure gauges, each of which you'll use during your confined water dives.

Summary Points

In this subsection on the Underwater World, you learned:

- Whether an object sinks, floats or does neither in water depends on its weight and its displacement.
- You'll use lead weight and a BCD, as well as lung volume, to control your buoyancy.
- The body is made up mostly of incompressible liquid, so you only feel pressure on the air spaces, which hold compressible air.
- There's a proportional relationship between pressure, air volume and density.
- You can use one of three techniques every metre/few feet to equalize your ears to prevent a squeeze while descending.
- You exhale into your mask through your nose to prevent a squeeze.
- Never continue to descend if you can't equalize.
- The most important rule in scuba diving is to never hold your breath.
- Don't dive with a cold or allergy congestion, even with decongestant.
- The deeper you go, the faster you use up your air supply.
- When scuba diving, breathe slowly and deeply, and avoid getting out of breath.

While you'll learn the basics here, keep in mind that dive gear comes in myriad styles and colors that makes it comfortable and stylish as well as functional. What types work best for you will depend on your preferences, the type of dive activities that interest you, where you'll be diving and other variables. Your PADI Dive Center, Resort or Instructor can show you the different types and models that best suit your needs.

Masks

Purpose. It's not earth-shattering news that you need a mask to see underwater. *Why* you need it is that light behaves differently in water than in air, and your eyes focus according to how light behaves in air. That's why water makes everything blurry. The mask creates an air space so your eyes can focus.

As you learned, the mask creates an air space you must equalize during descent to prevent mask squeeze. That's why the mask must enclose your nose. Goggles, which cover only the eyes without enclosing your nose can't be equalized. They're fine for surface swimming, but they're not acceptable for diving.

When buying a mask, don't skimp. Get a good one specifically designed for scuba diving that fits you properly. If you think about it, in warm

Quick Quiz

Self Assessment 6

1. As you go deeper, you consume air from your scuba cylinder:
   - ☐ a. slower.
   - ☐ b. faster.
   - ☐ c. the same.

2. The most efficient method for breathing underwater is rapid and shallow.
   - ☐ True ☐ False

How'd you do?
1. b, 2. False.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

23. Why does a diver need a mask?

24. Why does the mask need to enclose your nose?

25. What six features should you look for in a mask?

26. When buying a mask, what are the two most important factors?

27. How do you prepare a new mask for use?

28. What three general maintenance procedures apply to mask care?

Dive Equipment
See the PADI *Encyclopedia of Recreational Diving* and the PADI *Multimedia Encyclopedia* CD-ROM

water you can have a lot of fun with *only* a mask, but if you had every piece of dive gear *but* a mask, there'd be no reason to get in the water. So your mask is important.

Styles. Mask styles range from simple round or oval-shaped models to more modern styles with lower internal volumes and wider fields of vision. Wraparound masks feature two panels along the sides to improve peripheral vision. The vast majority of masks you'll choose from are lower-profile masks, which have a notched face plate and a nose pocket to allow your nose to protrude past the lens. This gets the lens closer to your face, for a wider vision field, plus makes it easy to pinch your nose for equalizing. Many wrap-around type masks incorporate low-profile design.

Owning your equipment. The complete diver.

Dive gear comes in myriad styles and colors that makes it comfortable and stylish as well as functional. What types work best for you will depend on your preferences, the type of dive activities that interest you, where you'll be diving and other variables.

Window on the underwater world.

The vast majority of masks you'll choose from are lower-profile masks, which have a notched face plate and a nose pocket to allow your nose to protrude past the lens.

Features. Masks intended for scuba diving have these features:

1. Tempered-glass lens plate. If broken, tempered glass is less likely to shatter into fine, hazardous slivers.

2. Comfortable skirt with a close fit against your face and a good seal.

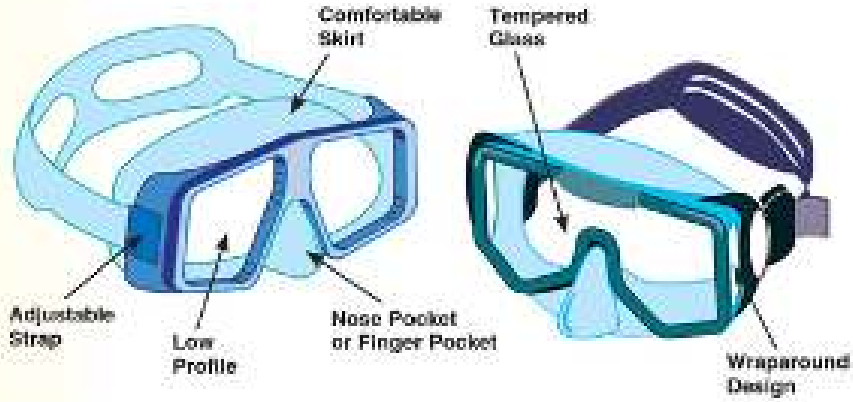
3. Nose or finger pockets. To make equalizing your ears easier, a mask should have some way of letting you conveniently pinch or block your nose.

4. Low-profile. The lower the profile of the mask, the less air you need to equalize it and to clear if it floods, but the main benefit is that it gives you a wider vision field.

5. Adjustable strap that can be locked in place.

6. Wide field of vision. This is accomplished through low profile and/or wraparound design.

An optional feature you might find in a few masks is a *purge valve*. A purge valve is a one-way valve used for clearing water from a mask. It's easy to clear water from a mask without a purge valve, so consider it optional, but it's a nice extra feature if the mask suits you in every other way.



Six features found in masks for scuba diving.

Materials. Masks for scuba diving are most often made from silicone rubber. Silicone rubber is usually translucent, though manufacturers sometimes add coloring agents to make it black, or a translucent color, which is primarily to make the mask look better. Why not be stylish and functional?

At one time you could find masks made from black or colored neoprene rubber, but these have all but vanished, even in inexpensive models. This is because silicone lasts three to four times longer than neoprene, is generally softer and more comfortable, usually looks better, and doesn't usually irritate sensitive skin. You may see neoprene masks in use, but they tend to be the exception rather than the rule.

Selection and Purchase. When buying *any* equipment for scuba, your two most important selection factors are *fit* and *comfort*. This is particularly true for your mask, because a mask that doesn't fit well will leak and/or irritate you and take the fun out of the dive. (Note: You needn't suffer for style. Dive equipment comes in enough

variety that you can accommodate fit and comfort first, yet still look good. (You can buy almost everything in basic black, too.)

To test a mask for a proper fit, use the "sniff" test. Place it gently against your face without using the strap and inhale through your nose. A properly fitting mask will pull into place by suction and stay as you inhale. If you have to push or twist the mask to make it seal, try a different one. After finding some that fit, try pinching your nose with each on to see which is easiest.

Stuck on you.
To test a mask for a proper fit, use the "sniff" test. Place it gently against your face without using the strap and inhale through your nose. A properly fitting mask will pull into place by suction and stay as you inhale.

If you need visual correction, some masks accept prescription lenses. You'll want to think about this when buying a mask, because not all masks do this readily. Your PADI Dive Center, Resort and Instructor can help you pick out a mask that's right for you.

Preparation for Use. Manufacturers coat new masks with a protective chemical that you need to scrub off or you won't be able to defog the mask. To remove the film, use a soft cloth to gently scour the glass inside and out with a non-gel toothpaste or other low abrasion cleaner with fine grit that can remove the film without scratching the glass. Be sure to do this before your confined water dive.

Next, adjust the mask strap for a comfortable fit across the crown of your head. The strap should be snug, but not tight, and make sure to close the locking device (they differ a bit from one mask to another) so it doesn't slip.

See clearly.
To remove the chemical film from manufacturing, use a soft cloth to gently scour the glass inside and out with a non gel toothpaste or other low abrasion cleaner with fine grit that can remove the film without scratching the glass.

Maintenance. Three general maintenance procedures apply to caring for all dive equipment, including masks: 1) rinse thoroughly with fresh water after each use (even in a swimming pool), 2) keep out of direct sunlight and 3) store in a cool, dry place.

Quick Quiz

Self Assessment 7

1. You need a mask to see underwater because:
- ☐ a. the human eye can't focus in water.
- ☐ b. the mask specially filters the light underwater.
- ☐ c. the mask is an important part of looking really sharp.

2. A mask needs to enclose your nose:
- ☐ a. for a better field of view
- ☐ b. so you can equalize the mask.
- ☐ c. so you can pinch your nose and equalize your ears.

3. The features you look for in a mask include (check all that apply):
- ☐ a. low profile
- ☐ b. purge valve
- ☐ c. nose or finger pockets
- ☐ d. wide vision field

4. The most important factors when buying a mask (and other dive gear) are:
- ☐ a. style and color.
- ☐ b. fit and comfort.

5. To prepare a new mask for use (check all that apply):
- ☐ a. scrub off the protective film left from manufacturing
- ☐ b. adjust the strap

6. Maintenance for your mask (and most dive gear) includes (check all that apply):
- ☐ a. rinsing in fresh water after use.
- ☐ b. storing in a cool, dry place.
- ☐ c. drying thoroughly in the sun.

How'd you do?
1. a. 2. b. 3. a, c, d. 4. b. 5 a, b. 6 a, b.

The freshwater rinse removes salt, chlorine and/or minerals that contribute to corrosion and deterioration. Rinse thoroughly as soon as possible after diving; if you can't rinse your gear right away, it's generally better to keep it wet than to let salt water dry on it because it's much harder to remove salt after it dries.

Sunlight damages silicone (and especially neoprene), so avoid leaving your equipment in direct sunlight. If it has to stay out in direct sunlight at a dive site or on a boat, you can throw a beach towel over it. Dry your equipment thoroughly before storing it in a cool, dry place away from hydrocarbons and ozone.

Keep masks and other dive equipment made from silicone out of contact with neoprene. The neoprene leaches into the silicone and discolors it, which doesn't harm it functionally, but makes it look less attractive.

Snorkels

Purpose. Since scuba divers have a cylinder and regulator, you may wonder why a snorkel is a standard piece of scuba gear. Actually, you want a snorkel for a few reasons when you scuba dive. First, it lets you rest or swim with your face in the water, like when you're looking for something below, without wasting cylinder air. Second, when there's a bit of surface chop, splashing waves can get in your mouth if you don't have a snorkel, but the snorkel is usually high enough to get above these. Third, if you run low on air away from the boat or shore, it makes it easier to swim back, again resting with your face in the water.

When you're skin diving or snorkeling, the snorkel permits you to view the underwater world continuously, without the interruption of having to lift your head for a breath. You can stay in the water all day resting with your face in the water, but you tire quickly if you keep having to raise your head to breathe. Try it and see.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

29. Why does a diver need a snorkel?

30. What three features does an easy-breathing snorkel have?

31. When purchasing a snorkel, how do you check it for fit and comfort?

32. How do you prepare a new snorkel for use?

Breathe easy.
Your snorkel is standard equipment for scuba diving because it allows you to rest at the surface with your face in the water, and allows you to save cylinder air when swimming on the surface.

Styles. Snorkels suitable for scuba diving are simple devices – at the most basic level, they're little more than a mouthpiece and tube that fits comfortably in your mouth and extends above the surface. They are available with a variety of features.

Features. Look for an easy breathing snorkel. The snorkel's tube diameter (bore), length and shape affect breathing resistance, so generally look for:

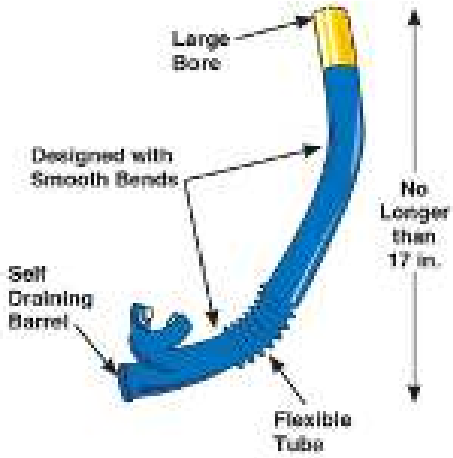
1. A large bore — so it's not like trying to breathe through a soda straw.

2. Not excessively long — If a snorkel's too long, it's hard to clear and you rebreathe a lot of your air. About 43 cm/17 in, give or take, is a suitable length.

3. Designed with smooth, rounded bends — sharp bends add breathing resistance.

Today's popular snorkels have other features: they fit closely to the contours of your head to minimize drag, and most have an optional self-draining feature. This feature makes it easier to clear water from your snorkel at the surface. Some snorkels have a flexible lower portion that allows the mouthpiece to comfortably drop away from the mouth area when you're not using it. A few snorkels have splash guards on the top to help keep the snorkel dry. All of these features are fine if you want them, as long as they don't interfere with easy breathing.

Materials. Most snorkels sold today are made from a combination of silicone and plastic. The upper portion of the snorkel (the barrel) is usually constructed of semirigid plastic tubing. The lower portion and mouthpiece are usually made from silicone rubber. You can find snorkels in a variety of colors to match your mask.



Features in snorkels used for scuba diving.

High tech tubes.
Most snorkels sold today are made from a combination of silicone and plastic. The barrel is usually constructed of semirigid plastic tubing. The lower portion and mouthpiece are usually made from silicone rubber.

Selection and Purchase. Choose your snorkel based on comfort, fit and minimal breathing resistance. To check for these, place the snorkel in your mouth with the mouthpiece flange between your lips and teeth, and the barrel of the snorkel against your left ear. You should be able to adjust the mouthpiece to fit comfortably, without chaffing or causing jaw fatigue, while sitting straight in your mouth. Your instructor, dive center or resort can help you buy an appropriate snorkel.

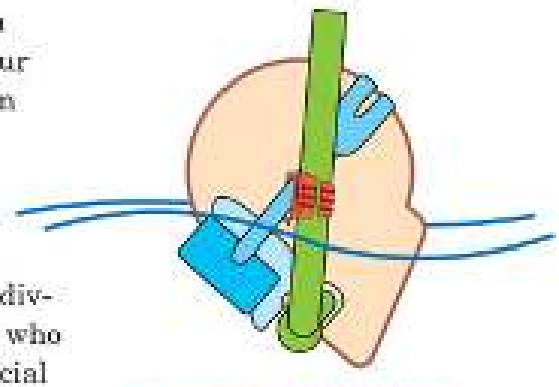
Preparation for Use. Attach the snorkel to the *left* side of your mask (because your regulator comes from the right). You do this with a clip or slot on the snorkel, or with a snorkel keeper that comes with it. Adjust the snorkel and snorkel keeper so the top of the snorkel sits at the crown of your head with the mouthpiece in place. You should be able to relax your jaw without losing the mouthpiece.

Maintenance. As with the mask, rinse your snorkel after each use and store it in a cool, dry place and kept out of direct sunlight. Store it away from neoprene rubber to prevent staining of silicone parts.

Fins

Purpose. Fins provide a large surface area so your powerful leg muscles can move you through the water. This is much more effective than swimming with your arms, though there are divers with limited leg use who use their arms with special hand fins.

All fins, regardless of style or features have pockets for your feet and blades for propulsion.



Everything in its place.
Adjust the snorkel and snorkel keeper so the top of the snorkel sits at the crown of your head with the mouthpiece in place. You should be able to relax your jaw without losing the mouthpiece.

Quick Quiz

Self Assessment 8

1. You need a snorkel when scuba diving (check all that apply):
- ☐ a. to conserve air while swimming or resting at the surface.
- ☐ b. to make it easier to breathe when the surface is a bit rough.
- ☐ c. in case you have a long swim with an empty cylinder.

2. An easy breathing snorkel has which features? (Check all that apply):
- ☐ a. large bore
- ☐ b. really long tube
- ☐ c. smooth, rounded bends

3. A properly adjusted snorkel (check all that apply):
- ☐ a. has the opening near your forehead.
- ☐ b. remains in your mouth with a relaxed jaw.
- ☐ c. sits on the left side of your mask.

How'd you do?
1. a, b, c. 2. a, c. 3. b, c.

Styles. Modern fins come in two basic styles: adjustable strap and full-foot. Adjustable fins have open heel foot pockets and adjustable heel straps, whereas full-foot fins enclose the heel and fit like rubber slippers.

Most scuba divers wear adjustable fins because you can wear wet suit boots with them. Also, most high-power fins appropriate for scuba diving are adjustable strap types, though there are exceptions. Warm water snorkelers and scuba divers often prefer full-foot fins because they don't need wet suit boots.

Features. Fins have several features to choose from, especially blade design features. Blade features include ribs, which add rigidity to the blade and act as vertical stabilizers; vents, which reduce resistance to fin movement and increase efficiency; and channels, which increase efficiency by guiding water smoothly over the fin. Split fins are designed to thrust water straight back for maximum efficiency. (You can have long, passionate debates with fellow divers over which of these offers the best performance, but while this gives you something to do when you can't go diving, the reality is that all the top fins offer comparable performance *when you wear the best fin for you.)*

Materials. Most modern fins use a composite construction, with foot pockets and heel straps made from neoprene rubber (or a similar material), and the blade

Main Objectives

Underline/highlight the answers to these questions as you read:

33. Why does a diver need fins?

34. What are the two basic fin styles?

35. What blade design features may enhance a fin's performance?

36. How do you prepare new fins for use?

37. What three considerations do you have when buying a specific type of fin?

Foot power.
Modern fins come in two basic styles: adjustable strap and full foot. Adjustable fins have open heel foot pockets and adjustable heel straps, whereas full foot fins enclose the heel and fit like rubber slippers.

Rubber and plastic.
Modern composite open heel fin.

Split decisions.
Some of the newest fins have a split down the center to reduce resistance by shaping the blade much like a fish or whale's tail.

made from an appropriate plastic. However, non composite, all-neoprene fins remain popular even as neoprene fades from use in other dive equipment. Neoprene fins last a long time and have performance characteristics many divers prefer. Divers who prefer composite fins like the fact they're lighter in weight, may have greater propulsion efficiency and you can buy them in a variety of colors to match your mask and snorkel. Composite fins may affect your buoyancy compared to all neoprene fins because they're lighter.

Selection and Purchase. You buy your fins based on your size, your physical ability and where you plan to dive. If you're looking at adjustable heel fins, you'll want to have your wet suit boots for a proper fit. With the boots on, put your foot in the pocket. The pocket should come to the point where your ankle meets your foot — if it won't come up that high, you need a larger size. Full foot fins should fit comfortably without binding, yet not feel loose. It helps to wet your bare feet when trying on full foot fins. For a given fin size, the larger and stiffer the blade, the more strength you need to use it.

In looking at fins that accommodate your size, physical ability and where you intend to use them, your primary concerns are (you guessed it) fit and comfort. If you're not sure what model to select, have your PADI Instructor, Dive Center or Resort help you.

Preparation for Use. Full foot fins generally require no preparation, but you need to adjust adjustable-strap fins for a snug, comfortable fit. Do this with your wet-suit boots on, of course. You may find new fin straps coated with a slick preservative. Wipe this off, otherwise your straps will tend to slip out of adjustment.

Maintenance. As with your mask and snorkel, rinse your fins in fresh water after use, store them in a cool, dry place and keep them out of direct sunlight. Inspect fin straps regularly — they tend to wear out faster than straps on other dive gear.

Quick Quiz

Self Assessment 9

1. Fins help you move more effectively by letting you use your leg muscles to swim.
☐ True ☐ False

2. What type of fin do you normally wear with wet suit boots?
☐ a. full foot fins
☐ b. wet suit fins
☐ c. adjustable strap fins

3. Which of the following are blade design features that enhance fin performance? (Check all that apply):
☐ a. vents
☐ b. vanes
☐ c. channels
☐ d. ribs

4. To prepare new fins for use (check all that apply):
☐ a. adjust the strap (for adjustable strap)
☐ b. you don't have to do anything special (for full foot)
☐ c. None of the above.

5. Considerations affecting the fin you buy include (check all that apply):
☐ a. your size
☐ b. your strength
☐ c. where you plan to dive

How'd you do?
1. True 2. c. 3. a, c, d. 4. a, b.
5. a, b, c.

Performance and posh.
Today's diver can choose equipment that's sophisticated and functional, and color-coordinated and stylish, too, with colors ranging from vivid reds to muted blues, grays and black.

Fin foot fit.
The fin pocket should come to the point where your ankle meets your foot — if it won't come up that high, you need a larger size.

Full foot fin fit.
Full foot fins should also come up to the point where your ankle meets your foot. They should fit comfortably without binding, yet not feel loose.

Scuba Systems

Although scuba diving has been around for more than 50 years, it was in the last two decades that the equipment evolved into the effective, reliable and streamlined package you use today. You're going to find scuba equipment easy to use, reliable, comfortable and a joy to own.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

38. Why does a diver need a BCD?

39. Why do divers need a backpack?

40. Of the three styles of BCD, which is the most commonly used by recreational divers?

41. What five features do BCDs have in common?

42. How do you prepare a BCD for use?

43. What two special maintenance procedures apply to caring for a BCD?

The modern scuba unit consists of three basic components: the BCD, the scuba cylinder (with valve) and the regulator. Let's look at each, beginning with the BCD.

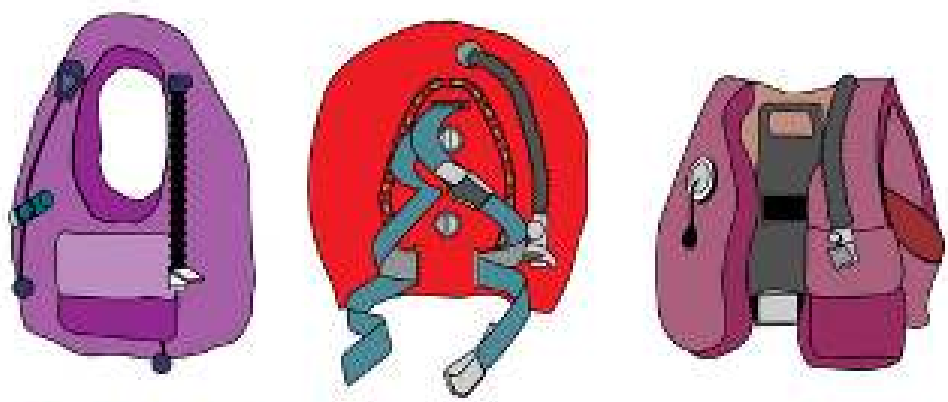
BCDs

Purpose. As you read earlier, the aptly-named buoyancy control device, or BCD, is an expandable bladder that you inflate or deflate to regulate your buoyancy. You can do this orally, using air from your lungs, though most of the time you'll use a *low pressure inflator*, which inflates the BCD with air directly from your cylinder. To decrease buoyancy, you deflate the BCD through a hose or valve.

Besides allowing you to regulate your buoyancy underwater, the BCD provides positive buoyancy for resting, swimming or lending assistance to others. As you might imagine, it's considered standard equipment mandatory for scuba diving.

Styles. There are three basic BCD styles: front-mounted, back-mounted and jacket-style. Of these, recreational divers by far most commonly use the jacket style. It wears like a sleeveless coat, holding your cylinder in place as well as providing buoyancy control.

It's unusual to see a front-mounted BCD any more, although this is the original BCD design. It looks



Past and present.
There are three basic BCD styles: front-mounted, back-mounted and jacket-style. Of these, recreational divers by far most commonly use the jacket style.

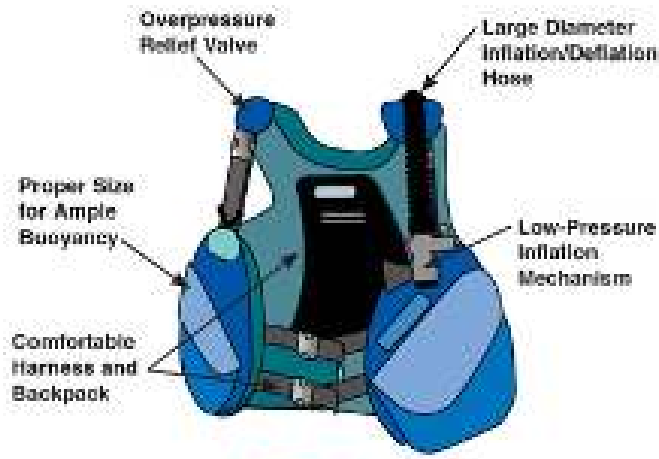
On your back.
You need a backpack to hold the cylinder on your back, but today the jacket BCD integrates the backpack into its design.

somewhat like a life vest, worn over the head, and requires a separate backpack for the cylinder.

Back-mounted BCDs are also relatively uncommon, though they're still used in double cylinder diving. Some modern BCDs fall somewhere between a back-mount and a jacket BCD, with jacket styling and features but most of the BCD bladder behind you like a back-mount. Without arguing semantics, for our purposes we'll treat them as modern jacket style BCDs suited to recreational diving.

A related piece of equipment is the *backpack*, which in the days of front-mounted BCDs you had to have as a separate piece of gear. You need a backpack (again, obviously) to hold the cylinder on your back, but today the jacket BCD integrates the backpack into its design. As with front-mount BCDs, it's very unusual to see separate backpacks today.

Features — Regardless of the style, a BCD has five features necessary for scuba diving: First, it must hold enough air to give you and your equipment ample buoyancy at the surface. Second, it must have a large-diameter inflation/deflation hose, so you can release air quickly and easily. Third, it should have a low-pressure inflation system that fills your BCD with air directly from your cylinder. Fourth, it must have an over pressure relief valve to prevent the BCD from rupturing due to overfilling or due to air expansion during ascent. And finally, it should be adjustable enough (within your size) to fit comfortably and not ride up on your body when you inflate it.



BCD features.

Selection and Purchase. Virtually every BCD on the market has these features, so besides fit and comfort, you'll buy your BCD based on other features. Try to choose a BCD that's as streamlined as possible. Other desirable features include a utility pocket, a whistle for surface communication, hose retainers and utility rings for attaching accessory equipment. Many divers like BCDs that include a weight system, which eliminates a separate weight belt (more about weight systems in Section 2). Your dive center, resort or instructor can help you find an appropriate one.

Materials. Modern BCDs come in either double-bladder (or "bag") or single-bladder designs. The single-bladder design is usually made from a coated fabric that serves to both hold air and resist cuts, punctures and abrasions. Double-bladder BCDs consist of an inner bladder (usually made of urethane plastic), which holds the air, and an outer nylon shell that protects the inner bladder from cuts, punctures and abrasions. Single bladder types have become the most common.

Preparation for Use. BCDs require adjustment for a proper fit. If it's too loose, it rotates awkwardly around you, and if it's too tight, it can restrict breathing, especially when you inflate it. Fortunately, most modern BCDs adjust easily — you can usually tighten or loosen them (to a degree) without taking them off.

With the BCD deflated, estimate the adjustment of the straps, lengthening or shortening them as needed. Next, put it on (have someone help you if

Quick Quiz

Self Assessment 10

1. You need a BCD to (check all that apply):
   - ☐ a. control your buoyancy underwater.
   - ☐ b. provide positive buoyancy at the surface.
   - ☐ c. keep your chest warm.

2. Of the three styles of BCD, the one recreational divers use most commonly is:
   - ☐ a. jacket style
   - ☐ b. back mount
   - ☐ c. front mount

3. Which is not one of the five features a BCD needs to have?
   - ☐ a. large diameter inflation/deflation hose
   - ☐ b. low pressure inflator
   - ☐ c. knife pocket

4. What additional maintenance requirements do you have with a BCD? (Check all that apply).
   - ☐ a. store deflated
   - ☐ b. rinse the interior with fresh water
   - ☐ c. store partially inflated
   - ☐ d. do not let water get inside the bladder

How'd you do?
1. a, b. 2. a. 3. c. 4. b, c.

necessary) and fine-tune the adjustments until it fits snugly, yet comfortably. Finally, inflate the BCD. Even fully inflated, it shouldn't feel restrictive. Your instructor will help you adjust your BCD during your confined water dives.

Maintenance. In addition to rinsing, drying and storing it out of sunlight, your BCD has two additional maintenance considerations. First, you need to rinse the inside as well as the outside with fresh water. To do this, fill it about one third with water through the inflator hose, then the rest of the way with air. Swish the water around the inside, then turn it upside down and drain it completely through the hose. You may have to reinflate with air a few times to get all the water out. The second consideration is that you want to store your BCD partially inflated. This keeps the bladder from sticking together internally.

Some BCDs may have additional maintenance requirements. Follow the recommendations in the manufacturer's instructions.

Scuba Cylinders and Valves

Cylinders and valves work together, so we'll look at them together.

Purpose. Even a nondiver knows that a scuba cylinder is a cylindrical metal container used to safely store high-pressure air so you have something to breathe underwater. Almost as obvious is the purpose of the cylinder valve, which is to control air flow from the cylinder. Sounds simple, but what you may not realize is that there are *different types* of cylinders and valves to handle these two simple jobs.

Cylinder Styles and Features — Cylinders come in a variety of air capacities, depending upon their pressure rating and size. In the metric system, you express cylinder capacity in litres or kilograms of water capacity. The most common sizes are 8, 10, 12 and 15 litres. In the imperial system, you express capacity in the number of cubic feet of air you would

MAIN Objectives

Underline/highlight the answers to these questions as you read:

44. Why does a diver need a scuba cylinder?

45. What does a cylinder valve do?

46. With what piece of equipment is the backpack usually integrated?

47. What are the four common sizes and the two materials for scuba cylinders?

48. What five markings do you commonly find on the neck of a scuba cylinder?

49. What are the two basic types of cylinder valves?

50. What does a J-valve do, and why is its use declining?

51. What's the difference between a DIN valve and a yoke valve?

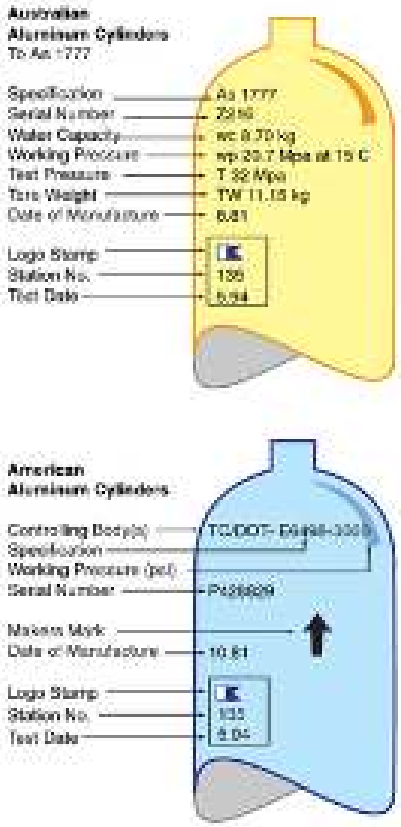
52. What is the purpose of a burst disc?

53. What three safety precautions for handling scuba cylinders should you follow going to and at a dive site?

54. How do you turn a cylinder valve on and off?

55. What's the best way to keep water out of a scuba cylinder?

56. Why do you need scuba cylinder visual inspections and pressure tests?



Deciphered. *Cylinder markings indicate the cylinder material, working pressure, a serial number, dates of all pressure tests, and the manufacturer or distributor. These markings may vary internationally.*

have if you released it all at the surface. The three most common cylinder sizes are 50, 71.2 and 80 cubic feet, although other sizes are available.

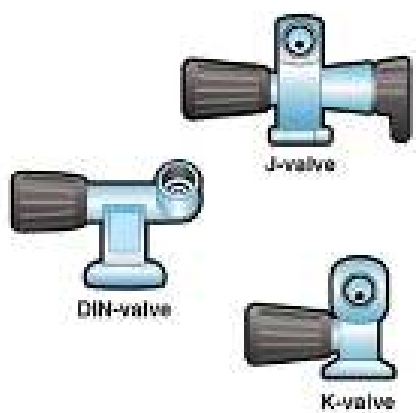
The standard 12 litre/ 71.2- or 80-cubic-foot cylinder contains about the same air you have in a walk-in closet, compressed into a space about 600 mm/two feet long and 150 mm/half a foot in diameter. As this air is compressed into the cylinder, its pressure increases. The pressure in scuba cylinders may be higher than 320 bar/4500 pounds per square inch (psi), but typical pressure ratings range from about 170 to 200 bar, or 2250 and 3000 psi.

Cylinder Materials. Scuba cylinders are either made of aluminum or steel. Both types are subject to regulations usually established by government agencies such as the U.S. Department of Transportation (DOT), Transport Canada (TC) and similar agencies in other countries. Among these regulations, scuba cylinders must pass periodic pressure tests (discussed below) mandated by these agencies.

Both steel and aluminum are equally acceptable materials for scuba cylinders, with different advantages and disadvantages. Aluminum cylinders hold up against corrosion better, whereas steel ones can hold a similar quantity of air in a smaller cylinder, at higher pressure.

The regulating agencies require cylinder manufacturers to stamp specific information onto the cylinder neck. These markings indicate the type of material the cylinder is made of and the maximum pressure permitted in the cylinder (working pressure). Additional markings include a serial number identifying the cylinder, dates of all pressure tests, and a manufacturer or distributor symbol. These marking may vary internationally.

Valve Types. Virtually all scuba cylinder valves are made from chrome-plated brass. Historically, divers identified cylinder valves as two basic types: the K-valve, which is a simple on/off valve, and the J-valve, which has a built-in mechanism that signals when you run low on air.



Without and with reserve. *K-valve and J-valve cylinders. J-valves are not used commonly anymore in most areas.*

The J-valve contains a spring-operated shutoff valve that is held open by cylinder pressure until the pressure drops to approximately 20-40 bar/300-500 psi. When the cylinder pressure drops below that point, the pressure no longer holds the shutoff open, causing breathing resistance to increase and warning that air is low. Pulling down the reserve lever releases the remaining "reserve" air. Although J-valves were almost standard equipment in the 1960s before common use of submersible pressure gauges, today you see them much less frequently, and usually left in the nonreserve position. An exception is in areas where regulations require them. They're prone to accidental tripping (so they don't warn you), and they increase the cost and service requirements of the valve. The only reliable way to monitor your cylinder pressure is to use a submersible pressure gauge (SPG), which you'll practice using during your confined water dives.

Today, you can identify cylinder valves as yoke valves or DIN (Deutschees Institut fuer Normung) valves. By far the most common are yoke valves; as the name implies you attach the regulator via a yoke assembly. With the DIN valve system, you screw the regulator into the valve. Although less common worldwide, the DIN valve system has the advantage of being rated to higher working pressures. The DIN system is very common in central Europe.

Valve Features: One thing to notice is that all cylinder valve connections with the regulator require an O-ring, which makes an air tight seal. You find the O-ring mounted in the valve with the yoke system, and mounted in the regulator with the DIN system. Either way, you can't dive without this O-ring — the regulator won't seal — so learn to check for it when setting up your gear.

Without and with threads.
By far the most common valve is the yoke valve (right); you attach the regulator via a yoke assembly. With the DIN valve system (left), you screw the regulator into the valve. Note the threaded opening.

No O-ring, no diving.
You find the O-ring mounted in the valve with the yoke system, and mounted in the regulator with the DIN system. Either way, you can't dive without this O-ring — the regulator won't seal — so learn to check for it when setting up your gear.

Another feature you find in the valve is the burst disk. Burst disks relieve cylinder over pressurization which can happen by accidentally overfilling the cylinder, or exposing it to excess heat. If the pressure gets too high, the burst disk ruptures, releasing the air well before the cylinder would explode. In some countries, cylinder valves do not have burst disks.

Selection and Purchase. Selecting a cylinder and valve depends, among other factors, on your size, the type of diving you will be doing,

and where you'll use the cylinder. Consult your PADI Dive Center, Resort or Instructor for help when purchasing a cylinder for your area.

Preparation for Use. Aside from assembling it with the rest of your scuba gear, the only preparation required for a cylinder is having it filled at a reputable fill station, such as a dive center. You'll read about setting up your gear in the Confined Water Preview. Your cylinder will come with the valve installed, so you don't have any preparation requirements there.

Stay put!
When carrying your cylinders in your automobile, lay them down horizontally and block or tie them so they can't slide or roll.

Handling. Out of water, scuba cylinders are heavy, unstable when left standing and tend to roll when lying down. The cylindrical shape has a purpose – it's structurally very strong and one of the best shapes for containing pressure.

To avoid damaging your cylinders, or having your cylinders damage something else or even hurt someone, always block or secure them so they can't roll. Don't leave them standing unattended, because they fall over easily, which can damage your BCD or regulator if you've set up your unit. If you need to leave cylinders standing up — which is common to save deck space on a boat — you need to secure them so they can't fall. Dive boats commonly have special racks for this. When carrying your cylinders in your car, lay them down horizontally and block or tie them.

Maintenance. Besides rinsing your cylinder and valve with fresh water and storing it out of the sun, you have some extra considerations for care.

Dive Equipment
See the PADI *Encyclopedia of Recreational Diving* and the PADI *Multimedia Encyclopedia* CD-ROM

Your cylinder valve should operate easily and smoothly. If there is any difficulty in operation, don't try to lubricate it. Have a professional dive operation service it. Closing a valve too tightly can damage its high-pressure seal. When setting up your equipment, open the valve slowly, all the way until it stops turning.(Note: It used to be common to open the valve all the way, and then close it a quarter to half a turn. This isn't necessary with modern valves, though it doesn't hurt anything if someone does it.) When you're

taking it apart, close it all the way gently. Always close valves gently and avoid over tightening.

Your dive operation fills your cylinder with totally dry air because moisture inside can cause rust or corrosion on its inner surface. It is also important to keep water out of your cylinder. The best way to do this is to never allow it to completely empty. If you do empty the cylinder completely, close the valve immediately to keep moisture out. Water can even enter an empty cylinder by backing up through a regulator, so having the regulator attached doesn't guarantee a dry interior. Also, bleeding the air from your cylinder quickly can cause internal condensation and corrosion.

In recreational diving, scuba cylinders should only be filled with compressed air for breathing — *never pure oxygen*. During filling, your dive operation will usually cool your cylinder in water (it heats as the pressure rises). Cylinders should only be filled to the rated pressure, since overfilling can lead to metal fatigue and shorten the life of the cylinder.

One Stop Equipment Care

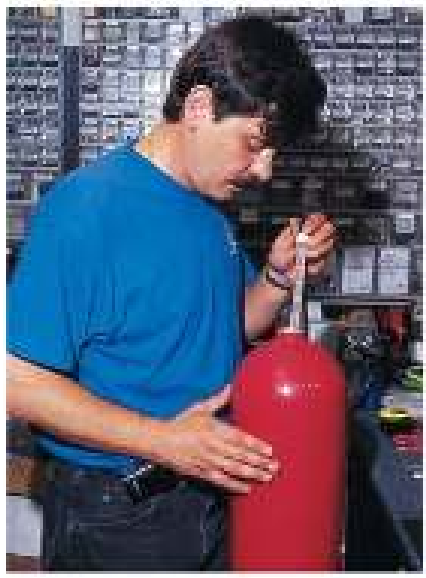
Although you have several considerations for taking care of your scuba equipment, your PADI Dive Center or Resort makes life easy: Apart from rinsing after use, drying and storing properly, they can complete preventative maintenance and repair so you don't have to trek to twenty different places. Look to your PADI Dive Center or Resort for:

- Regulator overhauls and adjustment
- Quality air fills
- Cylinder visual inspections
- Hydrostatic tests
- Gauge accuracy checks and calibration
- Routine adjustments, problem diagnosis and repair.

Diver's home away from home.
Look to your PADI Dive Center or Resort for the specialized expertise you need for long term equipment maintenance and periodic repair.

Your cylinder may have a rubber or plastic boot, which allows the cylinder to stand (where appropriate) and creates some protection if it bumps into things. Check underneath the boot periodically for corrosion. To check for *internal* rust and corrosion, you need to have a professional visually inspect the inside at least once a year. To do this, the inspector drains the cylinder slowly and removes the valve. Using a special inspection light, the inspector checks for corrosion, cracks, debris and other possible damage. (This service must only be performed by a trained professional at a qualified service center — do not empty the cylinder yourself.) Once the cylinder passes the visual inspection, the inspector usually puts a sticker with the test date on the cylinder (they're not used in all areas). Professional dive facilities will not fill a cylinder without a current visual inspection sticker.

Because cylinders are also subject to metal fatigue, they must receive periodic pressure tests called *hydrostatic tests*. The test subjects the cylinder to very high pressure in a special testing tank, and evaluates how much it expands and contracts, which reveals metal fatigue or stress. When a cylinder passes the hydrostatic test, signifying that it can safely hold air at its rated pressure, the tester stamps the test date onto it. Professional dive facilities will not fill a cylinder lacking a current hydrostatic test date. Your instructor will tell you what local or national standards relate to your cylinder hydrostatic testing. Standards vary from country to country; for example in the United States and Canada, you need to have your cylinder hydrostatically tested every five years. In central Europe, steel cylinders require hydrostatic testing every two years, and aluminum require it every five years.



Inside information.
To check for internal rust and corrosion, you need to have a professional visually inspect the inside of your cylinder at least once a year.

You also need to store your cylinders properly. Keep them in a cool place, especially when full, because the pressure of compressed air rises when exposed to heat. Full scuba cylinders left in a hot environment, for example, can rupture the valves' burst discs. Store cylinders with between 10-20 bar/100-300 psi of air to keep moisture out. If you

store a cylinder without using it longer than six months, have the cylinder refilled since the air inside can turn stale. Different types of cylinders may have other maintenance considerations that you'll want to follow according to the manufacturer's instructions.

With proper handling and maintenance, a scuba cylinder and valve can last many years. And you can buy cylinders in a wide variety of colors, including some with patterns and pictures.

Quick Quiz

Self Assessment 11

1. The two metals scuba cylinders are commonly made from are:
☐ a. aluminum and copper.
☐ b. aluminum and steel.
☐ c. copper and steel.

2. The circled marking on the cylinder is:

☐ a. the hydrostatic test date.
☐ b. the working pressure.
☐ c. the serial number.

3. A _____ valve is an on-off valve, and a _____ valve has a built in reserve.
☐ a. K, DIN
☐ b. K, yoke
☐ c. J, K
☐ d. K, J

4. You connect a regulator to a _____ by screwing it into the valve.
☐ a. yoke
☐ b. DIN
☐ c. None of the above.

5. A burst disk:
☐ a. relieves pressure from an overfilled or heated cylinder.
☐ b. is required for your regulator to seal to the valve.
☐ c. None of the above.

6. When transporting cylinders (check all that apply):
☐ a. block them so they can't roll or fall.
☐ b. don't leave them standing unattended.
☐ c. if they must be left standing, secure them so they can't fall.

7. To keep water from entering a cylinder:
☐ a. don't let it drain of air completely.
☐ b. always close the valves very tightly.
☐ c. All of the above.

8. You need an annual visual inspection to:
☐ a. check the quality of air in the cylinder.
☐ b. check for internal corrosion.
☐ c. All of the above.

How'd you do?
1. b. 2. a. 3. d. 4. b. 5. a. 6. a, b, c. 7. a. 8. b.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

57. What does a regulator do?

58. When looking at a regulator, which are the following parts:
    - first stage?
    - second stages?
    - dust cover?
    - purge button?

59. What's the most important feature for consideration when purchasing a regulator?

60. How do you rinse a regulator after use, and what three points do you need to keep in mind while doing so?

Regulators

Purpose. Your regulator makes it possible to use the air in your cylinder. It reduces the scuba cylinder's high pressure air to match the surrounding water pressure, and it delivers air only on demand, when you inhale. It regulates the air flow, hence the name "regulator." Technically, it's a highly sophisticated demand valve, so in some areas divers prefer "demand valve" to "regulator."

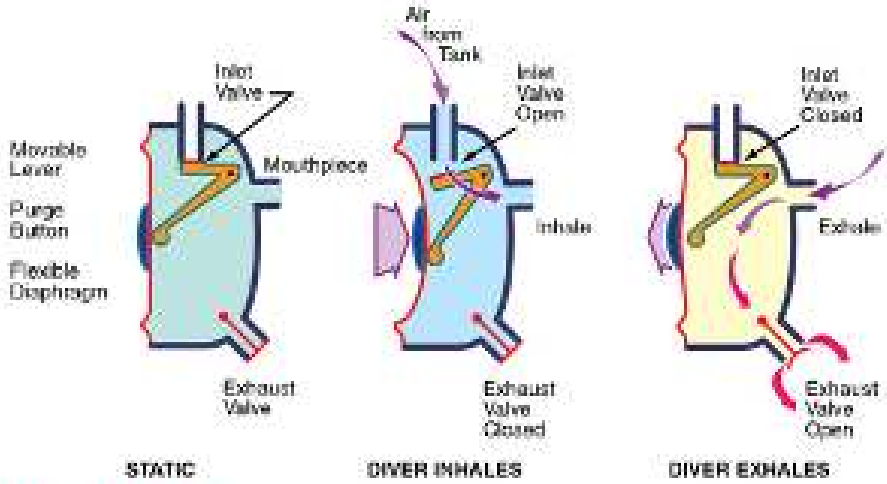
Styles and Features. The modern scuba regulator is a simple and reliable device with only a few moving parts. It has two stages: a first stage, which you attach to the scuba cylinder valve and a second stage that has a mouthpiece. The stages reduce high-pressure air from the scuba cylinder sequentially. The first stage reduces the high cylinder pressure to an intermediate pressure of 7-10 bar/100 to 150 psi above the surrounding water pressure. The second stage reduces this intermediate pressure to the water pressure surrounding you, which is what you need for comfortable breathing. Easy breathing is the most important feature of a regulator.

Regardless of make, all modern regulators share a relatively similar basic structure. Familiarization with regulator terminology and how it functions will help you understand further explanations regarding regulators.

Look at the regulator second stage diagram. The second stage is basically a cup or air space covered with a flexible diaphragm (usually silicone rubber), a lever-operated inlet valve, a mouthpiece and an exhaust valve. When you inhale, you pull the diaphragm inward, which pushes the inlet valve lever to release air. When you stop inhaling, air pressure inside the second stage rises, and the diaphragm returns to its relaxed position, releasing the lever and allowing the valve to close. The purge button lets you manually control the flow of air by depressing the diaphragm and valve lever.

Less is more.
The modern scuba regulator is a simple and reliable device with only a few moving parts.

When you exhale, the exhaust valve opens and the air vents out through the one-way exhaust valve. The exhaust valve remains closed when you're not exhaling, keeping water out of the regulator.



How it works.

The second stage is basically a cup covered with a flexible diaphragm, a lever-operated inlet valve, a mouthpiece and an exhaust valve. When you inhale, you pull the diaphragm inward, which pushes the inlet valve lever to release air. When you stop inhaling, air pressure inside the second stage rises, and the diaphragm returns to its relaxed position, releasing the lever and allowing the valve to close. When you exhale, the exhaust valve opens and the air vents out through the one-way exhaust valve.

The regulator you use during confined-water training will have several attachments. The first of these is a submersible pressure gauge (SPG), which shows you how much air you have (discussed in detail shortly). Your SPG may be part of your dive computer, which you'll learn more about in Sections Two, Four and Five. Your regulator will also have an extra second stage called an alternate air source. (The alternate air source may also be part of your BCD inflation/deflation hose.)

Dive Equipment
See the PADI *Encyclopedia of Recreational Diving* and the PADI *Multimedia Encyclopedia* CD-ROM

The alternate air source simplifies sharing air with another diver, should the need arise. The alternate air source usually has a longer hose and a bright color so you can find it easily. You'll pick up more detail on alternate air sources in Section Two of this manual, and you'll get practice using one during your first confined water dive.

Besides these, your regulator will have a hose with a coupling device at the free end. This hose connects to the low-pressure inflator on your BCD. If you're using a dry suit, you'll have two of these; the longer one generally goes to your dry suit.

Materials. Although there are several manufacturers of popular regulators, virtually all regulators are made from the same basic materials. The first stage is generally made from chrome-plated brass, though there are a few high end models made from titanium. The second stage may be made from brass, high-impact plastics or a combination of both. Parts like mouthpieces and exhaust tees are generally made from plastic, neoprene and silicone rubber.

Selection and Purchase. As mentioned, you want to choose a regulator based on ease of breathing. With your PADI Dive Center's help, you can choose an easy-breathing regulator by comparing flow rates and breathing resistance. Virtually all modern regulators perform well within recreational diving limits, so you'll be choosing based on the feel you prefer, taking into consideration things like service availability and so on. Of course, you can usually purchase a suitable regulator that matches the style of your mask, fins, snorkel, BCD and cylinder.

Take care of it, it takes care of you.
During rinsing, flush fresh water through any holes in the first stage (except the high-pressure inlet covered by the dust cap, of course) and through the second stage mouthpiece. Keep the first stage higher than the second to minimize the possibility that water will flow up the hose to it.

When buying your regulator, you'll want to get your alternate air source at the same time. Again, have your PADI Resort, Instructor or Dive Center assist with your selection.

Preparation. Aside from assembling of your scuba unit, your regulator requires no special preparation other than the attachment of accessories. Leave attaching accessories to the trained professionals at your dive center or resort— they usually take care of this when you purchase your regulator.

Maintenance. After each use, rinse your regulator with the rest of your equipment. It's often best to soak it, while still attached to your scuba cylinder, then rinse it with running water. If rinsing your regulator after it's been removed from your cylinder, keep these points in mind:

1) Put the first stage dust cover firmly in place to keep water out of the first stage.

2) Do not use high-pressure water to rinse your regulator — only gently flowing water.

3) Don't press the purge button while rinsing or soaking, because this opens the second stage inlet valve and can allow water to flow up the hose into the first stage.

You may prefer to rinse your regulator while attached to your cylinder with the valve open. By doing this, there's no way water will accidentally enter the valve and first stage. During rinsing, flush fresh water through any holes in the first stage (except the high-pressure inlet covered by the dust cap, of course) and through the second stage mouthpiece. Keep the first stage higher than the second to minimize the possibility that water will flow up the hose to it. It's a good precaution to

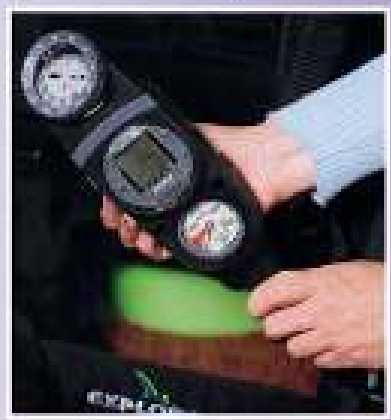
The Integrated Approach to Buying

Scuba Equipment

As you learn about scuba equipment function and use, you quickly learn that nothing you use works in isolation. Much equipment has little utility without other equipment that integrates with it. So as you invest in your own equipment, select integrated packages rather than buying items in isolation.

Your PADI Dive Center or Resort can guide you in purchasing equipment packages that integrate well together. They may even have popular equipment prepackaged with this in mind.

Here's a list of integrated equipment packages, along with accessories. Notice that because integration overlaps, some items appear in more than one package. Don't look at these packages as isolated systems because they're not. Rather, choose equipment based on the type of diving you plan with it, and the way it works with other equipment you have or will have. This gets you kitted up with gear that works well together. Of course, you can look to your PADI Dive Center or Instructor for advice as well.



1. Mask, fins and snorkel. You can have a lot of fun with just these, and it doesn't make much sense to have any two and not the third. Don't forget mask defog, wet suit boots for open heel fins, spare straps and a mesh carrying bag.

2. Regulator, alternate air source, submersible pressure gauge, BCD, weight system, cylinder. This makes up your "scuba unit." If you plan to travel by air for most of your diving, the cylinder may be optional. Don't forget an equipment bag, hose protectors, clips and paraphernalia for rigging, spare o-rings, etc.

3. Exposure suit, exposure suit accessories, BCD, weight system. The BCD appears in this list because if you're looking at cooler water diving, you may need to integrate your exposure suit (dry) with the appropriate BCD. Don't forget a mesh bag for carrying a wet exposure suit, suit repair cement, wet suit detergent, and plastic hangers for drying/storing.

4. Dive computer, SPG, compass. You may opt for an instrument console or independent (wrist mount) gauges, but think in terms of the data: depth, time, direction, air supply. It's a good idea to look at these along with package #2. Don't forget gauge face protectors, clips and rigging accessories, spare batteries and padded cases.

Greater than the sum of the parts.
When purchasing equipment, think in terms of integrated packages rather than isolated pieces.

attach the regulator to the scuba cylinder after rinsing and to purge the regulator briefly to blow out any water that may have entered the first stage accidentally.

Keep your regulator free of sand, mud and debris. To prevent damage to the hoses when storing or packing your regulator, allow the hoses to form large, gentle curves rather than tight loops. Don't use hoses to pull or handle your scuba unit (they're strong, but they're not *that* strong). It's better to store your regulator lying flat than to hang it by one of the stages or hoses.

Your regulator requires periodic lubrication and adjustment, not to mention inspection, to assure that it operates reliably. So, an important part of regulator maintenance includes professional servicing at least once a year, or sooner if it begins to breathe hard or leak air, or according to manufacturer specifications. With proper maintenance and with annual servicing, your regulator should provide many years of dependable service.

Submersible Pressure Gauge

Purpose. The submersible pressure gauge (SPG — sometimes called the "contents gauge") tells you how much air you have during a dive, in much the same way that an auto's fuel gauge tells you how much fuel you have. You'll learn to use your SPG to plan and control your dive so you return safely to the boat or shore without running out of air. Since you don't want to run out of air underwater, as you might expect, the SPG is mandatory equipment.

A point to remember is that your SPG is a passive device. You have to read it, or it doesn't do you any good. Develop the habit of checking your submersible pressure gauge frequently while diving. With practice you'll get a feel for how fast you use air and won't need to check quite as much, but for now check it all the time. Better too much than too little.

Quick Quiz

Self Assessment 12

1. A regulator reduces high pressure cylinder air in four steps.
☐ True ☐ False

2. The part of the regulator in the photo is:

☐ a. first stage
☐ b. second stage
☐ c. low pressure hose

3. When rinsing your regulator, remember to:
☐ a. put the first stage dust cover in place.
☐ b. not depress the purge button.
☐ c. use gently flowing water.
☐ d. All of the above.

How'd you do?
1. False. It reduces it in two steps.
2. b. 3. d.

Main Objectives

Underline/highlight the answer to this question as you read:

61. Why do divers need a submersible pressure gauge?

Styles, Features, Materials. Although SPGs all have the same purpose, there are a few basic styles and features. These range from gauges that simply tell you your air pressure, to electronic gauges that incorporate other instruments (dive computers). Some of the newest models have no hose, but use a transmitter mounted on the first stage to send air supply data to a computer on your wrist.

Selection and Purchase. Have your PADI Dive Center, Resort or Instructor help you select the best SPG when you invest in your regulator. Since it's mandatory equipment, it makes sense to purchase an SPG along with the regulator.

Preparation. The only preparation required is to have your dive center or resort attach the SPG (or transmitter, if it's the hoseless type) to your regulator.

Maintenance. Whether a simple gauge or part of a computer, your SPG is a precision instrument that requires careful handling. Do not drop or bang it, and be careful to avoid lying a cylinder or other heavy object on top of it. While diving, don't let it drag or dangle, which not only damages the SPG, but can damage fragile aquatic life.

Because the SPG (or transmitter) remains attached to your regulator, simply rinsing and soaking it along with the regulator takes care of its maintenance. When you take your regulator in for annual servicing, be sure to have your dive professional take care of your SPG as part of the servicing.

Equipment Identification

It's a good idea to mark your equipment for easy identification using special diving equipment markers. These may be marking paint, crayons or colored tape, among others. After you've invested in matching mask, fins, snorkel, etc., it's a good idea to mark your gear where it's not visible when you're wearing it, but is when you're not — such as putting your initials *inside* the fin foot pocket.

Nice to know.
The submersible pressure gauge (SPG — sometimes called the "contents gauge") tells you how much air you have during a dive.

Quick Quiz

Self Assessment 13

1. The SPG (submersible pressure gauge) is mandatory equipment on all scuba dives.
☐ True ☐ False

How'd you do?
1. True.

MAIN Objectives

Underline/highlight the answer to this question as you read:

62. What are three reasons for diving with a buddy at all times?

That's what friends are for.
Diving with someone adds to the fun, and it's important for safety. Together, you and your buddy share experiences and underwater adventures, sometimes seeing things that no one else ever will. You may be surprised how many new friends you meet through diving and the buddy system.

Marking your equipment prevents frustration and confusion when you're around other divers using similar equipment, adjusted to different sizes. This happens a lot on dive boats, and there may be others with similar gear in your confined water dives.

The Buddy System

During your confined water dives, you'll start practicing the buddy system — always diving with a buddy who stays nearby at all times. Your buddy assists you with things like putting on and checking your equipment before the dive, helps remind you to check your depth, time and air supply limits, and provides emergency assistance in the unlikely event you need it. Hopefully it goes without saying that you do the same for your buddy. With a proper buddy system, you both benefit in terms of convenience, safety and fun.

Diving is a social activity, so the buddy system is more than one of diving's safety rules — though it is that. Diving with someone adds to the fun. Together, you and your buddy share experiences and underwater adventures, sometimes seeing things that no one else ever will. You may be surprised how many new friends you meet through diving and the buddy system. Three general reasons apply to diving with a buddy: 1) practicality, 2) safety and 3) fun.

You and your buddy have a responsibility to each other. For the buddy system to work, you and your buddy must take it seriously (but still have fun) and work at staying together underwater. So, develop the habit and start practicing the buddy system during your confined water dives.

Quick Quiz

Self Assessment 14

1. Reasons for diving with a buddy include (check all that apply):
   - ☐ a. practicality
   - ☐ b. safety
   - ☐ c. fun

How'd you do?
1. a, b, c.

Summary Points

In these subsections on Dive Equipment and the Buddy System, you learned that:

- Comfort and fit are the two most important criteria in purchasing dive gear.
- You can't use goggles for scuba diving because they don't enclose your nose.
- You need to rinse your equipment in fresh water after each use.
- The jacket BCD is by far the most common BCD used by recreational divers.
- Your scuba cylinder needs an annual visual inspection, and periodic pressure (hydrostatic) testing.
- You never leave scuba cylinders standing unattended. You block/secure them when transporting so they can't fall or roll.
- Regulators reduce cylinder pressure in two stages to breathing pressure.
- A regulator's most important feature is ease of breathing.
- You need to have your regulator professionally serviced annually.
- Have the dust cap in place and don't push the purge button when you rinse your regulator.
- You need an SPG (submersible pressure or contents gauge) so you can tell how much air you have at any time during the dive.
- You always dive with a buddy for safety, practicality and fun.
- You can make all your dive gear match and look good without sacrificing comfort, fit or important features.

Confined Water Dive Preview

Okay, now you're about ready to go diving in the pool or confined water. If you've never done it before, you'll find it exhilarating breathing underwater for the first time. You'll never forget it.

During your first confined water dive, your instructor and the instructor's assistants will help you set up your gear, put it on and take you through the steps of going underwater with scuba for the first time. Then, you'll start learning and practicing some of the skills you'll need as a diver.

Your instructor will be at hand the whole time, guiding you and making sure you have fun learning to dive. If you have a question or want some assistance, ask. The PADI Open Water Diver course enables you to meet physical and academic performance requirements through a variety of adaptive techniques. And as it said in the introduction, if you don't understand *why* you're doing something, find out. After all, it doesn't matter if you can do something perfectly if you don't know when and why you would do it.

Your instructor will go over each of the following scuba skills, and may present them in a slightly different order or manner to accommodate logistics, your individual needs, local conditions and so on. But this will give you an idea of what you're going to be doing.

WOW!

If you've never done it before, you'll find it exhilarating breathing underwater for the first time. You'll never forget the first time you use scuba.

Confined Water Dive One

Skill Requirements

Here's what you'll be able to do when you successfully complete Confined Water Dive One:

1. Don and adjust mask, fins, snorkel, BCD, scuba and weights with the assistance of a buddy, instructor or certified assistant.
2. Inflate/deflate a BCD at the surface using the low pressure inflator.
3. In water shallow enough to stand in, demonstrate proper compressed-air breathing habits, remembering to breathe naturally and not hold the breath.
4. Clear a regulator while underwater by exhalation and purge-button methods, and resume breathing from it.
5. In water shallow enough to stand in, recover a regulator hose from behind the shoulder while underwater.
6. In water shallow enough to stand in, clear a partially flooded mask while under water.
7. Swim underwater with scuba equipment while maintaining control of both direction and depth, properly equalizing the ears and mask to accommodate depth changes.
8. While underwater, locate and read the submersible pressure gauge and signal whether the air supply is adequate or low based on the gauge's caution zone.
9. In water shallow enough to stand in, breathe underwater for at least 30 seconds from an alternate air source supplied by another diver.
10. While underwater, recognize and/or demonstrate standard hand signals.
11. Demonstrate the techniques for a proper ascent.

Assembling Your Scuba Equipment

Before you can use scuba equipment, you have to put your cylinder, regulator and BCD together. Your instructor may have your gear already set up for this first confined water dive, or may guide you in putting it together. Between now and when you finish the course, you'll have put it together and taken it apart until it's second nature.

Put the BCD on the cylinder. If you bought a brand new BCD, wet the nylon cylinder band. You do this because new nylon stretches when wet; if you attach the band dry, it may loosen when you get in the water. Now:

1. Slide the BCD onto the standing cylinder from the top.

2. Turn the cylinder so the valve opening faces toward the BCD, where your head will be. For most BCDs, you want the top of the hard plate in the jacket (if it has one) or the collar to be about even with the base of the cylinder valve. Your instructor can help you with this, and you may go higher or lower to suit your preference after using your gear a bit.

3. Secure the cylinder band by tightening it as far as you can by hand, then swinging over the locking mechanism. It should take a bit of strength. Locking mechanisms vary, so have your instructor show you how yours works if it's not obvious (it often isn't). Some BCDs use two cylinder bands; tighten and secure both.

4. Now check that it's secure. See if the band slides up and down on the cylinder. If not, you can lift the cylinder off the ground slightly holding the top of the BCD backpack, and give it a little shake. If the BCD doesn't shake or slide on the cylinder, good job. If it moves, you're too loose. Readjust the band for a tighter fit.

Attach the regulator. If the regulator's out of reach, lay the cylinder and BCD down, with the BCD up, before you go get it.

1. The cylinder valve opening may be covered by a piece of tape or a plastic cap. If so, remove the tape or cap (discard tape properly — please do not litter).

Right height.
For most BCDs, you want the top of the hard plate in the jacket (if it has one) or the collar to be about even with the base of the cylinder valve. Your instructor can help you with this, and you may go higher or lower to suit your preference after using your gear a bit.

Swing and lock.
Secure the cylinder band by tightening it as far as you can by hand, then swinging over the locking mechanism. It should take a bit of strength.

Put it together.
Position the regulator so the primary second stage comes off to the right. Tighten the yoke screw finger tight, or for DIN equipment, gently screw in the regulator until it is snug. Attach the low pressure hose to the BCD inflator.

2. Check the valve opening for an O-ring (yoke system — for DIN, check the regulator first stage connection). It should be clean and free from cuts or nicks. If you need a new O-ring, see your instructor.

3. Open the cylinder valve slowly — just for a burst — to blow any accumulated water or dirt from the valve opening. Aim it away from people. If you're certain there's no water or debris, you can skip this step.

4. Remove the regulator dust cap by loosening the yoke screw (yoke system) or unscrewing (DIN system).

5. With the cylinder between your legs and the BCD away from you, put the first stage on the cylinder valve so that the valve opening meets the first stage opening, and so the second stage hose leads to the right. The primary second stage hose goes over your right shoulder.

6. Tighten the yoke screw until it is just finger tight, or for DIN equipment, gently screw in the regulator until it is snug.

7. Attach the low pressure hose from the regulator to the BCD low-pressure inflator.

Turn on the air and check its operation. You should now be ready to turn on the air. Hold the SPG in your left hand away from you, facing away, as you turn it on — this is a precaution in the unlikely event the SPG leaks internally and the face bursts; modern SPGs have blow out plugs so this isn't likely to happen even if it *does* have a leak. Play it safe anyway.

Open the valve slowly and gently. If you hear a small leak, the O-ring may be dirty or defective. Close the valve and ask your instructor to show you how to inspect and replace it. Assuming no leaks, open the valve all the way.

Check your air with the submersible pressure gauge. Look at the working pressure on the cylinder and compare it to the SPG, and you'll have an idea how full the cylinder is. You'll quickly learn the full pressure for most cylinders in your area.

Next, test the regulator by pressing the purge button momentarily. The air should flow freely and stop when you release the button. A slight hissing from the second stage may stop if the purge button is pressed or the mouthpiece opening is blocked momentarily. If it does not, notify your instructor. Some very sensitive regulators may begin to free flow (release air continuously) loudly when you press the purge; put your fingers across the mouthpiece and it should stop.

Check the exhaust valve by exhaling into the regulator. Exhalation should be easy. If not, the exhaust valve may be stuck — notify your instructor. If both the purge and exhaust valves function properly, take a few breaths from the regulator as a final check. The regulator should breathe easily and smoothly.

Face away.
While holding the SPG away from you, open the valve all the way gently.

Secure hoses and streamline your gear.
Dangling SPGs and alternate air sources damage themselves as they drag on the bottom and the reef. They create drag while you swim and they can destroy and kill sensitive aquatic life.

Breath of fresh air.
If both the purge and exhaust valves function properly, take a few breaths from the regulator as a final check. The regulator should breathe easily and smoothly.

Your BCD and hoses will have clips, snaps and other attachments so that none of your hoses dangle. Ideally, when swimming underwater nothing hangs below your body line more than about 20 cm/8 inches — and less is better. Typically, you run the SPG hose under your left arm and attach it to the front of your BCD where you can either see it, or easily swing it up and see it. Your alternate air source usually runs under your right arm (though this may vary with the type) and attaches in the triangle formed by your chin and the corners of your rib cages. You'll use a clip or holder that holds it securely, but releases with a firm tug.

Your instructor will help you secure hoses and streamline your gear. When you're done, remember to lay it down carefully, BCD up, with the second stage on top so it stays out of the sand or dirt.

Adjustments and Gearing Up

You'll probably prepare and adjust your mask, snorkel

and fins before you come to your first confined water dive. Let's look at your other gear, much of which for this first dive you'll probably put on in shallow water. Your instructor will guide you through the steps for gearing up.

Don't be a drag.
Use clips, snaps and other attachments on your BCD so that none of your hoses or accessories dangle. Ideally, when swimming underwater nothing hangs below your body line more than about 20 cm/8 inches — and less is better.

Adjusting your BCD. As you read earlier, adjust the BCD jacket to feel snug and comfortable. This may require tightening or loosening the shoulder straps and the waist straps. If you're wearing the right size BCD, you can probably make these adjustments after you put your scuba unit on.

With your own equipment, you'll make many initial adjustments that you won't have to change. Each time you gear up, your equipment is already set for your comfort.

Adjusting the weight belt. If you're using a weight belt, your instructor will tell you approximately how much weight to use. Distribute the weights evenly on the belt and adjust the belt length to be no more than 15 to 20 cm/6 to 8 in longer than needed to fit your waist. (You will learn more about weight belts and weight systems in Section Two.) Now it's ready to put on.

Wet Suit. You may wear a wet suit jacket, vest, or an entire wet suit during your confined-water dives. This gets you used to using it before you go into open water.

If you're wearing a full wet suit, you'll put the pants on first. Wet suits have to fit snugly, so expect some effort doing this — it gets easier with practice.

After you get the pants on, wet suit boots come next. Tuck them under the wet suit pants cuff. Put on a wet suit jacket one arm at a time. Work the sleeve all the way up to your arm pit before starting on your other arm.

Snug = warm.
Wet suits have to fit snugly, so expect some effort in pulling one on — it gets easier with practice.

With a proper fit, the suit should feel snug and somewhat restrictive. The restriction eases in the water, and after wearing a wet suit a bit, you'll get used to how it feels.

Left gets it right.
Be sure you wear the weight belt so that it has a right hand release. This is a standard release position. Generally, if you have the buckle on the left side, the release opens to the right.

If you don't use a wet suit jacket or vest during this dive, it's a good idea to wear a body suit, or at least a T-shirt or sweatshirt (with a catchy logo on it) to reduce any chaffing.

Weight belt. Whether you put on a weight belt before or after your scuba unit depends on the BCD — usually it goes on first. If you're using a weight integrated BCD, this isn't an issue at all.

Regardless of when you put on the weight belt, you must be able to remove it quickly and easily, so it must remain free and clear of all other equipment. Your instructor will help you do this.

To put on a weight belt before entering the water, hold the buckle end in your left hand and the free end in your right. Step over it and then bend forward, laying the belt across the small of your back. By donning the belt in this manner, you take the strain off the front so you can position the belt and secure the buckle.

Be sure you wear the weight belt so that it has *a right hand release*. This is a standard release position. Generally, if you have the buckle on the left side, the release opens to the right. Note that you set the weight belt release and the scuba unit releases to open in opposite directions to help prevent confusion. Loosen and secure the weight belt release without looking. Underwater, with a mask and BCD on it's difficult to see your waist, so you'll want to be sure you can operate the weight belt by touch.

Finally, try to distribute the weights evenly so they don't interfere with the quick-release buckle. It also helps to have them slightly forward to make you more stable when swimming, with a gap in the center of your back where the cylinder lies.

Scuba Unit. Before putting on the scuba unit, first make sure you connect the BCD shoulder releases (if present) and that

you've unfastened the waist belt. The easiest way to put your scuba unit on is to have your buddy hold it while you slip into it like a coat. Before your buddy lets go, putting its weight on you, straighten any twisted straps and make sure you're not trapping any hoses or accessories inside the jacket. After setting the unit on you, your buddy can help you find the waist belt on each side.

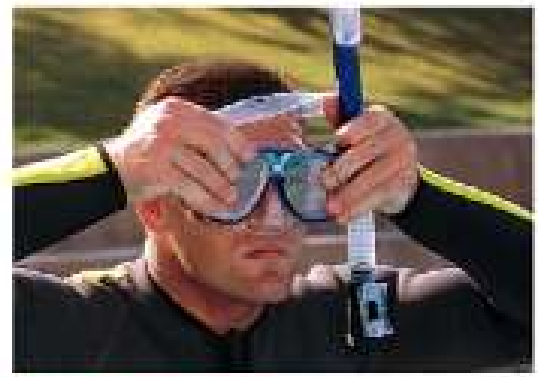
Take a load off.
The easiest way to put your scuba unit on is to have your buddy hold it while you slip into it like a coat. Before your buddy lets go, putting its weight on you, straighten any twisted straps and make sure you're not trapping any hoses or accessories inside the jacket.

Next, bend forward and balance the cylinder on your back to take the strain off the harness. It is easier to adjust and secure the unit in this position than when standing upright. Check to be sure that the waist belt release opens to the left.

After everything feels secure, stand upright and tilt your head back. If your head can touch the valve, the cylinder is probably too high. You don't want it hitting your head, so take the unit off and readjust the BCD height on the cylinder.

Mask. Condensation will fog the inside of your mask unless you use defog. It's best to use commercial defog, though saliva will work if none is available. Rub defog on the inside of your mask lens and rinse it *once*, briefly.

Now you're ready to put your mask on. Hold it on your face with one hand while pulling the strap into place with the other. Develop the habit of keeping your mask on your face whenever you're in the water.



Proper application.
To put on your mask, hold it on your face with one hand while pulling the strap into place with the other.

Fins. You usually put fins on last, as close to the water — or even in the water when appropriate — as possible. Walking in fins is clumsy at best, and can be hazardous. If you must walk with fins (whether in or out of the water), shuffle your feet and walk backwards, looking over your shoulder to see where you're going.

Backward is forward.
Walking in fins is clumsy at best, and can be hazardous. If you must walk with fins, whether in or out of the water, shuffle your feet and walk backwards, looking over your shoulder to see where you're going.

Wet your feet (or boots) and fins to make them easier to don. Have your buddy steady you as you put on one fin at a time. Work your foot well into the foot pocket before pulling on the strap (adjustable strap) or pulling up the heel portion (full foot).

Inspect your equipment. Develop the habit of inspecting your and your buddy's equipment for correct positioning, adjustment and function before entering the water. You should be familiar with where to find and how to work each other's BCD controls and releases. During your second confined water dive, you'll learn how to do this with a five step predive safety check.

A matter of balance.
When donning fins out of the water, have your buddy steady you as you put on one fin at a time.

Inflating and Deflating Your BCD

Now you're ready to practice some dive skills. You want to know how to inflate your BCD at the surface so that you can remain upright and rest, talk, listen or adjust equipment without having to tread water. An inflated BCD also provides support while swimming at the surface. Whenever you're at the surface, you should have your BCD partially inflated.

Check it out.
Develop the habit of inspecting your and your buddy's equipment for correct positioning, adjustment and function before entering the water.

You can inflate your BCD two ways: orally and through the low-pressure inflator mechanism connected to your regulator. You'll learn to inflate it orally in your next confined water dive.

To inflate the BCD using the low-pressure inflator mechanism, press the inflation button (not the same one you used to orally inflate). Put air in your BCD in short bursts, so you

Push button buoyancy.
To inflate the BCD using the low-pressure inflator mechanism, press the inflation button (not the same one you used to orally inflate). Put air in your BCD in short bursts, so you can control the inflation.

can control the inflation. You'll normally use the low pressure inflator because it's quicker, easier and (surprisingly) saves air because it takes less effort.

Whether inflating orally or with the low-pressure inflator, you'll seldom find full inflation necessary and may find it uncomfortable. Fill your BCD until you can float comfortably, which rarely takes more than about half its capacity.

To deflate the BCD, get into a vertical — or relatively head up — position and depress the exhaust valve while holding the hose up. On some BCDs, you may use a "dump" valve for convenient deflation without holding up the hose. Either way, you want to orient yourself so you put the spot where the hose joins the BCD (or the dump valve location) at the highest point.

More than one way.
Although you usually gear up standing on land or in shallow water, that's not always the case. There's no reason why you can't get into your equipment while seated if your physical characteristics require it.

Breathing Underwater

Okay, this is it! You're about to go under. But first (patience), listen to your instructor who may give you hand signals to watch for, and tell you what to do. Okay, *now*.

As you breathe from scuba for the first time, remember to breathe slowly, deeply and continuously. Keep in mind the primary rule in scuba — never hold your breath. While underwater, watch your instructor for signals. Relax and enjoy the experience. At first, you may not want to trust your scuba equipment, but after a few breaths, you realize — it works! You'll love it.

Regulator Clearing

Once you're comfortable with breathing underwater, your

instructor will teach you how to take the second stage out of your mouth and replace it. Why? Because you need to do this for some skills, to make a face at your buddy, or because it might get bumped out of your mouth, or you might drop it out by accident.

When the regulator leaves your mouth, it fills with water. No problem, though, because you can easily replace it, clear out the water and resume breathing. There are two standard methods: by exhaling into it (the exhalation method) and by using the purge button (the purge method).

The exhalation method is as easy as it sounds. Simply blow into the regulator with the second stage in an upright position (so the exhaust valve is the lowest point). The air forces the water out the exhaust valve. Remember that you must exhale before inhaling, and that the regulator must be more or less upright.

But what if you don't have any air to clear with? Use the purge method. Place the second stage in your mouth (again, more or less upright) and block the mouthpiece opening by sticking your tongue against it. This keeps water from

Push button buoyancy control.
You'll normally use the low pressure inflator because it's quicker, easier and (surprisingly) saves air because it takes less effort. The inflator adds air to your BCD; the deflator button releases it.

Going down.
To deflate the BCD, get into a vertical — or relatively head up — position and depress the exhaust valve while holding the hose up.

Remember the most important rule.
You need to develop an important habit while you practice regulator clearing. When the regulator's not in your mouth underwater, always blow a small, continuous stream of bubbles by making an aaaahhh sound. This is so you never hold your breath while scuba diving.

Sweep and recover.
To recover your regulator using the arm sweep method, lower your right shoulder, extend your arm out and back along side your cylinder, then sweep it forward. The second stage hose should end up against your elbow.

spraying into your mouth and making you cough. Now, push the purge button briefly. This releases air from the second stage, which forces the water out the exhaust valve. Now you can inhale.

Most of the time you'll probably use the exhalation method because it's the quickest and easiest, but you need to know both methods. As you practice, turn the regulator mouthpiece downward when you remove it from your mouth. If you turn it upward, it may free-flow and waste air. If you forget, just turn the mouthpiece down and it will stop.

You also need to develop an important habit while you practice regulator clearing. When the regulator's not in your mouth underwater, always blow a small, continuous stream of bubbles. This is so *you never hold your breath* while scuba diving. As you've already learned, ascending with compressed air trapped in your lungs can cause *serious* (possibly fatal) lung over expansion injuries. By making a continuous sound, you keep the airway to your lungs open to release expanding air.

Reach and recover.
To recover your second stage using the reach method, reach behind your head and find where the hose attaches to the first stage. Follow it with your hand until you locate the second stage.

Regulator Recovery

Recovering your second stage goes hand-in-hand with clearing it. Why? Because when you drop it from your mouth, it tends to swing behind your back. Or, you may need to find it after using your snorkel to swim to your descent point on the surface. Well, not to worry, you can find it by two methods: the arm-sweep method and the reach method.

To recover your regulator using the arm sweep method, come to an upright position and lower your right shoulder. Next, extend your arm out and back, along side your cylinder, then sweep it forward. The regulator hose should end up against your elbow; grasp the hose while sliding your hand down to the second stage. Put it back in your mouth and clear it.

Sometimes the second stage snags on something, so you recover it using the reach method. Reach back behind your head and find where the regulator hose attaches to the first

Things are looking up.
To clear a mask without a purge valve, hold the top of the mask firmly against your forehead, then look up slightly while exhaling through the nose.

stage. Follow it with your hand until you locate the second stage. You may find it helpful to lift the bottom of your cylinder with your left hand, pushing it up and to the right to make it easier for your right hand to reach the first stage and find the hose.

You will practice regulator recovery during this confined water dive. Remember to blow bubbles and make a continuous sound when the regulator's out of your mouth.

Mask Clearing

By the time you finish practicing regulator clearing and recovery, you'll notice that water tends to trickle into your mask during a dive. No big deal, you just blow it back out. During this confined water training dive, you'll learn to clear water from a partially flooded mask.

You clear your mask differently without and with an optional purge valve. Without a purge valve, hold the top of the mask firmly against your forehead, then look up slightly while exhaling through the nose. The air from your nose forces the water out the bottom of your mask. Note: Begin exhaling before tipping your head back to prevent water from getting in your nose.

Hold and exhale.
To clear a mask with a purge valve, hold the mask snugly against your entire face and look down, making the purge valve the lowest point in the mask, then exhale through your nose.

With a purge valve, hold the mask snugly against your entire face and look down, making the purge valve the lowest point in the mask. Exhale through your nose. The air forces the water out through the purge valve.

Mask clearing is easiest when you exhale steadily and continuously through your nose. Before you try it, exhale an entire breath slowly and steadily through your nose. Since a mask has much less volume than your lungs, with practice you may be able to clear your mask several times on just one breath.

Swimming Underwater

After you've practiced a few skills, you'll be ready to swim around a bit. The standard kick for diving is the *flutter kick*, but it's different from the short, quick kick you use without fins. With fins, slow your kick and lengthen the stroke. Point

your fins behind you, and move them primarily from your hip, which gets those powerful thigh muscles in gear. Your knees should bend only slightly. The down stroke applies the power, and the upstroke rests. When you kick properly, you feel the tendons pull on the top of your foot where it meets the ankle.

Flutter by.
The standard kick for diving is the flutter kick. Point your fins behind you, and move them primarily from your hip, which gets those powerful thigh muscles in gear. Your knees should bend only slightly.

Gettin' around.
Divers with a physical challenge that limits leg mobility usually swim with their arms and hands. Note the special webbed finger gloves that increase hand swimming power.

Fins only provide propulsion when submerged, so keep them underwater when swimming at the surface. Kick down farther and up less, while arching your back upward to force your legs downward. You may find it easier to swim on your back or side for a wider kick while keeping the fins submerged.

Don't try to swim fast with scuba. Doubling your speed takes four times the energy (it's that exponential thing again). Arm movements create drag and actually reduce momentum, so keep your arms still, trailing at your sides. If you have a physical challenge that requires swimming with your arms and hands, there are several effective techniques that may be useful. Ask your instructor for more information.

Equalization and Underwater Swimming

To get used to equalizing and changing depth, you'll swim back and forth from shallow to deeper water. Relax, swim slowly to conserve air and energy. Equalize your ears as soon as you submerge and frequently (every metre/few feet) as you move to deeper water. Don't forget to equalize your mask by blowing into it. It may take some practice before equalization becomes natural. Be patient, and don't force it.

Early and often.
Equalize your ears as soon as you submerge and frequently (every metre/few feet) as you move to deeper water. Don't forget to equalize your mask by blowing into it.

Swimming underwater you use long, slow flutter kicks. Stay with your buddy, and try to stay off the bottom. Your instructor will communicate with you using hand signals (you'll discuss these before you go under); pay attention to these and respond appropriately.

Managing Your Air

While you're underwater, get in the habit of checking your SPG frequently. Most SPGs have a marked caution zone — be sure to let your instructor know if your air gets this low. Digital SPGs usually blink or otherwise alert your air is low. Your instructor will have you signal your air supply level, either indicating that you're not near the caution zone, or using your fingers to show how much air you have in bar/psi.

Know air to prevent no air.
Get in the habit of checking your SPG frequently. It's the most effective way to avoid a low-on-air or out-of-air situation.

Alternate Air Source

In the next two sections, you'll start learning about alternate air source types and how to respond to an out-of-air emergency. You normally respond with alternate air source use as the preferred means for sharing air with your buddy. During this confined water dive, you'll learn the basics for doing this.

As you'll see, alternate air sources come in three basic configurations. Regardless of type, though, you must be able to locate, secure and breathe from an alternate air source supplied by a buddy. The following procedures apply to the use of all three types of alternate air sources; your instructor will demonstrate the specifics for the type you use during this dive.

The alternate air source sits in the chest area — readily accessible — and secured so that it pulls free for use with a firm tug. Make a habit of checking where and how your buddy secures the alternate air source.

Stay out of the red.
Most SPGs have a marked caution zone — be sure to let your instructor know if your air gets this low.

Depending on the alternate air source configuration, the donor (diver supplying air) may give the receiver (diver getting air) the alternate, or may give the receiver the primary air source (one in the mouth) and switch to the alternate. The important point is to agree on the procedure before the dive.

If you need your buddy's alternate air source, first get your buddy's attention and signal "out of air" and "share air." Your buddy should respond by swimming toward you, offering you a second stage

mouthpiece. If not, you may need to locate and secure the alternate air source on your own and begin breathing.

A friend in need.
You normally respond with alternate air source use as the preferred means for sharing air with your buddy. During this confined water dive, you'll learn the basics for doing this.

Because there are many variations of alternate air sources, use caution when placing the alternate regulator in your mouth. If you put some types in upside down, you will have trouble clearing it and may choke on some water. Once you have the alternate air source, make contact with your buddy. The best method for holding on to each other depends on the alternate air source configuration, but generally you hold on to your buddy's cylinder valve, arm, shoulder or BCD.

After you're breathing comfortably, begin ascending. Keep eye contact and hang on to your buddy while breathing normally. You and your buddy will adjust your own BCDs, with the ascent rate controlled by the donor. (For this first time, you'll practice stationary and swimming, but you probably won't ascend.)

Your instructor will demonstrate how to accomplish all these points with the type of alternate air sources you and your buddy have. This is a good skill to practice or review frequently, especially when you dive with a new buddy or encounter an unfamiliar type alternate air source.

Look up, reach up and come up.
As you ascend, reach up, look up and rotate so you can see the entire area. When you reach the surface, inflate your BCD enough to float comfortably.

Ascending

When your instructor gives the "up" signal, you and your buddy will swim together slowly to the surface. Reach up, look up and rotate (so you can see the entire area) as you ascend. When you reach the surface, inflate your BCD enough to float comfortably. Keep your mask on and the regulator in your mouth until you swim back to shallow water.

Exiting the Water

You'll probably learn several methods for exiting the water during this course, each for a different diving situation. During

this dive, you'll probably exit in shallow water. With your buddy's help, slip out of your weight system and scuba unit in water about waist deep. Take off your fins and place everything on the pool's edge, or hand it up to your buddy. Your instructor will demonstrate the equipment removal procedure to use exiting the water.

Shower so it lasts.
It's important to rinse all your gear after a pool dive because chlorine can harm it as much as salt water can.

Equipment Disassembly and Care

When you finish, you need to disassemble your gear for rinsing and storage. First, turn off the cylinder air by turning the valve clockwise gently until it stops. Next, push the purge button on the regulator to release all the pressure in it. If you forget to do this, the pressure will make it almost impossible to take the regulator off.

Disconnect the low pressure inflator hose from the BCD, and unclip/release the SPG and alternate air source from their holders. Remove the regulator by loosening the yoke screw, or unscrewing (DIN), being careful to keep water from dripping into the high-pressure inlet on the first stage. Dry the regulator dust cap with a towel and replace it.

Wrap and secure the BCD straps so they won't drag and tangle. Release the cylinder band and slide off the BCD. Lie the cylinder down so it can't fall over while you rinse with fresh water and pack all of your equipment. This is even important after a pool dive because chlorine can harm your gear as much as salt water can.

Knowledge Review

Chapter 1

1. True or False. An object is neutrally buoyant when it displaces an amount of water less than its own weight. _____

2. Explain why buoyancy control, both on the surface and underwater, is one of the most important skills you can master:

   On the surface: _____

   Underwater: _____

3. Fill in the blanks with the appropriate words: freshwater or saltwater.

   "The same object would be more buoyant in_____ than it would be in_____."

4. True or False. Because water is denser than air, the pressure change for a given distance ascent or descent is significantly greater in water than in air. _____

5. Complete the following chart for a sealed flexible bag, full of air at the surface.

Depth	Pressure	Air Volume	Air Density
0m/0ft	1 bar/ata	1	x 1
10m/33ft		1/2	
30m/99ft		1/4	
40m/132ft	5 bar/ata		x 5

6. Circle the letter of the best definition for a squeeze.

   a. A condition that causes pain and discomfort when the pressure outside an air space of your body is less than the pressure inside an air space.
   b. A condition that causes pain and discomfort when the pressure inside an air space of your body is less than the pressure outside an air space.

7. Check each statement that describes a technique used to equalize air spaces during descent:

   ☐ a. Block your nose and attempt to gently blow through it.
   ☐ b. Swallow and wiggle the jaw from side to side.
   ☐ c. Block your nose and attempt to gently blow through it while swallowing and wiggling the jaw from side to side.

8. State how often you should equalize your air spaces during descent.

9. True or False. "If you feel discomfort in your ears while descending, continue downward until the discomfort is gone." _____

10. State the most important rule in scuba diving.

11. Circle the letter of the best definition for a reverse block.

    a. A condition that occurs when expanding air cannot escape from a body air space during ascent, causing pain and discomfort.
    b. A condition that occurs when expanding air escapes from a body air space during ascent, causing pain and discomfort.

12. Describe what action you should take if you feel discomfort during ascent due to air expansion, whether in your ears, sinuses, stomach, intestines or teeth.

13. When scuba diving, why must your nose be enclosed in the mask?

14. Explain the best way to prevent water from entering your scuba cylinder.

15. Circle the appropriate answer. The most important feature for consideration when purchasing a regulator is:

    a. The color b. The number of hoses it has c. Ease of breathing d. Size

Student Diver Statement: I've completed this Knowledge Review to the best of my ability, and any questions I answered incorrectly or incompletely I've had explained to me, and I understand what I missed.

Name _____ Date _____

Adapting to the Underwater World

Above water, you see, hear and move about in a familiar and comfortable manner that seems "normal" because you're used to it. But underwater, you're in a new world where seeing, hearing and staying warm differ from in air. You probably noticed this during your first confined water dive (or you will).

Water is about 800 times denser than air, which is why light, sound and heat act differently in water. Let's look more specifically at some of these differences so you can begin adapting to them during your dives.

Seeing and Hearing Underwater

You reach for your buddy and . . . you miss. What happened? Underwater things sometimes look closer than they really are.

As you learned in Section One, the human eye needs air to focus, which your mask provides. However, even though your eyes can focus, you still have some optical effects because light travels at different speeds in water and in air. When light changes speed going from water to air (like when it enters your mask), it shifts its course slightly (this is called *refraction)* which magnifies every-

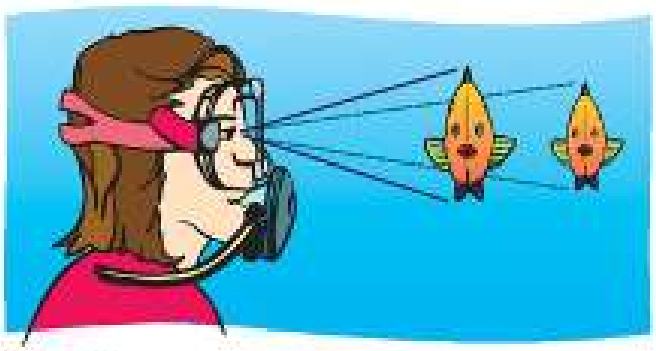
MAIN Objectives

Underline/highlight the answers to these questions as you read:

1. **How does looking at something underwater affect its apparent size?**
2. **How does water affect light intensity and color?**
3. **How does being underwater affect hearing?**

TWO

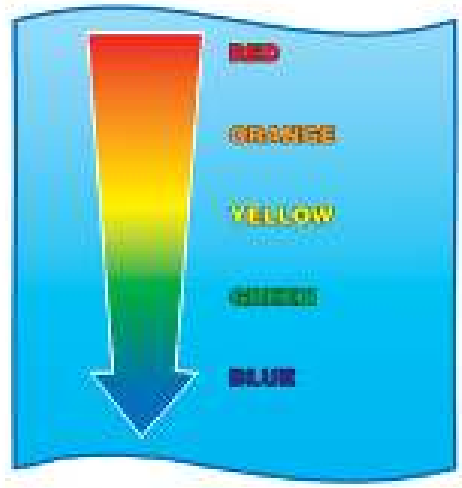
thing. This makes things look larger and/or closer, depending on your perspective.



What big eyes you have.
When light changes speed going from water to air, it shifts its course slightly, magnifying everything. This makes things look larger and/or closer, depending on your perspective.

Water affects light in other ways. As you descend, you've probably noticed there's less of it. This is because light reflects off the water's surface, scatters off particles in the water, and the water absorbs it directly. However, water doesn't absorb light uniformly.

White light, such as sunlight, consists of all colors mixed together. As white light travels through water, the water absorbs colors one by one: first red, followed by orange and yellow. Since each color makes up part of the total light, less light remains as depth increases and the water absorbs each color. This makes deeper water darker and less colorful. Red, orange or yellow objects often appear brownish, gray or black. To see more vivid colors on deeper dives, you may want to take an underwater light, which provides unfiltered light and reveals color.



Rainbow.
As white light travels through water, the water absorbs colors one by one: first red, followed by orange and yellow, with green and blue last.

Water also affects sound. You'll quickly realize that the underwater world is not a silent world. You'll hear many new and interesting sounds, like snapping shrimp, grunting fish, and boat engines passing in the distance. Sound travels farther in water than in air, so you'll be able to hear things at distances that you can't in air.

Sound also travels about four times faster in water than in air. This makes it difficult to tell where a sound comes from. Underwater, sound usually seems to come from directly overhead, like listening to a mono recording through headphones.

Unless you use special electronic communications gear, you won't be talking much underwater. You can attract attention vocally, and a few divers can even make themselves under-

standable yelling through a regulator, but you'll usually limit underwater communication by sound to attracting your buddy's attention. The easiest way to do this is to rap on your cylinder with your dive knife or something else solid. Your buddy will hear the rapping, but may have to look around to figure out where the sound comes from.

Heat Loss Underwater

Being cold takes the fun out of diving, and beyond enjoyment, there's the potential for a serious health threat if you get too cold. In air, you lose body heat as it transfers from the skin into the air, and as perspiration cools the skin through evaporation. Water conducts heat about 20 times faster than air does, meaning that for a given temperature, water cools you much faster. In air, 30°C/86°F is warm, but in water it becomes chilly after a while.

Left unchecked, body heat loss can lead to *hypothermia,* a serious condition in which your body cools so much it can't function normally. To avoid this, you use insulation (wet suits and dry suits), especially when diving in water colder than about 24°C/75°F. To stay comfortable, you may want to wear a wet suit in even warmer water.

Exposure suits don't really "keep" you warm, but slow down heat loss enough that you stay comfortable throughout the dive. This means that even with an exposure suit, you will chill if you stay in the water long enough. Continuous, uncontrollable shivering is your body's warning signal that heat loss has reached a critical level.

Quick Quiz — Self Assessment 1

1. Underwater, what you look at will be:
- ☐ a. larger and/or farther away.
- ☐ b. smaller and/or closer.
- ☐ c. smaller and/or farther.
- ☐ d. larger and/or closer.

2. Water absorbs light, causing (check all that apply):
- ☐ a. it to get darker as you go deeper.
- ☐ b. colors to become more vivid with depth.
- ☐ c. colors to become less vivid with depth.
- ☐ d. None of the above.

3. Underwater, sounds:
- ☐ a. don't travel very far.
- ☐ b. are easy to locate.
- ☐ c. often seem to come from directly overhead.

How'd you do?
1. d. 2. a, c. 3. c.

Main Objectives

Underline/highlight the answers to these questions as you read:

4. **How does the rate of body heat loss in water compare to the rate of body heat loss in air?**

5. **What should you do if you begin to shiver continuously underwater?**

Quick Quiz

Self Assessment 2

1. Water absorbs heat about _____ times faster than air.
   - ☐ a. 10
   - ☐ b. 15
   - ☐ c. 20
   - ☐ d. 30

2. Beginning to shiver continuously means
   - ☐ a. you should swim faster to warm up.
   - ☐ b. you should immediately end the dive, dry off and seek warmth.

How'd you do?
1. c. 2. b.

Main Objectives

Underline/highlight the answer to this question as you read:

5. How should you move underwater to compensate for the increased resistance of water?

When you begin to shiver continuously, get out of the water immediately, dry off and seek warmth.

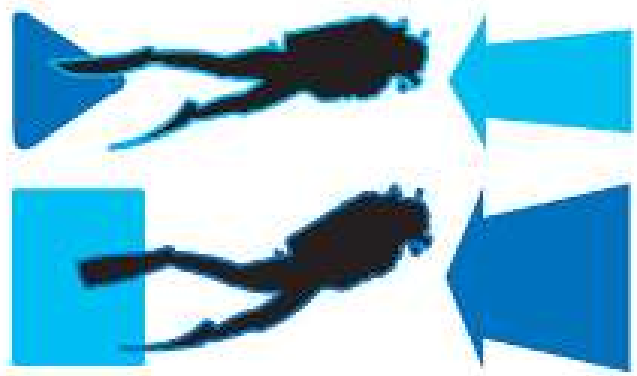
An important point is that modern wet suits and dry suits do an impressive job — even in fairly cool water, you don't have to get cold. If you feel cold while diving, you're probably not wearing enough insulation. Ask your PADI Professional for advice when buying your exposure suit.

Motion in Water

One of the interesting things about diving is that it's exciting and relaxing at the same time. You want to avoid getting out of breath, and there's little reason for hurrying anyway.

Water's density makes it resist movement. If you've ever tried to run in waist-deep water, you've experienced this. So, you conserve energy by moving slowly and steadily. Avoid rapid or jerky movements that waste energy and cause you to use air faster. Take your time and you'll stay under longer and go farther.

Your profile in the water relates to this, too. If you streamline yourself by swimming level and keeping your hoses and equipment tucked in close, you save



Sleek = easy.

Streamlining by swimming level and keeping your hoses and equipment tucked in close saves energy by reducing drag. Wearing more weight than you need pulls your hips down and requires extra air in your BCD, which creates more drag. Your PADI Professional can help with suggestions on streamlining your equipment.

Quick Quiz

Self Assessment 3

1. The best way to move underwater is:

☐ a. as rapidly as possible.
☐ b. slowly and smoothly, relaxed.

How'd you do?
1. b.

Summary Points

In this subsection on Adapting to the Underwater World, you learned:

- ▲ Objects are magnified when you see them underwater, making them look closer and/or larger.
- ▲ Water absorbs light and colors.
- ▲ It's hard to tell sound direction underwater.
- ▲ Water absorbs heat about 20 times faster than air.
- ▲ If you start to shiver continuously, get out of the water, dry off and seek warmth.
- ▲ It's best to move slowly and stay relaxed underwater.

energy because there's much less drag against the water. On the other hand, if you wear more weight than you need, it tends to pull your hips down, and you don't swim horizontally. You need more air in your BCD, which raises your upper body and creates more drag. All of these cause you to use air faster and tire quickly.

Even when you're streamlined and weighted properly, swimming fast or working causes you to tire quickly. Learn to pace yourself, take it easy and relax while diving.

Respiration

You probably noticed that you can't breathe water. Hence the cylinder. But even though you breathe air underwater when you scuba dive, it differs a bit from breathing at the surface. Let's look at why it differs, and how you breathe most effectively while scuba diving.

Breathing Efficiency

Each breath you take contains oxygen, which your body uses to create energy. This is why you need oxygen to live.

MAIN Objectives

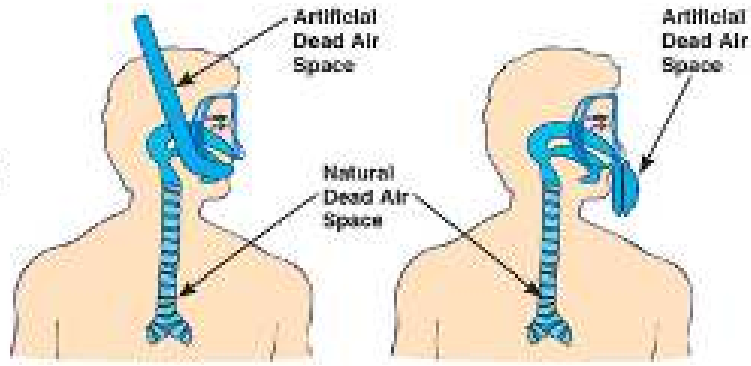
Underline/highlight the answer to this question as you read:

7. How do you breathe underwater for maximum efficiency?

When the air reaches your lungs, your blood absorbs the oxygen and carries it throughout your body as it circulates. It picks up waste carbon dioxide from the cells and returns it to the lungs, so when you exhale, the waste carbon dioxide leaves.

The oxygen and carbon dioxide transfer only within your lungs. The air passages to and from your lungs — your mouth, throat and windpipe — contain air

Dead air.
Your mouth, throat and windpipe contain air that plays no direct part in oxygen and carbon dioxide transfer. These are called dead air spaces. Snorkels and regulators increase the dead air space.



Quick Quiz — Self Assessment 4

1. For maximum efficiency, underwater you should breathe:
   - ☐ a. slowly and deeply.
   - ☐ b. quickly and shallowly.

How'd you do?
1. a.

Main Objectives

Underline/highlight the answers to these questions as you read:

8. **What are eight symptoms of diving overexertion?**
9. **How do you prevent diving overexertion?**
10. **What should you do if you become overexerted while diving — either at the surface or underwater?**

that plays no direct part in oxygen and carbon dioxide transfer. These are called *dead air* spaces. Snorkels and regulators increase the dead air space by increasing the volume of the air passages.

When you inhale, the first air that reaches your lungs is air left in the dead air spaces from your previous breath. This air is high in carbon dioxide. If you take shallow breaths, you inhale proportionately little fresh air and proportionately high carbon dioxide. You essentially re-breathe the air from your dead air spaces. Shallow breathing isn't efficient because so little of the air you move actually takes part in oxygen and carbon dioxide exchange.

On the other hand, with a deeper breath you draw in proportionately more fresh air. This means deep breathing is more efficient breathing. For maximum breathing efficiency, you want to breathe slowly and deeply underwater. When using scuba, inhale and exhale more slowly and deeply than normal — not an exaggerated amount, but a bit more than usual. Breathe the same way when using a snorkel, but you may need to exhale sharply and rapidly from time to time to blow out water.

Overexertion

If you try to maintain an elevated activity level while diving — like swimming against a current, swimming long distances or carrying excessive weight — you may experience *overexertion*. The

Stop!

If you experience overexertion symptoms underwater, stop all activity, breathe deeply and rest. Catch your breath. Hold on to an object for support, if possible, and relax.

symptoms include fatigue, labored breathing, a feeling of suffocation, weakness, anxiety, headache, muscle cramping or a tendency to panic.

Overexertion results when your body demands air faster than breathing can deliver it. This can happen more easily underwater because you're breathing dense air, you're moving against water resistance, and scuba regulators have limits on how much air they can deliver.

Obviously, you want to prevent overexertion. Know your physical limits and pace yourself to avoid breathlessness. Move slowly and avoid prolonged exertion. If you experience overexertion symptoms underwater, stop all activity, breathe deeply and rest. Catch your breath. Any further activity only adds to your body's oxygen demand. Hold on to an object for support, if possible, and relax until your breathing returns to normal.

If you experience overexertion at the surface, establish buoyancy (by dropping weights, if necessary) and stop moving. Rest and catch your breath. Signal for help if necessary. Once you recover, proceed at a slower pace.

Airway Control and Breathing Goals

You'll find that it's not unusual to have a small amount of water in your regulator or snorkel, particularly after clearing it. No problem — you use

Quick Quiz — Self Assessment 5

1. Symptoms of overexertion include (check all that apply):
- ☐ a. labored breathing
- ☐ b. euphoria
- ☐ c. anxiety
- ☐ d. a feeling of suffocation

2. To prevent overexertion (check all that apply):
- ☐ a. wear a lot of weight.
- ☐ b. pace yourself.
- ☐ c. know your limits.
- ☐ d. avoid prolonged heavy exertion.

3. If you become overexerted:
- ☐ a. stop all activity and rest.
- ☐ b. swim rapidly into the current.

How'd you do?
1. a, c, d. 2. b, c, d. 3. a.

MAIN Objectives

Underline/highlight the answer to this question as you read:

11. What are three techniques used for airway control?

airway control to avoid accidentally drawing a few drops into your throat.

Proper airway control means to: 1) Always inhale slowly if water enters your regulator, snorkel or mouth, so you don't pull it into your throat; 2) always inhale cautiously and slowly after clearing your snorkel or regulator; and 3) use your tongue as a splash guard by putting the tip on the roof of your mouth when you breath past small amounts of water. Looking downward slightly helps keep the water in the second stage and out of your mouth. After you breathe slowly past the water, exhale sharply to expel the water from your mouth, regulator or snorkel. With practice, you'll find you can use airway control to breathe past a surprising amount of water.

If you ever accidentally inhale some water, you'll choke and cough a bit. Not to worry, this is how your body keeps water out of your lungs. Stay calm, hold your snorkel or regulator in place with a hand and cough into the mouthpiece as you need to. Each cough helps clear the regulator/snorkel, so you're solving both problems at once. Swallowing may help you to stop coughing, resume breathing and regain airway control. Airway control typically becomes a natural habit with a little experience.

To summarize, your breathing goals underwater: **Always breathe slowly and deeply and continuously when using scuba. Strive to develop airway control.**

Quick Quiz

Self Assessment 6

1. Techniques for airway control includs (check all that apply):
- ☐ a. inhaling slowly if water enters your regulator or snorkel.
- ☐ b. inhaling cautiously after clearing your regulator or snorkel.
- ☐ c. using your tongue as a splash guard.

How'd you do?
1. a, b, c.

Dive Equipment

In the last section, you learned about masks, snorkels, fins, BCDs, cylinders, valves, regulators, and the SPG. That's not a bad start, but as you know there's more. Let's look at exposure suits and their accessories, weight systems, alternate air sources, dive knives, equipment bags and dive instruments.

Summary Points

In this subsection on Respiration, you learned:

- For maximum efficiency, breathe slowly and deeply.
- Overexertion symptoms include fatigue, labored breathing, a feeling of suffocation, weakness, anxiety, headache, muscle cramping and a tendency to panic.
- You prevent overexertion by staying relaxed and knowing your limits.
- If you become overexerted, stop all activity and rest.
- Airway control lets you breathe past small amounts of water.

Form fitting.
Made from colorful Lycra, nylon or a similar material, body suits provide full-length abrasion and sunburn protection. They don't insulate much, so they're primarily worn in tropical waters.

Exposure Suits

Purpose. You'll want to use an exposure suit in virtually all diving activities for two basic purposes: to reduce heat loss, and to protect you from minor scrapes, stings and abrasions.

Styles. You can use three basic styles of exposure suits, each with its own characteristics of how much exposure protection it provides: the body suit, the wet suit and the dry suit.

Body suits — Made from colorful Lycra, nylon or a similar material, body suits provide full-length abrasion and sunburn protection. They don't insulate much, so they're primarily worn in tropical waters. You may wear a body suit to help you slide into a wet suit more easily and for extra warmth in a wet suit. Body suits fit your figure closely, and you can get them in bright colors and patterns.

Wet suits — Wet suits are by far the most common form of exposure suit. You can get them in many styles, patterns and thicknesses, making them suitable for insulation in water as cold as 10°C/50°F to as warm as 30°C/86°F.

Main Objectives

Underline/highlight the answers to these questions as you read:

12. **What are the two reasons for wearing an exposure suit while diving?**
13. **How do dry suits and wet suits insulate divers?**
14. **Why must a wet suit fit snugly?**
15. **What two properties may an exposure suit lose due to increased water pressure at depth?**
16. **What three factors should you consider when selecting an exposure suit?**
17. **What four procedures apply to caring for an exposure suit?**

Exposure Protection Doesn't Mean Reef Protection

When you explore the fragile environment around corals, sponges and other aquatic life without exposure suit protection, you tend to be cautious. After all, you need to watch what you touch to prevent abrasion or a minor sting.

Wearing exposure suits takes away this incentive, which can mean harm to the environment unless you keep its welfare in mind. Hopefully, you wouldn't intentionally kick, kneel on or bump against fragile aquatic life, but exposure suits make it more difficult to tell when you do it accidentally. Realize that even a light touch can harm or kill some organisms. Break a 25 cm/ 10 in piece of branching coral, for example, and you've destroyed over a decade of growth.

By using some simple diving techniques, you can minimize accidental damage:

1. Swim next to the reef rather than above it. This avoids damage from your fin kicks.

2. Watch your buoyancy, and don't dive overweighted. Stay neutral to avoid the tendency to drag along the reef where your legs and feet can destroy things.

3. Turn sideways when you look under ledges. Your cylinder adds some height, and it's not always easy to estimate how much. If you turn sideways, you reduce the likelihood of bashing your tank against the reef.

4. If you need to swim over the reef, swim well above it.

5. Keep your hoses secured and don't let anything dangle.

In general, avoid touching living organisms underwater. Keep in mind that just because you are safe from the reef doesn't mean the reef is safe from you. Visit www.projectaware.org to learn more and download *Ten Ways a Diver Can Protect the Underwater Environment.*

Wet suits reduce heat loss by putting a layer of insulating foam neoprene over your skin. Wet suits get their name because you get wet while wearing them — water enters at the wrists, ankles and neck and gets trapped between your skin and suit.

Your body quickly heats the water, and then as long as it remains trapped, you only lose heat as it radiates slowly through the wet suit material. If water circulates in and out of your suit, however, you lose a lot of heat to incoming cold water. This is why wet suits have to have a snug fit. You can get wet suits in many colors that go with the rest of your kit.

Dry suits — Dry suits can provide more insulation than wet suits by keeping you dry. They provide the most thermal protection of all suits used by recreational divers, and make a noticeable difference in how long you stay comfortable at temperatures of about 18°C/65°F. In water colder than about 10°C/50°F they're the main option for a comfortable dive.

Air conducts heat relatively poorly, so the dry suit insulates you with a layer of air, plus insulating material that may be an undergarment within the dry suit, or the dry suit material itself. Unlike a wet suit, in a dry suit everything between your skin and the water reduces heat loss, and also unlike a wet suit, they fit relatively loosely.

You read earlier that since dry suits create an air space, you need to equalize them just like any other air space. You also need to release expanding air as you ascend. To do this, dry suits fill with air directly from your cylinder via a low-pressure inflator similar to the one on your BCD. This adds another hose to your regulator. Dry suits also have an exhaust valve for releasing air as you ascend.

Versatile.
Wet suits are by far the most common form of exposure suit. You can buy them in many styles, patterns and thicknesses, making them suitable for insulation in water as cold as 10°C/50°F to as warm as 30°C/86°F.

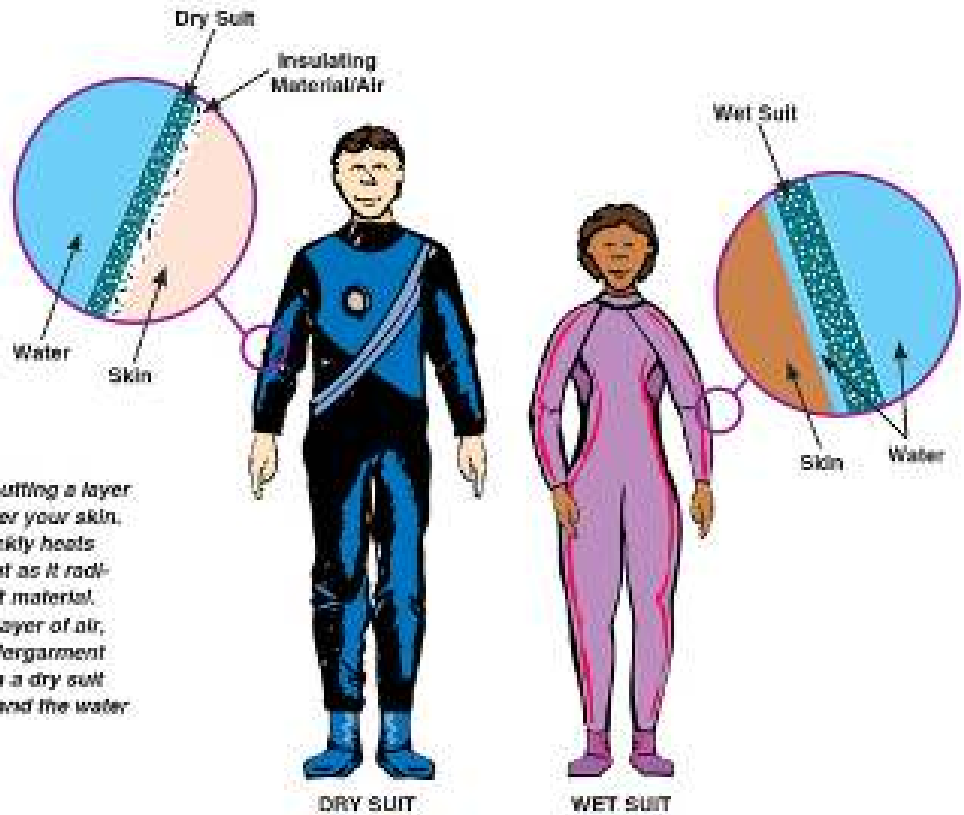
Max Insulation.
Dry suits provide the most thermal protection of all suits used by recreational divers, and make a noticeable difference in how long you stay comfortable at temperatures of about 18°C/65°F. In water colder than about 10°C/50°F they're the main option for a comfortable dive.

Diving with a dry suit isn't difficult, but it requires some special instruction — a short course you can usually complete over a weekend. If you'll use a dry suit during this course, your instructor will orient you to its use during one

of your confined water dives. In any case, remember that cold water *doesn't* take the fun out of diving — *being cold* does. With a dry suit, you can dive in surprisingly cold water in reasonable comfort, which is a good thing because you find some of the best dive sites in water below 15°C/60°F.

Features. Of the three styles of exposure suits, the wet suit has the widest array of available features. This is because of the very diverse environments in which you can use a wet suit. Common wet suit options include length, one-piece or two piece, long sleeve or short, thickness, color, pads for the knees and elbows, pockets, and zipper position. Dry suits also have most of these options, but since they're intended for cooler water, they cover your entire body.

Materials. As mentioned earlier, body suits, which are the simplest exposure suits, are made of thin nylon or Lycra. Wet suits are made from closed-cell neoprene foam lined on both sides by nylon or another material (for strength and appearance). Closed-cell means that the bubbles in the foam differ from sponge foam



How they hold heat.
Wet suits reduce heat loss by putting a layer of insulating foam neoprene over your skin. You get wet, but your body quickly heats the water and you only lose heat as it radiates slowly through the wet suit material. A dry suit insulates you with a layer of air, plus insulating material (an undergarment or the dry suit material itself). In a dry suit every-thing between your skin and the water reduces heat loss.

Suit in a suit.
In addition to a dry suit itself, you need a special undergarment like the one this diver is wearing. The undergarment provides the insulation, and the dry suit keeps you dry.

in that the bubbles don't connect. Neoprene foam won't soak up water like a sponge, nor will water flow through it.

It's the thousands of tiny closed-cells that make wet suits buoyant. If you've not tried it yet, even a partial wet suit has enough buoyancy to float you comfortably at the surface. Without weight to offset the suit's buoyancy, it's quite difficult to get below the surface.

The gas trapped in the neoprene foam bubbles provides excellent insulation, but as you descend, they compress from water pressure. Consequently, a wet suit loses buoyancy and insulation the deeper you descend. You compensate for reduced buoyancy by adding air to your BCD; to stay warm, choose a wet suit based on the depth you'll be diving.

You can find dry suits made from several fabrics, including neoprene. All dry suits have a special watertight zipper and neck and wrist seals to keep the water out.

A neoprene dry suit gets most of its insulation from the neoprene and the air inside it, while dry suits made from other fabrics insulate with special undergarments — in fact, without the undergarments, you'd chill in these dry suits, even in moderately warm water. The advantage is that you can vary the undergarments to suit the temperature, so you can use the same suit whether you're diving in water 24°C/75°F or 2°C/36°F.

Because you fill them with air, dry suits tend to be more buoyant than wet suits. However, with modern suits and undergarments, they're not that much more buoyant in most cases. Another advantage of a dry suit is that with most types, you don't lose buoyancy or insulation with depth. As you go deeper, you add air to the suit, maintaining both normal buoyancy and insulation.

Selection and Purchase. You buy an exposure suit based almost entirely on the environment you intend to dive in. The most important considerations — regardless of whether you choose a body suit, wet suit or dry suit — are warmth (insulating ability), fit and comfort. Fit is especially important with wet suits;

if a stock suit doesn't fit you well, a custom wet suit doesn't cost that much more, yet makes a huge difference in comfort.

Don't underestimate how important your exposure suit will be — your comfort depends on it. Look at the total picture. For instance, the two primary drawbacks of a dry suit are that it's a higher initial investment than a wet suit, and it requires more predive and post dive care. But if you live in a cooler climate, the added insulation may mean you make longer dives, dive for a longer part of the year, and make more dives in a day. Your PADI Instructor, Dive Center or Resort can recommend the best exposure suits for your needs and where you'll be diving.

Preparation. Body suits and wet suits generally require no special preparation before use. Some dry suits do require preparation, however, this varies from suit to suit. Consult the owner's manual included with the suit.

Maintenance. All exposure suits have four basic maintenance steps: 1) rinse, 2) dry inside out, 3) store and 4) lubricate dry suit zippers periodically. Store wet suits on a wide plastic or wooden hanger (not wire); store dry suits folded gently with the zipper on top, or as directed by the manufacturer. Always dry and store suits out of direct sunlight.

Avoid leaving your wet suit tightly folded or

Quick Quiz

Self Assessment 7

1. The two reasons for wearing an exposure suit are (check two):
   - ☐ a. thermal protection.
   - ☐ b. so you can disregard whether you bump into the reef.
   - ☐ c. to protect against minor scrapes, abrasion and stings.

2. A _____ suit insulates you with a layer of neoprene against your skin, whereas a _____ suit insulates you with a layer of air and other insulating material.
   - ☐ a. dry, wet
   - ☐ b. wet, body
   - ☐ c. body, dry
   - ☐ d. wet, dry

3. A wet suit must fit snugly to:
   - ☐ a. maintain streamlining.
   - ☐ b. keep the suit from coming off.
   - ☐ c. minimize water circulation and retain heat.

4. As you go deeper, a wet suit may lose what two properties?
   - ☐ a. fit and comfort
   - ☐ b. buoyancy and comfort
   - ☐ c. buoyancy and insulation
   - ☐ d. insulation and fit

5. When purchasing an exposure suit, you need to consider (check all that apply):
   - ☐ a. fit
   - ☐ b. comfort
   - ☐ c. thermal protection
   - ☐ d. looking really attractive

6. To care for your exposure suit, you should (check all that apply):
   - ☐ a. hang it on a wire hanger.
   - ☐ b. rinse it after each use.
   - ☐ c. dry inside out.
   - ☐ d. store on a hanger (for wet suits).

How'd you do?
1 a, c. 2. d. 3. c. 4. c. 5. a, b, c. d is a consideration, but not a necessary consideration. 6. b, c, d.

packed for extended periods. At the creases the closed-cells collapse, reducing their ability to insulate. Coated-fabric dry suits may stick together if folded or stored too long; storage recommendations for dry suits vary, so consult the manufacturer's literature.

Modern wet suit zippers seldom need lubrication if you rinse them properly after use. You lubricate dry suit zippers with a special zipper wax — never use silicone lubricant on a dry suit. Minor suit repairs can be made easily with special cement available from dive stores.

Exposure Suit Accessories

In cooler water — below about 21°C/70°F — you need exposure protection for your head, hands and feet as well as the rest of you, and you may prefer these in warmer water. You also need to protect your feet and hands from cuts and abrasion. You get this protection through exposure suit accessories — namely hoods, gloves and boots.

Hoods. If you are wearing full-body exposure protection (wet suit or dry suit), but leave your head uncovered, you will lose approximately 75 percent of your body heat through your head. You may want it in warmer water, but you definitely want to consider a hood any time you dive in water below about 21°C/70°F. Hoods provide some abrasion protection as well.

Wet suits, and most dry suits used by recreational divers, use neoprene wet suit hoods. You can choose from a variety of thicknesses in three basic types: bibbed hoods, nonbibbed hoods and hooded vests.

Over head. *Bibbed hoods (right) flare into a broad flange, or "bib" that you tuck under the neck of a wet suit jacket, or into a special collar on some dry suits. Dry suits with insulated neck seals use nonbibbed hoods. (left)*

Bibbed hoods flare into a broad flange, or "bib" that you tuck under the neck of a wet suit jacket, or into a special collar on some dry suits. In wet suits, the bib creates a snug fit between your neck and the jacket and minimizes water circulation. In dry suits, the bib insulates the neck seal to eliminate a cold spot. Dry suits with insulated neck seals use nonbibbed hoods. Some divers use a

MAIN Objectives

Underline/highlight the answers to these questions as you read:

18. **Why do you need a hood and what are the three basic types of hoods?**
19. **Why should you avoid an excessively tight-fitting hood?**
20. **What are two reasons for wearing dive gloves?**
21. **What are three reasons for wearing wet suit boots while diving?**

hooded vest, which gives you all the benefits of a bibbed hood, plus extra insulation for your entire torso.

Divers who live in cooler climates may not select a separate hood at all, but may instead choose an exposure suit with a permanent attached hood. You can find both wet suits and dry suits with this configuration.

A hood that's too tight can constrict blood flow through the neck, which can cause light-headness, and, if you keep the hood on, fainting and unconsciousness. A hood this tight will be uncomfortable, so don't try to endure it and wear it anyway. Purchase your hood based on comfort and fit.

Gloves. Your hands don't have much natural insulation, making them susceptible to heat loss. In colder water, they may become numb and lose dexterity if you don't protect them. You may find it difficult to operate your equipment and perform other safety-related tasks. In warmer water, your hands may soften after you've been in a short time, making them especially vulnerable to scrapes, cuts and stings.

Tender fingers.
You want to protect your hands on virtually every dive. In warmer water, you may use lightweight noninsulating gloves ("reef" gloves, left); in moderately cool water, wet suit gloves provide insulation and protection (center); thick wet suit mitts may be worn in coldest water (right).

So, you want to protect your hands on virtually every dive. In warmer water, you may use lightweight noninsulating gloves ("reef" gloves); in moderately cool water, wet suit gloves provide insulation and protection. In the coldest water, you might want to buy thick wet suit mitts, or with a dry suit, dry gloves (common in commercial diving, but not so common in recreational diving).

Although gloves provide protection, don't treat them as a license to touch anything you want. First, you can still get cut or stung through gloves, and second, your touch can damage or injure aquatic life. Use common sense, and be careful to protect the underwater environment.

Boots. Even if you dive exclusively in tropical waters, you may still want to purchase wet suit boots (also called "booties") for three reasons: Warmth (particularly in water below 21°C/70°F),

Put your foot in it.
Typical boot construction consists of neoprene foam with semirigid soles molded from hard or semihard rubber, with textured surfaces for traction and protection.

protection against cuts, scrapes and bruises while walking to and from the water, and for comfort when wearing adjustable-strap fins.

Typical boot construction consists of neoprene foam with semirigid soles molded from hard or semihard rubber, with textured surfaces for traction and protection. In some models, the sole wraps up over the heel and toe for protection and longer wear. Some boots have side-entry zippers, which helps when putting them on.

Dive boots fit either by shoe size or S, M, L, XL, XXL, etc., and should be comfortable without being excessively large or small. Your instructor, resort or dive center can help you choose properly fitting boots.

Overheating

An important note regarding wet suits, dry suits and their accessories: Because they're such good insulators, out of water on a warm day you can overheat in them. You can follow these points to avoid overheating:

1. Set up all your equipment before putting on the exposure suit. Put the suit on at the last possible moment.

2. Once you have the suit on, limit your activity as much as possible.

Main Objectives

Underline/highlight the answer to this question as you read:

22. In what six ways can you prevent overheating before a dive when wearing an exposure suit?

Quick Quiz

Self Assessment 8

1. You need a hood because as much as _____ percent of body heat loss can occur there.
   - ☐ a. 25
   - ☐ b. 50
   - ☐ c. 75
   - ☐ d. 90

2. A bibbed hood:
   - ☐ a. does not get tucked into a wet suit jacket.
   - ☐ b. is never used with any type dry suit.
   - ☐ c. None of the above.

3. An excessively tight hood:
   - ☐ a. can cause you to faint, so you shouldn't wear it.
   - ☐ b. will be the warmest, so it's the best bet.
   - ☐ c. usually loosens in water, so you'll find it comfortable while diving.

4. You wear gloves for insulation and:
   - ☐ a. to protect your hands.
   - ☐ b. so you can touch anything you want.

5. Wet suit boots (check all that apply):
   - ☐ a. insulate your feet.
   - ☐ b. provide protection against cuts and scrapes.
   - ☐ c. provide comfort with adjustable strap fins.

How'd you do?
1. c. 2. c. 3. a. 4. a. 5. a, b, c.

Quick Quiz — Self Assessment 9

1. To prevent overheating before a dive (check all that apply):
- ☐ a. exercise to promote perspiration.
- ☐ b. put your exposure suit on at the last possible moment.
- ☐ c. keep your hood off as long as possible.
- ☐ d. cool off in the water.

How'd you do?
1. b, c, d.

Main Objectives

Underline/highlight the answers to these questions as you read:

23. What are two types of weight systems?

24. What's the most important feature of any weight system?

25. How do you determine how much weight you need for a dive?

3. Stay out of the sun as much as possible.

4. Keep your hood off, or at least pulled back off your head as long as possible.

5. Leave your jacket unzipped as long as possible.

6. Cool off by entering the water, or spraying down with a hose (common on dive boats) as much as you need.

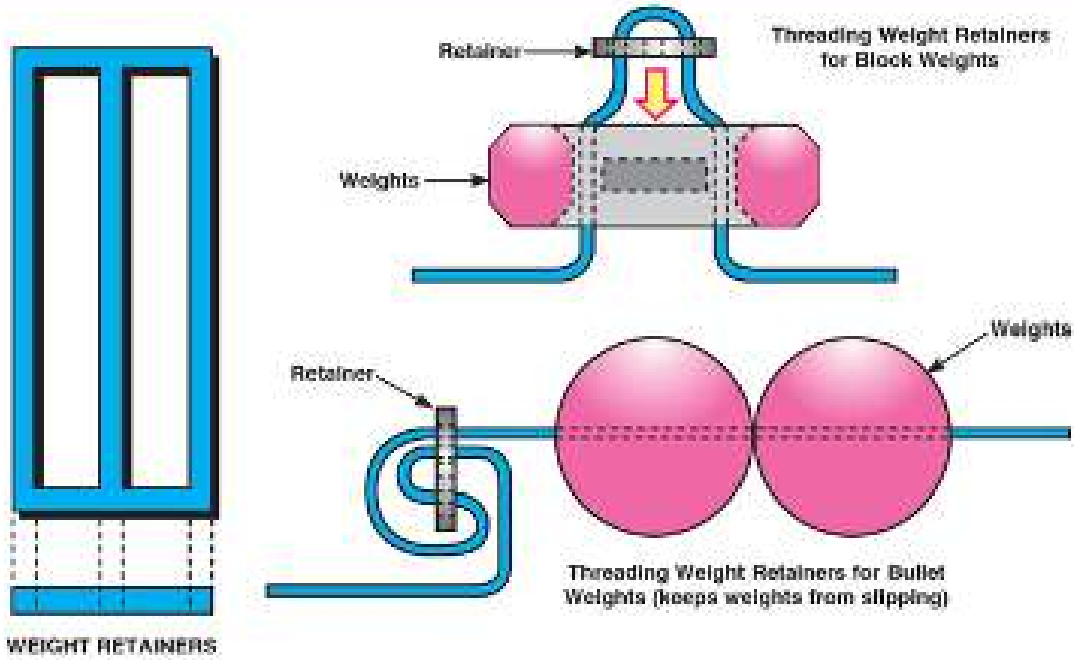
Weight Systems

Purpose. If you ask most people why divers strap lead to themselves, the most likely answer would be, "To make you sink," which would be a logical, common-sense answer. A *wrong* answer, but logical and common sense anyway. If you're like most people, you naturally float, and if you wear a wet suit or dry suit, you **will** float. So, you'll often wear a weight system to *let* you sink — not *make* you sink. This isn't splitting hairs — you want to *just offset* your positive buoyancy, which *allows* you to sink. If you're properly weighted, you do *not* sink like a stone.

Styles, Features and Materials. You can get two basic weight system types: the weight belt, and the integrated weight system. Both use lead weights, and both have a quick release that allows you to release your weight with one hand in an emergency. *The quick release is the most important feature on any weight system.*

Weight belts have the longest history as weight systems; they're the most common, though divers use other weight systems more and more. The typical weight belt consists of 5 cm/2 in nylon webbing threaded with weights and a quick release buckle. Variations include different belt material and pocketed belts that you can adjust more easily. A few belts use lead shot for comfort, either in specific weight pouches, or in one

Setting Up a Weight Belt



If you select a weight belt as your weight system, you'll want to set it up so that it's comfortable, and so the weight stays where you put it. Some divers who wear a lot of weight also put part of their weight in an integrated weight system, and part on a belt, distributed so that ditching either results in ample positive buoyancy in an emergency.

First, determine how long you need the belt to be. The free end should protrude about 15 to 20 cm/6 to 8 inches from the buckle when you're wearing it. You'll probably need to trim yours — but don't do it until you've figured out the right amount of weight you need on it. Alternatively, many weight belt buckles let you take up slack at the buckle end and route it back under the belt. This way you don't have to buy a new belt if you need more weight and length later. If this isn't an issue, trimming the belt eliminates excess webbing.

Either way, measure the belt with all the weights and the buckle on it as it fits around your wet suit. After cutting the belt to the right length, you singe the cut edge to keep it from unraveling. A butane lighter works well for this. Before singeing, you may want to round the corners first, to make it easier to pass the end of the belt through the buckle.

Try to distribute the weights evenly, so the sides mirror each other. Leave a space in the center of your back where the cylinder goes, and leave about 10 cm/4 in clear next to the buckle so you can work it easily. Finally, after you're happy with the weight distribution, use retaining clips so they stay put.

Ballast on board.
Weight belts are the most common weight systems, though divers use other types more and more. The typical weight belt consists of 5 cm/2 in nylon webbing threaded with weights and a quick release buckle. Weight systems usually integrate with the BCD and have a quick release or releases for one hand weight ditching in an emergency.

giant pouch with exactly the weight you need. The latter is very comfortable, but much more trouble to set up.

Weight systems usually integrate with the BCD, though a few integrate with a separate harness you wear under your BCD. They vary widely, but like the weight belt, they also have a quick release or releases for one hand weight ditching in an emergency.

Remember that you need to wear your weight system so it's clear of all other equipment and you can release weight quickly with one hand in an emergency. Note that some integrated weight systems will have *two* quick releases — that's fine because you don't have to be able to release all your weight, but enough weight to assure positive buoyancy in an emergency.

Selection and Purchase. Whether you buy a conventional weight belt or a weight system depends on your preferences, and how much weight you'll need (usually more in cooler water to offset the buoyancy of your exposure suit). It's something to consider when selecting your BCD, since that's where you'd probably have an integrated system.

Preparation. See the sidebar for weight belt basic setup. Integrated weight systems vary, consult the manufacturer literature. An important part of setup is determining how much weight you need. Here's how you do it — you'll practice with your instructor during the confined water dives:

1. Enter the water with all your equipment on and your estimated weight requirement.

2. Keep your regulator in your mouth, and staying at the surface, deflate your BCD and hold a normal breath. Be ready to kick or hold onto something in case you've got too much weight.

3. You should float at eye level. If not, add or subtract weight until you do. You can hold weights while you figure out how much you need, then adjust your weight system.

4. As a final check, exhale. You'll begin to slowly descend if you're properly weighted.

5. If you're using a full cylinder, now add a small amount of weight (usually about 2 kg/5 lbs). Why? Remember, air has weight (that's why it causes pressure). As you use up the air in your cylinder, the cylinder gets lighter. Using a single cylinder, adding about 2 kg/5 lbs compensates so that you'll have about the proper weight at the end of your dive with a near-empty cylinder.

Maintenance. Most weight systems require very little maintenance, aside from a brief rinse after use. Integrated weight systems may have additional requirements, so consult the manufacturer instructions.

Do handle weight systems carefully. Dropping a weight belt can break gear and cause injury. Scuba units with integrated weight systems usually won't stand well, even

Quick Quiz

Self Assessment 10

1. The two types of weight systems are the weight belt and the integrated weight system.
☐ True ☐ False

2. The most important feature of a weight system is:
☐ a. comfort.
☐ b. fit.
☐ c. a quick release.
☐ d. easy adjustment.

3. If you're properly weighted, you will:
☐ a. sink quickly.
☐ b. float at eye level with an empty BCD and holding a normal breath.
☐ c. None of the above.

How'd you do?
1. True. 2. c. 3. b.

on level solid ground, so be sure to lay them down or secure them in place.

Alternate Air Sources

Purpose. If you pay attention to your SPG and plan your dive conservatively, it's unlikely that you'll run out of air underwater. Nonetheless, you need to be able to handle such an emergency; you'll practice a few responses during your confined water dives. Among the most desirable options is to use an alternate air source, which you practiced using during your first confined water dive. An "alternate air source" is any second stage you may use, other than your own primary second stage, to ascend while breathing normally.

Just in case.
The extra regulator second stage is the alternate air source second stage, also called an "octopus." For ease of use, it typically has a hose longer than the primary second stage that you put in your mouth.

Styles and Features. The alternate air sources most recreational divers use require your buddy's help, though you can use some on you own.

Alternate air sources that require another diver include the alternate air second stage and the alternate inflator regulator.

The extra second stage on your regulator is the alternate air source second stage (also called an "octopus") type. For ease of use, it typically has a hose longer than the primary second stage that you put in your mouth.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

26. What's an alternate air source?

27. What two types of alternate air source require the help and cooperation of another diver?

28. What type of alternate air source does not require the help and cooperation of another diver?

29. Why it is important to specially mark an extra second stage used as an alternate air source?

30. How and where should you attach your alternate air source?

One for two.
An alternate inflator regulator combines the functions of a low pressure BCD inflator and a second stage, so you find it on your BCD hose. With this alternate air source, the donor usually gives the buddy the primary second stage and switches to the alternate inflator regulator.

Know where to look.
Mark your alternate air source so your buddy can identify it quickly. Secure the alternate in the triangle formed by your chin and the lower corners of your rib cage.

An alternate inflator regulator combines the functions of a low-pressure BCD inflator and a second stage, so you find it on your BCD hose. With this alternate air source, the donor usually gives the buddy the primary second stage and switches to the alternate inflator regulator.

In either case, with this type of alternate air source, your alternate allows you to assist your buddy, or your buddy to assist you. Obviously, having an extra second stage doesn't do you any good if there's no air in your cylinder.

The pony bottle is an alternate air source that you can use independently. It's a small scuba cylinder normally strapped alongside your main cylinder, with its own regulator. Another alternate air source you can use is the self contained ascent bottle, which is a small air cylinder with a very simple regulator that has just enough air to reach the surface. You usually strap these to your BCD in a special holster. Most divers who have a pony bottle or self contained ascent bottle also have an alternate second stage for sharing air with an out-of-air buddy.

Help yourself.
The pony bottle (upper) is a small scuba cylinder with its own regulator. The self contained ascent bottle (lower) is a small air cylinder with a very simple regulator that has just enough air to reach the surface.

Selection. Most divers prefer alternate air source second stages and alternate inflator regulators because they cost less and have less bulk and maintenance than pony bottles. Some divers, though, prefer the added security that a pony bottle offers in some diving situations. Your instructor can help you choose the most appropriate alternate air source for the type of diving that interests you.

Preparation. Whichever alternate air source you select, you want to make it easy to see and secure it so it doesn't drag. Marking it clearly makes it easy to identify quickly and without confusion in an

Quick Quiz — Self Assessment 11

1. An alternate air source is any mouthpiece, other than your primary, that you can ascend with while breathing normally.
☐ True ☐ False

2. The _____is an example of alternate air source that requires buddy assistance.
☐ a. alternate second stage
☐ b. self contained ascent bottle
☐ c. None of the above.

3. The _____ is an example of an alternate air source that you can use independently.
☐ a. alternate second stage
☐ b. alternate inflator regulator
☐ c. None of the above.

4. It's important to mark your alternate air source clearly so:
☐ a. your dive center can recognize it during servicing.
☐ b. you or a buddy can locate it without confusion in an emergency.

5. You want to secure the alternate air source on the front of either shoulder securely so it doesn't drag but comes loose with a firm tug.
☐ True ☐ False

How'd you do?
1. True. 2. a. 3. c. 4. b. 5. False. Locate it in the triangle formed by your chin and the corners of your rib cage.

emergency. To make it conspicuous, you can select a bright color second stage (yellow is popular) or have a bright color hose, or both. You secure the alternate to your chest in the triangle formed by your chin and the lower corners of your rib cage, which gives you or a buddy quick and easy access to it.

Don't let your alternate air source drag or dangle. This can damage it, and the environment, and it can fill with sand or mud, making it difficult or impossible to use if needed. You want to secure it so that it remains in place, but releases quickly for use with a firm tug. Your dive center should have quite a few devices that do this.

Maintenance. Care for your alternate air source like any other regulator and/or scuba cylinder.

Low Pressure Inflator

Purpose. You're probably familiar with low pressure inflators, which you use to quickly and easily inflate your BCD with one hand. Like the SPG and the alternate air source, the low-pressure inflator is mandatory equipment.

Styles, Features, Materials and Selection. When you select a BCD, it will have a low pressure inflator, so you don't normally have to choose it separately. Although you can get different varieties, operationally most low pressure inflators are more similar than different. An exception might be if you decide to invest in an alternate inflator regulator; most BCDs don't come with these as standard equipment, so your dive center or resort would install it for you.

Main Objectives

Underline/highlight the answer to this question as you read:

31. Why do you need a low pressure inflator?

Preparation. When you get your BCD and regulator, you'll need the low pressure hose installed on your regulator. This should be done by your PADI Dive Center or Resort. The only other preparation is to connect the low-pressure inflator during equipment assembly, which you'll do several times during this course.

Maintenance. Following the normal maintenance procedures for your BCD will cover the maintenance of the low-pressure inflator.

Comes with the package.
When you select a BCD, it will have a low pressure inflator, so you don't normally have to choose it separately. There are different varieties, but most low pressure inflators are similar.

Dive Knives

Purpose. You carry a dive knife or tool so you have a practical tool at hand, for safety and for convenience. Besides the obvious use — cutting — you can measure, pry, saw and pound, always being mindful not to harm aquatic life. Your dive knife isn't a weapon. In some areas, local law prohibit or regulate divers' knives, or prohibit dive centers and resorts from selling them.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

32. Why do you need a dive knife or dive tool?

33. What three features should you consider when selecting a dive knife or dive tool?

Styles, Features and Materials. You can choose from a variety of dive knives, ranging in material, size and features. They differ from other knives primarily in the metal used to make them and the design of the blade and handle. At minimum, a diving knife should: 1) be made from stainless steel (or titanium), 2) have both a sharp cutting edge and serrated sawing edge, and 3) come with a sheath or holder.

Selection and Purchase. Beyond those three minimum features, you may also want to consider the sheath design and where you carry the knife (inside of your calf, on the thigh, arm or weight belt, attached to an instrument console, etc.). Be aware that some coun-

Quick Quiz

Self Assessment 12

1. You need a low pressure inflator
- ☐ a. to allow you to quickly and easily inflate your BCD with one hand.
- ☐ b. to control the BCD inflation pressure to a low setting.

How'd you do?
1. a.

tries require a license for possession of a knife.

Maintenance. Most dive knives are made from stainless steel, but they still rust. Rinse your knife in fresh water after use, and carefully sharpen and clean it as needed according to the manufacturer's instructions. You can choose some higher end dive knives made from titanium, which require less maintenance.

Gear (Equipment) Bags

Purpose. You'll want to buy something to get your dive equipment to the dive site and that something is a gear bag or equipment bag. On a boat, it keeps your equipment together so you don't lose it and so someone else doesn't pick it up by mistake.

Look sharp.
You carry a dive knife or tool so you have a practical tool at hand, for safety and for convenience.

Styles, Features, Materials and Selection. It's tempting to think that any large sack will work, but think again. Dive gear can be heavy and salt water corrodes conventional zippers, quickly destroying luggage not intended for the purpose. Choose your equipment bag by picking one large enough for everything except your cylinder, weights and dry suit if you have one. (Cylinders and weights would damage other gear, and dry suits travel separately because the zipper needs protection.) The bag should be made of heavy-duty fabric that resists rotting and have a large zipper that won't corrode. Many equipment bags have features such as shoulder straps, pockets and padding. A good gear bag isn't cheap,

Quick Quiz — Self Assessment 13

1. You need a dive knife (check all that apply):
   - ☐ a. as a practical tool.
   - ☐ b. for safety.
   - ☐ c. as weapon for self defense.

2. The three features to look for in a dive knife include (check all that apply):
   - ☐ a. smooth edge
   - ☐ b. serrated edge
   - ☐ c. sheath
   - ☐ d. butt cap

How'd you do?
1. a, b. 2. a, b, c.

but will cost less in the long run because it lasts, and because you're less likely to lose or damage the contents. Options include backpack designs that let you carry them hands free, or designs with wheels to make life easier in airports and parking lots.

Quick Quiz

Self Assessment 14

1. You need an equipment bag to carry your gear to the dive site.
☐ True ☐ False

2. The ideal way to pack your bag for diving is:
☐ a. with items of the same color together.
☐ b. in the reverse order in which you will need it.

How'd you do?
1. True. 2. b.

Main Objectives

Underline/highlight the answers to these questions as you read:

34. Why do you need an equipment bag?

35. How do you pack an equipment bag before a dive?

Preparation. You prepare an equipment bag by packing properly. Pack for diving with your equipment in the reverse order in which you'll need it. This way you don't have to pull everything out of the bag to get kitted up. When getting out of your gear after the dive, put it right into your bag to avoid losing it or getting it mixed in with other diver's gear.

Maintenance. Empty and rinse your equipment bag after each use. Allow it to dry before storing it.

Right tool for the job.
It's tempting to think that any large sack will work as a gear bag, but diving quickly destroys luggage not intended for the purpose. Choose your equipment bag by picking one large enough for everything except your cylinder, weights and dry suit if you have one.

Dive Instruments

Since you're not a fish, you don't have instincts that tell you everything you need to know underwater: time, depth, direction, temperature and air supply (not that fish would need an air supply). You use dive instruments to provide this information at a glance.

Underwater timepieces. As you progress through this course, you're going to learn that you can't 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 know how long you've been underwater.

You can time your dive with either a water resistant watch, or with a bottom timer. Underwater watches include analog

MAIN Objectives

Underline/highlight the answers to these questions as you read:

36. **What five types of reference information can you get from dive instruments?**

37. **What are two types of underwater timepieces used for diving?**

38. **Why do you need a depth gauge?**

39. **What is the purpose of a dive computer?**

40. **What are three reasons that you need an underwater compass?**

Where'd the time go?

Underwater watches include analog (time displayed by hands) and digital (time displayed numerically) models. Using an analog watch, you measure elapsed time against a rotating scale (bezel) you set at the beginning of the dive; with a digital watch, you normally use the stopwatch function.

(time displayed by hands) and digital (time displayed numerically) models. Using an analog watch, you measure elapsed time against a rotating scale (bezel) you set at the beginning of the dive; with a digital watch you normally use the stopwatch function. Both types must be checked at the start and end of the dive. In choosing a watch for diving, be sure to choose one that's rated for depth, not just water resistance. Most watches intended for scuba diving have a depth rating of 200 metres or more, and will last for years as they're designed to withstand far greater pressures than recreational divers will ever experience.

Bottom timers are pressure-activated stopwatches that automatically start when you begin your descent, and stop when you return to the surface. Today, most modern bottom timers are digital and track your time between dives (you need to know that, too). The majority combine with digital depth gauges or dive computers into a single instrument.

Handle underwater timepieces with care, and rinse them after each dive. Most modern timepieces are fairly maintenance-free beyond that; consult the manufacturer instructions.

Depth gauge. As mentioned, you have time limits based on depth, so you need to know how deep you are. For that, you need a depth gauge, which you can find in a wide variety of types, styles and price ranges. Like underwater timepieces, there are both analog and digital models, with the electronic digital types the most popular today. Depth gauges are considered mandatory dive equipment.

Treat your depth gauge like any other precision instrument. Protect it from rough handling and rinse it after each dive, following the manufacturer's instructions. Some analog depth gauges can be damaged by exposure to the reduced pressures at altitude. Keep your depth gauge out of prolonged direct sunlight.

Dive computers. Dive computers are by far the most common dive instruments and have become standard equipment. Your computer is usually one of your first equipment investments. Your computer combines your depth

Three gauges in one.
Dive computers combine your depth gauge, timer and sometimes your SPG into a single instrument that reads the data and computes the remaining allowable dive time you have at any point. You can choose from a wide variety.

Find your way.
A dive compass will be liquid-filled to make it pressure resistant, and to help stabilize the compass needle. The preferred type of compass has a reference mark called the lubber line and index markers that you align over the compass needle to maintain a directional heading.

Just how warm is this water?
You can get a thermometer as a separate instrument, but today they're more commonly part of your SPG.

gauge, timer and sometimes your SPG into a single instrument, but this is far more than to make a convenient package. Your dive computer applies depth and time information to a decompression model to keep track of nitrogen that dissolves into your body during a dive, and in so doing constantly tells you the time you have remaining. This can be done with tables (you'll learn how), but your dive computer does it more efficiently so you have more dive time, as well as more conveniently. Dive computers give you more freedom in the way you dive, making them one of the most significant advances in dive equipment. You'll learn more about using dive computers in Sections Four and Five. Your PADI Professional can help you choose one suited to you and where you'll be diving.

Compass. A compass helps you know where you are and where you're going, which is useful because being underwater can throw off your sense of direction. Having and using a compass lets you follow a designated course, find your way to the exit, and know where you are at all times. Sometimes it comes in handy at the surface, such as in low-visibility conditions like fog.

A dive compass will be liquid-filled to make it pressure resistant, and to help stabilize the compass needle. The preferred type of compass has a reference mark called the *lubber line* and index markers that you align over the compass needle to maintain a directional heading. You'll learn a bit about compass navigation later on in the course.

As with other dive instruments, rinse your compass after each dive, avoid dropping it and keep it out of direct sunlight.

Thermometer. Although not an essential dive instrument, a thermometer makes diving more comfortable by giving you a temperature reference. With experience, you learn how much exposure protection you need for a given temperature, making it easier to plan a comfortable dive. You can get thermometers as separate instruments, but today they're more commonly part of one of your other gauges, such as your SPG.

Altogether.
Consoles put instruments in one place, which reduces your gearing up time, since you don't need to strap anything on. On the other hand, some divers find wearing gauges on the wrist more effective for streamlining because a console is relatively large compared to an SPG alone, making consoles more likely to protrude.

Submersible Pressure Gauge (SPG). You learned about the SPG in Section One, but it's repeated here because it's a mandatory instrument for diving, so it would be odd not to at least mention it while discussing dive instruments.

Instrument consoles. You can wear dive instruments individually on your wrist, or you can combine them into a single console attached to your SPG. Consoles put everything in one place so you get all your information at a glance. They also reduce your gearing up time, since you don't need to strap anything on.

On the other hand, some divers find wearing gauges on the wrist more effective for streamlining. A console is relatively large compared to an SPG alone, making consoles more likely to protrude or dangle. Gauges on your wrist can't dangle.

Quick Quiz

Self Assessment 15

1. The reference information you get from dive instruments includes (check all that apply):
   - ☐ a. time
   - ☐ b. temperature
   - ☐ c. direction

2. Underwater timepieces can be (check all that apply):
   - ☐ a. dive watches
   - ☐ b. bottom timers
   - ☐ c. lap timers

3. You need a depth gauge because
   - ☐ a. local dive regulations require one.
   - ☐ b. underwater time limits relate to depth.

4. A dive computer provides an underwater library reference, such as a giving you facts about aquatic life.
   - ☐ True ☐ False

5. Reasons for having an underwater compass include (check all that apply):
   - ☐ a. monitoring your air supply.
   - ☐ b. determining where to find your exit point.
   - ☐ c. following a course.

How'd you do?
1. a, b, c. 2. a, b. 3. b. 4. False. A dive computer determines your dive time remaining based on your depth and the elapsed dive time. 5. b, c.

Main Objectives

Underline/highlight the answers to these questions as you read:

41. What are two ways of gaining the attention of another diver underwater?

42. What are two ways of communicating with another diver underwater?

43. What are the 25 standard hand signals (visually) and what does each mean?

44. What should you do if you get an underwater recall?

Buddy System: Communication and Procedures

Section One introduced you to the buddy system, and how it's important for safety and fun. Let's look at some of the ways you communicate with your buddy underwater, and some of the procedures for an effective buddy system.

Communication

Sound travels well in water, but voice communication isn't an option without electronic communication systems. As a result, you do most of your talking with your hands — by signaling or writing on a slate.

Gaining attention. For hand signals to do any good, your buddy has to look at you. This means you tap your buddy's shoulder or rap on your cylinder to get attention. Don't startle your buddy when you do this.

Speak in gesture.
You do most of your talking underwater with your hands — by signaling.

Signals. After gaining your buddy's attention, you can communicate by writing on a slate or by using hand signals. The primary drawback to using a slate is that writing takes a lot of

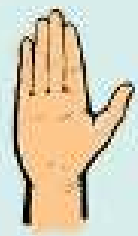
Summary Points

In this subsection on Dive Equipment, you learned:

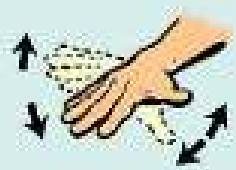
- Wet suits and dry suits insulate you, but differ in that you get wet in a wet suit and stay dry in a dry suit.
- You should avoid wearing an excessively tight hood.
- You want to wear gloves while diving for thermal protection and to avoid cuts, scrapes and stings.
- Although you're protected (to a large extent) from the environment, remember that the environment isn't protected from you — use care to avoid damaging aquatic life.
- Be cautious to avoid overheating in your exposure suit.
- The most important feature in a weight system is the quick release.
- Locate your alternate air source in the triangle formed by your chin and the corners of your rib cage.
- Look for a dive knife with both smooth and serrated edges and a sheath.
- You need dive instruments to tell you depth, direction, temperature, time and air supply.

Common hand signals.

Signals may vary somewhat, so review them when planning a dive with a new buddy.



1. Stop, hold it, stay there



2. Something is wrong

OK? OK.

4. OK? OK. (glove on)

5. Distress, help

6. OK? OK. (on surface at distance)

7. OK? OK. (one hand occupied)

8. Danger

9. Go up, going up

10. Go down, going down

11. Low on air

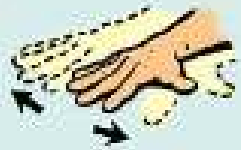
12. Out of air

13. Share air

14. Come here

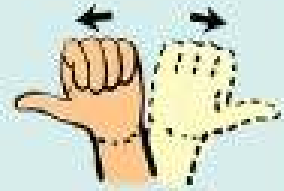
15. Me, or watch me

16. Under, over, or around



17. Level off, this depth

18. Go that way



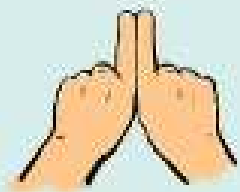
19. Which direction?

20. Ears not clearing

21. I am cold

22. Take it easy, slow down

23. Hold hands



24. Get with your buddy

25. You lead, I'll follow

time, so you'll use hand signals when you can. The illustrations show standard underwater hand signals (take a few minutes to learn them — they're pretty intuitive), plus you and your dive buddy can invent and improvise some as needed. Because signals vary somewhat, review them when you dive with a new buddy for the first time or two.

Quick Quiz

Self Assessment 16

1. To get your buddy's attention underwater you can touch your buddy or:
☐ a. rap on your cylinder.
☐ b. blow your whistle.

2. The two methods of communicating underwater are using a slate and:
☐ a. hand signals.
☐ b. Morse code.

3. Identify the following:

a. _____ b. _____ c. _____

4. If you receive an underwater recall, you should:
☐ a. swim to the boat immediately.
☐ b. cautiously surface and look to the boat for instructions, or as directed in the briefing.

How'd you do?
1. a. 2. a. 3. a. okay, b. let's go up, c. out of air. 4 b.

Communication at the surface. Sometimes you need to communicate with someone on shore or a boat while you're at the surface. You can use hand or audible signals. The illustrations show some of the common hand signals, and as you can see, waving means "HELP!" So don't wave as a greeting. To get attention, you'll want to carry a whistle as standard equipment. A whistle carries a long way and gets attention without expending much energy (as opposed to yelling). Attach it to your BCD hose where it's out of the way, but easy to get to and use. You can also get a whistle/horn powered by your low pressure hose; they're quite loud, but it's a good idea to carry a regular whistle, too, in case you need to signal but have no air left in your cylinder.

When at the surface, be cautious regarding boats and boat traffic. Many divers carry inflatable signal tubes that alert boats to their presence at the surface. They're also useful when trying to get the attention of someone on a boat or shore at a distance.

Underwater recall. Most dive charter boats have a recall procedure to get your attention while underwater, which can include electronic underwater sirens, banging on something metal, starting and revving the boat engine and other methods. The crew will explain the recall during the briefing. If you get the recall, cautiously surface and look to the boat for instructions. Don't swim toward the boat until the captain signals that it's okay to do so. Depending on the circum-

stances, the boat crew may brief you on slightly different procedures for a recall.

Have a plan.
You and your buddy should plan your dive together and dive your plan together.

Buddy System Procedures

In Section One, you learned your responsibility as a buddy includes helping your buddy avoid problems and assisting when needed. You provide "extra" eyes and hands for your buddy, and vice versa. There are nine specific points to agree upon with your buddy to coordinate your efforts and optimize both your safety and enjoyment.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

45. What nine considerations should you discuss with your buddy when planning a dive?

46. What are the steps of the Predive Safety Check?

47. If you lose contact with your buddy underwater, what should you do?

1. Agree on appropriate entry and exit points and techniques.
2. Choose a course to follow.
3. Agree upon time and depth limits.
4. Establish and review communications.
5. Establish a returning air pressure.
6. Discuss the technique you'll use to stay together.
7. Agree on what to do if separated.
8. Discuss emergency procedures.
9. Agree on your dive objective. "Let's just look around," is as much of an objective as you need, but check that your buddy has the same objective.

Begin — B — BCD

With — W — Weights

Plan your dive together and dive your plan together. Before each dive, run through each other's equipment using the predive safety check. Use the phrase **Begin With Review And Friend** to help you remember the checks:

Begin — **B** — **BCD** — Check adjustment, operation, low pressure inflator connection, and that cylinder is firm in the band. If appropriate for the entry technique, make sure it's partially inflated.

With — **W** — **Weights** — Check for proper weighting, and that the quick release system is clear for ditching. Weight belts should have a right hand release.

Review — **R** — **Releases** — Make sure you're familiar with your buddy's releases and how they work. Check each other to make sure they're secure.

And — **A** — **Air** — Confirm that you both have ample air for the dive, that your valves are open, that regulators and alternate air sources work, and that you know where to find and how to use each other's alternate air sources.

Friend — **F** — **Final Okay** — Give each other a final inspection looking for out of place equipment, dangling gauges, missing gear, etc.

Review — R — Releases

And — A — Air

Friend — F — Final Okay

Make a habit of performing this check — with experience you'll do it quickly and almost intuitively. If it helps you remember, make up your own recall statement for BWRAF.

During the dive, you and your buddy need to stay together so you can lend assistance to each other if necessary, not to mention because it's more fun. Ideally, stay within a couple metres/a few feet of each other. Staying together is easier if you agree on who will lead, your relative positions, and the general course to follow until you both acknowledge a change. If separated, the general guideline is to search for each other for not more than one minute, then surface and get back together. In some instances it may be better to avoid surfacing to reunite. If this applies on a particular dive, it's important to agree on another course of action that reunites you within a few minutes.

The buddy system only works when divers stay together. **Remember: It's *your* responsibility to stay with your buddy and follow the rules, guidelines and recommendations for each other's dive safety.** No one can do it for you.

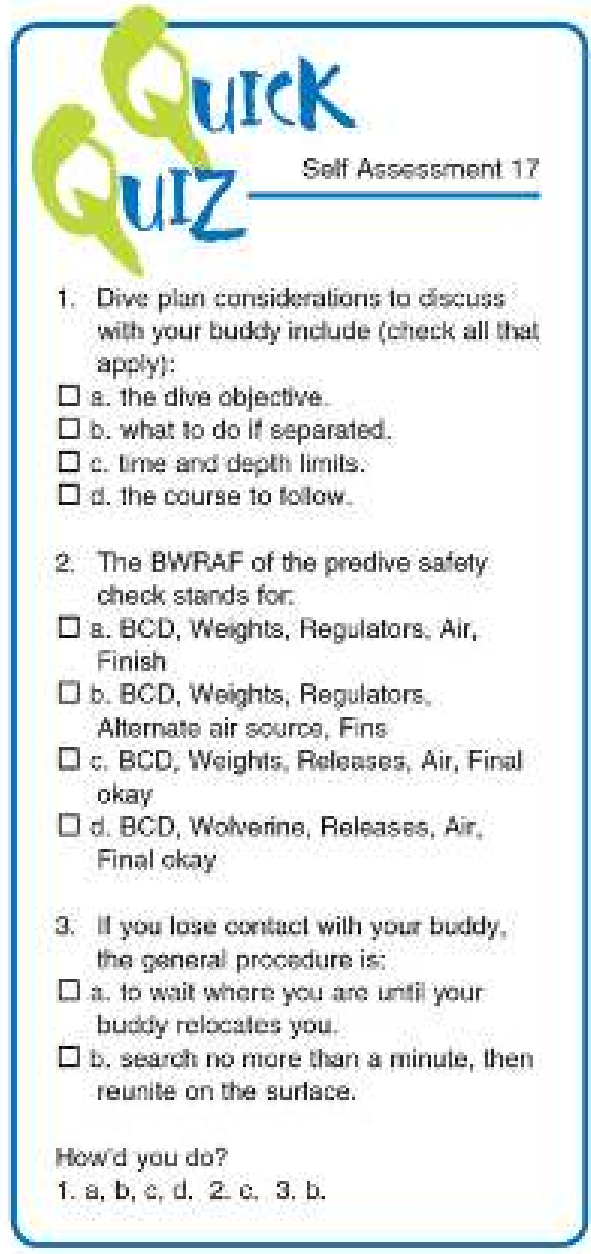
Confined Water Dive Preview

Predive Safety Check

As you just read, you perform the predive safety check with your buddy before each dive. Starting in this confined water dive, you and your buddy will practice the check before each entry. By the time you finish the course, you should have run through it many times. Remember **BWRAF** — **B**CD, **W**eights, **R**eleases, **A**ir and **F**inal okay.

Entering the Water

Different types of dive sites have different types



of entries — and different divers may even use different entries at the same site. In general, the best entry is usually the easiest. If you can wade or lower yourself in, that's usually better than a long drop. The idea is to enter without becoming disoriented or knocking any equipment loose. Some general rules for entries include:

1. Be sure the entry area is clear so you don't hit anything or anyone getting in.

Confined Water Dive Two

Skill Requirements

Here's what you'll be able to do when you successfully complete Confined Water Dive Two:

1. Perform the predive safety check.
2. Demonstrate appropriate deep-water entry(s).
3. Clear a snorkel of water by using the blast method and resume breathing through it without lifting the face from the water.
4. Exchange snorkel for regulator and regulator for snorkel repeatedly while at the surface without lifting the face from the water.
5. Swim a distance of at least 50 metres/yards at the surface, while wearing scuba and breathing through the snorkel.
6. Demonstrate a descent using the appropriate five step method.
7. Completely remove, replace and clear the mask of water while underwater.
8. Breathe underwater for not less than one minute while not wearing a mask.
9. Demonstrate the response to a leaking low pressure inflator by disconnecting the low pressure hose from the inflator mechanism.
10. At the surface in water too deep to stand in, orally inflate a BCD to at least 1/2 full and then fully deflate it.
11. Adjust for proper weighting, which is defined as floating at eye level at the surface with an empty BCD and holding a normal breath.
12. React to air depletion by giving the out-of-air signal in water too deep to stand up in.
13. Demonstrate an ascent using the appropriate five step method.
14. Remove weights at the surface with minimal assistance using the weight system's quick release mechanism.
15. In water too deep to stand up in, remove the weights, scuba unit and fins (if necessary), then exit using the most appropriate means. (Buddy assistance may be provided.)

2. If entering water too deep to stand in, have your BCD about half-inflated so you'll be buoyant.

3. Be sure your buddy is prepared to enter, too.

4. Hold your mask so the water doesn't knock it off. This isn't an issue with some types of entries.

5. After entering, signal that you're okay and clear the entry area to wait for your buddy.

Safety starts with a check.
Beginning in this confined water dive, you and your buddy will practice the predive safety check before each entry. By the time you finish the course, you should have run through it many times. Remember BWRAF — BCD, Weights, Releases, Air and Final okay.

You can use *the controlled seated entry* to enter from a platform just above the water — like a dock, boat swim step or pool side. Sit on the platform with your feet dangling in the water. Turn slightly and reach across yourself with one arm so you place both hands on the platform on the same side. Then, using your arms for support, gently pivot so you turn and face the platform as you lower yourself into the water. Once in and comfortable, let go of the platform and clear the entry area. Because you use your arms for this entry, it may be a useful entry technique if you have a physical challenge that limits leg use.

In easy.
You can use the controlled seated entry to enter from a platform just above the water — like a dock, boat swim step or pool side.

When you must enter the water from a raised platform such as a boat, wall or pier, you may use a *giant stride entry*. To do this, secure your equipment, check that your BCD is about half-inflated, place your regulator in your mouth and hold your mask tightly in place. When your buddy's ready, check the area below, then simply step out with one foot.

Keep your legs spread until they hit the water, then pull them together in an upward kick to minimize how far you sink. Once in the water, give the okay signal and clear the entry area for your buddy.

You'll practice the controlled seated entry, the giant stride and/or other appropriate methods for entering water deeper than you can stand in.

Snorkel Breathing and Blast Clearing

During this confined water dive, you'll start making a habit of using your snorkel to save energy and rest at the surface without wasting cylinder air. If you're not used to using a snorkel, there's not much to it: breathe slowly and deeply. Bite gently on the mouthpiece, letting your lips seal around it and hold it in place. When you put the snorkel in your mouth exhale before inhaling, and inhale cautiously, just in case there's some water in it.

Blast!
To clear water from your snorkel, simply exhale forcefully and sharply into it.

To clear water from your snorkel, such as you'll typically do when you surface and switch to it from your regulator, simply exhale forcefully and sharply into it. This "blasts" the water out of the barrel through the top and through the self drain valve. The "blast method" of clearing will remove nearly all the water from the snorkel. Use airway control to carefully breathe past any small amount left, and then clear it with a second blast.

Remember: When using the blast method to clear a snorkel, the exhalation must be quick and forceful, as though you are shooting a giant pea-shooter. Use this method to clear any water sloshing into the snorkel while swimming at the surface.

Snorkel clearing becomes automatic and easier with experience. Keep in mind that if there's some water left in the snorkel, by inhaling slowly and using airway control, you can "bubble" the air through the water until you have enough air for another blast.

Snorkel/Regulator Exchanges

Quite often you'll snorkel on the surface to the place where you want to dive so you don't waste air on the way. When you get there, you exchange your snorkel for your regulator. Since you can have waves or chop in the ocean or a lake, you may effectively have to do this with your face in the water. So during this confined water dive, you'll simulate this by keeping your face in the water as you switch between your snorkel and regulator.

Find your regulator and hold it in your right hand. Take a breath and then with your left hand, remove your snorkel from your mouth, put in your regulator (right hand), clear it and begin breathing. Face in the water — no cheating. When you surface after your dive, you exchange your regulator for your snorkel. To practice this, do the opposite. Take a breath, remove your regulator with your right hand and replace it with your snorkel in the left. See why you wear your snorkel on the *left* side? Blast the water from your snorkel and inhale cautiously as you resume breathing. Blow small bubbles during the exchange so you reinforce the habit of never holding your breath with scuba.

You'll practice exchanging your regulator and snorkel until you can do so with minimal effort, which is to say, until it's boring. But that means you know it.

Right, left. Left, right.

Practice exchanging your regulator and snorkel with your face in the water. This prepares you for doing so in open water, where the surface may not be as calm.

Surface Snorkeling

During this confined water dive, your instructor will have you practice swimming on the surface while snorkeling with scuba equipment. Watch your body position. Keep your arms at your side and the top of the snorkel out of the water. Swim slowly and relaxed with your fins below the surface for maximum efficiency. This may be easier if you look ahead, not down. You may find it easier to swim on your side or backward (you may need to readjust the snorkel tip to keep it out of the water).

Descending

Descending has five steps that you'll start practicing during this confined water dive:

1. You and your buddy signal that you're 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 or start your stopwatch. If

you don't have an underwater watch, 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 don't need to be straight up and down like you're saluting a general or something, but staying in a generally head up position helps you stay oriented and makes it easier to equalize.

Watch your buoyancy.
Control your descent so you can stop or ascend at any time. Pay attention to your lung volume and add air to your BCD to offset buoyancy lost to wet suit compression. Descend slowly, keeping your fins beneath you so you can kick upward if you need to.

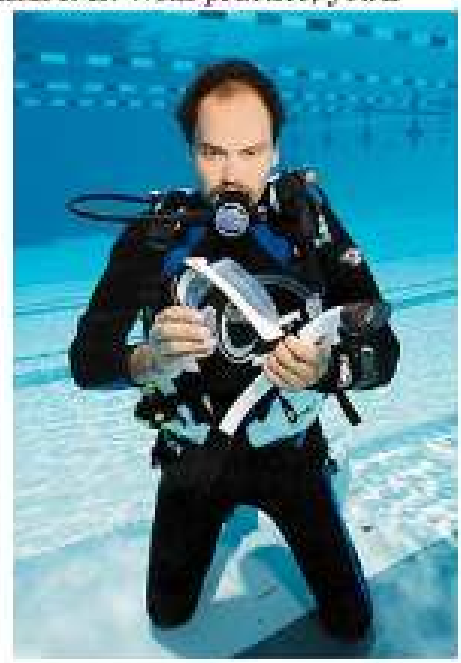
Always control your descent so you can stop or ascend at any time. Pay attention to your lung volume and add air to your BCD to offset buoyancy lost to wet suit compression. Descend slowly, keeping your fins beneath you so you can kick upward if you need to.

No-mask Breathing

It doesn't happen often, but it's possible for you to lose your mask, so you need to be able to breathe and swim with your nose exposed to the water. This may sound more difficult than it is. With practice, you'll easily be able to breathe through your mouth with no mask on while keeping water out of your nose.

At first, you may find it easier to inhale through your mouth and exhale through your nose. After you're comfortable with that, practice inhaling and exhaling through your mouth only. If it feels like water's entering your nose, just exhale slightly through it to push the water out. Water won't go in your nose by itself unless you turn upside down or tilt your head back. If you need to look up without your mask on, exhale through your nose while you do it.

With a little practice, you'll discover that breathing without a mask is as easy as breathing with one. Your instructor will have you do this for



No sweat.
With a little practice, you'll discover that breathing without a mask is as easy as breathing with one. Your instructor will have you do this for one minute, which would be long enough to reach the surface on a typical dive.

one minute, which would be long enough to reach the surface on a typical dive. That way you can be confident you can surface under control if you lose your mask and can't relocate it.

Mask Replacement

If you lose your mask underwater, chances are you'll find it or your buddy will hand it to you, and you'll put it right back on. First, put the mask on your face, making sure there's no hair or the edge of your hood trapped under the skirt. Otherwise, it will leak.

Make sure the strap is out of the way by looping it forward over the back of the hand holding the mask. Once you have the mask properly positioned and the skirt unobstructed, either immediately clear the mask like you did in the first confined-water dive, or replace the strap and then clear it. Some people find that replacing the strap first makes mask clearing a little easier; others find that clearing the mask before replacing the strap helps them be sure they've properly seated the mask. Use whichever works best for you.

Strap on.
After replacing your mask, you may find that replacing the strap first makes clearing a little easier, or you may find that clearing the mask first, then replacing the strap is easier.

Disconnecting the Low Pressure Inflator Hose

If your BCD (or dry suit) inflator mechanism were to stick or leak, it could begin inflating your BCD (or dry suit) by itself. To stop this, you disconnect the low pressure hose and then end the dive. To simulate a sticking inflator, your instructor may have you hold down the inflation button with one hand, while you disconnect the low pressure hose with the other. Remember to reconnect the hose after the exercise.

Inflating Your BCD Orally

In Confined Water Dive One, you learned to inflate your BCD using the low pressure inflator. During this session, you'll learn to do so orally. You might orally inflate it if you had no air in your cylinder, or if you had a problem with the low pressure inflator and disconnected it. To orally inflate the BCD:

1. Take a breath.

2. Place the mouthpiece on the BCD hose in your mouth.

3. Open the valve by pressing the same button you use to release air.

Good ol' lung power.
To orally inflate the BCD, take a breath and blow two thirds into the BCD hose, then release the valve button. Your mouth doesn't have to be above water while you blow.

4. Blow about two thirds of the air in your lungs into the BCD hose.

5. Release the valve button.

Your mouth doesn't have to be above water while you blow. In fact, you save energy if it's not — simply lift your chin to take a breath, then relax with your face back in the water as you blow into the BCD mouthpiece. Lift your face to take the next breath, and repeat until you have sufficient buoyancy to stay up without kicking. Release the valve button between breaths; otherwise the water pushes the air back out and you'll never get it inflated.

Proper Weighting

Your instructor will have you adjust your weight using the method you learned earlier in this section:

1. Enter the water with all your equipment on and your estimated weight requirement.

2. Keep your regulator in your mouth, and staying at the surface, deflate your BCD and hold a normal breath. Be ready to kick or hold onto something in case you've got too much weight.

3. You should float at eye level. If not, add or subtract weight until you do. You can just hold weights while you figure out how much you need.

4. As a final check, exhale. You'll begin to slowly descend if you're properly weighted.

5. If you're using a full cylinder, now add enough weight to offset the weight of the air you use during the dive (usually about 2 kg/5 lbs with a single cylinder).

Your instructor will help you get your weight set.

Air-Depletion Exercise

Watch your SPG regularly and you should never find yourself running out of air. Nonetheless, you should know what it feels like when you're running out of air so you have as

The eyes have it.
When you're properly weighted, you should float at eye level with an empty BCD and while holding a normal breath.

Gasp?
To simulate low air, your instructor will close your cylinder valve as you continue to breathe. When you have difficulty getting a breath, signal out-of-air, and your instructor will immediately reopen the valve. Resume normal breathing.

much advance warning as possible.

To simulate low air, your instructor will sit in front of you and close your cylinder valve as you continue to breathe from your regulator. You'll feel the breathing effort gradually increase until you have difficulty getting a breath. At that point, signal out-of-air, and your instructor will immediately reopen the valve. Resume normal breathing.

Naturally, you want to avoid an out-of-air situation by always keeping an ample reserve supply. You may need this air to retrieve something you drop after surfacing, and to make sure you don't completely drain your cylinder. As a rule of thumb, plan to surface with *at least* 20-30 bar/300 psi in your cylinder. Many divers reserve about 35 bar/500 psi; the smaller the cylinder and the more complex the dive, the more reserve you want to keep. With proper planning, you should be able to make a slow, comfortable ascent, a three-minute safety stop at 5 metres/15 feet, and reach the surface without using your reserve. This is one of the marks of a good diver.

Ascents

Building on what you practiced in Confined Water Dive One, a proper ascent has five steps that you learn and practice starting in this confined water dive:

1. You and your buddy signal each other and agree to ascend.

2. Note the time of your ascent. (If you don't 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 don't run into anything) and hold up the BCD hose with exhaust control with your left. As you'll see, air expanding in your BCD during ascent increases 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.

Out easy.
To exit the water onto a low platform or small boat without a ladder, you may remove your weights and scuba gear at the surface, then lift yourself out.

5. Swim up slowly, at a rate no faster than 18 metres/60 feet per minute (slower is fine), while breathing normally.

As soon as you and your buddy reach the surface, inflate your BCDs so you can float comfortably and effortlessly. Make a habit of keeping your regulator in your mouth until you've inflated your BCD.

Weight Removal at the Surface

In an emergency at the surface, your first reaction should be to be sure you can float. You'd usually do this with your BCD and low pressure inflator, but if that doesn't work (such as if you had an empty cylinder), your next option would be to ditch your weights. So that you're familiar with this, your instructor will have you practice using your weight system quick release.

With a weight belt, reach down with your right hand, flip the release, grasp the free (no buckle) end and pull the belt clear of your body. That way you know it won't hang up when you drop it. During this practice session, your instructor may ask you *not* to actually drop your weight (such as if it would damage the pool), or your instructor may have you drop it. Either way, before removing your belt be sure there are no divers beneath you who could be hurt by falling weights.

If you're using a weight integrated system, you'll use the system's quick release. However, depending on the system configuration, to prevent pool damage, your instructor may remove all but one or two weights and have someone catch them as they release, or have you practice this in shallow water.

Deep Water Exit

At times you might need to remove your weights, scuba unit and (perhaps) fins to exit the water — like when diving from a small boat. Since you already took your weights off in the last skill practice, your instructor will probably have you learn to do this next.

First, remove your weight system (if you haven't already; if you have a weight integrated BCD, the weights can usually stay in for exiting) and hand it to your buddy, or place it up on the pool deck. Next, slide out of the scuba unit — it is usually easiest to slide it off one shoulder first. Make sure you put enough air in it so that it doesn't sink, then hold it for your buddy to pull up on the deck.

Remove your fins last, if necessary. On a low platform, you may find it easier to leave them on because you can kick as you lift yourself out. If you must remove your fins, to climb a ladder for example, make sure you have solid contact with something so you won't drift away from the exit. In open water, try to exit when the waves will help lift you onto the platform, boat or rocks.

Knowledge Review

Chapter 2

1. Check one. "Underwater, objects appear _____ , making them seem _____ and/or _____ ."

   ☐ a. minimized, smaller, further away ☐ b. magnified, larger, closer

2. Check one. "Since it travels about four times faster in water than in air, you will have difficulty determining the origin of _____ underwater."

   ☐ a. light ☐ b. sound

3. Fill in the blank with the appropriate word: faster or slower.
   "Water conducts heat away from your body _____ than air does."

4. Describe what you should do if you begin shivering continuously underwater.

_____

_____

5. Of the procedures you can follow to compensate for the increased resistance of water while diving, check those listed here:

   ☐ a. Streamline yourself and your equipment.
   ☐ b. Avoid rapid jerky movements.
   ☐ c. Move slowly and steadily.
   ☐ d. Pace yourself.

6. Check the statement that best describes the proper breathing pattern for diving.

   ☐ a. Consistently rapid and shallow.
   ☐ b. Consistently slow and deep.

7. It is easy to prevent overexertion while diving. Check the proper preventative measures listed here.

   ☐ a. Move slowly and avoid extended strenuous activity.
   ☐ b. Use your arms rather than your legs for propulsion underwater.
   ☐ c. Know your physical limits.

8. Explain what to do if you become overexerted while diving.

   a. Underwater:

_____

   b. At the surface:

_____

9. Check each statement that describes a technique used for airway control:

- ☐ a. Use your tongue as a splash guard by placing the tip on the roof of your mouth.
- ☐ b. Inhale slowly.
- ☐ c. Avoid rapid, jerky movement.
- ☐ d. Inhale cautiously.

10. Explain why it is important not to wear a tight-fitting hood.

_____

_____

11. Check the appropriate answer. The most important feature of any weight system is:

- ☐ a. the size and shape of the weights.
- ☐ b. the ease of adjustment.
- ☐ c. a quick-release mechanism.

12. Check one. An alternate air source should be_____, so it can be quickly and easily identified by a diver needing the device.

- ☐ a. tucked under the weight belt
- ☐ b. conspicuously marked

13. Describe where you should attach an alternate air source to your body.

_____

_____

14. True or False: A diving knife is used as a tool (to measure, pry, dig, cut and pound), but is not intended to be, nor should be, used as a weapon._____

15. Identify the meaning of the standard hand signal illustrated here.

☐ a. OK? OK ☐ b. Distress, help ☐ c. Out-of-air

16. Explain how to check for proper weighting.

_____

_____

17. List and describe the steps of the predive safety check, and explain when you should use the check.

_____

_____

Student Diver Statement: I've completed this Knowledge Review to the best of my ability, and any questions I answered incorrectly or incompletely I've had explained to me, and I understand what I missed.

Name _____ Date _____

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The Dive Environment

During your first two confined water dives, you experienced the underwater environment for the first time. Even then, you probably noticed some underwater conditions that vary and affect divers.

If a relatively empty environment like a swimming pool or confined water site has environmental variables, just imagine the variables you can find at unconfined dive sites depending on weather, climate and other factors. The conditions that most directly affect you when you're diving are:

1. Temperature
2. Visibility
3. Water movement
4. Bottom composition
5. Aquatic life
6. Sunlight

Perhaps one of diving's greatest appeals comes from the diversity of environments you can explore. You can explore rivers, lakes, quarries, ponds, tropical seas or temperate oceans, each with its unique characteristics and its unique attraction. Weather, climate and season affect environmental

MAIN Objectives

Underline/highlight the answers to these questions as you read:

1. **What six general environmental conditions can affect you in any aquatic environment?**
2. **How can you obtain an orientation to an unfamiliar aquatic environment?**

Local wisdom.

Keep in mind that when you're planning to dive in an area for the first time, you want to get an orientation to the local area from, or better yet, dive under the supervision of, an experienced local diver.

conditions, so your dive experiences at a specific site will vary depending on the time of year.

During this section, you'll get an idea of how environmental conditions can affect you as a diver, plus basic information about both saltwater and freshwater diving environments. Your instructor will tell you a bit about the conditions you can expect at the dive site where you'll be making your first open water dives.

On this subject, keep in mind that when you're planning to dive in an area for the first time, you want to get an orientation to the local area from, or better yet dive under the supervision of, an experienced local diver. The PADI Discover Local Diving experience is one way to do this. This program is a guided tour by a PADI Instructor, Assistant Instructor or Divemaster that introduces you to a new dive environment, what's interesting about it, what to watch out for, and any unique dive skills or procedures you need to know. This is not only prudent for safety, but a local orientation is the best way to end up at the better dive sites and making the best dives.

Temperature

The discussion on exposure suits and heat loss in Section Two made it pretty clear that as a diver, you need to pay attention to water temperature and proper insulation. The amount of insulation varies with the water

Quick Quiz

Self Assessment 1

1. Conditions that can affect you as a diver in any aquatic environment include (check all that apply):
   - ☐ a. sunlight
   - ☐ b. temperature
   - ☐ c. water movement
   - ☐ d. bottom composition

2. To obtain an orientation to local dive conditions, you can (check all that apply):
   - ☐ a. check with a local PADI Dive Center or Resort.
   - ☐ b. take a Discover Local Diving orientation.
   - ☐ c. talk to an experienced local diver.
   - ☐ d. check the local newspaper.

How'd you do?
1. a, b, c, d. 2. a, b, c.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

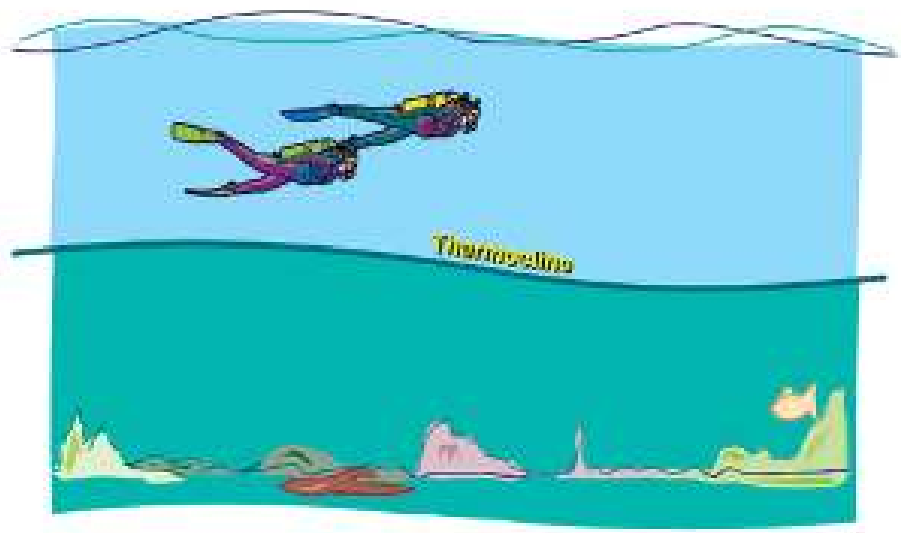
3. How can you expect temperature to change with depth?

4. What's a thermocline?

5. How should you plan to dive in an area known to have a thermocline?

temperature, and the water temperature varies with where you are, the season, and to some extent with the weather. Water temperatures range from -2°C/28°F (yow!) in polar regions to more than 30°C/85°F (ahhhh!) in the tropics. Within a given region, water temperature usually varies, but not usually by more than 8°-11°C/15°-20°F throughout the year. In moderate climates, that's more than enough to make a dry suit preferable during cool seasons, and a wet suit more than adequate in the warm ones.

Water temperature often changes with depth, usually getting colder as you descend. Water tends to form distinct layers based on temperature, with a boundary so abrupt that in calm water you can swim in warm water and stick your hand into distinctly colder water. This is called a *thermocline*. The temperature difference above and below the thermocline may be as great as 8°-11°C/15°-20°F. Sometimes you can see distortion at the thermocline, somewhat like the shimmering rising from a hot asphalt road, caused by the mixing of two temperature layers.



Hot and cold.
Water tends to form distinct layers based on temperature, with a boundary so abrupt that in calm water you can swim in warm water and stick your hand into distinctly colder water. This is called a thermocline.

You may find thermoclines in both fresh and salt water, and they're especially abrupt in freshwater lakes, ponds and quarries during the warmer seasons. The thermocline rises and falls with seasonal temperature.

To stay comfortable and avoid excessive heat loss, base your exposure protection on the water temperature at

Nice and warm.
You can dive comfortably in even polar waters if you use an appropriate dry suit. But diving in extremely cold water or diving under ice requires special equipment and training.

your planned dive depth, which may be cooler than the surface temperature. Since bottom temperatures and thermoclines may be hard to predict, ask your PADI Resort, Instructor or Dive Center for local information. If you find unexpected cool water, you and your buddy may want to revise your dive plan and stay in the shallower, warm water.

Quick Quiz

Self Assessment 2

1. As you descend, most commonly you can expect a temperature change to_____ water.
☐ a. warmer ☐ b. cooler

2. While descending, a thermocline is
☐ a. an abrupt change to a layer of warmer water.
☐ b. a gradual change to a layer of warmer water.
☐ c. a gradual change to a layer of colder water.
☐ d. an abrupt change to a layer of colder water.

3. If you know there's a thermocline, in dive planning you should
☐ a. make no changes.
☐ b. choose your exposure protection based on the temperature at depth.

How'd you do?
1. b. 2. d. 3. b.

You learned in Section Two that body heat loss can create a serious health risk (hypothermia). Very cold water can also cause some equipment complications. Believe it or not, you can dive in even polar water (it is one of the world's most spectacular underwater environments) with adequate comfort — *but*, diving in extremely cold or icy water requires special equipment, plus special training and experience. You may find special courses (like the PADI Ice Diver course) locally that can provide you with supervised training in cold water diving.

Visibility

Pass a diver headed toward the water as you're headed away, and invariably you get the question, "Hey, what's the viz?" Visibility influences your dive significantly, so it's the first thing you want to know. During your open water dives, you'll learn how to keep from reducing the visibility, how to measure it, and when it's too poor to dive.

You define underwater visibility based on how far you can see horizontally. Since this can be somewhat subjective — sometimes you can see a silhouette but not much else — some divers add that the visibility is the horizontal distance you can recognize another diver.

Visibility ranges from 0 to more than 60 metres/200 feet. Factors that affect visibility include 1) water movement, 2) weather, 3) suspended particles and 4) bottom composition. Waves, surf and currents churn up sediment, and rain runoff commonly clouds visibility. If disturbed by your kicks, the boat wake or other water movement, fine bottom sediment can swirl into the water, quickly ruining visibility. In certain conditions, suspended microscopic animals (plankton) and plants (algae) proliferate and cloud the water — oceanic plankton blooms called red tides can be so extreme that they kill fish and turn the water reddish.

The effects of some visibility conditions are obvious, while others are more subtle. In limited visibility, it's more difficult to stay with your buddy and to keep track of where you are and where you're going. You may feel disoriented when you can't see the surface or the bottom for reference.

To handle these concerns, stay closer to your buddy than you might usually, where you can watch each other. Track your position using your compass and noting conspicuous features (you'll learn more about using your compass in Section Five). You can remain oriented while ascending and descending by using a reference line, or when shore diving, by following the bottom to and from deeper water.

If visibility is really poor, you may want to do something else. But with special training and experience, you may find you enjoy the challenges of diving in extremely limited visibility — you may find it surprising, but many divers do. You can learn more about the skills and challenges of low visibility diving in the PADI Underwater Navigator and Search and Recovery Diver courses.

It may sound strange, but diving in extremely clear water requires some caution. Because water magnifies, the bottom may appear closer than it really is. As you descend, you need to watch your depth gauge (or computer) and stay within your planned depth limit. Even though you can see the bottom and the surface, you can experience disorientation (vertigo) during descents and ascents without a reference in clear water. Again a line

MAIN Objectives

Underline/highlight the answers to these questions as you read:

6. What's the definition of "underwater visibility"?
7. What four principle factors affect underwater visibility?
8. Restricted visibility can affect you in what three ways?
9. How do you avoid the problems associated with diving in clear water?

What you see, not how far.
With special training and experience, you may find you enjoy the challenges of diving in limited visibility — many divers do. You can learn more about the skills and challenges of low visibility diving in the PADI Underwater Navigator and Search and Recovery Diver courses.

Air clear.
Diving in extremely clear water may require some caution. The bottom may appear closer than it really is and, you can experience disorientation during descents and ascents without a reference.

or other reference helps avoid this problem. And in clear water, remember to stay close to your buddy — just because you can see each other doesn't mean you're close enough.

Currents

Earlier, you learned to remain relaxed, avoid over exertion and take it easy while diving. You also learned that water resists your movement, which is why you streamline yourself as much as possible. So it follows then, that when you have a current pushing against you, you need to learn some techniques to avoid getting breathless and tired, to avoid using your air too quickly, and to avoid long, difficult swims back to the boat or shore. Let's start by looking at what causes current.

Currents are mass movements of water and occur in oceans, but also in large lakes, seas and even smaller water bodies to some extent. Some currents are global and relatively permanent (more about these in a bit), while others are temporary and caused by 1) winds blowing over the surface and 2) unequal heating and cooling of the water 3) tides and 4) waves.

Trying to swim against even a mild current can quickly

Quick Quiz

Self Assessment 3

1. You define underwater visibility as:
   - ☐ a. more or less the greatest distance you can see in any direction.
   - ☐ b. the least distance you can see in any direction.
   - ☐ c. the approximate distance you can see horizontally.

2. Factors that affect underwater visibility include (check all that apply):
   - ☐ a. water movement.
   - ☐ b. suspended particles.
   - ☐ c. bottom composition.
   - ☐ d. fish population.

3. Restricted visibility can cause (check all that apply):
   - ☐ a. buddy separation.
   - ☐ b. disorientation.
   - ☐ c. loss of direction.

4. When diving in clear water, it's recommended that you:
   - ☐ a. use a line or other reference when ascending and descending.
   - ☐ b. close your eyes to avoid vertigo.

How'd you do?
1. c. 2. a, b, c. 3. a, b, c. 4. a.

tire and exhaust you. It's a lot of work, which means you'll burn through your air faster, too. This is why you need to use the right techniques, and avoid all but a mild current.

When there's a mild current at a dive site, begin your dive by slowly swimming into the current so that at the end of the dive, instead of fighting to get back to the boat or shore, the current assists your return. Avoid long surface swims against even a mild current; you'll make better progress on the bottom where the current is generally weaker than at the surface.

If by accident you end up with a current carrying you past your exit point, don't try to swim against it. Instead, swim *across* (perpendicular to) the current. Fighting a current by swimming directly into it will exhaust you. By swimming *across* the current, you may be able to swim out of the current, reach a line trailed from the boat, or reach the shore down current.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

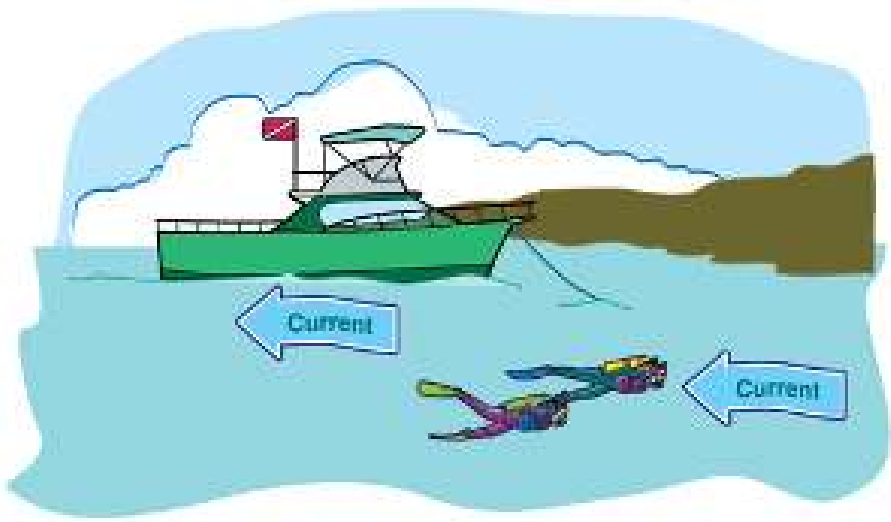
10. What four primary causes generate surface and underwater currents?

11. What should you do if you get caught in a current and carried downstream past a predetermined destination or exit point?

12. In most circumstances, which way should you go when there's a mild current present?

13. What should you do if you get exhausted and caught in a current at the surface while diving from a boat?

When diving from a boat, if you become caught in a current at the surface and can't get to the boat, don't fight it. Fill your BCD to establish buoyancy (drop your weights if you have a BCD problem), signal for help, rest and wait for the boat to pick you up. Above all, remain calm. Diving in *strong* currents and swift mov-



Face the flow.
When there's a mild current at a dive site, begin your dive by slowly swimming into the current so that at the end of the dive, the current assists your return to the boat or shore.

ing water (like rivers) requires special training and experience, which you usually find in areas where you find those conditions frequently.

Quick Quiz

Self Assessment 4

1. Causes of currents include (check all that apply):
   - ☐ a. waves
   - ☐ b. wind
   - ☐ c. tides

2. Under most circumstances, if there's a current you should begin your dive
   - ☐ a. swimming with the current.
   - ☐ b. swimming against the current.
   - ☐ c. swimming perpendicular to the current.

3. If a current carries you past your planned exit point
   - ☐ a. swim across the current to some other exit point, a line trailed from the boat, or out of the current.
   - ☐ b. fight the current as best you can.

4. When diving from a boat, if you get exhausted and caught in a current at the surface, you should
   - ☐ a. establish positive buoyancy, signal for help and rest.
   - ☐ b. fight the current as long as you can.

How'd you do?
1. a, b, c. 2. b. 3. a. 4. a.

Bottom Composition

You spend most of your time diving near the bottom ('cause that's where all the stuff is). The bottom's composition can affect you and the dive techniques you want to use. You can loosely categorize compositions as silt, mud, sand, rock, coral and vegetation. All of these harbor aquatic life and offer interesting diving, with rock, coral and vegetation bottoms. These ecosystems jump out at you, whereas it takes closer observation to appreciate the fascinating aspects of silt, mud and sand.

You can easily stir up some bottom compositions, especially silt and mud, and some compositions require care while entering and exiting, or while moving about underwater. You may sink into a soft mud bottom while wading, and if you drop something into a very soft silt or sediment, it may vanish into the bottom. If you don't pay attention to where you're going, there's some possibility of entanglement in

Gear tight, fins up.
Establish neutral buoyancy, keep all your equipment secure and stay well off the bottom. Swim with your fins up to avoid stirring the sediment and reducing visibility.

Main Objectives

Underline/highlight the answers to these questions as you read:

14. Aquatic bottom compositions include what six types?

15. What are the two ways to avoid bottom contact?

submerged trees, bushes, man-made objects or aquatic plants. Rocks or coral can cut and scrape if you're careless. Obvi-ously, it's important to know the bottom composition and any problems associated with it. As you gain experience, you'll learn to know what type of bottom to expect in most cases, and how to cope with any associated problems. It's mainly a matter of awareness, watching where you put your feet and hands, and common sense.

Sometimes the bottom needs to watch out for you. As you've already learned, some organisms are so delicate that even a light touch can damage or kill them. So it helps you avoid problems and minimize environmental damage to avoid contact with any bottom that harbors sensitive aquatic organisms.

Regardless of the bottom composition, effective buoyancy control provides the easiest way to avoid contact. Establish neutral buoyancy, keep all your equipment secure and stay well off the bottom. Also, swim with your fins up to avoid stirring the sediment and reducing visibility. Although you'll learn to recognize insensitive bottom that you can settle on without hurting the environment and without significant risk to you, it's best to avoid direct bottom contact as much as possible.

Quick Quiz

Self Assessment 5

1. List the six general types of bottom compositions:
   1. _____
   2. _____
   3. _____
   4. _____
   5. _____
   6. _____

2. To avoid bottom contact, you (check all that apply):
   - ☐ a. pull yourself along gently by hand.
   - ☐ b. stand on your fin tips.
   - ☐ c. remain neutrally buoyant.
   - ☐ d. swim with your feet up off the bottom.

How'd you do?
1. silt, mud, sand, coral, vegetation, rock. 2. c, d.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

16. What are the two basic classifications for interaction between divers and aquatic life?

17. What causes nearly all injuries from aquatic life?

18. What should you do if you sight an aggressive animal underwater?

19. Nine simple precautions minimize the likelihood of being injured by an aquatic animal. What are they?

20. Why should divers follow local fish and game laws?

Aquatic Life

Interaction with aquatic life. As a diver, you'll interact with new and fascinating underwater organisms. Some will swim up to you curiously, while others will flee in your presence. Some will freeze, solid as a rock. You may swim among aquatic plants that tower over you like a forest, or spread out beneath you like a manicured lawn. This privilege carries with it a responsibility.

Leave nothing but bubbles . . .
You can classify your interactions with aquatic life as passive or active.

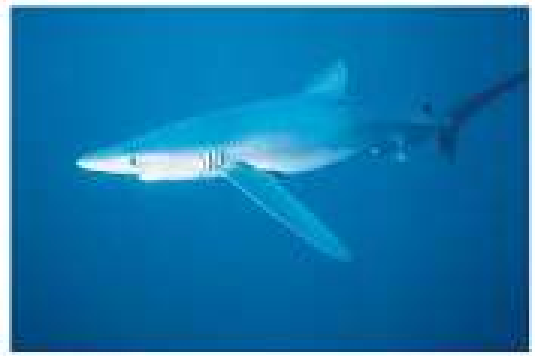
You can classify your interactions with aquatic life as *passive* (watching, leaving undisturbed, photographing, etc.) or *active* (feeding, touching, disturbing, chasing, filleting, etc.) As the name implies, even passive *interaction* affects aquatic life, which is very sensitive to its environment. Approaching aquatic animals can cause them to alter their behavior and the natural rhythm of their lives. Move quietly and smoothly — which is less likely to disturb them — and you'll have more chances to observe aquatic animals behaving naturally, rather than fleeing or hiding.

Active interaction means that you make physical contact with aquatic life. You already know that bumping into sensitive coral, for example can harm it, and other active interactions like hunting, certainly don't benefit the organism you affect. Other active interactions can appear to benefit the organism or environment, but may or may not. Fish feeding, for example, can harm organisms if you feed them nonnatural foods; frequent, heavy feeding by humans can alter normal behaviors and cause fish and other animals to stop feeding on normal prey. This in turn creates a population imbalance that can widely affect the local ecology.

This isn't to say there aren't positive active interactions — freeing fish from an abandoned trap or surveying species populations to support protective regulations, for example — but you need to take the responsibility of ensuring that your active interactions — intentional or accidental — cause minimal damage and disruption to the environment and organisms you interact with. By doing this,

you're doing your part to assure that your children, and theirs, will be able to see and interact with the same creatures. You're setting a positive example as the underwater world's advocate and ambassador, and on a broader scale, you're contributing to a healthier planet — something we can all live with.

Aquatic animals. The typical aquatic animal responds to human approach with "Run away! Run away!" The vast majority are timid and harmless, yet fascinating and enjoyable to watch. But there are a few that require your caution.



It is rare for humans to suffer attacks from aquatic animals.

Nearly all injuries involving aquatic life (plants or animals) result from human carelessness, and the vast majority are minor. It takes only a little bit of understanding and care to avoid potential problems.

You're far more likely to suffer from an unpleasant encounter with an unaggressive organism — such as a puncture wound from sea urchins, a sting from jellyfish and their relatives, or cuts and scrapes from barnacles and coral. To avoid these, watch what you touch and wear an exposure suit as protection from accidental contact. If you're not familiar with an organism, leave it alone. An excellent rule of thumb: If it's very pretty, very ugly, or it doesn't flee from you — don't touch it! Venomous fish and other stinging aquatic animals tend to have these characteristics.

Very few aquatic animals are outwardly aggressive. While it's true that almost any good sized animal is potentially dangerous when provoked, it's actually very rare for humans to suffer attacks from aquatic animals. The reputation of some animals as bloodthirsty killers, such as sharks and killer whales, resulted from inaccurate and distorted reports that became myths. The vast majority of incidents between sharks and divers involve spearfishing (wounded fish stimulate shark feeding behavior). Killer whales (more properly, orcas) have the capacity to harm humans, yet there's no documented case of one ever attacking a diver.

Injuries from animals that may *seem* aggressive, such as eels and stingrays, actually result from frightening animals, causing them to react *defensively* — such as if you carelessly stick your hand in an eel's hole without looking first. (If a giant arm came in your front door and started groping around your living room, you'd bite it, too.)

Sea urchin

Hands off.

If you're careful, you can avoid an unpleasant encounter with an unaggressive organism, such as a puncture wound from sea urchins, a sting from jellyfish and their relatives, or cuts and scrapes from barnacles and coral. Attacks by aquatic animals are very rare.

So if you see a shark, or some other potentially aggressive animal, remain still and calm on the bottom. Do not swim toward it, which could trigger a defensive reaction. Watch it and see what it does. Chances are, it's just passing through. And enjoy the experience — these are some of the most magnificent of nature's creatures, and you don't get to see them too often. If it stays in the area, calmly swim away along the bottom, keeping an eye on it and exit the water.

These guidelines will help you avoid potential problems with aquatic animals:

1. Treat all animals with respect. Don't tease or intentionally disturb them.
2. Be cautious in extremely murky water where you may have trouble watching where you put your hands. Potentially aggressive animals could mistake you for prey in murky water, so you may want to avoid diving if they're known to be in the area.
3. Avoid wearing shiny, dangling jewelry. These can resemble bait fish or other small prey and can attract the interest of some animals.
4. If you spearfish, remove speared fish from the water immediately.
5. Wear gloves and an exposure suit to avoid stings and cuts. It goes without saying that an exposure suit that covers your whole body offers more protection than cut off jeans and a t-shirt.
6. Maintain neutral buoyancy and stay off the bottom.
7. Move slowly and carefully.
8. Watch where you're going and where you put your hands, feet and knees.
9. Avoid contact with unfamiliar animals. If you don't know what it is, don't touch it.

While you may want to avoid contact with a few animals, there are others that some divers seek as game or specimens. To name a few, these include lobster, crab, abalone, scallops, fish, clams, conch and other shellfish. Before collecting any game, learn local fish and game laws, including seasons, size and catch limits and other restrictions. Fish and game laws exist to assure a continuing supply of these animals for the future. If local laws permit game taking, collect only what you can eat or use — even if the

law allows more. Be reasonable in what you take, so that there can be game for divers to enjoy in the future. Keep in mind that in many areas, the local dive community does not engage in game taking, even if legal.

Aquatic plants. The first thing you'll notice is that it is far, far easier to sneak up on aquatic plants than many aquatic animals. Aquatic plants range from giant kelp forests common to New Zealand, California and other cool-water areas, to smaller grasses and algae in freshwater rivers and lakes. Plants provide food and shelter to aquatic animals, so you can usually expect lots of animal life in aquatic plant environments.

There's a small possibility of entanglement in some plant types. This isn't a serious problem, and you'll find that with a little care, you can move easily in and about aquatic plants without ever getting entangled. Keeping your equipment streamlined, watching where you go, and avoiding dense growth areas help minimize the chances of snagging or tangling.

If it does happen, remain calm. As soon as you feel that you're snagged, stop, and back up slightly. Don't turn around, which may wrap some of it around you. Chances are, you're only hung by one or two strands, so reach back and free yourself, with your buddy's help. Don't struggle or try to use force because that usually makes

Quick Quiz

Self Assessment 6

1. The two types of interactions you can have with aquatic life are (check two):
   - ☐ a. passive
   - ☐ b. aggressive
   - ☐ c. dominant
   - ☐ d. active

2. Nearly all injuries from aquatic life result from:
   - ☐ a. attacks
   - ☐ b. diver carelessness
   - ☐ c. feeding behavior
   - ☐ d. maternal protection

3. If you sight an aggressive animal underwater, you should watch it and leave the area calmly on the bottom if it remains or appears aggressive.
   - ☐ True ☐ False

4. Precautions you can take to avoid injury by an aquatic animal include (check all that apply):
   - ☐ a. wearing an exposure suit and gloves.
   - ☐ b. watching where you put your hands, feet and knees.
   - ☐ c. arming yourself with a spear-gun.
   - ☐ d. not touching anything you don't recognize.

5. You should follow fish and game laws:
   - ☐ a. to maximize the amount of game you take.
   - ☐ b. to help assure future populations of game animals.

How'd you do?
1. a, d. 2. b. 3. True. 4. a, b, d. 5. b.

Forest for the seas.
Kelp forests create impressive aquatic environments in temperate climates.

things worse. Although you want to minimize damage to aquatic life, if necessary break free by bending and snapping the stalk. This is usually more effective than using your knife. You'll learn more about handling entanglement later in this section.

Sunlight

Diving typically takes you into direct sunlight aboard boats, on beaches and off of docks, so you need to take precautions to prevent sunburn. Out of the water, wear protective clothing (broad brimmed hats, light long sleeve shirts, etc.), stay in the shade as much as possible and use sunscreen. Keep in mind that a cloudy day doesn't protect you — the burning ultraviolet rays penetrate the clouds, but since you don't feel the heat, you don't realize you're burning. That's why you see some of the worst sunburns on overcast days.

You can also sunburn in the water, especially in shallow water while snorkeling. Wear an exposure suit and waterproof sunscreen to protect yourself while snorkeling, and remember that in water you may not feel a burn until it's too late. Sunburn is probably the most common "injury" divers experience, and it's entirely avoidable. Don't let sunburn ruin a dive trip or vacation.

Fresh Water and Salt Water

As you gain experience diving, you'll probably discover great diving in fresh water and salt water, even though

MAIN Objectives

Underline/highlight the answer to this question as you read:

21. How can you prevent sunburn while out of the water (three ways), and what two ways can you use to prevent it while snorkeling?

QUICK QUIZ

Self Assessment 7

1. You don't have to worry about sunburn when it's overcast, or when you're in the water.

☐ True ☐ False

How'd you do?

1. False. You can sunburn through clouds and in water.

they differ in their conditions, animal and plant life, and call for different techniques and procedures. Depending where you're diving, you may pursue your favorite underwater activity — photography, wreck diving, whatever — somewhat differently in fresh water than in salt water. Or you may prefer entirely different activities in the environments.

MAIN Objectives

Underline/highlight the answer to this question as you read:

22. What are the general considerations for diving in freshwater, and in saltwater?

Freshwater diving. Typical freshwater dive environments include lakes, quarries, springs and rivers. Most of these offer good places for photography and exploration as well as more adventurous activities like wreck diving, ice diving, cavern diving and swift-water diving. Some of these require special training and equipment before you participate in them.

Even far from the sea.
Typical freshwater dive environments include lakes, quarries, springs and rivers. Most of these offer good places for photography and exploration as well as more adventurous activities like wreck diving, ice diving, cavern diving and swift-water diving.

Freshwater environment dive considerations include currents, bottom compositions, limited visibility, thermoclines, cold water, entanglement, deep water and boats — many of the same considerations you have in salt water. You may dive in mountain areas well above sea level, which requires special techniques and training to account for the altitude.

Since fresh water weighs less than salt water, you're not as buoyant for a given displacement. This means if you dive in fresh water after diving in salt water, assuming you're wearing the same gear and exposure suit, you'll need less weight. Keep in mind that you're likely to find a thermocline when diving in freshwater lakes and quarries.

Saltwater diving. The saltwater dive environment fits into three general areas: 1) temperate, 2) tropical and 3) polar. The vast majority of recreational diving takes place in the temperate and tropical areas, though as mentioned the Arctic and Antarctic offer spectacular diving for those trained and equipped for it. Saltwater activities include all general diving activities, plus photography, spearfishing, and diving on artificial structures like jetties, piers, oil rigs, wrecks and artificial reefs. General considerations for this environment include waves, surf, tides, currents, coral, boats, deep water, marine life and remote locations.

Quick Quiz

Self Assessment 8

1. Freshwater dive considerations include (check all that apply):
- ☐ a. deep water
- ☐ b. altitude
- ☐ c. thermoclines
- ☐ d. limited visibility

2. Saltwater dive considerations include (check all that apply):
- ☐ a. surf
- ☐ b. tides
- ☐ c. marine life
- ☐ d. waves

How'd you do?
1. a, b, c, d. 2. a, b, c, d.

Another world.
The vast majority of recreational diving in saltwater takes place in the temperate and tropical areas.

Clearly, every place you dive has its own considerations, which is why you want to get a local orientation to a new area. It makes your diving more fun, more enjoyable and safer.

Ocean Diving

The ocean is a dynamic environment that constantly changes and moves. It can be calm and tranquil, or angry and powerful. Its moods have a direct influence on diving. So without assigning it any more emotions, let's look at the basic principles behind waves, surge, longshore currents, rip currents, upwelling and tides. This way you'll understand what you'll see and experience ocean diving, and what you can expect.

Waves and Surf. Most water motion that concerns you as a diver involves waves. The wind forms waves by blowing over the ocean surface, with wave size determined by wind strength, and how long the wind pushes the wave. A strong wind blowing continuously for several hours can make waves large enough to trash the conditions — making them either unfavorable, or even hazardous. Once formed, waves can travel across an entire ocean, affecting the diving hundreds of kilometres/miles from where they formed.

A wave travels across the surface until wind from another direction flattens it, until it gradually loses its energy, or until it encounters shallow water and breaks as *surf*. This phenomenon is the basis for an entire culture of surfboards and bleached hair.

Waves break in shallow water because the wave bottom drags on the sea floor; this slows it compared to the wave top, causing the top of the wave to peak up and become unstable. Eventually the wave "stumbles" and breaks as surf, spilling its energy onto the beach.

Overhead Environments

Whether you dive in fresh or saltwater, you may encounter places you can swim into that *don't* permit you to swim straight up to the surface. Examples include inside shipwrecks, under ice and in caves or caverns. These are called *overhead environments*. The may appear deceptively safe and simple — *but they're not*. They can pose hazards that you may not recognize, nor realize are present until it's too late.

Your training in this course prepares you for diving in *open water* — with direct access to the surface at any time. As soon as you lose the ability to ascend directly to the surface, your risk and the potential hazards go up dramatically.

You can learn to dive in these environments safely — but it requires special training and special (often extensive) equipment to handle the added risks and complications. For this reason, *until you have the training and equipment you need do not enter a cavern, cave, wreck or any other overhead environment*. Doing so places you in an unnecessary and *extremely hazardous* situation.

Many overhead environments may *seem* inviting and safe, but any time you can't swim directly up to the surface, you're in a special situation. A sobering thought. *One of the leading causes of diver fatalities is going into overhead environments without the proper training and equipment.* Those with proper training and equipment have an excellent safety record in caves, wrecks, under ice and in other overhead environments — those without this training (including otherwise highly trained dive professionals) have a *very poor* safety record in these environments.

Avoid this risk entirely. Enjoy the fun and adventure of diving outside the overhead environment. If you're interested in this type of diving, get the training you need — but stay out until then.

A deceptively easy way to die.
Do not enter a cavern, cave, wreck or any other overhead environment unless you have the training and equipment you need. Doing so places you in an unnecessary and extremely hazardous situation.

The area where waves break is called the *surf zone*. Moderate to large surf can complicate entries and exits unless you use special techniques. You won't find it difficult entering and exiting on a gently sloping beach through mild waves no higher than, say, your waist (technically surf, but not really considered "surf" in most dive environments) — but you need specific techniques to dive in higher surf.

Waves break in water only slightly deeper than their height, so watching the surf tells you something about the depth. An offshore reef, wreck or sand bar can create a shallow area that causes waves to break. Offshore shallow areas can be popular dive sites, or hazards to avoid (something to learn during an area orientation). Sometimes you'll see waves break, reform and break again. This indicates that the bottom rises, drops and then rises again as you move seaward. Knowing what the waves tell you helps you plan your dive.

Sometimes waves approach shore from different directions. Depending on the angles and timing, the waves can combine into very large waves, or cancel each other out and diminish the surf. This is why you often have a series of smaller waves — or none — followed by a series of larger waves. When entering and exiting through surf, you watch the water and learn the wave pattern, so that you can time your entries and exits to pass through the surf zone during the small waves.

Avoid diving in large and rough surf. Not only can it be hazardous, but the dive conditions tend to be poor anyway.

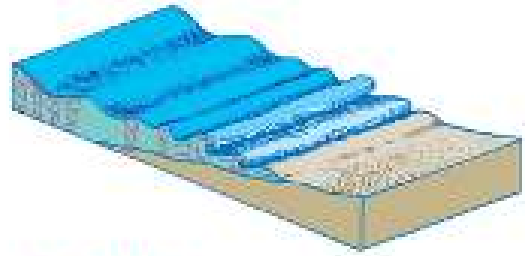
Ocean in motion.
Most water motion that concerns you as a diver involves waves. The wind forms waves by blowing over the ocean surface, with wave size determined by wind strength, and how long the wind pushes the wave.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

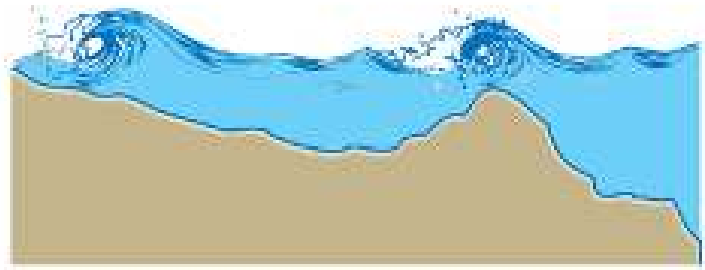
23. What creates surge and how do you avoid it?
24. What causes long shore currents, and how may they affect you?
25. Why would a wave break offshore?
26. What causes a rip current, and how do you know when there's one present?
27. What should you do if you get caught in a rip current?
28. What causes an upwelling, and how might it affect local offshore dive conditions?
29. Tidal movement changes what three environmental conditions?
30. What's generally the best tidal level for diving?

You need specialized surf training before attempting to dive in surf of any size. In surf training, you learn to judge conditions and use the correct techniques for entering and exiting through the waves. Stay out of the surf until you have had this training. Keep in mind that surf diving techniques vary from area to area, and even from season to season in the same area.



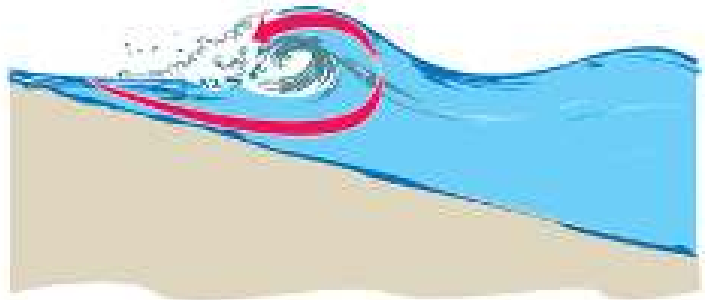
Surf's up.
Waves break in shallow water because the wave bottom drags on the sea floor; this slows it compared to the wave top, causing the top of the wave to peak up and become unstable. Eventually the wave "stumbles" and breaks as surf, spilling its energy onto the beach.

Surge. In shallow water waves passing overhead move you back and forth. This is called *surge*. Surge can move you an appreciable distance as large waves pass over, and strong surge can be hazardous. It tends to dissipate as you go deeper, so you can often avoid surge by planning a deeper dive. Avoid diving near shallow, rocky areas when there's strong surge present.



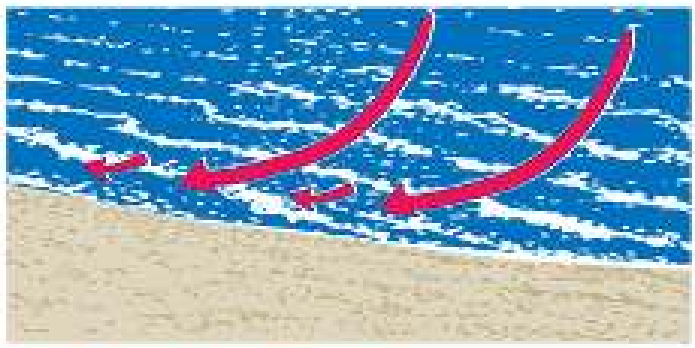
Offshore clues.
Waves break in water only slightly deeper than their height, so watching the surf tells you something about the depth. An offshore reef, wreck or sand bar can create a shallow area that causes waves to break.

Undertow. After a wave breaks, it flows back into the ocean under oncoming waves, causing *undertow* or *backrush*. In conditions in which you're likely to be diving, backrush usually dissipates at a depth no greater than about a metre/three feet. It's not a current that pulls things far out to sea, but you do need to be aware of it. On steep beaches backrush can be quite strong; since the waves push your upper body shoreward and the backrush pulls your legs seaward, you have to pay attention to keep your balance during entries and exits. Avoid diving from beaches with extremely steep shorelines when there's anything more than very mild surf.



Flow underfoot.
After a wave breaks, it flows back into the ocean under oncoming waves, causing undertow or backrush.

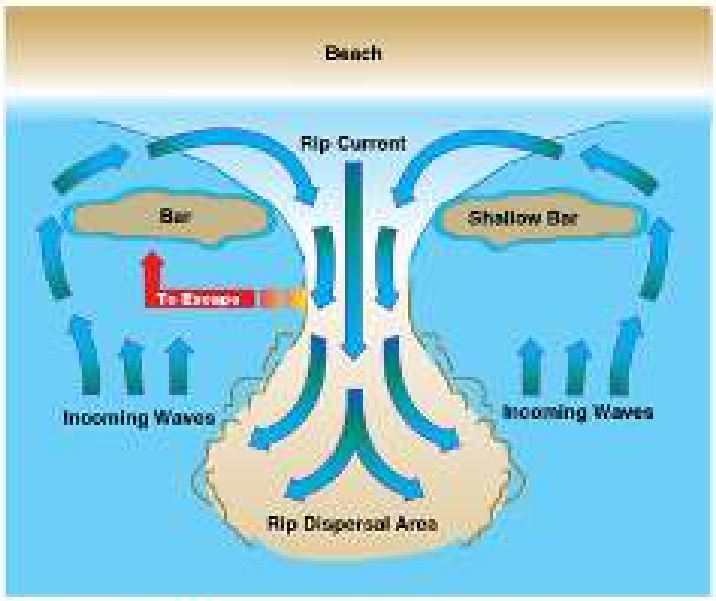
Currents. Waves cause many of the currents that affect divers. They typically approach shore at a slight angle, which pushes water down the shoreline, creating a *longshore current*. A longshore current tends to push you down the beach — away from your intended exit area if you didn't know to account for it. When diving in a longshore current,



Down shore, down current.
Waves approaching shore at a slight angle push water down the shoreline, creating a longshore current.

you can begin your dive up-current from your exit point, or dive into the current so you can drift back to the exit at the end of the dive.

Another wave-generated current is the *rip current*. A rip current occurs when waves push water over a long obstruction such as a sand bar or reef. The water can't flow out on the bottom, so it funnels back to sea through a narrow opening. Because they tend to be strong, rip currents can carry you away from shore very quickly, which can be alarming if you don't know what's happening and what to do about it. You can usually recognize a rip current as a line of turbid, foamy water moving away from shore; it also disrupts the waves where it rushes seaward.

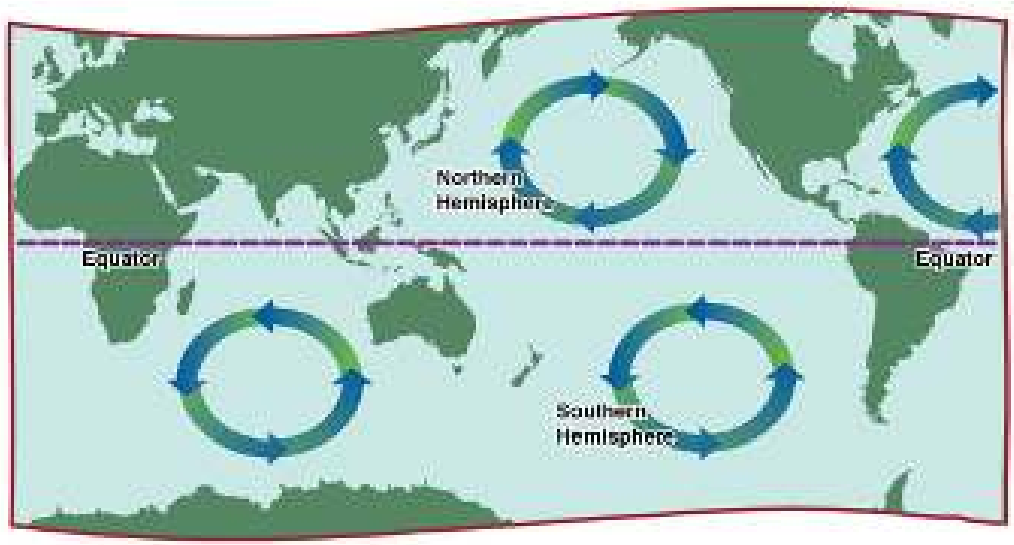


Rushing water.
A rip current occurs when waves push water over a long obstruction such as a sand bar or reef. The water can't flow out on the bottom, so it funnels back to sea through a narrow opening.

Obviously, you want to avoid rip currents. If you get caught in one, establish buoyancy and swim *parallel* to shore to clear the rip area. They're usually relatively narrow and disperse quickly in deeper water. Once you're out you can resume your original course, though you'll be further from shore. Never try to swim directly against a rip current.

When diving in current from a boat, you generally begin your dive swimming into the current, so that it's pushing you back to the boat when you end the dive. If you get caught in a current, don't fight it. At the surface, inflate your BCD, signal the boat to pick you up and rest.

Although most currents you encounter come from the wind, offshore currents, which are permanent large-scale currents like the Gulf Stream, can also affect diving. The earth's rotation generates these currents, which makes them generally predictable,

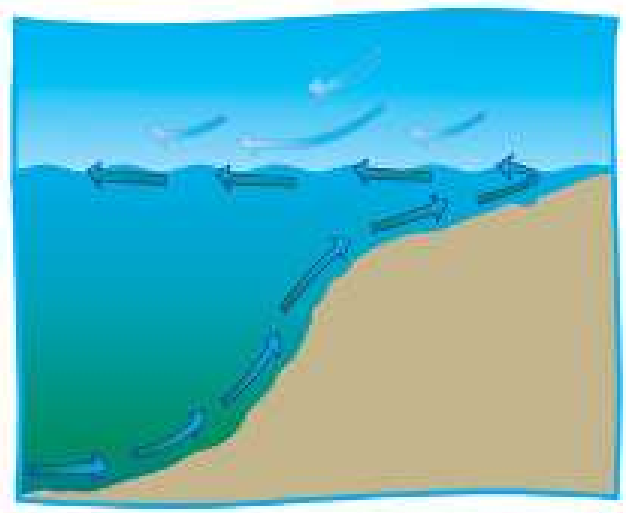


As the world turns.
The earth's rotation generates permanent, large scale currents. They're generally predictable, though eddies and counter currents can cause local flow direction to change.

though eddies and counter currents can cause local flow direction to change. Keep in mind that a current can sometimes change direction during your dive.

You'll learn a bit more about currents later.

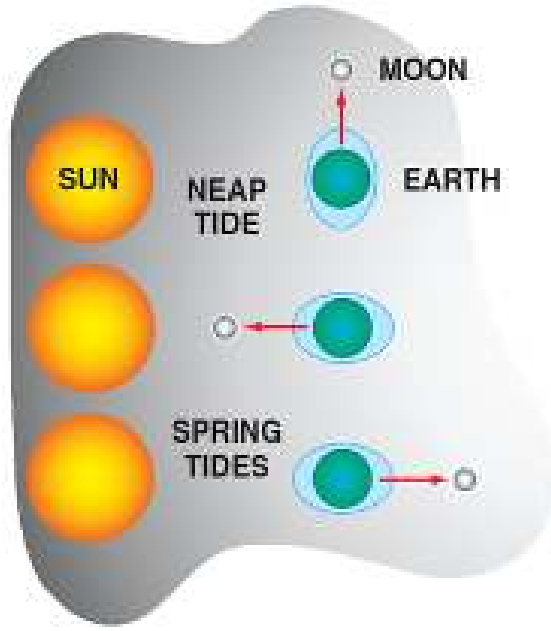
Upwelling. An upwelling is a slow-moving current commonly caused by offshore winds pushing the surface water away from shore. As the surface water moves out to sea, deep water flows up to take its place. The deeper water is usually clear and cold, creating excellent, though cooler, diving conditions.



Out of the deep.
An upwelling is a slow-moving current commonly caused by offshore winds pushing the surface water away from shore. As the surface water moves out to sea, deep water flows up to take its place.

Tides. The water level in the oceans and seas (and even some very large lakes) rises and falls in a daily cycle called *tide*. The moon and sun causes tide as their gravity pulls on the water, creating a bulge that, from our perspective, moves across the oceans as the earth turns. Tides vary in their time and height from place to place due to geographic configuration. They affect dive conditions — sometimes improving them, sometimes worsening them — by producing currents, changing depth and changing visibility.

Before diving, check local tide tables and become familiar with how tides affect local conditions. As a general guideline, the best diving conditions occur at high tide.



Outer space influence.
The moon and sun cause tides as their gravity pulls on the water, creating a bulge that, from our perspective, moves across the oceans as the earth turns.

Dive Planning

Dive planning avoids disappointments due to misunderstandings with your buddy, forgotten equipment or poor dive site conditions — it's really planning your fun. You can think of dive planning in

Quick Quiz

Self Assessment 9

1. _____ create surge, which you avoid by _____ .
- ☐ a. Tides, avoiding high tide.
- ☐ b. Waves, going deeper.
- ☐ c. Tides, going deeper.
- ☐ d. Waves, staying shallow.

2. Longshore currents tend to:
- ☐ a. push you parallel to the shore.
- ☐ b. carry you seaward.
- ☐ c. None of the above.

3. Waves breaking off shore indicate:
- ☐ a. a coming change in the surf conditions.
- ☐ b. an upwelling.
- ☐ c. a rip tide.
- ☐ d. None of the above.

4. You can recognize a rip current by:
- ☐ a. turbid, foamy water.
- ☐ b. strong flow away from shore.
- ☐ c. disruption of the waves.
- ☐ d. All of the above.

5. If caught in a rip, you should:

_____

_____

_____

6. An upwelling tends to cause _____ dive conditions.
- ☐ a. poor
- ☐ b. excellent
- ☐ c. unpredictable

7. Tides affect diving conditions by (check all that apply):
- ☐ a. causing currents.
- ☐ b. affecting visibility.
- ☐ c. generating rip currents.
- ☐ d. causing upwellings.

8. Generally, the best tidal level for diving is:
- ☐ a. low tide.
- ☐ b. high tide.

How'd you do?
1. b. 2. a. 3. d. 4 d. 5. swim parallel to shore. 6. b. 7. a, b. 8. b.

Summary Points

In this subsection on The Dive Environment, you learned:

- Temperature, visibility, water movement, bottom composition, aquatic life and sunlight affect dive conditions.
- A thermocline is an abrupt transition to colder water.
- Plan your dive accounting for the water temperature at your planned depth.
- When possible, use a visual reference for descending and ascending.
- When diving with a current present, head into the current during the dive.
- If caught in a current, don't fight it. Swim across the current, or establish buoyancy and signal for assistance.
- Avoid bottom contact by staying neutrally buoyant.
- Most aquatic life injuries result from carelessness — watch where you put your hands, feet and knees.
- Wear gloves and an exposure suit to reduce the likelihood of aquatic life stings and cuts.
- Sunburn is entirely avoidable.
- Surf diving requires special training and techniques.
- If you get caught in a rip current, swim parallel to shore until you're out of it.

four steps : advance planning, preparation, last-minute preparation and predive planning.

Advance Planning

Planning a dive starts when you decide to go diving. At this stage, you generally: select a buddy (or vice versa), establish a dive objective (i.e., agree on what you'll do on the dive), choose a dive site (may be a general choice at this stage), determine the best time to dive and discuss logistics (agree on where/when to meet, etc.) with your buddy.

It's a good idea to agree on a common objective to avoid misunderstandings. If you show up with camera gear and your buddy arrives kitted up for search and recovery, one of you won't be doing what you planned.

If necessary, you can check your log book for relevant information about the site if you've been there before. Plan an alternate dive site in case you can't dive at your primary site (poor conditions, speed boat competition, ex-spouse is there, etc.). Decide on the best time to go, which the tides and other activities in the area may influence. Finally, discuss logistics, such as when to leave for the dive, how to get there, what to take and emergency contact information.

Preparation

It's a good idea to start preparing for a dive at least a day or two ahead of time. Inspect all the equipment you'll be using, make sure your tank is filled, gather your equipment into one place and use an equipment checklist to make sure you've got everything. (There's a sample checklist in the Appendix.) Check your equipment while you have ample time to fix or replace anything broken, missing or that your dog chewed on. If possible,

check local information sources like television, radio, your dive center, etc., for a report on dive site conditions.

Last-minute Preparation

Just before you leave for the dive:

1. Check the weather report.
2. Let someone who isn't going with you know about your planned dive, including where you are going, when you expect to be back and what to do if you're delayed. Include your mobile phone number if you take one with you.
3. Gather those last-minute type items like a jacket, hat, sunglasses, wallet, lunch, ice chest, certification card, log book, etc.
4. If you haven't yet, pack your gear bag; if you're boat diving, pack so the first thing in is the last thing out.
5. Make an "idiot check" so that you don't leave anything behind and show up with, say, only one fin.

Predive Planning

At the dive site, you plan the details. It's best to do the following before you start putting your gear together:

1. Evaluate the conditions. Take your time, especially if you're watching wave patterns.
2. Decide whether or not conditions favor the dive and your objective. If they don't, go to your alternate site, and if conditions are bad there, too, pull the plug. Diving's supposed to be fun; if it's not going to be fun, do something else.
3. Agree on where to enter, the general course to follow, the techniques to use on the dive and where to exit.
4. Review hand signals and other communications.
5. Decide what to do if you become separated.
6. Agree on time, depth and air supply limits.
7. Discuss what to do if an emergency arises.

The idea in predive planning is to anticipate, discuss and agree on as much as possible before you get in the water.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

31. You need to plan your dives for what three reasons?

32. What are the four stages of proper dive planning?

33. What five general steps do you follow during the advanced planning stage of dive planning?

34. What four general steps do you follow during the preparation stage of dive planning?

35. What five steps do you follow during the last-minute preparation stage of dive planning?

36. What seven steps do you follow during the predive planning stage of dive planning?

You can't plan by accident.

Think of planning your dive as planning your fun – and safety. No one can plan a dive and follow that plan for you – you and your buddy have to do it.

Dive the Plan

It doesn't make much sense to form a dive plan, then not use it. You have more fun and fewer problems when your dive follows what you agreed upon. You'll get what you want out of the dive when you and your buddy understand what to do when because you discussed it before the dive. By following a solid dive plan, you're much less likely to run into any hazards, and more likely to handle them if you do.

A dive plan does not have to be complicated, nor does it need to take a lot of work, nor does it need to be inflexible. It can be very simple, take only a couple of minutes to discuss, and offer plenty of options depending on what you find underwater — but you should follow it.

Get the most out of diving by planning your dive with your buddy, and then diving the plan. This is important for your safety and fun – no one can plan a dive and follow that plan for you – you and your buddy have to do it.

Boat Diving

Chances are, you'll make a lot of dives from boats. In many areas, it takes a dive boat to reach the sites with the best clarity, the most aquatic life, and the most interesting reefs. Boats take you to dive sites inaccessible from shore, and in some places you reach all or most dive sites only by boat. Boat diving eliminates long, tiresome surface swims, dealing with surf, and hikes to and from the water. Beyond all this, it's fun to go boating with other divers. You get to know new people, sight see on the way to and from the dive site, and generally enjoy the whole experience.

Before heading out on a boat, spend some time getting ready:

1. Inspect your equipment for potential problems, fill your tank and pack spare parts. Once you're out

Quick Quiz

Self Assessment 10

1. Planning your dive helps avoid disappointments due to misunderstandings, forgotten equipment, or poor site conditions.
☐ True ☐ False

2. You can divide dive planning into advanced planning, preparation, last minute preparation and predive planning.
☐ True ☐ False

3. Steps in advanced planning include (check all that apply):
☐ a. choosing a buddy.
☐ b. agreeing on an objective.
☐ c. agreeing on logistics.
☐ d. reviewing hand signals.

4. In the preparation stage, you don't need to inspect your equipment.
☐ True ☐ False

5. Last-minute preparation includes (check all that apply):
☐ a. letting someone know where you're going and when you plan to return.
☐ b. packing items like ice chests, jackets, etc.
☐ c. checking the weather.

6. If you find conditions poor at your dive site:
☐ a. be brave and dive anyway.
☐ b. try your alternate site. Otherwise, cancel the dive.

How'd you do?
1. True. 2. True. 3. a, b, c. 4. False. 5. a, b, c. 6. b.

Cast off!
It's fun to go boating with other divers. You get to know new people, sight see on the way to and from the dive site, and generally enjoy the whole experience.

there, missing or broken gear often means you miss the dive. Having spares can make you immensely popular with other divers who need something but don't have their own spares.

2. Be sure you've marked your stuff so it doesn't get confused with someone else's on a crowded boat.
3. Use a dive bag for carrying your equipment to and from the boat.
4. Pack your equipment so what you need first ends up on top.
5. Take ample warm/dry clothing, as appropriate for the region. Be prepared because in many places, it's common to experience abrupt weather changes out on the water.

Prepare yourself as well as your equipment. Be well rested, especially if the boat departs early. It's best to avoid excessive alcohol the night before, and avoid foods you don't digest well. It's important to be well hydrated with lots of water or juices. Make sure you have your ticket, money, lunch and warm clothes, etc. all rounded up as necessary.

If you've not spent much time around boats, you're going to want to learn some new terms so that when the captain says, "the head is forward, on the portside o' the galley and aft o' the wheelhouse, mate," you don't respond, "Eh?"

The *bow* is the front of the boat,

MAIN Objectives

Underline/highlight the answers to these questions as you read:

37. **What are three benefits of diving from a boat?**

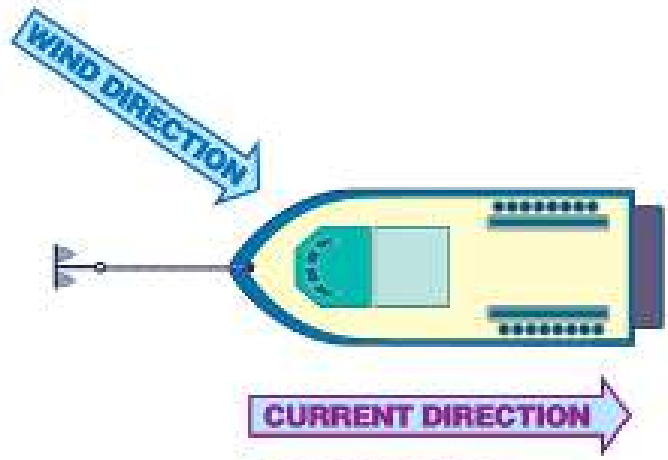
38. **When preparing for a boat dive, what five general considerations apply to equipment preparation?**

39. **Before a boat dive, what four general considerations for personal preparation apply?**

40. **What part of the boat is:**
    - **bow (forward)?**
    - **stern (aft)?**
    - **starboard?**
    - **port?**
    - **leeward?**
    - **windward?**
    - **bridge?**
    - **head?**
    - **galley?**

41. **By what four ways can you minimize the effects of motion sickness while on a boat?**

and the rear is called the *stern*. Going toward the bow is going *forward*, and *aft* is toward the stern. The *port* side of the boat is the boat's left when you stand facing the bow. The *starboard* side is the right. (To help you remember, "port" and "left" have the same number of letters. Think of "left port.")



Easy as she goes.
Typical charter dive boat layout.

When the wind blows across the boat, the wind comes from the *windward* side and the side away is the *leeward* (pronounced "loo-ard" in many areas) side. A boat's bathroom is called the *head*, and the kitchen is called the *galley*. The steering wheel is the *helm*, which is found *on* the *bridge*. The bridge is often in the *wheelhouse*, a cabin with all the controls that make the boat do what the captain wants (most of the time).

On charter boats, you may find areas off-limits, or just off-limits when you're wet. Check with the crew or captain before entering the bridge, galley or sleeping area when you're wet.

Try to arrive at least a half hour before departure. This gives you time to check with the crew, sign in and secure your dive equipment. On some charter boats, you'll also pick out a bunk or a cabin space to stow your dry clothes and personal items.

You need to think about seasickness before it happens. Seasickness is like sunburn in that it's one of those things that makes you absolutely miserable, but you can take precautions. So if you may be prone to seasickness, avoid it by taking seasickness medication (as advised by your physician) *before* you get underway and avoid greasy foods prior to boarding.

Underway, 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'll be prepared to enter the water as soon as possible. Reading and intricate tasks tend to promote seasickness, so leave the needlepoint at home.

If you do get sick, go to the leeward side (wind at your back) and have someone come with you (no joke — to hold on to you for safety when you lean over the side). Stay out of the head (that's about the *worst* place to go), and try to relax. To avoid seasickness, many divers *take seasickness medication* if it might be a problem — check with your physician or pharmacist if you need a recommendation on the type that's best for you.

The ride to the dive site can take minutes or hours, depending on where you are. Once the boat anchors at the site, diving begins only after the captain or crew give the okay. Typically a crew member briefs you about dive procedures, which you'll need to listen to closely. Pay attention to crew briefings, because they include important information you'll use to plan your dive with your buddy, such as current strength and direction, the depth, emergency procedures and similar information. If you fail to pay attention to crew briefings, you can put yourself and your buddy at risk.

As you gear up, be careful with heavy equipment. On a pitching boat, it's easy to lose your balance and hurt yourself, and dropping tanks or weight belts can damage the deck. When putting on your scuba unit, get someone to assist you and help you stay balanced. Many dive boats have benches and racks that make it easy to slip into your gear while seated. To don a weight belt, step over it rather than swing it around your waist.

Be careful walking with equipment on. Equipment changes your center of gravity and makes your balance awkward, all the more difficult if the deck is slippery and the boat rolls. If necessary, hang onto railings and handholds as you move, and don't try to walk with fins on. Put your fins on immediately before entering the water, using a rail or your buddy for balance.

When you and your buddy are ready to enter, check with the divemaster or a crew member, and enter where they tell

you to. The most common entry when you dive from large dive boats is the giant stride, but from smaller vessels you may use a controlled seated entry or a back roll. If you have a physical challenge that requires a different entry, let the crew know so they can accommodate you. Be certain the entry area is clear before entering.

If you're using a camera or other accessory, don't enter the water with it. Have someone hand it to you after you get in. Note the current direction so you can swim into it on the bottom, and then descend, preferably along the anchor line or other descent line to the bottom. On the bottom, get your bearings and swim into the current. Plan your dive and navigate so you finish near the boat with enough air so you'll be back on board with 20-40 bar/300 to 600 psi left in your tank. If there's a current, you'll find it easiest to ascend the anchor line, which keeps you from being carried past the boat.

If you hear the boat's underwater recall during the dive, remember to surface and look toward the boat for instructions, or as they direct during the briefing.

At the end of the dive, you usually surface in front of the boat, keeping one hand over your head for protection. When you break the surface, establish buoyancy and signal to the divemaster or crew that you're okay. Avoid swimming back to the boat immediately below the surface because if there are other boats underway in the area, they will not be able to see you. If you're at the surface away from the boat, watch out for boat traffic. You can use an inflatable signal tube, whistle or other signalling device to attract the attention of the dive boat, or of other boats that might not see you.

It's not very likely, but if you surface and the boat's not in sight, stay calm and get buoyant. The boat may have slipped anchor or the captain may have needed to leave for an emergency. Relax and wait to be picked up. If the shore and a reasonable exit area are close, slowly swim in that direction.

When you reach the boat's exit area, don't crowd it. Exit one at a time and stay clear of divers climbing the ladder ahead of you because they can fall, drop a weight belt or have a tank slip loose, which you wouldn't enjoy one bit if you're directly beneath. Hand accessory equipment up before climbing the ladder, but keep all your other equipment in place until you're aboard (mask on, breathing from snorkel or regulator, etc.) You'll usually need to take off your fins, but don't do so until you have a firm hold of the boat, because a current can carry you away from it and without your fins, you'd have difficulty swimming back. When wearing adjustable strap fins, you can slip the fins over your wrist so that if you did lose your grip, you'd be able to pull them back on and swim.

Once aboard, clear your stuff off the deck. A cluttered deck can cause people to trip, and stuff gets broken when divers step on it. Stow your gear directly into your equipment bag as you remove it, secure your tank and store accessories appropriately.

After the last dive, try to get your gear packed before the boat gets underway, since it's usually easier to pack at anchor. On a charter boat, pay attention to crew directions regarding pre and post dive roll calls, equipment stowage and other instructions.

Old salts.
On your first few boat dives, watch experienced boat divers and learn from them. Boat diving procedures are mostly common sense and not particularly difficult, and they allow boat dives to rank among your best dive experiences.

Quick Quiz

Self Assessment 11

1. Benefits of diving from a boat include (check all that apply):
   - ☐ a. reaching dive sites inaccessible from shore.
   - ☐ b. avoiding long surface swims.
   - ☐ c. fun.

2. In preparing your equipment for a boat dive, you'll want to (check all that apply):
   - ☐ a. inspect it.
   - ☐ b. use an equipment bag.
   - ☐ c. make sure everything's marked.
   - ☐ d. include appropriate clothing when you pack it.

3. To be ready for a boat dive, you should (check all that apply):
   - ☐ a. be well rested.
   - ☐ b. avoid excessive drinking the night before.
   - ☐ c. eat a heavy meal.
   - ☐ d. pack your bag so that what you need first is on top.

4. The _____ is the front of the boat; the _____ is the bathroom.
   - ☐ a. bow, starboard
   - ☐ b. stern, galley
   - ☐ c. bow, galley
   - ☐ d. bow, head

5. To minimize motion sickness (seasickness) you may choose to (check all that apply):
   - ☐ a. take seasickness medication.
   - ☐ b. stay in fresh air on deck.
   - ☐ c. look at the horizon.
   - ☐ d. stay near the center of the boat

How'd you do?
1. a, b, c. 2. a, b, c, d. 3. a, b, d. 4. d. 5. a, b, c, d.

On your first few boat dives, watch experienced boat divers and learn from them. Boat diving procedures are mostly common sense and not particularly difficult, and they allow boat dives to rank among your best dive experiences.

Problem Management

Diving enjoys a safety record better than many other sports and adventure activities — but common sense tells you that when you're under and in water, you face hazards and risks. The guidelines and procedures you learn in the course help you minimize and control (but never completely eliminate) these risks, and you'll find that if you and your buddy dive within your limitations, plan your dives and follow safe diving practices, you'll avoid problem situations. Keeping yourself physically fit and maintaining your dive skills also play important parts in problem prevention.

Nonetheless, if a problem does arise, you'll want to be able to care for yourself and lend assistance to another diver. This section introduces you to some of the basic concepts of dive problem management. In this section you'll learn how to prevent and respond to problems such as how to recognize when a diver needs assistance, how to assist another diver, how to respond to problems underwater and the basic procedures for emergencies with an unconscious diver.

Keep in mind, though, that if you plan to dive where secondary assistance (paramedic, lifeguard, divemaster or instructor) is either remote (by time, distance or both) or completely unavailable, you should have additional training beyond this course in first aid, cardiopulmonary resuscitation (CPR) and diver rescue. CPR and first aid training provide skills that can help others no matter where you are,

Summary Points

In these subsections on Dive Planning and Boat Diving, you learned:

- Planning your dive plans your fun.
- A dive plan doesn't have to be complex, nor take a lot of time, nor be inflexible, but you do need to follow it.
- Boat diving has many benefits that make it popular.
- You want to inspect and pack your gear appropriately before a boat dive.
- Different parts and areas on a boat have nautical terms you should know.
- Be careful when moving around on a rolling boat with your gear on.
- Listen to crew briefings about procedures, where to enter and exit the water, and other techniques and emergency considerations.
- Don't get under another diver who's climbing the boat ladder.
- You may choose to avoid seasickness by taking seasickness medication.

Serious fun.
To learn how to handle the specific and potentially complex problems unique to diving, plan to complete the PADI Rescue Diver course. Most divers cite the Rescue Diver course as one of the most rewarding they've taken.

making them worth having apart from diving. The Emergency First Response course offered by PADI trains you in CPR and first aid emergency care. Emergency First Response is available through PADI Professionals, Dive Centers and Resorts.

To learn how to handle the specific and potentially complex problems unique to diving, plan to complete the PADI Rescue Diver course. The Rescue Diver course makes you a more capable diver by expanding and refining your problem prevention, management and handling skills. Although it covers a serious subject, and it *is* challenging, most divers cite the Rescue Diver course as one of the most rewarding courses they've taken.

But for now as a diver, you need to emphasize problem prevention and be prepared with emergency contact information: phone numbers for local paramedics and police, radio frequencies for Coast Guard, contact information for area diver emergency services like the Divers Alert Network (DAN) and the Diving Emergency Service (DES). In areas that lack diver emergency services, have the number and contact information for the nearest recompression chamber and emergency medical services. Carry change, a phone card, a mobile telephone, or whatever is appropriate so you can contact help in an emergency. Your instructor will give you emergency contact information specific to the area where you'll be diving.

Surface Problem Management

Considering that you scuba dive *underwater*, it may seem odd that the majority of diver distress situations take place *at the surface*, but that's exactly what happens. You can control or prevent surface problems by diving within your limitations, by relaxing while you dive and by establishing and maintaining positive buoyancy when you're on the surface.

Can you lend a hand?

Divers who have a problem, but who are in control of their actions normally appear relatively relaxed and breathe normally. Typically, they signal for help if appropriate, keep their equipment in place, move with controlled, deliberate movements, and respond to instructions.

Possible surface problems include overexertion, leg muscle cramps and choking on inhaled water. You've already learned about handling overexertion, and as you recall, if you choke on water, you hold your regulator or snorkel in place and cough through it — keep it in your mouth, and keep your mask on. Swallowing sometimes helps relieve choking, too. Be sure you have sufficient buoyancy, because coughing lowers your lung volume, decreasing your tendency to float.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

42. By what three ways can you prevent or control most dive problems that occur at the surface?

43. What should you do if a diving-related problem occurs at the surface?

If you have a problem at the surface, immediately establish buoyancy by either inflating your BCD or dropping your weights. Let your equipment do the work — having to swim, tread water or otherwise having to fight to stay above water exhausts you quickly. Don't hesitate to discard your weights if you can't stay up with your BCD; weights are easily replaced.

Stop, think, then act. Need help? Ask! Whistle, wave and yell. It's the *smart, safe thing to do*. Get help when you need it, before a small problem becomes a big one, and you make it easier on yourself *and* other divers. Divemasters will tell you it's not the people who ask for assistance who give them gray hair — it's those who need it and *don't ask*.

Problem Recognition

Before you can help another diver, you have to recognize that the diver needs help, then follow your recognition with appropriate action. Divers who have

Quick Quiz

Self Assessment 12

1. You can prevent and control most problems at the surface by (check all that apply):
   - ☐ a. establishing positive buoyancy.
   - ☐ b. diving within your limits.
   - ☐ c. relaxing while you dive.

2. If you have a problem at the surface, you should (check all that apply):
   - ☐ a. establish positive buoyancy.
   - ☐ b. ask for help.

How'd you do?
1. a, b, c. 2. a, b.

a problem, but who are in control of their actions, look pretty much like divers without problems. Generally, if they need help, they signal for it. Divers in control normally appear relatively relaxed and breathe normally. Typically, they keep their equipment in place, move with controlled, deliberate movements, and respond to instructions.

Red alert!

Panicked divers, fearing drowning, typically struggle to hold their heads high above the water. They usually fail to establish positive buoyancy, and spit out their regulators and shove their masks up on their foreheads. They pay no attention to their buddy or others and make quick, jerky movements. Their eyes are wide and unseeing, and they don't usually respond to directions.

Divers who have a problem and panic lose self control, and sudden, unreasoned fear and instinctive inappropriate actions replace controlled, appropriate action. Panicked divers, fearing drowning, typically struggle to hold their heads high above the water, expending tremendous energy. They usually fail to establish positive buoyancy, and spit out their regulators and shove their masks up on their foreheads, requiring them to fight even harder to breathe. Panicked divers will generally be anxious and breathe rapidly and shallowly. They pay no attention to their buddy or others and make quick, jerky movements. Their eyes are wide and unseeing, and they don't usually respond to directions. Divers exhibiting these signs need immediate help, because they will continue to struggle until completely exhausted and unable to remain afloat.

Assisting Another Diver

There are four basic steps to assisting another diver: 1) establish ample buoyancy (for *both* of you), 2) calm the diver, 3) help the diver reestablish breathing control and 4) if necessary, assist the diver back to the boat or shore.

Always begin with buoyancy — you reduce the immediate risk by assuring that nei-

MAIN Objectives

Underline/highlight the answer to this question as you read:

44. How do the appearance and actions of a diver who is under control differ from the appearance and actions of a diver who has, or is about to have, a problem involving panic?

QUICK QUIZ

Self Assessment 13

1. Panicked divers typically (check all that apply):

- ☐ a. drop their weights and establish positive buoyancy.
- ☐ b. push off their masks and spit out their regulators.
- ☐ c. respond to instructions.
- ☐ d. need immediate help.

How'd you do?

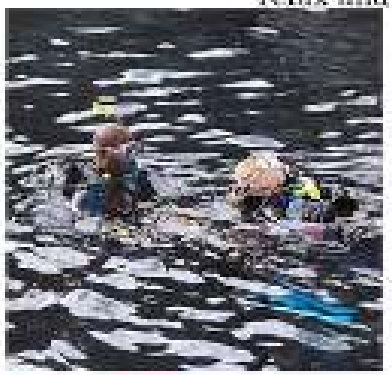
1. b, d.

ther of you will sink. To do this, ideally throw or extend some flotation to the diver, but if you can't do that, inflate the diver's BCD and/or discard the weights. Once you've established buoyancy, calm the individual by talking, offering encouragement and persuading the diver to relax and take it easy.

MAIN Objectives

Underline/highlight the answer to this question as you read:

45. What are the four basic steps to assisting another diver?



Enjoy the ride.
After some time to rest and recover, if necessary assist the diver using the cylinder valve tow or the modified tired-swimmer carry.

Have the diver take deep, slow breaths to reestablish breathing control, and encourage relaxation and self-control. After some time to rest and recover, if necessary assist the diver using the cylinder valve tow or the modified tired-swimmer carry, which you'll practice during Confined Water Dive Three.

Underwater Problem Management

You can prevent or control underwater problems by 1) relaxing while you dive, 2) keeping close watch on your air supply and 3) diving within your limitations. Of the few problems that do occur under water, the most likely are overexertion, running out of or low on air, regulator free flow and entanglement. Another way to prevent or control underwater problems is to stay well within the depth and time limits of your dive table/computer. Exceeding these limits can lead to serious injury called decompression sickness, which you'll learn more about in Chapter Four.

To the rescue.
The fastest and preferred method for helping a diver establish buoyancy is to throw the diver something that floats, preferably on a line so you can gently pull the diver to you.

Overexertion. In Section Two, you learned to prevent overexertion by moving and breathing slowly and deliberately, and by pacing yourself. You also learned that if you do get overexerted, stop all activity, rest, relax and breathe slowly until you restore your normal breathing pattern.

Underwater, overexertion can give you a feeling of *air starvation* because breathing resistance through the regulator increases as you go deeper. Overexertion is the problem, but it may feel like your regulator isn't delivering enough air. Actually, you're demanding more air than it can deliver — as you recall, you prevent overexertion (and air starvation) by avoiding strenuous activity and by pacing yourself.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

46. By what three ways can you prevent or control most dive problems that may occur underwater?

47. What are four problems that may occur underwater?

48. What are the low-on-air/out-of-air emergency procedures?

49. How do you breathe from a free-flowing regulator?

50. What should you do if you become entangled underwater?

Running low on or out of air. Running out of air is probably the easiest problem to avoid, and air stoppage due to a malfunction is extremely remote (more about this in a moment). To keep from running excessively low on or out of air, make a habit of checking your SPG frequently. Obviously, your SPG only works if you look at it.

But suppose the unlikely happens and your air either runs out or stops unexpectedly. It's still not a serious situation if you take a moment to consider your options and then act intelligently. Here are the options you can consider in a low-air situation as well as guidance as to when you would use each:

1. *Make a normal ascent.* Do what? No, it's not as odd as it sounds. If you're very low on air (you feel resistance and have to pull hard, but you're still getting something), your cylinder isn't completely empty. As you ascend, the water pressure surrounding you decreases, so more of the remaining air in your cylinder becomes usable. Breathing lightly (but continuously), you can make a controlled, continuous ascent to the surface.

2. *Ascend using an alternate air source.* Think of this as your best all-round choice when you're out of air and your buddy is near. But for this to work, you must know how to locate your buddy's alternate, how to secure it and how to use it. Don't neglect these steps in your predive safety check.

3. *Ascend using a controlled emergency swimming ascent.* Supposing you're completely out of air and your buddy is too far away to provide an alternate air source (What did you learn about staying close to your buddy?) and the water is 6 to 9 metres/20 to 30 feet deep or less, you may decide to make a controlled emergency swimming ascent. This simply involves looking up and then swimming to the surface, exhaling continuously while making a continuous *aaaahhh* sound into your regulator to release expanding air and to prevent lung over expansion injury. Upon reaching the surface, orally inflate your BCD for positive buoyancy. The emergency swimming ascent isn't difficult and you'll have a chance to practice during your third confined water dive.

Sing all the way to the surface.
A controlled emergency swimming ascent involves looking up and then swimming to the surface, exhaling continuously while making an "aaaahhh" sound into your regulator to release expanding air and to prevent lung over expansion injury.

4. *Make a buoyant emergency ascent.* You're too deep for a controlled emergency swimming ascent and you're too far for your buddy to help you. You can still make it to the surface, though the situation isn't ideal. You make a buoyant emergency ascent, just like a controlled emergency swimming ascent, except you drop your weights. You look up and exhale continuously, making the *aaaahhh* sound into your regulator as you rise to the surface. You're going to exceed a safe ascent rate, and that has some serious risks — so use this method only when you doubt you can reach the surface any other way. You can flare out to create drag and help slow your ascent if you start to rise faster than necessary to reach the surface safely.

After reaching the surface using any of these options, remember that you may need to inflate your BCD *orally* to establish positive buoyancy. Remember to discuss out-of-air emergency options with your buddy as part of planning your dive, and stay close together so you can assist each other if necessary, especially as you go deeper. Look after one another, watching your air supplies, breathing patterns, and time and depth limits. By remaining alert and monitoring each other, you can avoid air supply and other problems.

Regulator free flow. Today's regulators are extremely reliable; it's highly unlikely that a regulator malfunction would cut off your air. Besides this, they're designed to *fail-safe*, that is, most malfunctions result in an air free flow rather than no air. You can breathe from a free-flowing regulator by following a couple procedures.

First, don't seal your mouth on the regulator because the continuous flow could, in the worst case, cause a lung over expansion injury, but more likely it would make the regulator pop out of your mouth and flood your mask. Instead, hold the regulator in your hand and press the mouthpiece to the outside of your lips, inserting one corner if you like. Breathe the air you

Quick Quiz

Self Assessment 14

1. You can prevent or control most dive problems underwater by (check all that apply):
   - ☐ a. relaxing while you dive.
   - ☐ b. watching your air supply.
   - ☐ c. diving within your limitations.
   - ☐ d. maintaining a brisk pace.

2. Problems that can occur underwater include (check all that apply):
   - ☐ a. overexertion.
   - ☐ b. regulator free flow.
   - ☐ c. entanglement.
   - ☐ d. running low or out of air.

3. The general best all round option if you run out of air is:
   - ☐ a. buoyant emergency ascent.
   - ☐ b. controlled emergency swimming ascent.
   - ☐ c. Neither of the above.

4. To breathe from a free flowing regulator (check all that apply):
   - ☐ a. don't seal your lips around the mouthpiece.
   - ☐ b. allow excess air to escape.

5. If you become entangled underwater, your first response should be:
   - ☐ a. to slowly untangle yourself.
   - ☐ b. to cut yourself free.

How'd you do?
1. a, b, c. 2. a, b, c, d. 3. c. The best all round option if you run out of air is to ascend using an alternate air source. 4. a, b. 5. a

need like drinking from a water fountain, letting the excess air escape.

You should begin your ascent immediately if your regulator free flows because you'll exhaust your air supply quickly. When you reach the surface, turn off the air and don't use the regulator until it has been serviced by a qualified technician. If you maintain your regulator properly, keep it out of the sand or debris and have your PADI Dive Center or Resort service it annually, you'll probably never have a free-flow problem.

Entanglement. As mentioned earlier in the discussion on aquatic plants, entanglement is rare. Besides plants, though, fishing line, tree branches, loose line and old fishing nets have the potential to cause entanglement problems. Prevent entanglement by moving slowly, watching where you go and keeping your equipment secure so it doesn't snag or tangle.

As long as you have air and are unhurt, entanglement really isn't an emergency. Stop, think, and then work slowly and calmly to free yourself. Get your buddy to help you, and don't twist or turn because this usually wraps line around you and worsens the tangles. If your scuba unit is tangled, you may have to remove it, keeping your regulator in your mouth, free it, and then put it back on. (You will practice taking your unit off and putting it back on underwater in Confined Water Dive Five.) If you're low on air, or you're severely entangled, you may need to use your knife to cut yourself free; if so, do so carefully — don't complicate the situation by injuring yourself or cutting a piece of gear. And, with tough rope, cutting may be slower than disentangling — use what works fastest. In any event, entanglement isn't common, and more of an irritation than a serious problem if you deal with it calmly.

Near Drowning and the Unresponsive Diver

Near drowning occurs when someone revives a diver (or swimmer) who became unresponsive (unconscious, or unable to respond or act coherently) and stopped breathing while submerged. Swallowing water, extreme fatigue, entanglement and lung over pressurization may be the cause, with panic, inefficient breathing, throat blockage, exhaustion, heart stoppage and unconsciousness contributing.

MAIN Objectives

Underline/highlight the answer to this question as you read:

51. What are the four general procedures for dealing with an unresponsive diver in the water?

With an unresponsive diver, *the primary concern is to check for breathing and to begin rescue breaths if the diver isn't breathing*. If a diver is unresponsive underwater, bring the diver to the surface; someone may need to perform rescue breathing in the water, and if the victim has no pulse, CPR. You can't perform CPR effectively in water, so you need to get the diver out of the water.

Breath is life.
With an unresponsive diver, the primary concern is to check for breathing and to begin rescue breaths if the diver isn't breathing.

Here are the four general procedures to follow if a diver appears to lose consciousness and becomes unresponsive in the water:

1. Quickly bring the diver to the surface and check for breathing.
2. Establish ample positive buoyancy for you and the victim.
3. Get assistance as needed in providing rescue breathing.
4. Help remove the diver from the water.

Assistance continues once out of the water, with the following steps also applying to a diver who, after diving, becomes unconscious or experiences symptoms of lung over expansion injury. These symptoms may include difficulty breathing, confusion, lowered

alertness, a change in the level of consciousness, unclear thinking, visual problems, paralysis, and chest pain.

Supine is fine.
If the diver doesn't require CPR or rescue breathing, keep the diver lying level on the left side supporting the head (called the recovery position). If the diver is responsive and more comfortable lying prone, that's fine.

1. Keep airway open and check for breathing. If necessary, start and continue rescue breathing and/or CPR.
2. Observe the diver constantly, checking breathing and pulse.
3. If the diver doesn't require CPR or rescue breathing, keep the diver lying level on the left side supporting the head (called the recovery position). Don't let this position interfere with transportation or other aid, and should not be used if CPR is required. If the diver is responsive and more comfortable lying prone, that's fine.
4. Administer emergency oxygen if possible.
5. Keep the diver still and maintain a normal body temperature by protecting the diver from heat or cold.
6. Seek emergency medical assistance.
7. If unable to accompany the diver to medical treatment, write down as much background information as possible and attach it to the diver in a conspicuous place.

Quick Quiz

Self Assessment 15

1. If a diver becomes unresponsive underwater, you should:

☐ a. bring the diver immediately to the surface and check for breathing.
☐ b. remove the diver's cylinder.
☐ c. All of the above.

How'd you do?
1. a.

Confined Water Dive Preview

Neutral Buoyancy

By now you're aware that you need to maintain neutral buoyancy while diving to avoid bottom contact, so you can relax and maneuver easily, and so you can prevent rapid, uncontrolled ascents and descents. In the last confined water dive, you adjusted your weight for neutral buoyancy at the surface. During this dive, you'll develop your neutral buoyancy skills further.

Summary Points

In these subsections on Problem Management, you learned:

- Most problems occur at the surface.
- You prevent most problems by staying relaxed and diving within your limits.
- If you have a problem at the surface, establish positive buoyancy and call for help if you need it.
- A diver with a problem who is in control tends to respond to instructions, and to establish buoyancy.
- A panicked diver tends to spit out the regulator, push off the mask and to not inflate the BCD or drop weights.
- When assisting another diver, establish buoyancy, calm the diver, help the diver reestablish breathing control, and if necessary help the diver back to the boat or shore.
- If you watch your SPG, it's highly unlikely you'll run out of air.
- Using an alternate air source is your best all-round option when you're out of air.
- You can breathe from a free-flowing regulator by not sealing your lips on the mouthpiece.
- Entanglement isn't a big deal if you react calmly and carefully untangle yourself.
- Bring an unresponsive diver immediately to the surface, check for breathing and pulse, and begin rescue breathing and/or CPR as necessary.
- Ask for help when you need it.

You've undoubtedly found that you need to use your BCD to trim and fine-tune buoyancy when you descend and ascend, due to exposure suit compression, and due to air compressing and expanding in your BCD. When making changes to your buoyancy, whether adding or releasing air, do it slowly. Rapid changes make it difficult for you to control buoyancy and can lead to runaway ascents or descents.

You've probably been using mainly your low pressure inflator to fill your BCD underwater. To orally inflate your BCD underwater — which you might do if you had a low pressure inflator problem for instance, take your second stage in your right hand and the BCD inflator in your left. Take a breath, remove the regulator and blow about two thirds of this air into your BCD, operating the controls just like you did when orally inflating it at the surface. Save enough air to clear the regulator, and don't forget to blow a stream of bubbles as you switch back and forth — never hold your breath. Do this until you've inflated the BCD sufficiently to attain neutral buoyancy.

Let's look at the fin pivot method for establishing neutral buoyancy. This method guides you in getting the feel of neutral buoyancy. You'll practice doing this several times in the course, using both your low pressure inflator and your oral inflator. When you use your low-pressure inflator, remember to add air in short bursts. Don't hold the button down continuously, and release air from your BCD in small amounts, too.

Confined Water Dive Three

Skill Requirements

Here's what you'll be able to do when you successfully complete Confined Water Dive Three:

1. Independently establish neutral buoyancy under water by pivoting on the fin tips, or, when appropriate, another point of contact (both oral and low-pressure inflation).
2. Swim at least 10 metres/yards underwater while maintaining neutral buoyancy.
3. Demonstrate the cramp removal technique.
4. At the surface in water too deep to stand in, perform a tired diver tow for 25 metres/yards.
5. React to air depletion by signaling out of air, then securing and breathing from an alternate air source supplied by a buddy for at least one minute while swimming underwater.
6. Breathe effectively from a free-flowing regulator for not less than 30 seconds.
7. Simulate a controlled emergency swimming ascent by swimming horizontally underwater for at least 9 metres/30 feet while continuously exhaling by emitting a continuous sound.

Basically, here's how you fin pivot: 1) lie face down on the bottom, 2) breathe slowly and deeply and 3) add air in small amounts to your BCD (or dry suit – your instructor will give you more detail on this if you'll be using a dry suit), gradually increasing your buoyancy until you slowly pivot upward on your fin tips as you inhale (buoyancy increasing with lung volume), and slowly pivot downward as you exhale (buoyancy decreasing with lung volume). This means you're neutrally buoyant at that depth and can fine-tune your buoyancy by controlling your lung volume. Be sure you don't hold your breath at any time.

If you have a physical challenge that makes it difficult to pivot on your fin tips, you can use your knees or another contact point for pivoting. However, use your fin tips if you can because it puts all your body mass on

Without LPI underwater.
To orally inflate your BCD underwater take your second stage in your right hand and the BCD inflator in your left. Take a breath, remove the regulator and blow about two thirds of this air into your BCD, operating the controls just like you did when orally inflating it at the surface. Save enough air to clear the regulator, and don't forget to blow a stream of bubbles as you switch back and forth.

Up and down.
To fin pivot: 1) lie face down on the bottom, 2) breathe slowly and deeply and 3) add air in small amounts to your BCD. Gradually increase your buoyancy until you slowly pivot upward on your fin tips as you inhale. When you exhale, you should slowly pivot back down again.

Minor difference.
If using a dry suit, you'll use the low pressure inflator on your suit instead of the one on your BCD to adjust your buoyancy for fin pivoting.

Protecting the environment.
After you've established neutral buoyancy, your instructor will have you swim 10 metres/yards or farther, remaining neutrally buoyant. This simulates how you swim avoiding damage to the environment when making open water dives.

the same side of the contact point; a contact point that has body mass on both sides (like your knees — your lower legs, feet and fin are on the other side) may not set your buoyancy quite as accurately.

With practice, you'll find it pretty easy to maintain neutral buoyancy, to the point that it becomes second nature. If it seems awkward at first, no worries. That's normal. Keep in mind that water's density slows movement, so changes in your buoyancy don't seem to have an immediate effect. That's why you add or release small air amounts and wait a moment to see what happens before adding or releasing more.

The volume of air in your BCD changes every time you change depth. In shallow water, where air volume expands and compresses the most for a given depth change, you'll find buoyancy control the most critical — it's actually easier as you go a bit deeper, like in open water.

Don't forget to adjust your buoyancy as you change depth, or you may find yourself floating away from the bottom unintentionally. If this should happen, exhale and vent air from your BCD, and swim downward. Some BCDs have extra exhaust valves that allow you to dump air while swimming downward

at the same time. If you're unable to and end up in a runaway ascent, flare out facing the surface to create maximum drag and resistance and slow your ascent, while breathing continuously and maintaining normal lung volume. With experience and by staying aware of your buoyancy, you should have few, if any, runaway ascents.

During a normal ascent, keep your hand on the deflator, releasing small air bursts as needed to prevent excess buoyancy. When you reach the surface, immediately inflate your BCD and establish positive buoyancy. You'll have to pay close attention to buoyancy control at first, but gradually it will become something you do automatically.

Neutral Buoyancy Swim

After you've established neutral buoyancy, your instructor will have you swim 10 metres/yards or farther, remaining neutrally buoyant. During this swim, pretend you're swimming over a reef with sensitive aquatic organisms and avoid any contact with the bottom. This simulates how you swim avoiding damage to the environment when making open water dives.

Ow!

To relieve a cramp, stop and rest the cramped muscle. Stretch and gently massage it to increase circulation and pull out the cramp. If you have a leg cramp in your calf muscle, you can stretch it by grasping the fin tip and pulling it toward you while you push with your leg.

Cramp Removal

A cramp is a painful, involuntary muscle contraction, which, as a diver, you may experience in your leg or foot muscles. Several things can contribute to cramps: dehydration, working the muscle beyond its fitness level, restricted circulation, cold water, and all of these working together. Your fins can contribute to cramping if the blade is too large for your leg strength, or if the foot pockets are too small and your feet don't go in them properly. Fitness, proper fin selection, practice, proper insulation and pacing your activity, will help you avoid cramps.

But they can happen anyway. Like most problems, it's more of an irritation than an emergency if you stop and think about what to do. For a cramp, stop and rest the cramped muscle. Stretch and gently massage it to increase circulation and pull out the cramp. If you have a leg cramp in your calf muscle, you can stretch it by grasping the fin tip and pulling it toward you while you push with your leg. Your buddy can also brace the fin tip for you.

Pull.
Cylinder valve tow.

Push.
Tired diver push, sometimes called a modified tired-swimmer carry.

After relieving the cramp, rest the muscle for a few minutes before continuing at a slower pace — with about 50 to 75 percent of the load you had on the muscle before. A cramped muscle usually recovers better if you resume using it at a reduced pace after a brief rest than if you stop using it completely.

Tired Diver Tow

Sometimes divers become so tired and out of breath they can't swim to the boat or shore. Or, they may have severe leg cramps that prohibit swimming. You can assist such a diver by establishing positive buoyancy and having the diver do the same, then helping the diver to the boat or shore using one of several tows, such as the *cylinder valve tow* or the *tired diver push*, sometimes called the *modified tired-swimmer carry*. Your instructor will demonstrate these and let you practice them.

Thanks for the assist.
As soon as you feel breathing resistance, signal "out of air" and "share air" to your buddy. Secure and start breathing from your buddy's alternate air source.

Air Depletion/Alternate Air Source Combined Exercise

During your first two confined water dives, you learned how to use an alternate air source, and you learned what it feels like to run out of air. Now you're going to put these together to practice responding to running out of air. Your instructor will turn off your air like when you did the air depletion exercise. Don't look at your SPG — but as soon as you feel breathing resistance, signal "out of air" and "share air" to your buddy. Secure and start breathing from your buddy's alternate; after you take a moment to get situated and make contact with each other, your instructor will have you swim together for at least one minute while you continue to use the alternate. This simulates swimming to the surface from 18 metres/60 feet deep.

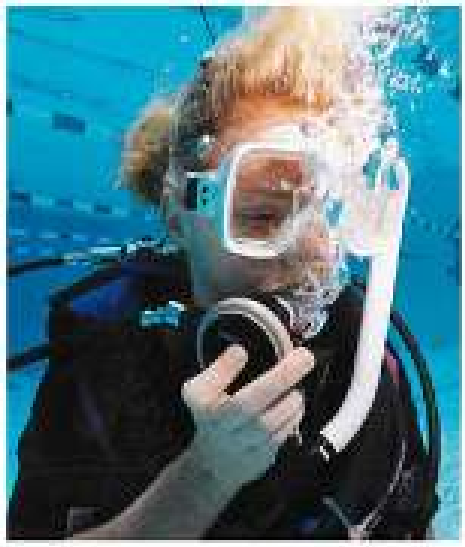
As soon as you secure your buddy's alternate and remove your regulator from your mouth, your instructor will turn your air

back on. That way, if you need to you can switch back to it. Confirm that the valve is open by checking your SPG, which should not be on (or near) zero if it is.

Free Flow Regulator Breathing

Earlier you learned that it's not likely that your regulator will fail so that it would cut off your air, but that a failure would most likely cause an air free flow. You can breathe from a free flowing regulator if you don't seal your lips on the mouthpiece. During this confined water dive, your instructor will have you practice breathing this way

Since your regulator probably won't cooperate by spontaneously malfunctioning right when you need to practice this, you'll *simulate* the free flow by (you guessed it) holding in the purge button.



Whoosh!

You'll simulate the free flow by holding in the purge button. Remember to breathe without sealing your mouth on the regulator, "sipping" the air you need while allowing excess air to escape.

Remember to breathe *without* sealing your mouth on the regulator, "sipping" the air you need while allowing excess air to escape. A free flowing regulator can really rush — don't be surprised if it jostles and floods your mask a bit. You'll breathe from your simulated free flow for at least 30 seconds, and your instructor may have you practice turning off your air after surfacing like you would with a real free flow. If you can't reach your cylinder valve unless you remove the scuba unit, do so for practice. Although your buddy might do this for you, doing it yourself develops self-reliance. Check your SPG when you're done; you'll be amazed how much air a free flow eats up in only 30 seconds — which is why you head straight for the surface if it happens.

Controlled Emergency Swimming Ascent

As you learned, the controlled emergency swimming ascent (also called CESA — pronounced "see-sa") is one option if you lose your air supply at 6 to 9 metres/20 to 30 feet or less, and your buddy is too far away to provide an alternate air source (Buddy system, buddy system! You shouldn't be that far from your buddy!).

Emergency swimming ascents are interesting because you start with air in your lungs, exhale all the way to the surface and still have air in your lungs when you get there. This happens

because air expands in your lungs as you ascend; the potential hazard is a lung over expansion injury, which you avoid by not holding your breath.

Horizontal is vertical.
Since you won't be 9 metres/30 feet deep during your confined water dive, you'll simulate the controlled emergency swimming ascent horizontally.

To make a controlled emergency swimming ascent, simply swim upward with all your equipment in place, including your regulator. Look up, reach up and come up, swimming at 18 metres/60 feet per minute or slower. Exhale the entire time by making a continuous *aaaahhhh* sound through your regulator as you ascend.

By saying *aaaahhhh*, you exhale air at the right rate to prevent lung over expansion injury, but you don't exhale too much either. The idea is to maintain a lung volume that is neither empty nor full.

Since you won't be more than 9 metres/30 feet deep during your confined water dive, you'll simulate the controlled emergency swimming ascent first *horizontally*, then diagonally from deeper to shallower water. You'll have enough air in your lungs to swim a long way horizontally while exhaling continuously, but 9 metres/30 feet will be ample for practice. After you do this horizontally, you can be more than sure that you can do it *vertically* assisted by air expanding in your BCD and lungs. After an actual controlled emergency swimming ascent, you don't feel out of breath — you still have air in your lungs. You'll get a chance to practice CESA vertically during your open water dives and may be surprised how much easier it is than simulating it horizontally.

Perhaps the greatest value of controlled emergency swimming ascent training is knowing you can do it. When you realize you can reach the surface without difficulty, even if you suddenly lose your air supply, you can relax and enjoy diving more. But watch your SPG and stay close to your buddy so you never need to.

General Open Water Skills

Now let's start looking at what you'll be doing during your open water dives. Depending on the course location, schedule, your preferences and other logistical concerns, you may have already

made Open Water Dive 1, or may make Open Water Dives 1 and 2 after you successfully complete Confined Water Dive Three. You'll do this if you're completing only the Scuba Diver certification. Alternatively, you may make all your open-water dives after completing all five confined water dives.

During your open water dives, you'll apply and further develop the skills you've learned during the confined water dives, and you'll start picking up some new skills that you can't practically learn
in a confined water environment. Skills in both categories may include : 1) evaluating dive conditions, 2) gearing up for a dive in open water, 3) making entries and exits through mild surf, 4) swimming on the surface and 5) descending/ascending in open water.

Diving report?

When you arrive at a dive site, you want to determine whether the diving conditions are within your training and experience limitations. Your instructor will show you how to account for considerations that have bearing on the dive.

Evaluating Dive Conditions

When you arrive at a dive site, you want to know whether the diving conditions are within your training and experience limitations. As you learned earlier, you normally check out the conditions before you gear up — no point unpacking and putting everything on only to find conditions don't warrant diving. Your instructor will show you how to account for considerations like weather, water temperature, bottom composition, waves, depth, local area hazards and anything else that has direct bearing on the dive. You'll also preplan your entry and exit points and procedures as part of this evaluation.

Decide whether you can make the dive safely. **Remember: This is *your* decision – you are ultimately responsible for your safety, and only *you* can make the final decision to dive.** If you don't feel confident about it, your instructor may have you check your alternate site for acceptable conditions. If conditions aren't good, it's best to go do something else — diving in poor or potentially hazardous conditions isn't fun. You're doing this for fun, adventure and challenge — not to expose yourself to unreasonable risks.

Suiting Up

In the discussion on exposure suits you learned ways to avoid

One piece at a time.
Suiting up requires thought at first, but after one or two dives, you'll be more familiar with your equipment and it becomes second nature.

overheating in your exposure suit as you get ready to dive. During your open water dives, you'll put this knowledge to use. Poor timing and sequence when you kit up can cause you to become somewhat frustrated, tired, breathless and overheated.

Ideally, you want to suit up so that you and your buddy finish simultaneously. This never happens, of course, but you can time it so you're both ready at about the same time while staying cool and rested, ready to enter the water.

First, it helps if you checked and packed your equipment properly before the dive. Start putting everything together, but take your time and rest as needed. In hot weather, cool off in the water if you need to. Pace yourself with your buddy, but be as self-reliant and independent as possible, so you become familiar with your equipment.

As a suggestion, prepare and don your equipment like this:

1. Assemble your scuba unit. Prepare anything else that can be made ready without putting your exposure suit on, such as defogging your mask, adjusting any straps, etc.
2. Don your exposure suit. If it is a wet suit, put on pants and boots first, then the jacket and hood.
3. Put on your weight belt. With a few scuba units, you'll put your weight belt on after the unit. If you're using an integrated weight system, it's usually part of your scuba unit.
4. Have your buddy help you put on your scuba unit.
5. Put on any wrist mounted gauges (often easier after putting on your scuba unit so they don't snag sliding into your BCD).
6. Perform the predive safety check with your buddy.
7. Don your mask and snorkel, which should've been adjusted ahead of time.
8. Put on your gloves.
9. Finally, just before entering the water (boat diving) or in waist deep water (shore diving) put on your fins; fins should've been preadjusted.

Suiting up requires thought at first, but after one or two dives, you'll be more familiar with your equipment and it becomes second nature.

Open Water Entries

Entry techniques vary from place to place according to the dive environment. If a dive site requires entry techniques that you don't know, always get an orientation to them so you can enter (and exit) safely. If your open water dives will be from shore, your instructor will teach you the proper entries for the dive site.

The following practices are generally recommended for most scuba entries from shore:

1. Have everything on before entering the water. Depending on the environment and conditions, you may have your fins on when you enter the water, or you may carry them until reaching water about waist to chest deep.
2. As a general rule, breathe from your regulator until you're floating in deeper water. This way, if you stumble, you can still breathe, even if you end up with your face in the water. Once in deeper water and floating with your BCD, switch to your snorkel to conserve air if you have a surface swim before descending.
3. If you're walking in with your fins on, walk backward or sideways and shuffle your feet. This helps you find obstructions or holes, scares away bottom-dwelling animals that could sting if you stepped on one, and helps minimize the chances of falling. In some environments, however, you may want to avoid shuffling your feet because it will disturb the visibility. Your instructor will teach you which is appropriate for your open water dives.
4. Swim as soon as the water is deep enough. Swimming is often easier than wading.

Surf Entries and Exits

Surf entries and exits require special training and shouldn't be attempted unless you have had that training. It is possible, though, that you'll enter and exit through *mild* surf as part of your open water dives. Here are a few simple general procedures.

Entries. First, watch the waves and note where they're breaking and how often. Do this during suiting up so you'll be familiar with the surf's pattern when you're ready to enter.

As you enter the water, breathe from your regulator. If wearing fins, walk backward, looking over your shoulder to watch where you're going and to see oncoming waves. Your buddy should be next to you, and if you're towing a float, it should be between you and the shore so a wave can't push it into you. The idea is to get through the surf zone as quickly as possible.

Hurry through the surf.
Breathe from your regulator when entering through surf. Your buddy should be next to you, and if you're towing a float, it should be between you and the shore so a wave can't push it into you. The idea is to get through the surf zone as quickly as possible.

When a wave is about to meet you, hold your mask (so the wave doesn't take it), stop, and lean into the wave as it hits you. It's best to have your side to the waves, which presents less surface to it and aligns your legs for the best balance. Once the wave passes, move on again quickly. As soon as the water is deep enough, begin swimming steadily and move quickly until you clear the surf zone, then rejoin your buddy if you became separated during the entry. Be sure to keep a hand on your mask whenever you go through a wave, and until outside the surf. Beyond the surf you can inflate your BCD and switch to your snorkel to swim out to your dive site.

Exits. When you're ready to leave the water through surf, stop outside the surf zone and watch the waves. Again, watch the wave sets — where they're breaking and when. The pattern can change during your dive, so take the time to check. Evaluate the situation and discuss it with your buddy.

Always save some air for exiting, because you'll use your regulator as you pass through the surf. Wait until the surf pattern reaches a lull, then swim toward shore as quickly as possible, keeping a hand on your mask when waves hit and checking your buddy every few seconds. Swim steadily with a free hand extended ahead of you. Avoid stopping in the surf zone and swim until you're in shallow water. If the backrush is strong and you are tired, you may elect to swim up to the beach and crawl out on your hands and knees. If you stumble in the waves, don't try to get up — just crawl out.

Handle waves the same way you did while entering — by stopping, holding your mask firmly and leaning against it. When you

stand up, walk backward so you can watch the waves and stay beside your buddy. If you have a surface float, push it ahead of you so it stays between you and the shore.

Surface Swimming

Swimming on the surface in open water differs from surface swimming in confined water. You may have lower visibility, you may have longer distances to swim, and there may be currents or waves. You've been simulating the right habits during your confined water dives, but here are a few reminders:

Use your snorkel.
Swimming on the surface in open water differs from surface swimming in confined water. You may have lower visibility, you may have longer distances to swim, and there may be currents or waves.

1. Swim with your BCD about half full so you won't have to struggle to stay at the surface. Don't over inflate your BCD, though because it creates unnecessary drag.
2. Pace yourself. Swim at a steady, comfortable pace. Surface swimming tires you more than swimming underwater, so don't try to go as fast.
3. Streamline yourself as much as possible. Keep your arms at your sides.
4. Use your snorkel, breathing cautiously to avoid choking on water that may enter the snorkel due to small waves.
5. Keep your fins below the surface when kicking. You may wish to swim on your side or back if conditions allow.
6. Check your location, direction and your buddy every 30 seconds or so. Stay close to your buddy, maintaining physical contact if necessary. Use something on shore, or an anchored boat, for orientation.

Descents in Open Water

You've been practicing proper descents during your confined water dives, but there are some points to remember in open water due to the greater depths and the bottom composition.

If you're weighted properly, you should be able to descend by slowly deflating your BCD and exhaling. Make the entire descent with your head above your feet, so you maintain control and orientation, and keep contact with your buddy. Remember to equalize your air spaces early and often during the descent.

You want to maintain neutral buoyancy during the descent —

Equalize early and often.

As you descend, maintain buddy contact and stay oriented so you have your sense of direction when you reach the bottom.

don't wait until you reach the bottom. Add small amounts of air as you descend so you reach the bottom neutrally buoyant. This minimizes kicking and stirring up the bottom.

For control and reference, it's a good practice to use a line during descents, or follow the bottom contour. If you descend along the anchor line of a boat, hold the line at arm's length so it won't strike you as the boat pitches up and down in the waves. Let your arm swing up and down with the line like a shock absorber so it doesn't jerk you up and down.

You want to descend steadily and with minimal effort, while maintaining neutral buoyancy so you can stop your descent at any time. Maintain buddy contact and stay oriented so you have your sense of direction when you reach the bottom.

Open Water Dives 1 and 2

Here's a preview of the skills and procedures you'll practice during your first two Open Water Dives. The sequence within each dive will vary, depending on the logistics, and your instructor may sequence some skills in different dives. Before each dive, your instructor will brief you about what you're going to do and when, along with other information you need for the dive, like communication signals, an environmental orientation, emergency procedures, safety rules, and so on.

Open Water Dive 1 introduces you to the skills you'll use on virtually all dives, to the experience of exploring underwater, and to the differences between confined water and open water. Open Water Dive 2 expands on this, plus you'll practice some of the skills you've mastered during the confined water dives.

Open Water Dive 1 Overview

Briefing
Equipment preparation
Don and adjust equipment
Predive safety check
Entry
Buoyancy/weight check
Controlled descent (max 12 m/40 ft)
Underwater exploration
Safety Stop*
Ascent
Exit
Debrief and log dive

* These skills may be sequenced in other dives, depending on logistics.

Open Water Dive 2 Overview

Briefing
Equipment preparation
Don and adjust equipment
Predive safety check
Entry
Buoyancy/weight check
(Cramp removal self and buddy)*
(25 metre/yard tired diver tow)*
(Snorkel/regulator exchange)*
Controlled descent (max. 12 m/40 ft)
Achieve Neutral Buoyancy - low pressure inflator
Partial and complete mask flood and clear
Regulator recovery and clearing
Alternate air source use stationary and AAS assisted ascent
Underwater exploration and buoyancy control
Safety Stop*
Ascent
(Weight removal at the surface)*
Exit
Debrief and log dive

Knowledge Review

Chapter 3

1. There are several factors that affect visibility underwater. Check those listed here.

   ☐ a. weather
   ☐ b. water movement
   ☐ c. ambient pressure
   ☐ d. suspended particles

2. True or False: To avoid problems associated with diving in clear water, use an accurate depth gauge, refer to it frequently and it is recommend that you use a line for ascents and descents. _____

3. Explain what you should do if you find yourself caught in a current at the surface.

_____

_____

4. True or False: You will find it easier to swim against a mild current along the bottom where it is generally weaker than on the surface._____

5. Check one. If a current is present, you should generally begin your dive:

   ☐ a. with the current.
   ☐ b. across the current.
   ☐ c. against the current.

6. Check one. Nearly all injuries from aquatic life are caused by_____action on the part of the animal.

   ☐ a. unpredictable
   ☐ b. unprovoked
   ☐ c. defensive

7. Describe what you should do if you spot an aggressive animal underwater.

_____

_____

8. True or False: For safety and enjoyment when diving in a new area or engaging in a new activity, be sure to obtain a proper orientation. _____

9. A rip current can be recognized as a line of turbid, foamy water moving:

   ☐ a. toward shore.
   ☐ b. seaward.
   ☐ c. parallel to shore.

10. Outline three ways to prevent or control most diving problems that occur at the surface.

    1. _____

    2. _____

    3. _____

11. True or False: The *first step* in assisting another diver with a problem at the surface is to talk to him, offering encouragement and persuading him to relax. _____

12. Draw lines to connect the low-on-air/out-of-air emergency options to when you would use them:

Buoyant emergency ascent	When low on air, not out of air
Controlled emergency swimming ascent	When buddy is near
Normal ascent	When buddy is too far away
Alternate air source ascent	When buddy is far away and you're deeper than 9 metres/30 feet

13. Check one. If you become entangled underwater, you should:

    ☐ a. Twist and turn to free yourself.
    ☐ b. Stop, think and then work slowly and calmly to free yourself.

14. True or False: With an unconscious diver, the primary concern is to remove him from the water. _____

15. True or False: Once removed from the water, an unconscious breathing diver should be administered oxygen if available. _____

Student Diver Statement: I've completed this Knowledge Review to the best of my ability, and any questions I answered incorrectly or incompletely I've had explained to me, and I understand what I missed.

Name _____ Date _____

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Handy.
When shore diving, and often when boat diving, you may tow a surface float, which is any small float that you use for resting, marking a dive site, assisting another diver, carrying things, and/or supporting a dive flag.

FOUR

Dive Accessories

By now you've learned a great deal about recreational diving, including dive equipment. Although you've focused on the major equipment pieces and how they integrate, in using them you've used items and accessories that contribute to making your dive go more smoothly and efficiently. Beyond these and the other major equipment let's look at other commonly used accessories. As you gain experience diving and participate in different underwater activities, you'll learn about others.

Surface Floats

When shore diving, and often when boat diving, you may tow a surface float, which is any small float that you use for resting, marking a dive site, assisting another diver, carrying things, and/or supporting a dive flag (more about dive flags shortly). Over

MAIN Objectives

Underline/highlight the answers to these questions as you read:

1. What are five uses for a surface float?

2. What do you do to avoid entanglement in a line connected to a surface float?

Quick Quiz

Self Assessment 1

1. Uses for a dive float include (check all that apply):
- ☐ a. assisting another diver.
- ☐ b. resting.
- ☐ c. supporting a dive flag.
- ☐ d. carrying accessories.

2. To avoid entanglement with a line to your surface float:
- ☐ a. don't use a line — let it drift in the general area.
- ☐ b. tie the line to your BCD.
- ☐ c. use a reel or line caddie.

How'd you do?
1. a, b, c, d. 2. c.

Main Objectives

Underline/highlight the answers to these questions as you read:

3. Why should you use a dive flag when diving?

4. How close should you stay to a dive flag, and how far should boats, skiers and water craft stay away if there are no local laws governing these distances?

the years divers have managed to use just about everything that floats and that they can tow for this: surf mats, inner tubes, small rubber rafts and Styrofoam floats are all common surface floats divers use. Covers over tire inner tubes make useful surface floats that provide lots of buoyancy and usually have a space for storing accessories; your dive center or resort probably has a selection of these you can choose from.

Depending on the dive site and the dive plan, you may anchor a surface float or tow it throughout the dive. In either case, you'll need a nylon or polypropylene rope not less than 15 metres/50 feet long for towing or anchoring. Carry the line on a reel or line caddie to avoid entanglement in slack rope. When towing a float by hand, don't attach it to your gear. This way, you simply let go if your float gets snarled on something, or snagged by a boat or something.

Dive Flags

You'll find that many places where you like to dive, people enjoy other watersports, including boating and water skiing. Boats and skiers zipping back and forth where you're diving pose a hazard, and it's nearly impossible for boaters to see you while you're underwater. So for safety when boat traffic may be a problem, and when required by law, you need to use a dive flag to warn off boaters.

The appropriate flag depends on where and under what conditions you dive. A dive flag is either a red rectangle with a white diagonal stripe or a blue-and-white double-tailed pennant (Alpha flag), and large enough to see from at least 100 metres/yards away. In some instances you may be required to fly both flags, particularly when boat diving.

When diving from a boat, place the dive flag on a mast, radio antenna or other elevated location for maximum visibility. If you're diving from shore or have a long swim from the boat, you'll fly the flag

Hey, we're here.
The appropriate flag depends on where and under what conditions you dive. In some instances you may be required to fly both flags, particularly when boat diving.

Over here!
In addition to staying near the flag, carry a surface signaling device, such as an inflatable signal tube that allows you to alert boats to your presence in the water.

from a surface float. In this case, your flag should have a wire to extend it into the "flying" position, and should ride at least a metre/three feet high so boaters can see it in choppy water.

Local laws regulate how close you have to stay to your flag, and how far boaters and skiers must stay away. For areas where no laws stipulate these distances, the rule of thumb is for you to stay within 15 metres/50 feet of your flag and for boats to stay at least 30 to 60 metres/100 to 200 feet away. Also, don't display the dive flag unless divers are actually in the water. Your instructor will fill you in on local dive flag laws.

Unfortunately, many boaters don't know what a dive flag means, and sometimes they can't see your flag (like when they're coming from directly up wind so that it flies directly away from them). These boaters may come much closer to you and your flag than they should, so don't assume that just because you have a flag that all boats will stay away. Even with a flag, always ascend cautiously, and if a boat sounds particularly loud and close, stay down, deep enough to be safe until it clears the area. Remember, too, that as a diver, you have an obligation to remain in the area with the flag. You can't complain about a boat zooming directly overhead if you're 300 metres/1000 feet from your flag.

As mentioned in Section Two, be careful of boat traffic. In addition to staying near the flag, carry an inflatable signal tube that allows you to alert boats to your presence in the water.

Surface Signaling Devices

You should consider surface signaling devices like inflatable signal tubes standard in your equipment setup. You use these to attract attention when you need help in an emergency, so that boaters stay well away from you if you accidentally surface too far from the dive boat or your flag, and to help the dive boat crew track your position. The latter can be especially important if you inadvertently end up too far down current and the boat must come pick you up.

There are both visual and audible surface signaling devices, and you should have at least one of each. Visual signaling devices include brightly colored inflatable tubes or balls that you can blow up to be seen more easily (inflatable signal tubes), as well as signal mirrors, and for diving at night, signal lights and flashers.

Most divers keep an inflatable signal tube and/or signal mirror in their BCD pockets at all time.

Audible devices are primarily whistles you blow and those powered by your low pressure inflator. The most popular place for both is on your BCD inflator hose, where it's out of the way yet readily accessible for use in an emergency.

Collecting Bags

Sooner or later, you'll find some things or need to carry several objects – equipment accessories, trash during an underwater cleanup, etc. – while diving. Doing that while trying to operate your gear becomes an awkward juggling act, so you'll want a *collecting bag*, also referred to as a *goodie bag* or *catch bag*.

You can get various types and sizes, with the typical collecting bag made from mesh nylon, so it drains quickly, and a wire frame to hold the top open or closed. Most have a lock so they stay shut.

Oh, goodie.
You can get various types and sizes, with the typical collecting bag made from mesh nylon, so it drains quickly, and a wire frame to hold the top open or closed. Most have a lock so they stay shut.

When you're using a collecting bag, keep in mind that once it's full and heavy, you carry it in one hand so you can give it the heave-ho if necessary in an emergency. Don't attach it to yourself or your equipment. When you're not diving, you can use a large collecting bag for carrying your mask, fins and snorkel.

Underwater Lights

Besides their usefulness for diving in the dark at night, you'll find underwater lights have uses in broad daylight. A compact underwater light is useful for illuminating and restoring color at depth (remember that water absorbs color), as well as for looking

Quick Quiz

Self Assessment 2

1. You should use a dive flag because (check all that apply):
☐ a. it warns off boaters.
☐ b. local law may require it.

2. If no laws stipulate otherwise, the rule of thumb is that you should stay within _____of your dive flag, and boaters should stay _____ away.
☐ a. 15 metres/50 feet, 30-60 metres/ 100-200 feet
☐ b. 30 metres/100 feet, 60 metres/ 200 feet
☐ c. 30 metres/100 feet, 300 metres/ 1000 feet
☐ d. None of the above.

How'd you do?
1. a, b. 2. a.

Main Objectives

Underline/highlight the answers to these questions as you read:

5. What three features does a typical collecting bag have, and why would you have a collecting bag?

6. You might take an underwater light on a dive during the day for what two reasons?

7. What are two reasons for carrying an underwater slate as a regular part of your dive gear?

into dark cracks and crevices (so you don't reach in without checking whether anyone's home).

An underwater light is both watertight and pressure-proof; you can take an ordinary flashlight underwater, but the water shorts it out and ruins it, so don't. (You were expecting something different?) Underwater lights remain watertight by using an O-ring seal that you need to inspect, clean and lubricate periodically (your PADI Dive Center, Resort or Instructor can show you how). Like most flashlights, store underwater lights without their batteries if you're not going to use them for an extended period to prevent possible damage from battery leakage. Professional dive stores usually stock a wide array of underwater lights, varying in power source, size and brightness.

See?
Besides their usefulness for diving in the dark at night, you'll find underwater lights have uses in broad daylight.

Underwater Slate

In the discussion about underwater communication you learned that you use hand signals and underwater slates as the two most common methods for communicating underwater. To use a slate, you have to have one. It's an important communication tool, but you also use it for carrying general information like time and depth limits, and making notes for your log book. They don't cost much, nor do they take up much space, so you probably want to make one standard equipment.

Right for writing.
A slate is an important communication tool, but you also use it for carrying general information like time and depth limits, and making notes for your log book.

Underwater slates are usually made of plastic and typically come with a pencil on a short cord (to prevent loss). Most slates fit in your BCD pocket, although some instrument consoles accept custom slates on the back. Others strap to your wrist, and there are a few special slates that erase easily underwater if you have to

Quick Quiz

Self Assessment 3

1. You might use a collecting bag for (check all that apply):
   - ☐ a. carrying several objects at once.
   - ☐ b. gathering trash during an underwater cleanup.

2. Reasons for taking an underwater light on a day dive include (check all that apply):
   - ☐ a. restoring lost colors.
   - ☐ b. looking in cracks and crevices.
   - ☐ c. unexpected solar eclipse.

3. You want to carry a slate as a regular part of your gear (check all that apply):
   - ☐ a. to communicate.
   - ☐ b. to carry information, like depth and time limits.
   - ☐ c. None of the above.

How'd you do?
1. a, b. 2. a, b. 3. a, b.

communicate a lot. You can also find specialized slates that carry information, such as PADI Data Carriers and fish identification slates that show you the names of fish you might see. Regardless of which slate you choose, be sure to secure it so it doesn't cause drag or pose an entanglement problem. Generally, it's best to carry it in a pocket.

Spare-Parts Kit

There's nothing quite so frustrating as missing an entire day's diving because of something inane like breaking a fin strap and having no spare. It doesn't take much effort or investment to make a spare-parts kit, and with it, you minimize the probability of missing dives due to minor problems like a broken fin strap.

You make a spare-parts kit by collecting those sundries that wear out, break or vanish at the worst time, and storing them, with a few basic tools, in a moisture proof container in your equipment bag. At first you won't need much room for this, but as you gain experience, you'll add to it — never throwing anything away — until it's basically an equipment locker you need a fork lift to move. But that won't happen for a few years, so here are a few suggestions to get you started:

1. Mask strap — tip: fabric/Velcro™ type straps fit virtually all masks, making them "universal" replacements
2. Fin strap — tip: When one goes, the other's close behind. Carry two and replace them at the same time
3. O-rings — tip: different cylinder valves take slightly different sizes; carry an assortment
4. Silicone lubricant — tip: carry silicone grease, not spray, and use it very sparingly according to the manufacturer of the particular equipment. A small container will last a decade or more, or until you lose it
5. Snorkel keeper
6. Cement for exposure suit repairs — tip: different suits require different cements

Save a dive.
You make a spare-parts kit by collecting those sundries that wear out, break or vanish and storing them with a few basic tools, in a moisture proof container in your equipment bag.

Underline/highlight the answers to these questions as you read:

8. Why should you take a spare-parts kit with you when you dive?

9. What do you put in a spare-parts kit?

10. There are three primary reasons for keeping a log book. What are they?

7. Waterproof plastic tape
8. Quick-release buckle
9. Pocket knife
10. Pliers — tip: even better, a plier-tool, like the Leatherman™ tool
11. Adjustable wrench
12. Screwdrivers
13. Spare sunglasses, sunscreen (well sealed so it doesn't goop up your kit), motion sickness medication. (These aren't spare parts, but things you really don't want to be without — so make them a permanent part of your kit.)

Your instructor can suggest other items for your spare-parts kits.

Log Book

The certification you earn in this course indicates that you're a qualified scuba diver. It's sort of like a diploma – it indicates that you've successfully completed the education. But if you were interviewing for a job, a prospective employer would want to see what you've done with your education – a resume listing your experiences since you received your diploma. In diving, your "resume" is your log book.

Your log book shows a divemaster or charter crew how frequently you dive, what type of dives you've made, the environments that you have experience with and so on. It's a proof-of-experience document often requested for diver training, and when diving at resorts or on boats. It helps you assess how your experience contributes to your diving ability and the dive opportunities open to you. And, you can check it once in a while to see how far the dive stories you tell depart from reality.

The three primary reasons to have a log book are to remember your dive experiences, to document your history as a diver, and to note specific details about a dive site for future reference. Make a habit of filling out your log book immediately after every dive, and having your instructor or buddy sign it (your instructor will sign your log book after each open water dive you make in

History of a diver.
Your log book shows how frequently you dive, what type of dives you've made, the environments that you have experience with and so on. It's a proof-of-experience document often requested for diver training.

Quick Quiz

Self Assessment 4

1. You want a spare-parts kit to reduce the chance you miss a dive due to something minor, like a missing O-ring or a broken strap.
☐ True ☐ False

2. Items you might put in a spare-parts kit include (check all that apply):
☐ a. O-rings.
☐ b. straps.
☐ c. food.
☐ d. basic tools.

3. Reasons for keeping a log book include (check all that apply):
☐ a. documenting your history as a diver.
☐ b. that it's required to keep your certification.
☐ c. recording specific dive site details.
☐ d. helping you remember your experiences.

How'd you do?
1. True. 2. a, b, d. 3. a, c, d.

Summary Points

In this subsection on Dive Accessories, you learned:

- ▲ You use a surface float to support your dive flag, for resting and to carry accessories.
- ▲ Use an appropriate dive flag when diving where boats may be present and according to local law.
- ▲ Don't attach a full collecting bag to your gear.
- ▲ Underwater lights have both day and night uses.
- ▲ A spare-parts kit can help you keep from missing a dive.
- ▲ Start and maintain a log of all your dive adventures.
- ▲ To communicate with an underwater slate, you have to have one.

this course). You can choose from log books ranging from simple ones with room for descriptions, to ones such as the PADI Adventure Log with more features such as space to record training, equipment purchases and maintenance, air use, dive site maps, personal information, and more.

Health for Diving

From what you've learned to this point, you know that diving is relaxing, but not sedate, and you need to be in good health. You also realize that there are times when strenuous activity comes into play, so you need to have levels of health, fitness and conditioning sufficient to handle moderately strenuous activity, which could include an emergency or other unanticipated physical demands. Being in good health helps assure that you can meet these demands, which in turn affects your safety.

General diving health recommendations follow the same recommendations regarding rest and diet for

MAIN Objectives

Underline/highlight the answers to these questions as you read:

11. **What three substances should you avoid using prior to diving?**

12. **How often is it recommended that you have a complete physical examination by a physician?**

13. **What two immunizations should divers keep up to date?**

14. **What can you do to maintain your dive skills, or restore them after inactivity?**

15. **What effect does menstruation have on diving?**

16. **Why is it recommended that pregnant women not dive?**

Heart Health

Diving is generally relaxing, but at times it can cause elevated physical stress. Swimming hard, hot sun while in an exposure suit and other factors can strain your heart and cardiovascular system. Like any other physical stress, this can cause a heart attack in predisposed individuals. Be sure to discuss this concern with your doctor if you may have a predisposition to heart disease due to age, lifestyle, body composition, family history or other factors.

everyday life. Never use alcohol, drugs or tobacco prior to diving. Alcohol and drugs, even in quantities that have minimal effect on the surface, can impair your judgment at depth, where pressure can increase their effects. Also, alcohol before or immediately after a dive also increases your risk of decompression sickness (discussed later in this section). Be conservative if drinking the night before diving; alcohol tends to dehydrate you, which can also predispose you to decompression sickness.

If you're taking a prescription drug, discuss its effects with your physician prior to diving. If in doubt, don't dive until you're no longer using the medication.

Avoid smoking, which tends to interfere with having an active lifestyle. Smoking is undeniably detrimental to your health. If you do smoke, abstain for several hours before and after diving because smoking significantly decreases the efficiency of your circulatory and respiratory systems. It can also promote air trapping within your lungs, theoretically raising your risk of lung over expansion injury — even when breathing normally.

Don't dive if you don't feel well, including (as you learned in Section One) diving with a cold. Doing so can cause ear and sinus squeeze or reverse blocks due to equalization difficulties. Diving with a chest cold can produce air trapping, with a risk of lung over expansion injury. No one wants to miss out on a dive, but you should be in good health to dive safely. Don't use medication to combat symptoms so you can make a dive when you're not well.

Maintain a reasonable degree of physical fitness and have a complete physical examination when you first enter diving, and at least every two years thereafter. Ideally, you should be examined by a physician knowledgeable in dive medicine. Keep your immunizations current; this is especially important for your tetanus and typhoid immunizations. Keep a well-balanced diet and get proper rest. Maintain a regular exercise program — you don't have to be an Olympian, just in good average health.

Dive health also includes taking care of yourself in other ways — including keeping your skills and knowledge sharp. The best way to do this is to be an active diver — dive — this helps maintain your dive skills. Take part in new underwater adventures, like dive travel and special activities and courses. You'll have fun while developing new dive skills and improving and refining those you have. If possible, swim with fins in a pool regularly to keep your leg muscles toned — and it's a good aerobic exercise. Practice the skills you learn in this course frequently.

If you're away from diving for awhile, no sweat — it happens to all divers once in a while — refresh your dive skills and knowledge. Review this manual, the *Open Water Diver Video* and practice your skills with a PADI Divemaster, Assistant Instructor or Instructor. The PADI Scuba Review program refreshes your knowledge and skills, and it's quick and easy — one evening or a morning is usually all you need.

Tune up, dive in.
If you're away from diving for awhile, no sweat — it happens to all divers once in a while — refresh your dive skills and knowledge. The PADI Scuba Review program refreshes your knowledge and skills, and it's quick and easy — one evening or a morning is usually all you need.

If you're a woman, you have some special health considerations, including menstruation and pregnancy. As long as menstruation doesn't normally keep you from participating in other active recreations, there's no reason why it should keep you from diving either. Diving while pregnant is another story. There's not much known about how diving may affect a developing fetus. It's generally agreed that it's not worth the risk; so discontinue diving while pregnant, or if you're trying to become pregnant.

Quick Quiz

Self Assessment 5

1. Before diving, you want to avoid (check all that apply):
☐ a. drugs.
☐ b. eating.
☐ c. alcohol.
☐ d. smoking.

2. It's recommended that you have a complete physical examination every _____ years.

3. Immunizations divers should keep up to date are _____ and _____.

4. To maintain your dive skills, (check all that apply):
☐ a. be an active diver.
☐ b. continue your diving education.
☐ c. participate in special diving activities.

5. If menstruation doesn't normally keep you from other active recreations, it shouldn't keep you from diving.
☐ True ☐ False

6. It's recommended that pregnant women:
☐ a. not dive, because there is little known about the effects of diving on a developing fetus.
☐ b. dive only to 10 metres/30 feet, because there is little known about the effects of diving on a developing fetus.

How'd you do?
1. a, c, d. 2. two. 3. tetanus, typhoid 4. a, b, c. 5. True. 6. a.

You need to feel well to dive well. Maintain good health, avoid habits that hurt your health, and stay in good mental and physical shape. Not just for diving, but for living.

Breathing Air at Depth

So far, you've learned about the direct effects that come from breathing air underwater and your responses: volume reduction and the need to equalize, increased air density and breathing slowly and deeply, volume expansion and never holding your breath while scuba diving.

Besides these direct effects, breathing air under pressure has indirect, more subtle effects. Like the direct effects, these effects are pretty predictable, and you can avoid associated problems by following some simple guidelines.

Air

To understand some of the indirect effects possible from breathing air at depth, you need to understand what air is. As you may be aware, air consists of many gases, but nitrogen and oxygen make up more than 99 percent, so for practical purposes, we can consider air 79 percent nitrogen and 21 percent oxygen. When you breathe your body uses the oxygen, and the nitrogen gas is physiologically inert (your body doesn't use it).

The compressed air in your scuba cylinder is essentially the same as

Main Objectives

Underline/highlight the answers to these questions as you read:

17. **What two primary gases make up air?**

18. **What are five possible symptoms of contaminated air?**

19. **What should you do for a diver suspected of breathing contaminated air?**

20. **How do you prevent problems with contaminated air?**

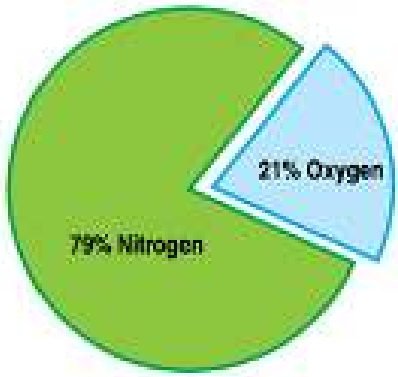
21. **How do you prevent problems with oxygen?**

Breathing Air at Depth
See the PADI Encyclopedia of Recreational Diving and the PADI Encyclopedia Multimedia CD-ROM

Summary Points

In this subsection on Health for Diving, you learned:

- ▲ Don't drink, smoke or take drugs before diving.
- ▲ Don't dive when you don't feel well.
- ▲ Stay in good health.
- ▲ Have a physical examination at least every two years.
- ▲ Keep tetanus and typhoid immunizations current.
- ▲ Pregnant women shouldn't dive.
- ▲ Review your dive skills and knowledge after a period of inactivity.



Two gases.
Air consists of many gases, but nitrogen and oxygen make up more than 99 percent, so for practical purposes, we can consider air 79 percent nitrogen and 21 percent oxygen.

the air you're breathing now. The filling process filters the air to remove chemical and particle impurities, and it removes most of the moisture, which can damage scuba cylinders and cause other problems.

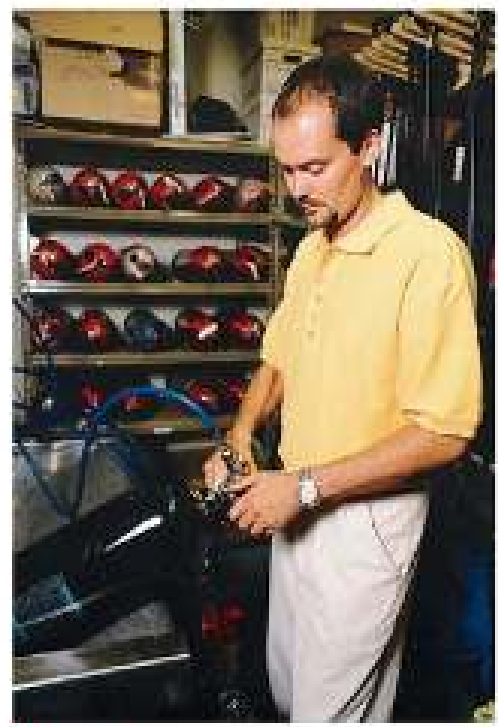
Contaminated Air

The first possible problem involved with breathing air under pressure (underwater) involves contaminates that aren't supposed to be there. This problem is rare, but possible.

Compressors for filling scuba cylinders (breathing air) use special filters and separators to keep contaminates such as carbon monoxide or oil vapor out of your breathing air. This is important because pressure proportionately increases the effects of a gas you breathe, so that traces of contaminants that would be harmless at the surface can be toxic underwater.

Contaminated air generally results from a problem with the compressor or its filtering system, and as a result often tastes and smells bad — but it can also be odorless and tasteless. A diver breathing contaminated air may experience headaches, nausea, dizziness and even unconsciousness. A diver afflicted by contaminated air may have cherry-red lips and fingernail beds, though this may be hard to see underwater.

Give a person suspected of breathing contaminated air fresh air, and administer oxygen if available. In severe cases, rescue breathing may be necessary. The diver should have medical attention in all cases.



Breathe easy.
Contaminated air is rare as long as you buy your air from reputable sources, such as professional dive stores.

Fortunately, as mentioned, contaminated air is rare as long as you buy your air from reputable air sources, such as professional dive stores. These stores recognize the seriousness of contaminated air and have their air checked frequently to

be sure of its quality. Don't fill your cylinder from a compressor or other air source that isn't intended specifically as a *breathing* air compressor system; for example, you wouldn't use industrial air systems such as those used for filling tires or powering sandblasters. To avoid contaminated air, be certain you have your cylinders filled only with pure, dry, filtered compressed air from a reputable air station.

Too much of a good thing?
To avoid oxygen toxicity problems, don't have your cylinder filled with enriched air or use a cylinder that's marked as being an enriched air cylinder, unless you're properly trained and certified as an Enriched Air Diver.

Even though you have a proper air source fill your cylinder, if the air tastes or smells bad, don't use it. If you feel ill or get a headache during a dive, end the dive immediately. If you suspect you may have contaminated air in your cylinder for any reason, save the air for analysis and don't dive with it.

There's another way to suffer contaminated air poisoning, and that's by breathing exhaust fumes aboard a boat. Try to stay out of a boat's exhaust and in fresh air.

Oxygen

Because you need oxygen to live, it may seem strange that oxygen can become toxic if you breathe it under pressure. But in fact, you can get "too much of a good thing" — if you were to fill your scuba cylinder with pure oxygen instead of compressed air, you could suffer oxygen poisoning in water as shallow as 6 metres/20 feet. This is why you should never have your cylinder filled with pure oxygen.

The 21 percent oxygen in compressed air can also be toxic, but not until you descend well past the recommended maximum limits for recreational diving. So when diving with air within recreational depth limits, oxygen toxicity isn't an issue.

Recreational divers sometimes use *enriched air* (also known as "enriched air nitrox" or "nitrox"), which has more than 21 percent oxygen. Enriched air has some advantages regarding how long you can stay underwater at a given depth, but you can have oxygen problems using it within recreational depth limits. For this reason, enriched air diving requires special training and some special equipment requirements (to avoid combustion problems possible with

Quick Quiz

Self Assessment 6

1. The two primary gases that make up air are:
- ☐ a. hydrogen and oxygen.
- ☐ b. helium and nitrogen.
- ☐ c. carbon dioxide and hydrogen.
- ☐ d. oxygen and nitrogen.

2. Symptoms of contaminated air include (check all that apply):
- ☐ a. headache.
- ☐ b. nausea.
- ☐ c. cherry red lips/nail beds.
- ☐ d. limb and joint pain.

3. If a diver is suspected of breathing contaminated air (check all that apply):
- ☐ a. give the diver fresh air.
- ☐ b. give the diver oxygen if available.
- ☐ c. the diver should get medical attention.
- ☐ d. None of the above.

4. You avoid contaminated air problems by having your cylinder filled only by a reputable air source with a compressor system intended for breathing air.

☐ True ☐ False

5. To prevent problems with oxygen (check all that apply):
- ☐ a. never have your cylinder filled with pure oxygen.
- ☐ b. don't exceed the limits of recreational diving.
- ☐ c. don't use enriched air (nitrox) unless trained and certified in its use.
- ☐ d. use air that has had all the oxygen removed.

How'd you do?
1. d. 2. a, b, c. 3. a, b, c. 4. True 5. a, b, c.

high oxygen levels); reputable dive centers will not provide enriched air without proof of enriched air certification.

So, to avoid oxygen toxicity problems, don't have (or try to have) your cylinder filled with enriched air, unless you're properly trained and certified. Don't use a cylinder that's marked as being an enriched air cylinder, (again, unless you're properly trained and certified).

Nitrogen Narcosis

Although nitrogen has no direct influence at the surface, that changes as you breathe it under pressure. Underwater, at depths approaching 30 metres/100 feet, nitrogen has a noticeable intoxicating effect that intensifies as you go deeper.

A diver affected by nitrogen narcosis behaves as you might expect someone to behave if intoxicated. Narcosis impairs the diver's judgment and coordination, and may create a false sense of security, cause disregard for safety and other foolish behavior. Nitrogen narcosis can make a diver feel anxious or uncomfortable, which can lead to panic or other poor decisions.

Main Objectives

Underline/highlight the answers to these questions as you read:

22. What are five symptoms of nitrogen narcosis?

23. What should you do if nitrogen narcosis becomes a problem?

24. How do you prevent nitrogen narcosis?

Nitrogen narcosis affects individuals differently, and affects the same individual differently from day to day. Its effect can combine with some drugs or alcohol and impair a diver at shallower than expected depths (hence the warning not to drink or use drugs before diving).

Quick Quiz

Self Assessment 7

1. Symptoms of nitrogen narcosis include (check all that apply):
- ☐ a. cherry red lips/nail beds.
- ☐ b. false sense of security.
- ☐ c. foolish behavior.
- ☐ d. anxiety.

2. If nitrogen narcosis becomes a problem (check all that apply):
- ☐ a. ascend to a shallower depth.
- ☐ b. descend slowly to a deeper depth.
- ☐ c. None of the above.

3. To prevent nitrogen narcosis (check all that apply):
- ☐ a. avoid deep dives.
- ☐ b. make all your dives in the 30 - 40 metre/100 -130 foot range

How'd you do?
1. b, c, d. 2. a. 3. a.

Nitrogen narcosis diminishes when you reach shallow water, with no aftereffects. If you begin to feel intoxicated, uncoordinated or confused, immediately ascend to shallower depths to relieve the narcosis. It usually goes away quickly. If your buddy acts impaired, assist your buddy to shallower water.

To prevent nitrogen narcosis, simply avoid deep dives. Nitrogen narcosis is not dangerous or harmful in itself, but creates a hazard by impairing the judgment and coordination you need to prevent emergencies and respond to them if they occur.

Decompression Sickness

As you've read a few times to this point, your time underwater has limits beyond your air supply, cold, fatigue and the like. The limits relate to how deep you go, and result from nitrogen gas dissolving in your body tissues during a dive. This is perhaps one of the most significant effects of breathing air under pressure.

During a dive, the increased pressure causes nitrogen from the air you breathe to dissolve into your body tissues. How much nitrogen you absorb this way depends primarily on how deep you dive, and for how long. The deeper you dive and the longer you stay, the more nitrogen your body absorbs.

Your body doesn't use nitrogen, so what goes into solution must come back out and leave your body. When you ascend, the pressure surrounding you decreases and the excess nitrogen can't stay dissolved in your body, so it begins to come out; therefore, making slow (no faster than 18 metres/60 feet per minute), safe ascents may reduce your risk of decompression sickness.

Keep a clear head.
Underwater, at depths approaching 30 metres/100 feet, nitrogen has a noticeable intoxicating effect that intensifies as you go deeper. This is called nitrogen narcosis.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

25. **What two primary factors influence the absorption and elimination of nitrogen in a diver?**

26. **What condition occurs when a diver exceeds established depth and time limits, producing bubbles in the body during and following ascent?**

27. **What nine secondary factors can influence the absorption and elimination of nitrogen from the body?**

28. **What signs and symptoms are associated with decompression sickness?**

29. **What is meant by decompression illness versus decompression sickness?**

30. **What is the necessary treatment for a diver suspected of having decompression illness?**

31. **What is the first aid procedure for assisting someone with decompression illness?**

32. **How do you avoid decompression sickness?**

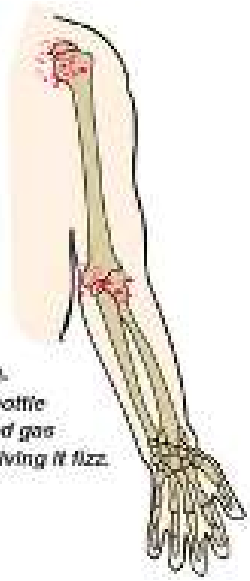
As long as you keep excess nitrogen within reasonable limits, your body eliminates it without complication. To keep within these limits, you use dive tables and dive computers, which give you maximum times at a given depth based on how much nitrogen your body theoretically absorbs and releases.

If, however, you stay underwater beyond these limits, your body absorbs so much excess nitrogen that when you ascend and surface, your body can't eliminate the nitrogen as fast as it comes out of solution. As it dissolves out of your body tissues, the excess nitrogen forms bubbles in your blood vessels and tissues. The phenomenon is similar to opening a bottle of soda; you release the pressure and the dissolved gas comes out of solution, giving your soft drink its fizz. Bubbles forming in the body after a dive cause a very serious medical condition called *decompression sickness* (DCS), sometimes called "the bends." (More about DCS in a moment.)

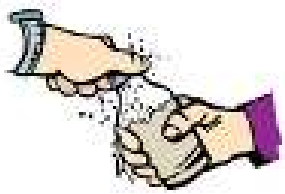
While your dive time and depth are the primary variables involved with decompression sickness, other factors influence how your body absorbs and eliminates excess nitrogen. When present, these secondary factors can contribute to developing DCS: fatigue, dehydration, vigorous exercise (before, during, or after the dive), cold, age, illness, injuries, alcohol consumption before or after a dive, and being overweight. Also, diving at altitude without following special procedures, or an increase in altitude after diving by flying or driving through mountains, can contribute to getting decompression sickness (more about this in Section Five).

You want to dive *well within* the limits of dive tables and computers, and use extra caution if any of the secondary factors apply to you. To reduce the risk of DCS, get in the habit of always diving with a conservative margin between the time you actually dive, and the maximum allowed by the dive table or computer you use.

Signs and symptoms of DCS. Because bubbles can form in different places in the body, DCS symptoms can vary.



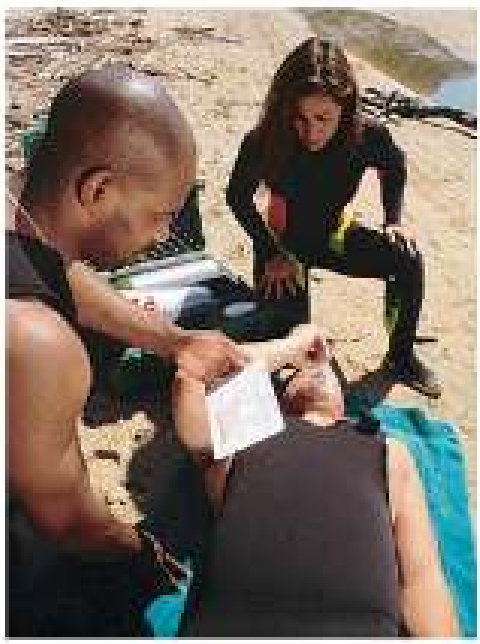
Watch your limits.
If you stay underwater beyond established limits, when you surface excess nitrogen dissolves out of your body tissues and forms bubbles in your blood vessels and tissues. The phenomenon is similar to when you open a bottle of soda and the dissolved gas comes out of solution, giving it fizz.



Signs and symptoms include paralysis, shock, weakness, dizziness, numbness, tingling, difficulty breathing, and varying degrees of joint and limb pain. In the most severe cases, unconsciousness and death can result.

Decompression sickness can also manifest subtly. Symptoms can include a mild to moderate dull ache, usually but not necessarily in the joints, mild to moderate tingling or numbness, usually, but not necessarily, in the limbs. Weakness and prolonged fatigue may result from DCS. Decompression sickness symptoms can occur together or individually, occur anywhere in the body, and may be accompanied by lightheadedness.

Symptoms usually occur anywhere from 15 minutes to 12 hours after a dive, though they can occur later. They tend to come on gradually and persist, though they can be intermittent. Regardless of the severity of the symptoms, consider all cases of decompression sickness serious.



Bubble trouble.
The dive medical community lumps DCS and lung overexpansion injury under the clinical term decompression illness (DCI). They do this because the first aid and treatment are identical for both, and there's no need to distinguish between them when assisting a diver.

First aid and treatment. Lung over expansion injuries and decompression sickness can produce very similar signs and symptoms, even though they result from two different causes (holding the breath versus exceeding time and depth limits). The dive medical community lumps DCS and lung overexpansion injury under the clinical term decompression *illness* (DCI). They do this because the first aid and treatment are identical for both, and there's no need to distinguish between them when assisting a diver.

If a diver has symptoms of decompression illness, or isn't sure, the diver should discontinue diving, seek medical attention and consult a dive physician. As you learned in Section Three, some areas have special diver emergency services that provide consultation and coordinate with local medical services to assist the diver.

First aid for decompression illness includes having the diver lie down and breathe oxygen. Contact local emergency medical care, and the local diver emergency service (if available — or the closest recompression chamber). Your instructor will tell you the emergency contact information for your local diving areas.

Redissolution.
Almost all cases of decompression illness require treatment in a recompression chamber, during which the diver is put back under pressure to help the body absorb bubbles in the tissues.

Monitor the diver and prevent or treat shock as necessary. A diver who isn't breathing will need rescue breathing, and CPR if the diver has no pulse. If the diver is unresponsive and breathing, lay the diver level left side down, head supported and breathing oxygen as described in Section Three. Continuously monitor breathing and pulse. If the diver is responsive and breathing, the diver may lie on his back if lying on the left side is too uncomfortable.

Don't delay first aid and getting the diver to treatment. The faster treatment begins, the less risk there is of permanent residual symptoms. Although decompression illness is a serious medical condition, with prompt, proper treatment it is rarely fatal in recreational divers.

A Prudent Measure

Decompression illness is a rare event among recreational divers, but it does happen. Medical services and recompression treatment can be costly, and may not be covered, or entirely covered, by your regular medical insurance.

Fortunately, you can obtain very inexpensive protection to fill coverage gaps you might have in the unlikely event you suffer decompression illness. The costs and coverages vary depending upon where you live, but the annual fee is typically less than a moderately priced mask. Having this insurance can save you a tremendous expense, and it can reduce treatment delays caused by concerns about how you'll cover the costs.

Diver protection insurance is available worldwide, and there are other programs. Chances are you won't need this insurance even in years of diving but if you do, it's likely you'll have saved yourself more than 10 times what you spend for 10 years coverage.

Remember, it's your responsibility to manage your own risk by diving safely, and by being prepared if something happens. Diver accident insurance is just too cheap not to have. Be prudent — see your PADI Dive Center, Resort or Instructor about obtaining and maintaining coverage. The least it buys you is peace of mind.

Quick Quiz

Self Assessment 8

1. The two primary factors influencing how much nitrogen you absorb during a dive are:
- ☐ a. dive depth and amount of air used.
- ☐ b. dive time and dive depth.
- ☐ c. dive time and amount of air used.

2. The condition that occurs when a diver exceeds established depth and time limits, producing bubbles in the body following ascent, is called:
- ☐ a. decompression sickness.
- ☐ b. decompression illness.
- ☐ c. lung over expansion injuries.
- ☐ d. nitrogen narcosis.

3. Secondary factors that can influence nitrogen absorption and elimination include (check all that apply):
- ☐ a. alcohol consumption before or immediately after a dive.
- ☐ b. dehydration.
- ☐ c. age
- ☐ d. being overweight

4. Signs and symptoms of decompression sickness include (check all that apply):
- ☐ a. limb and joint pain.
- ☐ b. mild tingling and fatigue.
- ☐ c. paralysis and unconsciousness.
- ☐ d. foolish behavior.

5. Decompression illness is a clinical term that means:
- ☐ a. decompression sickness.
- ☐ b. lung over expansion injuries.
- ☐ c. both decompression sickness and lung over expansion injuries.
- ☐ d. any injury that happens underwater.

6. A diver with decompression illness requires treatment:
- ☐ a. only in very few cases.
- ☐ b. in a recompression chamber.
- ☐ c. by being put back underwater.
- ☐ d. Both b and c.

7. First aid for decompression illness includes (check all that apply):
- ☐ a. emergency oxygen.
- ☐ b. lying on the left side if unresponsive and breathing.
- ☐ c. contacting local emergency medical care.
- ☐ d. contacting a dive physician or local diver emergency service.

8. You reduce the risk of decompression sickness by (check all that apply):
- ☐ a. staying within the limits provided by your dive table or computer.
- ☐ b. diving conservatively, well within established limits.
- ☐ c. making slow, safe ascents.

How'd you do?
1. b. 2. a. 3. a, b, c, d. 4. a, b, c. 5. c. 6. b. 7. a, b, c, d. 8. a, b, c.

Summary Points

In this subsection on Breathing Air at Depth, you learned:

- Air is 79 percent nitrogen and 21 percent oxygen.
- Contaminated air symptoms include headaches, nausea, dizziness, unconsciousness, and cherry red lips and nail beds.
- Don't have your cylinder filled with oxygen, and don't use enriched air unless certified in its use.
- To avoid nitrogen narcosis, avoid deep dives.
- Decompression sickness is caused by excess nitrogen forming bubbles in the body after a dive.
- Stay well within dive table and dive computer limits, especially if secondary factors apply to you.
- Signs and symptoms of DCS include limb and joint pain, tingling, numbness, paralysis, shock, weakness, dizziness, difficulty breathing, unconsciousness and death.
- Decompression illness (DCI) is a clinical term for both decompression sickness and lung over expansion injuries.
- A diver with DCI should receive emergency oxygen, rescue breathing and CPR if necessary, and will require treatment in a recompression chamber.

Almost all cases of decompression illness require treatment in a recompression chamber, during which the diver is put back under pressure to help the body absorb bubbles in the tissues. This treatment usually takes several hours, requires the use of pure oxygen, and often drug therapies. Don't allow a diver suspected of having decompression illness to go back underwater. Attempts to treat a diver underwater typically end with worsened symptoms and disastrous results, and only delay getting to proper treatment.

Although decompression sickness is a serious condition, both painful and potentially life-threatening, it is avoided by properly following the established safe time and depth limits of dive tables and dive computers. Lung over expansion injuries are also serious, painful and potentially life-threatening, but avoided by breathing continuously and never holding your breath. Additionally important in preventing decompression illness (both DCS and lung over expansion injuries) is a slow, safe ascent rate with a stop for safety at 5 metres/15 feet. You'll learn more about this stop in Section Five.

Dive Tables and Dive Computers (Introduction)

Your body absorbs nitrogen during a dive; after the dive, your body can tolerate a certain level of excess nitrogen without developing decompression sickness. The question is, how do you know what that level is, and then stay within it?

To answer this question, physiologists and other scientists created mathematical decompression models that track the theoretical nitrogen you have in your body before, during and after diving. For practical field use, these models are expressed by dive tables and in dive computers, which as you read earlier, you use primarily

MAIN Objectives

33. What is the primary use of dive tables and dive computers?

34. What are meant by no decompression/no-stop diving and decompression diving?

35. What is a no decompression limit (NDL)?

36. Why should you avoid the maximum limits of dive tables and dive computers?

37. How does the Recreational Dive Planner distributed by PADI differ from other dive tables?

38. Why is your body nitrogen level higher after a repetitive dive than if you made the same dive as a nonrepetitive dive?

39. What is residual nitrogen?

40. What is a repetitive dive?

41. What are the general rules for using the Recreational Dive Planner, and how do you apply them?

42. What is bottom time?

43. What is the maximum depth limit for all recreational diving?

to determine your maximum allowable time at given depths.

The fact that you derive your dive time limits based on a *model* explains why you need to dive conservatively and avoid the maximum limits your table or computer provides. Theoretical models can't account for variations from one individual to the next, so it's prudent to stay well within the limits a table or computer predicts. This is especially true if any of the factors that contribute to decompression sickness (vigorous exercise, cold, age, etc.) apply to you or the dive situation. You want to stay well within limits, and take extra precautions to avoid the secondary contributing factors that you can; that is, you can't change your age, but you can keep yourself from becoming dehydrated.

So, because people differ in their susceptibility to decompression sickness, no dive table or computer can guarantee that decompression sickness will never occur, even though you dive within the table or computer limits. It is always wisest to plan dives well within table and computer limits, especially if any contributing factors apply.

No decompression (no stop) diving. As a recreational diver, you'll be learning *no decompression diving*. No decompression diving means that you'll plan your dives and dive so that you can always ascend directly to the surface without stopping, yet without significant risk of decompression sickness. This is also called (somewhat more accurately) *no stop diving*, because you don't *have* to make a stop (though you usually will — more about that in Section Five). As a recreational diver, you *always* plan your dives as no decompression dives.

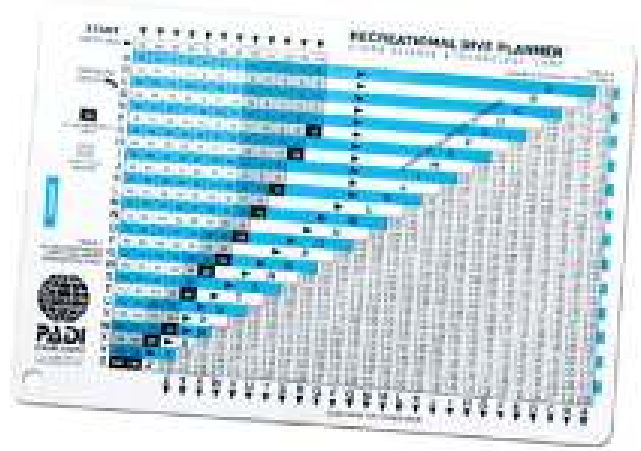
There are other types of diving besides recreational diving: military, commercial, research and technical diving often involve *decompression*

diving. Decompression diving means that the divers absorb so much nitrogen (or other gas) during a dive that it's not possible to ascend directly to the surface without a substantial risk of DCS. Instead, the diver makes a series of stops, each progressively longer, to allow sufficient time for the body to release dissolved nitrogen. Decompression diving usually calls for using special synthetic breathing gases, requires a good deal of surface support, and even when done properly, compared to recreational diving the diver has more risk from DCS and other hazards. Obviously, this type of diving is beyond the scope of the course and recreational diving, though you'll learn the procedures for making *emergency* decompression stops in the unlikely event you accidentally exceed a no decompression limit.

Dive tables. Although you'll be diving with a dive computer, you'll still want to understand basic table use. Dive tables have been around since 1907 and were the primary method of planning dives until the modern dive computer debuted in the 1980s. Dive tables still have their place because they help you understand what your dive computer is telling you, and because they're an effective backup for your dive computer (though modern dive computers are very reliable and rarely have problems).

Until 1988, the dive tables recreational divers used were really hand-me-downs from commercial and military diving. Although they were adequate for planning recreational dives, they were tables for decompression diving and had to accommodate large amounts of theoretical nitrogen, and consequently "penalized" recreational divers, who by making no decompression dives, had far less theoretical nitrogen. Furthermore, these tables were tested on predominantly young, male military divers, which didn't fully represent the population spectrum you find in recreational diving.

Commercial/military tables worked, but they weren't ideal. In 1988, DSAT (Diving Science & Technology) introduced the Recreational Dive Planner (RDP),which were the first dive tables designed for planning and making no decompression recreational dives. They were the first (and at this writing, still the only) such tables validated by test dives by volunteer recreational divers — men, women, younger, older, etc.



The RDP is available in two formats–a Table format and an electronic dive Table, the eRDPML.

This remains one of the largest and most extensive decompression tests in recreational diving. Distributed by PADI, the RDP quickly became (and remains) the world's most popular dive tables; quite a few popular dive computers even employ RDP test data in their electronic decompression models.

It's available in a Table format, and the eRDPML format, an electronic dive table, in both metric and imperial versions. For divers accustomed to conventional tables, DSAT developed the Table version. To simplify use and to make multilevel diving possible without a dive computer (more about multilevel diving in a moment), DSAT developed eRDPML. The eRDPML, introduced in 2008, is an electronic dive table that gives you the same information that the RDP Table does plus some additional features. Many people find the eRDPML's calculator-type format more familiar than a table.

Dive computers. Dive computers do the same job as the RDP, which is to estimate how much dissolved nitrogen you theoretically have in your body based on a decompression model. Dive computers are no more or less valid than a dive table, but take advantage of electronics to apply the model to your exact dive depths and times, constantly updating you on your allowable dive time remaining based on your depth. Dive computers are so versatile that today few people dive without them. Their advantages include:

- They're more convenient to use than tables because they track your depth and time automatically. This reduces human error.
- They give you more no stop time on multilevel profiles. As you ascend, you take up nitrogen more slowly and your dive computer credits you for this by increasing your available no decompression time. Tables must assume you spend the whole dive at the deepest depth you reach, giving you much shorter no stop times. The increased dive time offered by a computer is substantial and one of the primary reasons you'll want one. (Note that the eRDPML lets you plan multilevel dives with more no stop dive time, making it an excellent backup for your dive computer. However, a dive computer offers more dive time than even the eRDPML.)

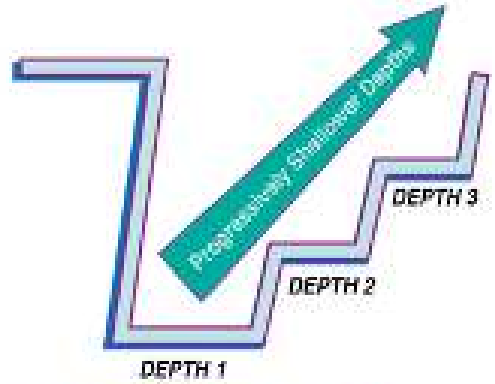
- They track your theoretical nitrogen throughout the course of an entire dive (and often longer). With tables, you have to calculate different allowable no stop times for each successive dive, which depends upon the depth and time of prior dives and how long you've been out of the water. Using the RDP this isn't difficult (you'll learn how), but a computer is far more convenient.

As mentioned, you'll learn to use the RDP even though you'll dive with a computer the vast majority of the time. Knowing how your personal dive computer functions as well as being proficient with the RDP will allow you to better plan and monitor all your diving activities. You'll learn more about dive computer procedures in Section Five.

Repetitive Diving

Dive tables and computers tell you your no decompression limit (NDL — the maximum allowable no-stop time at a given depth) based on the theoretical amount of nitrogen you absorb during a dive, and they also account for nitrogen you absorb on *previous* dives. This is because it takes quite a few hours — in theory, sometimes longer than a day — after surfacing for all the excess nitrogen to dissolve out of your body. The nitrogen left in your body after a dive is called *residual nitrogen*. A dive made before you lose all the residual nitrogen from a previous dive is called a *repetitive dive*.

The illustration gives you an idea of how this works. Before your first dive, your body has its normal nitrogen level (A). Upon surfacing, your nitrogen level is higher, even though you're within the safe limits established by your computer or table (B). After some time at the surface, your body has eliminated some of the residual nitrogen, but not all of it. You can also see that you're still closer to the maximum limit than

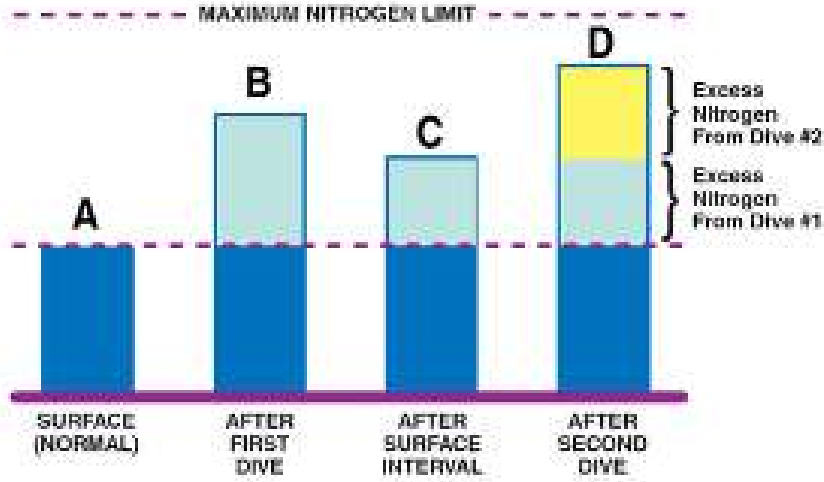


Go up for more down time.
Dive computers give more no stop time on multilevel profiles. As you ascend, you take up nitrogen more slowly and dive computers credit you for this by increasing your no decompression time. The eRDP also provides additional no decompression time on multilevel dives.

Almost standard.
With the convenience and added no stop dive time a dive computer gives you, today it's more unusual to a see a diver without one than with one.

you were before your dive, so a repetitive dive will have a shorter no decompression limit (C). After the repetitive dive, you're still within accepted limits, but your nitrogen level has risen and includes the extra nitrogen absorbed during this dive, plus the residual nitrogen left from your first dive (D). The RDP and/or your dive computer helps you determine acceptable time and depth limits for your first and repetitive dives, accounting for theoretical changes in body nitrogen.

How long you have to wait before a dive isn't a repetitive dive depends on the computer or table. A computer tracks theoretical nitrogen for varying intervals, but it isn't really important to know how long because the computer accounts for it automatically.



Nitrogen loads.
Before your first dive, your body has its normal nitrogen level (A). Upon surfacing, your nitrogen level is higher, even though you're within the safe limits established by your computer or table (B). After some time at the surface, your body has eliminated some of the residual nitrogen, but not all of it. You can also see that you're still closer to the maximum limit than you were before your dive, so a repetitive dive will have a shorter no decompression limit (C). After the repetitive dive, you're still within accepted limits, but your nitrogen level has risen and includes the extra nitrogen absorbed during this dive, plus the residual nitrogen left from your first dive (D).

Using the RDP, if you don't plan to dive for at least six hours, the residual nitrogen has little consequence. On the other hand, if you do plan to dive within six hours, you must account for the residual nitrogen when you plan your dive — and that's part of what you're about to learn to do with the Recreational Dive Planner.

General Rules for Using the Recreational Dive Planner

Whether you're learning to use the Table or the eRDPML version of the Recreational Dive Planner, there are some general rules to follow:

1. *Bottom time* is the total time in minutes from the beginning of descent until the beginning of final ascent to the surface or safety stop. (Note, for convenience, many divers use the time they leave the surface until the time they return to it as bottom time. This is more conservative than the true definition of bottom time, and acceptable.)

2. Any dive planned to 10 metres/35 feet or less should be calculated as a dive to 10 metres/35 feet.

3. Use the exact or next greater depth shown for the depths of all dives.

4. Use the exact or next greater time shown for the times of all dives.

5. Slowly ascend from all dives at a rate that does not exceed 18 metres/60 feet per minute (.33 m/1 ft per second). Slower is fine.

6. Always be conservative and avoid using the maximum limits provided.

7. When planning a dive in cold water, or under conditions that may be strenuous, plan the dive assuming the depth is 4 metres/10 feet deeper than the actual depth.

8. Plan repetitive dives so each successive dive is to a shallower depth. The large body of existing test data primarily involves forward profiles, that is, the deepest dive first and deep to shallow when multilevel diving. For this reason, forward profiles (deep dive first) is the recommendation.

9. Limit all repetitive dives to 30 metres/100 feet or shallower.

10. Limit your maximum depth to your training and experience level. Scuba Divers are limited to 12 metres/40 feet. As an Open Water Diver, limit your dives to a maximum depth of 18 metres/60 feet. Divers with greater training and experience should generally limit themselves to a maximum depth of 30 metres/100 feet. Divers with appropriate experience and/or training may dive as deep as 40 metres/130 feet. Plan all dives as no decompression dives and no dive should ever exceed the maximum depth limit for recreational scuba diving, 40 metres/130 feet. Decompression diving falls outside recreational diving, and the Recreational Dive Planner was not designed for planning decompression dives.

Depth Limits

- 18 m/60 ft Novice
- 30 m/100 ft Recommended
- 40 m/130 ft Absolute

11. Don't exceed the RDP limits, and whenever possible avoid diving to the limits of the planner. 42 metres/140 feet appears on the RDP solely for emergency purposes — don't dive that deep.

Quick Quiz

Self Assessment 9

1. The primary use of dive tables and dive computers is:
☐ a. to tell you the allowable dive time at a given depth.
☐ b. to calculate your air use.

2. No decompression diving means:
☐ a. you can ascend directly to the surface at any time without significant risk of DCS.
☐ b. you cannot run out of air within the given limits.
☐ c. you're within a depth range at which you cannot suffer nitrogen narcosis.

3. A no decompression limit is:
☐ a. the maximum time you can spend at a given depth and still make a no decompression dive.
☐ b. the maximum depth of a dive.

☐ You should avoid the maximum limits of dive tables and dive computers because:
☐ a. people differ in their susceptibility to decompression sickness.
☐ b. a random number of tables and computers are inaccurate.

5. The RDP differs from other tables in that:
☐ a. it was designed specifically for recreational no decompression diving.
☐ b. it was designed to allow recreational divers to make decompression dives.

6. Your body nitrogen level is higher after a repetitive dive than if you made the same dive as a nonrepetitive dive because you still have nitrogen left from the previous dive.
☐ True ☐ False.

7. Residual nitrogen is:
☐ a. excess nitrogen in your cylinder left after you use all the oxygen.
☐ b. nitrogen that remains in your body for several hours after a dive.

8. When using the RDP, if an exact depth or time doesn't appear, round to the closest depth or time.
☐ True ☐ False

9. Bottom time is:
☐ a. the time from when you arrive at the bottom to the time when you leave for the surface.
☐ b. the time from when you leave the surface to the time when you leave the bottom for your final ascent to the surface.

10. The maximum depth limit for all recreational diving is:
☐ a. 18 metres/60 feet
☐ b. 40 metres/130 feet
☐ c. 60 metres/200 feet

How'd you do?
1. a. 2. a. 3. a. 4. a. 5. a. 6. True. 7. b. 8. False, always round up to the next deeper depth or time. 9. b. 10. b.

Be a S.A.F.E. Diver — Slowly Ascend From Every Dive

During ascent, your body needs time to adjust to changing pressure, and you need time to regulate your buoyancy, keep track of your buddy and watch for obstructions overhead. It's important to ascend slowly — no faster than 18 metres/60 feet per minute, which is slower than you may realize.

As a new diver, you may find it a little difficult to judge your ascent rate at first. No worries. Start your ascent with plenty of air so you can make a slow, leisurely trip to the surface. Preferably, ascend along a line or follow the bottom contours to give you a visual reference and help you gauge your speed. Use your depth gauge as you ascend to help you know how fast you're going up, particularly when ascending without a visual reference. It should take you at least 10 seconds to ascend 3 metres/10 feet — but don't worry about being exact, as long as you're not exceeding this rate. In fact, it's a good idea to come up *slower* – most computers and gauges warn you if you exceed 10 metres/30 feet per minute.

Whenever possible, stop your ascent when you reach 5 metres/15 feet and wait three minutes — more is fine — before continuing your ascent, particularly after deep dives or dives close to the no stop time limit. This is called a *safety stop* (you'll learn more about safety stops in Section Five), which gives you an extra margin of safety.

Think of the 18 metre/60 foot per minute rate of ascent as a speed limit. It's fine to go slower, but don't go faster. Be a S.A.F.E. diver: Slowly Ascend From Every dive.

Summary Points

In this subsection on Dive Tables and Dive Computers Introduction, you learned:

- Dive tables and dive computers use mathematical models to estimate the theoretical nitrogen in your body before, during and after a dive.
- People vary in their susceptibility to DCS, so no computer or table can guarantee you'll never get DCS, even within its limits. So, dive well within table/computer limits.
- A dive computer has some use advantages and disadvantages compared to tables, but it is neither more nor less valid.
- Recreational divers only make no decompression (no stop) dives.
- The RDP is the most popular recreational dive table, and it is the first one developed and tested exclusively for recreational diving.
- The eRDPML and dive computers offer you more no decompression dive time when making multilevel dives.
- You must account for nitrogen you absorb on a dive if you make a repetitive dive before your nitrogen levels return to normal.
- Stay within the depth limit of your training and/or experience. Generally: Scuba Divers —12 m/40 ft; Open Water Divers — 18 m/60 ft; general recreational limit — 30 m/100 ft; maximum limit — 40 m/130 ft.
- Be a SAFE Diver: Slowly Ascend From Every Dive.

Using the Recreational Dive Planner

Turn to the *Instructions for Use* booklet that comes with your RDP. If you're learning to use The eRDPML, read the Instructions for Use booklet and work the sample problems. If you're learning to use the Table, read and complete the sample problems/exercises up to "Finding a Minimum Surface Interval."

Then come back to this manual and pick up with the Confined Water Dive Preview.

By the time you complete the assigned reading in the Instructions for Use booklet for the RDP (Table or eRDPML), you should be able to answer the following questions:

44. How do you find the NDL for any depth between 0 and 40 metres/130 feet using the Recreational Dive Planner?

45. What is a pressure group?

46. How do you find the pressure group for a certain dive depth and time using the Recreational Dive Planner?

47. What is a surface interval (SI)?

48. How do you find the pressure group after a surface interval using the Recreational Dive Planner?

49. What is residual nitrogen time (RNT)? [Table version only]

50. How do you find residual nitrogen times on Table 3 of the Recreational Dive Planner for particular depths and pressure groups? [Table version only]

51. What is an adjusted no decompression limit?

52. How do you find an adjusted no decompression limit on Table 3 of the Recreational Dive Planner, for particular depths and pressure groups? [Table version only]

53. What is a dive profile?

54. In drawing a three-dive profile, where do you label:
    - surface intervals?
    - pressure groups?
    - depths?
    - bottom times?

55. What is actual bottom time (ABT)? — [Table version only]

56. What is total bottom time (TBT)? — [Table version only]

57. How do you calculate the total bottom time of a repetitive dive? [Table version only]

58. How do you find the final pressure group after making multiple repetitive dives using the Recreational Dive Planner?

59. What are the two special rules for repetitive diving?

60. What are the minimum surface intervals that must be made when planning three or more dives when:
    - the ending pressure group after any dive is W or X?
    - the ending pressure group after any dive is Y or Z?

Confined Water Dive Preview

Although this is a scuba class, you'll start this confined water dive skin diving without scuba — but you'll be into your scuba gear and back to breathing underwater soon.

But what does skin diving have to do with learning scuba diving? Actually, quite a bit, because scuba diving often takes you into circumstances where it might be better to snorkel or skin dive. For instance, you may find some very shallow sites where there's no advantage to scuba. Or, you may want to tour a bit with your buddy to see if it's worth scuba diving — you can swim much more quickly as a skin diver. Sometimes you may want to dive a site, but the scuba weight and bulk get in the way, such as if diving from a small boat with maximum passengers.

For skin diving, you'll use all your equipment except your scuba unit, and you'll either use less weight so you're positively buoyant, or a snorkeling vest. Your instructor may have you set up your scuba gear while you're gearing up for skin diving so it's ready to use later.

Hyperventilation

Since you don't use scuba for skin diving, you hold your breath to leave the surface (or not, but you'll be back in a big hurry). Most people have trouble holding their breath for more than a minute, especially when they're doing something that takes lots of energy like swimming underwater.

To hold your breath longer, you can use *hyperventilation*, which temporarily suppresses your urge to breathe. Intentional hyperventilation is nothing more than taking three or four deep, rapid breaths before a breath-hold skin dive. After hyperventilating, it takes longer for you to feel the urge to breathe, so you can stay down longer.

Confined Water Dive Four

Skill Requirements

Here's what you'll be able to do when you successfully complete Confined Water Dive Four:

Note: Skin Diving Skills may be completed on Confined Water Dives Two, Three, Four or Five.

Skin Diving Skills

1. Demonstrate the use of proper hyperventilation when skin diving.
2. Dive vertically headfirst from the surface in water too deep to stand up in (without excessive splashing or arm movement).
3. Clear and breathe from a snorkel upon ascent.

Scuba Skills

4. Swim underwater without a mask for a distance of not less than 15 metres/50 feet, and replace and clear the mask underwater.
5. Using buoyancy control only, hover without kicking or sculling for at least 30 seconds.

Hyperventilation works because the urge to breathe comes from rising carbon dioxide in your body, not from low oxygen. The three or four breaths drop your body carbon dioxide levels below normal, so when you hold your breath it takes longer for the levels to rise high enough to trigger breathing.

If you've never tried it, you may be amazed how well hyperventilation works — but it's important that you limit it to only three or four breaths.

Excessive hyperventilation — more than three or four breaths — can be dangerous because you can lower your carbon dioxide levels so far that your body runs out of oxygen before you get the urge to breathe. This would lead to sudden unconsciousness — without warning — and drowning. Don't hyperventilate excessively.

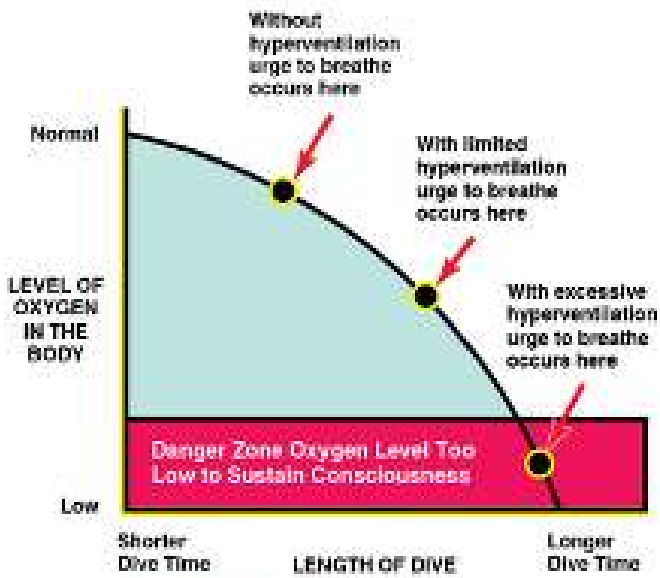
Besides limiting hyperventilation to three or four deep, rapid breaths, rest a minute or so between breath-hold dives so your body can restore its normal oxygen level. If you feel fatigued, dizzy or light-headed, stop diving down. Float, relax and rest.

You may be familiar with *unintentional* hyperventilation, which results from anxiety or stress, and causes someone to breathe rapidly and shallowly. This leads to respiratory difficulty, and contributes to the overexertion and air starvation problems you learned about earlier. By using proper diving techniques, you'll normally avoid this, but if you find yourself reacting to stress and anxiety with rapid, shallow breathing, force yourself to stop, breathe slowly and relax.

Skin Diving Surface Dives

To this point, you've made descents in a head-up, feet-down position using scuba equipment. This works fine for scuba diving, but when skin diving

Sans scuba.
For skin diving, you'll use all your equipment except your scuba unit, and you'll either use less weight so you're positively buoyant, or a snorkeling vest.



Avoid the extreme.
Excessive hyperventilation — more than 3 or 4 breaths — can be dangerous because you can lower your carbon dioxide levels so far that your body runs out of oxygen before you get the urge to breathe. This would lead to sudden unconsciousness — without warning — and drowning.

it takes too long — in all but very shallow water, you'd have to surface to breathe before you ever reached the bottom. Since you're not wearing scuba equipment, you can use a faster headfirst surface dive.

A headfirst surface dive gets you underwater and headed down quickly with minimal effort. Here's what to do: Deflate your BCD (if using one), and then float face down breathing through your snorkel. Begin swimming forward and at the same time, hyperventilate (not more than three or four times), then hold the last breath. Bend forward at your waist, thrust your head and arms downward, and simultaneously use your momentum to lift your legs above the surface. Get your legs as high and straight as possible so their weight drives you toward the bottom. Once your fins submerge, begin kicking, equalizing your ears and mask just like you do to descend using scuba. You can use your arms for leverage when you raise your legs for the dive, but once underwater use your fins to swim down. If you're not using a BCD, you should be somewhat positively buoyant and need to swim to stay down.

Head long.
To make a head first surface dive, begin swimming forward. Bend forward at your waist, thrust your head and arms downward, and simultaneously use your momentum to lift your legs above the surface. Get your legs as high and straight as possible so their weight drives you toward the bottom.

While you're down, your buddy remains at the surface watching you. You do the same when your buddy makes a dive. Use this one-up, one-down, buddy technique while skin diving so that if you need assistance, your buddy, who has a fresh breath, can come to your aid.

As you swim along underwater, move slowly to conserve oxygen. By relaxing and becoming interested in something, you'll be surprised how long you can comfortably stay underwater on a single breath.

When you come up, raise your hand over your head, look up and rotate so you get a complete view of the surface as you come up. Get in the

habit of looking for overhead obstacles such as boats and other divers. Before you reach the surface, you may be able to clear your snorkel using a method called the *displacement* method.

Displacement Snorkel Clearing

You can clear your snorkel with the blast method like you've already learned, but when skin diving you may find the displacement method easier. However, it does require a snorkel either without a self drain, or if it has one, it needs to have a relatively small valve.

Displacement clearing works like this: As you ascend looking at the surface, your head tilts back, so the top of your snorkel is *lower* than the mouthpiece. Keep your head tilted back throughout the ascent by looking at the surface and exhale into your snorkel as you rise through the last one to one and a half metres/ three to four feet of water. Your exhalation displaces the water, pushing it out of the snorkel's opening.

When you reach the surface, continue to exhale as you roll your head forward into the surface swimming position. The snorkel will be clear of water, though you'll use airway control and take your first breath cautiously, in case a few drops of water remain.

The reason this may not work with a self drain snorkel is that as you look up and exhale, your air may exit through the drain valve instead of pushing out the water. It may work when exhaling steadily using a snorkel with a small valve because air can't escape as fast as it comes in, so the snorkel clears. If you can't displacement clear your self drain snorkel because air escapes too easily, don't worry about it. With the self drain it doesn't take much effort to blast clear your snorkel anyway.

Look up as you come up.
As you ascend looking at the surface, your head tilts back so the top of your snorkel is lower than the mouthpiece. Keep looking at the surface and exhale into your snorkel through the last one to one and a half metres/ three to four feet of water. Your exhalation pushes the water out of the snorkel's opening.

Sitting Back Roll Entry

After you've practiced your skin diving skills a bit, your instructor will have you get into your scuba gear. You may practice new water entries appropriate to diving in your area, including the sitting back-roll entry. This is a good method when diving from a low, unstable platform such as a small boat or raft.

To accomplish a sitting back roll entry, first make sure all your equipment is in place and that your SPG or other hoses aren't snagged or hooked on something. Next, check the entry area to be sure it's clear. Sit on the edge of the platform with your BCD about half inflated and your regulator in your mouth. Hold your mask firmly in place, and lean back, so you roll gently into the water. Keep your legs tucked close to you during the entire entry so they don't strike the platform edge as you go. You may feel momentary disorientation (it's kind of exhilarating), then your buoyancy brings you to the surface. Let your buddy know you're okay and clear the entry area.

For low unstable platforms.
When using a sitting back roll entry, keep your legs tucked close to you during the entire entry so they don't strike the platform edge as you go.

No Mask Swimming

In the last confined water dive, you practiced breathing underwater without your mask, which doesn't do much for the view, but it's important to know in case your mask were to come off completely while diving. (Which, about half the time, results from swimming too close to your buddy's fin tips.) Since you might have to swim to the

surface without it, or to your buddy to get help finding it, in this session you'll practice by swimming at least 15 metres/50 feet underwater without your mask.

Remember to concentrate on breathing through your mouth and not your nose, and to exhale through your nose if you need to push water out. During your swim, open your eyes because even without your mask you can usually see well enough to tell where you're going. With contact lenses, however, keep your eyes shut and have your buddy guide you. In a real mask-loss situation, you might have to risk losing a lens, but there's no reason to do so during this dive.

Buoyancy Control — Hovering

No strings or wires.
To hover, adjust for neutral buoyancy and push gently off the bottom just about a metre/a couple of feet. Then, without holding your breath, use lung volume to maintain a stationary position in midwater.

You've been learning to control your buoyancy in each confined water dive, which as you recall helps you avoid stirring up the bottom, damaging aquatic life and wasting energy. First you learned the basics— proper weighting and BCD use. Then you learned to fin pivot. Now you'll demonstrate the next mastery level by (drum roll please) hovering motionless in midwater.

To hover, first adjust for neutral buoyancy on the bottom (you'll probably use the fin pivot). Once you're neutrally buoyant, push gently off the bottom just about a metre/a couple of feet. Then, *without holding your breath*, use lung volume to maintain a stationary position in midwater. If you begin to rise a bit, decrease your buoyancy by breathing with your lungs somewhat less full. If you begin to sink a bit, increase your buoyancy by breathing with your lungs a little fuller. It helps to have a

stationary visual reference to judge whether you're rising or sinking, so you may want to do this near a pool side, next to a line, or anything else that gives you this reference. You can fold your legs under you, stretch out, whatever works.

As you gain experience diving, you'll subconsciously and automatically adjust your buoyancy so you remain off the bottom and can stop and hover without even thinking about it. It only takes a little practice, and you'll find hovering easy.

Knowledge Review

Chapter 4

1. A detailed log book is the proof-of-experience documentation typically requested in many dive situations. Check those listed here.

   ☐ a. for additional diver training
   ☐ b. by dive stores when buying dive equipment
   ☐ c. when diving at resorts or on boats

2. Explain how to prevent problems with contaminated air.

_____

_____

_____

3. State the two ways divers prevent problems with oxygen.

   a. _____

   b. _____

4. Check each symptom related to nitrogen narcosis:

   ☐ a. impaired coordination
   ☐ b. foolish behavior
   ☐ c. joint and limb pain

5. Check one. To prevent nitrogen narcosis:

   ☐ a. skip breathe.
   ☐ b. equalize your air spaces early and often.
   ☐ c. avoid deep dives.

6. Check each symptom which may be related to decompression sickness:

   ☐ a. foolish behavior
   ☐ b. moderate tingling
   ☐ c. cherry-red lips
   ☐ d. weakness and prolonged fatigue

7. Outline the first aid procedure for assisting someone with decompression illness.

_____

_____

_____

8. True or False. When using either version of the Recreational Dive Planner, you must ascend at a rate that does not exceed 18 metres/60 feet per minute. _____

9. Match the following by placing the correct letter in the blank.

   _____ Maximum depth limit for Open Water Divers

   _____ Maximum depth limit for divers with training and experience beyond the Open Water Diver level

   _____ Maximum depth limit for divers with Deep Diver training

   a. 18 m/60 ft b. 40 m/130 ft c. 30 m/100 ft

10. According to the Recreational Dive Planner, the no decompression limit for 18 metres/60 feet is _____ minutes.

11. What is your pressure group after a dive to 14 metres/46 feet for 24 minutes?

    _____ Pressure Group

12. After a dive, you are in pressure group *K*. What will your new pressure group be after a 34-minute surface interval?

    _____ Pressure Group

13. A diver in Pressure Group *G* plans a dive to 17 metres/56 feet. What is the maximum allowable bottom time according to the Recreational Dive Planner?

    _____ Maximum Allowable Bottom Time

14. Indicate the final pressure group upon surfacing after the following series of dives.
    First dive: 16 metres/50 feet/23 min.; surface interval: 1:30.
    Second dive: 10 metres/35 feet/46 min.

    Final Pressure Group = _____

15. Indicate the final pressure group upon surfacing after the following series of dives.
    First dive: 18 metres/60 feet/15 min.; surface interval: 1:00.
    Second dive: 12 metres/40 feet/30 min.

    Final Pressure Group = _____

Student Diver Statement: I've completed this Knowledge Review to the best of my ability, and any questions I answered incorrectly or incompletely I've had explained to me, and I understand what I missed.

Name _____ Date _____

Special Dive Table and Computer Procedures

In Section Four you learned the basics for diving with dive tables and dive computers, but there are some additional procedures that you need to know about. These involve procedures for enhanced safety, for accidentally exceeding your no-stop limit, and for diving at altitude or ascending to altitude after diving.

Safety Stops

Although as a recreational diver you plan only no decompression dives that allow you to ascend directly and continuously to the surface, most of the time you'll want to make a *safety stop* for added conservatism. A safety stop provides extra time for your body to eliminate nitrogen, and it gives you a moment to stabilize and control your ascent rate before continuing to the surface.

To make a safety stop, you stop your ascent in the 3 to 6 metre/10 to 20 foot range — usually at 5 metres/15 feet for three minutes or longer. It's easiest to do this holding onto a line or on an ascending slope, but you can also hover in midwater where appropriate.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

1. **What are the recommended depth and time for a safety stop?**
2. **What's the purpose of a safety stop?**
3. **What are three situations in which a safety stop is considered required?**

FIVE

You plan your dive so you can make a safety stop and still reach the surface with 20-40 bar/300-500 psi or more air remaining in your cylinder.

You may make a safety stop at the end of any dive, and in fact, you should consider it a standard practice on virtually all your dives. However, consider a safety stop *required* if:

1. Your dive has been to 30 metres/100 feet or deeper.
2. Your pressure group at the end of the dive is within three pressure groups of the no decompression limit on the RDP.
3. You reach any limit on the Recreational Dive Planner or your dive computer. With a dive computer, this would be if your computer shows zero NDL time remaining at *any point* in the dive.

When using the RDP, in these circumstances the safety stop is considered *required*.

You may wonder whether you need to account for safety stop time when using the RDP. You don't need to add safety stop to your bottom time when using the Recreational Dive Planner. A computer will process safety stop time automatically.

Keep in mind that, although you should make safety stops a regular procedure for all your dives, it's optional under circumstances such as very low air (due to unforeseen circumstances during the dive), assisting another diver, or rising bad weather make it more important to get to the surface immediately.

Emergency Decompression

You plan your dive as a no decompression dive but something delays your ascent and you accidentally exceed the no stop limit. Now what? You need to make an emergency decompression stop to allow your body to eliminate nitrogen; without this stop, you face an unacceptable risk of DCS when you surface.

Using the RDP: If you exceed a no decompression limit or (on a repetitive dive) an adjusted no decompression limit

Quick Quiz

Self Assessment 1

1. The recommended general depth and time for a safety stop is:
- ☐ a. 10 metres/35 feet for 2 minutes.
- ☐ b. 5 metres/15 feet for 3 minutes.
- ☐ c. 2 metres/6 feet for 20 minutes.

2. The purpose of a safety stop is (check all that apply):
- ☐ a. to drain your cylinder as much as possible.
- ☐ b. to allow your regulator to stabilize its performance.
- ☐ c. to give your body extra time to eliminate nitrogen.
- ☐ d. to allow you to stabilize and control your ascent.

3. A safety stop is considered required when (check all that apply):
- ☐ a. you dive to 30 metres/100 feet or deeper.
- ☐ b. you reach any limit on your table or computer.
- ☐ c. your dive comes within three pressure groups of an NDL on the RDP.
- ☐ d. you're almost out of air.

How'd you do?
1. b. 2. c, d. 3. a, b, c.

by five minutes or less, slowly ascend at a rate not faster than 18 metres/60 feet per minute to 5 metres/15 feet and remain there for eight minutes prior to surfacing. After reaching the surface, do not dive for at least six hours because you will have extremely high levels of residual nitrogen in your body.

If you exceed a no decompression limit or an adjusted no decompression limit by more than five minutes, a 5 metre/15 foot stop for no less than 15 minutes is strongly urged, air supply permitting. Upon surfacing, you must remain out of the water at least 24 hours before diving again, due to the excess nitrogen in your body.

When making an emergency decompression stop, stay as close to 5 metres/15 feet as possible. If you don't have enough air for the emergency decompression stop, stay as long as you can, saving enough air to surface and exit safely. Discontinue diving for no less than 24 hours. Breathe pure oxygen if available and monitor yourself for decompression sickness symptoms.

Using a dive computer: If you exceed your computer's no decompression limits, it will go into decompression mode, which guides you through the emergency decompression stop. Computers differ in how they function in decompression mode, so consult the manufacturer's literature for the specifics for your computer. Many will show emergency decompression stops at 3 metres/10 feet instead of 5 metres/15 feet; stopping at 5 metres/15 feet until the computer says you can surface will still work, though, because the computer calculates the stop based on your actual depth. It may take a bit longer than the time indicated for a stop at 3 metres/10 feet.

It's not recommended that you make a repetitive dive after a dive requiring emergency decompression. Emergency decompression stops differ from safety stops in that an emergency decompression stop *must* be made or there is an excessive risk of decompression sickness, and that is an *emergency* procedure only in recreational diving. The Recreational Dive Planner

Wait a few minutes.
You'll want to make a safety stop for added conservatism as you finish most of your dives. The stop provides extra time to eliminate nitrogen, and it gives you a moment to stabilize your ascent rate.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

4. What should you do if you exceed a no decompression limit or an adjusted no decompression limit by five minutes or less when using the RDP?

5. What should you do if you exceed a no decompression limit or an adjusted no decompression limit by more than five minutes when using the RDP?

6. How do you determine emergency decompression requirements with a dive computer?

Going under when you're upper.
If you're interested in high-altitude diving, see your PADI Dive Center, Resort or Instructor about learning the techniques in an Advanced Open Water adventure dive, or by taking an Altitude Diver specialty course.

Altitude Diving
See the *PADI Adventures In Diving Manual*

was designed for recreational, no decompression diving only. It should never be used in commercial/military/technical diving situations that require planning for decompression dives.

Altitude Diving, Flying After Diving, and Cold/Strenuous Dives

Altitude Diving. Thinking back to Section One, you recall that as you ascend in air, pressure decreases. Dive tables and most computers give you their no decompression limits based on a dive ending at sea level; if you're under less pressure at altitude, nitrogen comes out of solution more easily following a given dive, making decompression sickness more likely.

You can use the Recreational Dive Planner for diving to altitudes as high as 300 metres/1000 feet. Above 300 metres/1000 feet, you need special conversion tables and procedures to account for the

Quick Quiz

Self Assessment 2

1. If you exceed your no decompression limit or adjusted no decompression limit by less than five minutes when using the RDP, you should
   - ☐ a. slowly ascend to 5 metres/15 feet and make an eight minute stop, then not dive for at least six hours.
   - ☐ b. slowly ascend to 5 metres/15 feet and make a three minute stop, then not dive for at least six hours.
   - ☐ c. None of the above.
2. If you exceed your no decompression limit or adjusted no decompression limit by more than five minutes when using the RDP, you should
   - ☐ a. slowly ascend to 5 metres/15 feet and make a stop for at least 15 minutes, air supply permitting, then not dive for at least 24 hours.
   - ☐ b. slowly ascend to 5 metres/15 feet and make an eight minute stop, then not dive for at least six hours.
   - ☐ c. None of the above.
3. If you exceed the no decompression limit of your dive computer, make an emergency decompression stop as it directs in its decompression mode, and do not make a repetitive dive.
   - ☐ True ☐ False

How'd you do?
1. a. 2. a. 3. True

MAIN Objectives

Underline/highlight the answers to these questions as you read:

7. Above what altitude do you need to use special dive procedures?

8. What are the recommendations for flying in a commercial airliner after diving?

9. What are the procedures for planning a dive in cold water or under strenuous conditions?

Wing your way carefully.
You're responsible for your own dive safety. Flying after diving recommendations change over time; stay up to date and follow the most current recommendations.

Flying After Diving
Flying after diving recommendations change over time. These are current at the time of printing. Always check with your instructor to stay apprised of the most current ones.

decreased atmospheric pressure or you can run an unacceptable risk of DCI.

The procedures for diving at altitude with a dive computer vary with the computer. Some automatically compensate for altitude, whereas with others you'll need to tell the computer your altitude. There are a few older models that you can't use at altitude.

If you're interested in high-altitude diving, see your PADI Dive Center, Resort or Instructor about learning the techniques in an Advanced Open Water adventure dive, or by taking an Altitude Diver specialty course (usually takes less than a day).

Flying After Diving. You also need to think about lowered atmospheric pressure if you plan to fly after diving. While this concern is similar to altitude diving, it's not identical. When you dive at altitude, you dive and return to reduced atmospheric pressure. When you fly after diving, you dive and return to normal atmospheric pressure, then expose yourself to further pressure reduction.

The dive medical community offers the following general recommendations for flying after diving, whether you're using the RDP, another table or a dive computer:

For Dives within the No Decompression Limits

- ***Single Dives*** – A minimum preflight surface interval of 12 hours is suggested.

- ***Repetitive Dives and/or Multiday Dives*** – A minimum preflight surface interval of 18 hours is suggested.

For Dives Requiring Decompression Stops

- A minimum preflight surface interval greater than 18 hours is suggested.

As with dive tables and computers, no flying after diving recommendation can guarantee that decompression sickness will never occur. These guidelines represent the best estimate presently known for a conservative, safe surface interval for the vast majority of divers. There always may be an occasional diver whose physiological makeup or special dive circumstances result in decompression sickness despite following the recommendations.

You're responsible for your own dive safety and behavior. Flying after diving recommendations change as we learn more about how pressure changes affect the body; stay current and follow the most current recommendations.

There are currently no recommendations for driving to altitude after diving, so the most prudent practice is to be conservative. The longer you wait before you go, the lower your risk. You may check with a local dive center, resort or instructor to see if divers in the area follow a particular recommendation or protocol.

Cold and Strenuous Conditions. If you get cold or exercise a lot during a dive, you may end your dive with more excess nitrogen in your body than calculated by your dive table or computer. When using the RDP for planning a dive in cold water or under conditions that may be more strenuous than usual, plan your dive as though the depth were 4 metres/10 feet deeper than it actually is.

How you handle this with a dive computer depends on the computer. A few sophisticated models track the water temperature and your breathing rate and automatically readjust to more conservative no stop times when necessary. For others, you can set the computer to be more conservative by using the altitude setting and setting it to an altitude higher than you actually are, or by connecting the dive computer to a personal computer (requires special hardware and software). However, you have to make these settings before the dive. If you can't set

Self Assessment 3

1. When using the RDP, you need to use special dive procedures above what altitude? _____

2. The minimum recommended surface interval for flying after diving is _____.

3. Using the RDP, under cold and strenuous conditions you plan your dive as though:
   - ☐ a. it were at altitude.
   - ☐ b. it were 4 m/10 ft deeper than actual.
   - ☐ c. it were 4 m/10 ft shallower than actual.
   - ☐ d. None of the above.

How'd you do?
1. 300 m/1000 ft. 2. 12 hours. 3. b.

your computer to be more conservative (and it doesn't do it automatically), or if you didn't expect cold/strenuous conditions, you'll need to be more conservative by making sure you always have plenty of no decompression time remaining throughout the dive.

It's especially prudent to make a safety stop when diving in cold water or under strenuous conditions.

Using a Dive Computer

As you learned in Section Four, you're probably going to be diving with a computer more often than not. The basic principles and guidelines that apply to the RDP apply, for the most part, to diving with your computer. Keep these points and procedures in mind:

1. Computers are sophisticated calculators with depth gauges and timers that calculate theoretical nitrogen in the body. They're no more or less valid than dive tables, and they don't track anything physical in your body. The recommendations for conservative diving with tables apply to computer diving.

2. Don't share your computer. Each diver needs an individual computer. A computer tracks theoretical body nitrogen as it rises

Main Objectives

Underline/highlight the answers to these questions as you read:

10. **What procedures and general recommendations apply to diving with a computer?**

Summary Points

In this subsection on Special Dive Table and Computer Procedures, you learned:

- You should make a safety stop at the end of virtually all dives (except when an emergency prohibits it).
- A safety stop is a pause in your ascent between 3 and 6 metres/10 and 20 feet for three minutes or longer.
- Consider a safety stop mandatory if you dive deeper than 30 metres/100 feet or reach any limit on the RDP or your computer.
- For recreational divers, decompression is only an emergency procedure.
- You need to follow special procedures when diving at an altitude greater than 300 metres/1000 feet.
- Follow the recommendations for flying after diving conservatively, and stay up to date with the most current recommendations.
- Plan cold/strenuous dives with the RDP as though the depth were 4 metres/10 feet deeper than actual. With a computer, be conservative using the most appropriate method for your computer.

and falls with each dive and surface interval, so it must stay with one diver for the entire dive day — you can't swap between dives. You can't share a computer within a buddy team either because it tracks depth quite closely. It will only be accurate for the diver wearing the computer.

3. Follow the most conservative computer. Surface or ascend when either computer — yours or your buddy's — approaches its no decompression limit. If you follow the least conservative, you're in effect sharing that computer, which you shouldn't do.

4. Don't turn your computer off between dives. Most won't let you, but if you take out the battery or shut the computer down, it loses its memory of your previous dives and your residual nitrogen. You'll have to allow all residual nitrogen to leave your body before resuming use of the computer. Your computer will shut itself off when it calculates no significant residual nitrogen remaining.

5. Make your deepest dive first and plan successive dives to progressively shallower depths. During a dive, start at the deepest point and work your way shallower. The medical community recommends avoiding going from shallow to deep because there's little test data about this kind of diving. Minor up and down variations (a few metres/feet) are not likely an issue, but there are some theoretical concerns if a successive dive is significantly deeper than a previous dive. Note that if you accidently don't follow this guideline, for safety, dive computers still provide no stop times.

6. Stay well within computer limits. Always try to have five or more minutes no decompression time remaining. If you let it near or reach zero, you've pushed the limits even though you'll have plenty of no stop time when you ascend to a shallower depth.

7. If your computer quits, you may need to stop diving for 12 to 24 hours. If it quits during a dive

Quick Quiz

Self Assessment 4

1. Procedures for diving with a computer include (check all that apply):
   - ☐ a. sharing a computer with no more than one other diver.
   - ☐ b. following the most conservative computer — yours or your buddy's.
   - ☐ c. keeping your computer turned on between all dives.
   - ☐ d. making your deepest dive first, and each subsequent dive progressively shallower.

2. Any dive that your computer provides no decompression dive time for is acceptable.
   - ☐ True ☐ False

How'd you do?
1. b, c, d. 2. False. Your computer may provide data for dives that aren't recommended.

Think.
Don't blindly accept everything your computer says, especially when it appears way out of line with a buddy's computer or your previous experience. Read the manufacturer's instructions completely before using your computer, and follow what they say.

and you've been staying well within the no decompression limits, ascend immediately to 5 metres/15 feet, make a safety stop for five minutes or more and surface. You can't simply grab another computer because it won't know how much residual nitrogen you have. Follow the manufacturer's instructions.

8. Take the RDP with you when you go diving. Although computer failure has become very rare, it still happens once in awhile. If you've been noting your depths and times (in your logbook, perhaps) and your dives have been RDP limits, you can continue diving using the RDP. Otherwise, you'll probably have to wait until the next day for residual nitrogen to clear before you resume diving.

Although it's common for dive resorts to have scuba equipment including regulators and computers that you can rent in case of a problem, that's not always the case. Take your RDP so you don't miss out. Many active divers invest in a second computer (and other gear) so there's a spare for themselves or a partner.

9. Keep thinking. Dive computers can fail just like any other piece of equipment. Don't blindly accept everything your computer says, especially when it appears way out of line with a buddy's computer or your previous experience. Read the manufacturer's instructions completely before using your computer, and follow what they say. You can learn more about the theory and use of dive computers in the PADI Multilevel Diver course.

Basic Compass Navigation

Navigation can seem pretty overwhelming when you consider that you're trying to keep up with where the rest of the world is. And that's without mentioning how it feels to get lost and realize you just lost track of an entire planet. By learning to navigate underwater you'll minimize how often you get disoriented, and if it does happen, you'll more quickly figure out where you mislaid the whole of existence. Don't let it intimidate you – there are two kinds of divers: those who have been lost underwater, and those who won't admit it.

MAIN Objectives

Underline/highlight the answers to these questions as you read:

11. What are the four basic features of an underwater compass?

12. What is the proper hand and arm position when using a compass mounted on the wrist?

13. What is the proper method of holding a compass when it is mounted in an instrument console?

14. How do you set an underwater compass to navigate a straight line from a beginning location to a predetermined destination?

15. How do you set an underwater compass for a reciprocal heading?

Basic Compass Navigation
See the PADI *Underwater Navigator Manual*

Follow me.
With experience you'll learn to navigate by following cues you find in the environment, but an underwater compass makes navigating easier and more accurate, and the more you use it, the more true this is.

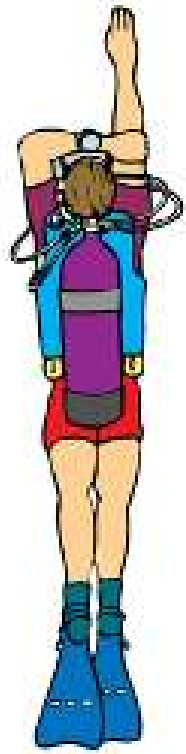
Basic underwater compass features.

Navigation makes your underwater adventure more fun in several ways. It lets you plan your dive so you don't waste time and air trying to find the best parts of the reef, and so you end your dive near your exit point with ample reserve air left. By knowing where you are at all times, you can head straight for the boat or shore if a problem crops up, and you know where you haven't explored yet. If there's anything in the area you want to avoid, navigation helps you do so. Compass navigation helps you swim a straight line — when you're lost, you tend to swim in a circle.

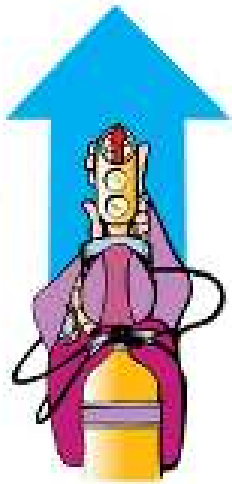
With experience you'll learn to navigate by following cues you find in the environment (a diver who has been there a gazillion times is a great cue to follow), but an underwater compass makes navigating easier and more accurate, and the more you use it, the more true this is.

Basically, compass navigation works like this: Your compass remembers where the North Pole is, and you remember where everything is in relation to the North Pole. Okay, more detail will help, but that's the essential principle of compass navigation. Let's start with the four basic features you'll find on most underwater compasses:

1. Lubber line: The lubber line indicates your travel direction and runs straight down the center of your compass. It may be imaginary – you draw the line mentally through the 0 degree and 180 degree marks. Or, the compass may have an actual line there or along one side of the compass. Any time you navigate with your compass, you have the lubber line pointed where you're headed, or you're using the compass to point the lubber line in the direction you should head. If you're navigating with your compass and you're not traveling along the lubber line, then . . . well, then you're not actually navigating with your compass.



Center and level.
Hold the compass so the lubber line aligns with the center line of your body. On your wrist, hold the arm without the compass straight out and grasp it with your opposite hand near or above the elbow, solidly placing the compass in front of you.



If your compass rides in your console, hold the console squarely in front with both hands.

2. Magnetic north needle: In the center of the compass is a needle (or an arrow printed on a disk) that is free to rotate inside the compass. This magnetic north needle, or compass needle, always points to magnetic north. By doing this, it creates an angle with the lubber line that you use to maintain a straight line as you swim.

3. Bezel: Most underwater compasses have a rotating bezel. To set the compass, align the two small, parallel index marks on the bezel over the compass needle. These help you maintain a straight direction of travel.

4. Heading References: Most underwater compasses have numbers so you can record your heading (your direction of travel as measured in degrees from magnetic north). A few compasses have only general markings for north, south, east and west; you can use these for general navigation, but for precision you'll want one with degree headings.

Electronic compasses provide the same information and functions, but use digital readouts. See the manufacturer instructions if you're using an underwater electronic compass.

To navigate with a compass, the first step is to hold it correctly. Hold the compass so the lubber line aligns with the center line of your body. If you wear your compass on your wrist, hold the arm without the compass straight out and grasp it with your opposite hand near or above the elbow, solidly placing the compass in front of you. If your compass rides in your console, hold the console squarely in front with both hands.

When using your compass, keep the lubber line aligned with your body center line. Otherwise you won't swim along the lubber line, and you'll throw off your navigation even if you use the compass correctly in all other respects.

To navigate a straight line, simply point the lubber line in the direction you want to go and align your body with the lubber line. Hold the compass reasonably level (otherwise the needle locks) and allow the needle to settle. Next, turn the bezel so the index marks align over the compass needle. (For swimming in a straight line, you don't need to use heading degrees or north, south, east and west.)

Lubber line leads.
To navigate a straight line, point the lubber line in the direction you want to go and allow the needle to settle. Next, turn the bezel so the index marks align over the compass needle. Travel along the lubber line keeping the needle within the marks.

Now, swim along the lubber line (your desired direction of travel) while keeping the compass level and the needle within the index marks. If the needle begins to leave the index marks, you're turning off course. Adjust your direction so the needle stays within the index marks. Remember that the compass needle never really turns — it *always* points to magnetic north. If the needle appears to have moved, it's *you* who moved from the course.

Back where you came from.
To set the compass for a reciprocal heading, if your compass has only one set, you rotate them 180° from your original heading. Some compasses have two sets of index marks (as shown) with the extra pair in place for a reciprocal heading. Either way, turn until the compass needle sits inside the index marks 180° from your original heading. You now face the direction you came from.

Now let's set the compass for a *reciprocal* heading. First turn the bezel so the index marks are exactly opposite their original location on the compass face. Next, turn until the compass needle sits inside the index marks again. You now face the direction you came from. Swim along the lubber line keeping the needle within the marks like you did on the way out.

For diving in many environments, you'll use the compass to swim out, then set a reciprocal heading to return to the boat or shore at the end of the dive. With a little practice, you'll find compass navigation not only useful, but a fun challenge — it's the kind of skill that's pretty easy to get down the basics you need, but takes a lot of practice and experience to attain the to-the-metre/foot precision that sets the master apart from the average.

Even if you're not into it for its own sake, you need rudimentary navigation skills. Besides what you'll practice in this course, you develop your navigation skills by making a point of using them when you dive, and you can participate in navigation Adventure Dives with your instructor. You can also spend a fun weekend diving and learning about navigation in the Underwater Navigator course, and in the Advanced Open Water program.

PADI Course Evaluation Questionnaire

The PADI organization's success comes from many factors not the least of which is the professionalism and excellence demonstrated by PADI Members. Over the years, PADI Members' commitment to providing divers with consistent, first-rate training has made the PADI name synonymous with quality educational programs. Acknowledging, as well as preserving this high level of customer satisfaction achieved by PADI Members is the cornerstone of the Quality Management and Recognition program.

PADI's Quality Management Department recognizes members for the superior service they provide to student divers and customers. Everyone benefits when members comply with PADI Standards – students receive thorough training, members protect themselves and enhance their businesses by using a tested educational system; consequently, PADI's reputation for quality remains intact.

Quick Quiz — Self Assessment 5

1. Basic features of an underwater compass include (check all that apply):
   - ☐ a. lubber line.
   - ☐ b. compass needle.
   - ☐ c. index marks.
   - ☐ d. bezel.

2. When using a compass, you want to align your body center line with:
   - ☐ a. the compass needle.
   - ☐ b. the index marks.
   - ☐ c. the bezel.
   - ☐ d. None of the above.

3. To navigate a straight line, point the _____ in your travel direction and then put the _____ over the _____.

4. To navigate a reciprocal heading, rotate the bezel so the _____ are/is exactly opposite the initial heading.

How'd you do?
1. a, b, c, d. 2. d. You align your body with the lubber line. 3. lubber line, index marks, compass needle.
4. index marks

Summary Points

In the subsections on Using a Dive Computer and Basic Compass Navigation, you learned:

- You should have your own computer while diving — don't try to share one.
- Keep your computer turned on all the time.
- The dive medical community recommends that you make your deepest dive first and plan successive dives to progressively shallower depths.
- Stay well within computer limits.
- Back up your computer with dive tables.
- Underwater navigation skills add to dive fun and safety.
- The compass lubber line always indicates your travel direction; the compass needle always points north.

Nav wizard.
Besides what you'll practice in this course, you develop your navigation skills by making a point of using them when you dive, and you can participate in navigation Adventure Dives with your instructor.

PADI Course Evaluation Questionnaires (CEQ's) are student surveys that are used to recognize outstanding performance by an instructor and to verify that all training elements were conducted in every course. PADI distributes the CEQ's to some of each PADI Instructor's students via email as well as by paper. If you receive one, help PADI maintain the highest standards in diving by taking a few moments to complete it." After you receive your certification card and you have not received a CEQ, you can have one sent electronically by contacting your PADI Office.

Continuing Your Adventure

You're not far from becoming a PADI Open Water Diver, and you're probably pretty focused on that goal. Soon you'll be a certified diver, inside the threshold of diving, looking at all the adventure diving offers.

Then what?

Maybe it's time you think about it. It's such a loss when a diver becomes certified and then . . . and then nothing. No adventure. No challenge. It's like someone hands the diver a new world, and not knowing what to do with it, the diver says, "No thank you," and walks away.

Surely you didn't take the time and

Main Objectives

Underline/highlight the answers to these questions as you read:

16. **What is the purpose of the PADI System of diver education?**
17. **What are three benefits of continuing your diver education beyond PADI Open Water Diver?**
18. **What dive adventure do you want next?**

People like you.
Your PADI Dive Center or Resort probably has a dive club or knows of one. Most of these organizations coordinate activities, dives, events and other dive- related fun — and you'll meet other people to dive with.

effort to earn your certification just so you can say, "been there, done that." But you may not know where to go, or what to do with this new world at your grasp. So let's look at what you need to do now so that when you look back in a year, or ten, you won't look back on ". . . and then nothing." You need to: 1. meet people, 2. go places and 3. do things.

Meet People.

Since you can't dive alone, the more diving friends you have, the more dive opportunities you'll have. Not having someone to dive with is one of the most common reasons why some divers don't keep diving after getting certified. Maybe you already have friends who dive, but if you don't or want more, what do you do?

You're off to a good start, if you think about it. Don't leave your final confined water dive and open water dive for this course without getting the name, telephone number and address for everyone in the class. You know these divers, and like you, they want someone to dive with.

Next, join a dive club. Your PADI Dive Center or Resort probably has one or knows of one, which is probably a local chapter of the PADI Diving Society (which you'll also want to join). Most of these organizations coordinate activities, dives, events and other dive-related fun — and you'll meet other people to dive with. Don't worry that you're new to diving — every dive group has members at all experience levels and they plan activities accordingly.

Go Places.

A great way to meet people is to go on a dive trip organized by your PADI Dive Center or Resort. Plus, it takes you diving — which is what you're trying to accomplish. Although an exotic dive destination has the most appeal, don't let time and money limit your thinking. Most dive operations offer local dive adventures close to home — and you may be surprised just how much fun you can have.

Do Things.

Diving isn't just about swimming around underwater sightseeing. Diving should be personal. It's about gaining the skills *you* need to visit new dive sites *you* want to see. It's about having the gear

you want so that diving takes *you* on the adventures that *you* think worthwhile, so that it presents *you* with the challenges that *you* think deserving, and so that diving grows with *you* and always rewards *you*.

Only *you* can say whether this means taking on artistic challenges like underwater photography and videography, skill challenges like navigating or finding and recovering lost objects, or technical challenges like deep diving or enriched air diving. But recognize that scuba diving isn't an activity, but a door through which you reach hundreds of underwater pursuits. Find those that ignite your heart, and you'll experience that which eludes many people — a burning passion for what you do.

The PADI System of Diver Education

Choose from many.
Recognize that scuba diving isn't an activity, but a door through which you reach hundreds of underwater pursuits. Find those that ignite your heart, and you'll experience that which eludes many people — a burning passion for what you do.

Looking at a flow chart for the PADI System of diver education, one might conclude that its purpose is to take you to Master Scuba Diver, or to PADI Open Water Scuba Instructor. *But that's not it at all.*

Becoming a PADI Master Scuba Diver, or Divemaster, or Instructor, or whatever isn't the purpose of the system, but a *result* of achieving its purpose. The *purpose* of the PADI System is to provide the means by which you 1. meet dive people, 2. go places diving, and 3. do things underwater. Sound familiar?

Continuing your education beyond Open Water Diver has some tangible benefits — doing so introduces you to specialized dive activities. It gets you acquainted with diving in different conditions, and it may get you diving in a wide variety of aquatic environments. But again, these all lead back to the primary purpose of helping you get out of diving what you got into diving for.

You'll find that other PADI courses differ from this course. Many — especially those that focus on adventure activities — take only a day or two, and they're mostly diving, with little or no classroom work. Others, like the leadership level PADI Divemaster and Open Water Scuba Instructor courses are much longer and more involved — but as with many things, the rewards reflect the effort and commitment required. Yet other programs are but a single dive.

Regardless, by continuing to learn, you meet and get to know other divers. You visit new dive sites (perhaps including dive travel), and you get to try new activities and to develop new skills, helping you find the aspects of diving that mean the most to *you*. Related to this, you see what types of equipment best suit your preferences and interests.

In other words, it assures that you meet people, go places and do things.

PADI Adventure Dives. What's it like to dive to 30 metres/100 feet? How hard is it to shoot a camera underwater? Is night diving as scary as it sounds?

You get the answers to questions like these by going on PADI Adventure Dives, which introduce you to the basics of special underwater activities. It's a great way to see what interests you, whether it's deep diving, night diving, wreck diving, and so on. Your instructor shows you what you need to know during a predive briefing and review, and then you're off doing it. The best part is, it's fun.

Adventures in Diving Program. Know what they call someone who's made five Adventure Dives? A PADI Advanced Open Water Diver. You make an underwater navigation dive and a deep dive, plus three other Adventure Dives that appeal to you. The background info you need you cover by reading short chapters in *Adventures in Diving* and during some predive briefings, but as with Adventure Dives, what you really do is meet divers, go places diving and do new things underwater. You can earn the Advanced Open Water Diver certification over time by going on Adventure Dives, or you usually can sign up for it as a program. It usually takes a weekend, but the schedule is incredibly flexible. Some people have done it in afternoons after work.

If you can't complete all five Adventure Dives you need for the PADI Advanced Open Water Diver certification, you can still earn the PADI Adventure Diver rating after completing any three Adventure Dives. PADI Adventure Diver certification dives can be completed in just one day.

Specialty Diver Courses. Once you start figuring out what types of diving you love, PADI Specialty Diver courses get you off on the

Keeps you diving.

The purpose of the PADI System is to provide the means by which you meet dive people, go places diving, and do things underwater.

right foot. In most of these programs you cover background materials by doing a bit of reading, watching some exciting and informative videos and discussing concepts in predive briefings. Then you make two to four dives in the activity. PADI Specialty Diver courses cover underwater photography, night diving, deep diving, wreck diving, equipment, underwater navigation, search and recovery, ice diving, cavern diving, altitude diving, boat diving, enriched air (nitrox), drift diving, dry suit diving, multilevel diving, underwater nature and more. Surely more than one gets your pulse up.

And even better: The Advanced Open Water program Adventure Dive happens to be the first dive of many PADI specialty courses. So if you try, say, a dry suit Adventure Dive (by itself or as part of an Advanced Open Water Diver course) and decide that you just have to have a dry suit and finish the whole course, you've already got the first course dive under your weight belt (at the instructor's discretion).

It works the other way, too. If you know now that you love, say, underwater photography and go straight into the Underwater Photographer course (which is a really great program, by the way . . . but we digress), the first dive from the course counts toward your Advanced Open Water certification (at the instructor's discretion).

Good things to know.
The Rescue Diver course refines and further develops your accident prevention and handling skills, plus teaches you to manage an emergency.

Discover Local Diving. Not a course, and you already know about this from the discussion on getting a local orientation when diving in a new area. The Discover Local Diving experience provides a single, supervised open-water experience to some place new, with a briefing covering local conditions, hazards and points of interest, as well as an orientation to special procedures and techniques used in the area. During the dive, you'll see some of the interesting points, as well as the potential hazards to avoid. It's a good way to plug into the local dive community when you go some place new, and find out what activities suit the local environment. Meet people, go places and do things.

Scuba Review. Ditto, you already learned about this, but it's worth a reminder: If you go several months or longer without diving (it happens, best laid plans notwithstanding), you'll want to brush up your dive skills and knowledge. In Scuba Review, you complete some short self-study (with a workbook or CD-ROM) and review it with a PADI Divemaster, Assistant Instructor or Instructor. Then you make a confined water dive to put the polish back on your skills. Usually takes only a couple hours — easy way to limber up mentally and physically
for diving.

Rescue Diver Course. Serious fun. You learn a pile of skills, most of which you hope you'll never use. It's a demanding and challenging course. *You'll love it.* Virtually all who take this course cite it as one of the most rewarding courses they've taken. Though challenging, you don't have to be an athlete – you learn rescue techniques suited to your physical characteristics and fitness level – what works for you.

During the Rescue Diver course you learn to refine and further develop your accident prevention and handling skills, plus learn to manage an emergency if you're ever faced with one. Good things to know.

Emergency First Response. Like the Rescue Diver course, in the Emergency First Response program you learn skills you hope you never need, but will be glad you did if you ever do. Emergency First Response combines CPR and first aid into a single course, teaching you (at a lay level) the same emergency protocols used by paramedics and doctors. Your nondiving friends can take this course with you, and it can make a big difference — even when you're not diving.

Rewards = efforts. *It takes effort and commitment to become a PADI Open Water Scuba Instructor, but it is as rewarding as it is demanding.*

Master Scuba Diver. The PADI Master Scuba Diver rating is the highest nonprofessional rating in recreational diving. This prestigious rating means you've developed skills and experience in a broad number of dive activities and environments. What makes a Master Scuba Diver? Earn the PADI Advanced Open Water Diver, the PADI Rescue Diver and five PADI Specialty Diver certifications.

Turn Pro. At some point, you may decide to make diving a full or part time profession. For a lot of people, it beats working at a desk, and if you love working at a desk, you can still turn pro. Does all this seem too far off? No worries — you don't need to look this far ahead yet. But this will give you some idea how your instructor and the instructor's staff got where they are.

After Rescue Diver, your next step is PADI Divemaster. During the Divemaster course, you sharpen your dive skills to demonstration quality, develop a professional-level understanding of dive theory, learn to organize and conduct diving activities, and learn how to assist with divers in training.

After Divemaster comes the PADI Assistant Instructor course. The Assistant Instructor course begins developing the basic knowledge and skills needed to *teach* diving. Next, you attend a PADI Open Water Scuba Instructor Course (OWSI). In this instructor-training course, you learn how to teach scuba diving. After completing the OWSI course, you must pass a two-day

Instructor Examination (IE) conducted by one of PADI's world wide offices. After completing the IE successfully, you're certified as a PADI Open Water Scuba Instructor — the most in-demand dive professional in the dive community.

It takes effort and commitment to become a PADI Open Water Scuba Instructor, but each step rewards you — and you're diving. Meeting people. Going places. Doing things.

Some Hard Truths About Diving

Before everything begins to sound too perfect, walk with open eyes about diving and being a diver:

1. You'll have dive experiences you don't like. Count on it. The conditions will not be good, you won't like the boat, you'll choose a buddy you don't like, you won't like the area you're visiting, or you'll find you don't like the particular activity you're trying. But guess what: If you play golf, you'll slice the ball off the course. If you ride horses, one will step on your foot. If you ski, you'll fling yourself face first into a snow bank. If you play chess, some whiz kid will checkmate you in 12 moves.

Everything worth doing has its less-than-love-it moments. *Don't* let a bad day of diving ruin diving for you. Learn from it and do it differently next time. Pursue what *you* want out of diving and progress in diving at *your* rate, and you'll have many, many great dive memories for each one you'd rather forget.

2. It's better to have your own gear. It really is. Divers who own their own equipment dive more often and dive more comfortably. They avoid the hassles of fitting into rental gear every time they go.

This isn't to say you need to drop everything and go get set up head-to-toe in gear at this moment (but if you *want* to, go for it). However, keep it in mind and begin investing as your budget and dive activity can accommodate.

3. You get out of diving what you put into it. You've just read about a lot of different things you can do underwater, and there are others not mentioned. If you ever find yourself bored with diving, you need to look closely at what you want out of diving, and what you're doing. If you're not satisfied, you need

to turn your diving in a new direction. There are people who have made more than 1000 dives over more than 30 years – and they're still meeting new people. Going new places. Doing new things. Only *you* can make yourself reach for what's new and exciting in diving.

Your Next Dive Adventure

Okay, so you won't look back in a year and wonder why you haven't been diving, before you finish this course, go to your PADI Dive Center or Resort and do one or more of the following:

1. Sign up for a dive trip.
2. Sign up for a local dive with the store or the store's dive club/Diving Society Chapter.
3. Sign up for a PADI specialty course, Advanced Open Water course, or Adventure Dive.
4. Invest in a regulator/BCD package, or exposure suit package.

Do not leave until you do one of these. No joke — because research shows that people who do one of these when they finish their Open Water Diver course are more likely to get out of diving what they got into diving for. Plan your next step *now*.

Meet people.
Go places.
Do things.
Underwater.

Using the Recreational Dive Planner (Continued)

Finish the rest of the *Instructions for Use* booklet that comes with your RDP.

Then come back to this manual and pick up with the Confined Water Dive Preview.

Quick Quiz — Self Assessment 6

1. What dive adventure do you want next?

Answer: Your choice — ***but choose,*** or . . . or nothing.

Main Objectives

By the time you complete the assigned reading in Instructions for Use booklet assignment for the RDP (Table or eRDPML), you should be able to answer the following questions:

19. How do you find the minimum surface interval required to complete a series of no decompression dives using the Recreational Dive Planner?

20. How do you plan a multilevel dive with the eRDPML? [The eRDPML only.]

Dive Tables Definitions

You've learned the following terms in the discussions on dive computers and in learning to use the RDP (if you learned to use the eRDPML, you may not have run into some of these because you don't need them with the eRDPML). This list provides a convenient and quick reference and review.

Actual Bottom Time (ABT) — In repetitive diving, the total time actually spent under water (in minutes) from the beginning of descent until leaving the bottom for a direct continuous ascent to the surface or safety stop.

Adjusted No Decompression Limit — The time limit for a repetitive dive that accounts for residual nitrogen. Found on Table 3 of the RDP Table; the eRDPML automatically adjusts for residual nitrogen. Actual Bottom Time should never exceed the adjusted no decompression limit.

Ascent Rate — The proper speed for ascending, which is no faster than 18 metres/60 feet per minute. A rate slower is acceptable, and appropriate.

Bottom Time — The time from the beginning of descent until the beginning of a direct, continuous ascent to the surface or safety stop.

Decompression Diving — Diving that requires planning stops during ascent to avoid decompression sickness. In recreational diving (no decompression diving), a decompression stop is considered an emergency procedure only, and is never an intentional part of the dive plan.

Dive Profile — A drawing of your dive plan, used to avoid confusion and omissions when using the dive tables.

Multilevel Diving — Planning profiles that credit you for slower nitrogen absorption when you ascend to a shallower depth. This provides more no-stop dive time. The eRDPML version of the Recreational Dive Planner can be used for multilevel diving.

No Decompression Limit (NDL) — The maximum time that can be spent at a depth before decompression stops are required. Also called "no-stop time."

No Stop Dive — A dive made within no decompression limits because you don't have any required emergency decompression stops.

Pressure Group — A letter used on the Recreational Dive Planner to designate the amount of theoretical residual nitrogen in your body.

Repetitive Dive — A dive that follows another while there's still a significant amount of residual nitrogen in your body. Using the Recreational Dive Planner, this is a dive made within six hours of a previous dive.

Residual Nitrogen — The higher-than-normal amount of nitrogen remaining in your body after a dive.

Residual Nitrogen Time (RNT) — An amount of nitrogen, expressed in minutes (found on Table 3 by using a pressure group letter) for a specific depth, that you add to the actual bottom time of a dive to account for residual nitrogen from a previous dive. Not needed with the eRDPML.

Safety Stop — A stop made between 3 and 6 metres/10-20 feet — usually 5 metres/15 feet for three or more minutes at the end of a dive for additional safety. The safety stop is recommended after all dives (air supply and other considerations allowing), and required on those to 30 metres/100 feet or greater, and those coming within three pressure groups of the no decompression limit.

Surface Interval (SI)— The amount of time spent on the surface between two dives. It is usually recorded in hours:minutes (e.g. 3:25 — 3 hours, 25 minutes).

Total Bottom Time (TBT) — The sum of Residual Nitrogen Time and Actual Bottom Time after a repetitive dive, used on Table 1 to determine the pressure group. Not needed with the eRDPML.

Confined Water Dive Preview

This is the last confined water dive in the Open Water Diver course. As in the previous sessions, you'll practice skills you've already learned, and learn some new ones.

Weight System Handling

There may be times when you'll need to remove or replace your weight system on the surface or underwater. Your weight belt may have become tangled with other equipment, you may need to adjust your gear, or you may need to take it off before entering small boats or climbing onto a platform without a ladder.

To remove a weight belt, release the buckle with one hand and grasp the free end, like you did during Confined Water Dive Three, pulling it clear of your body. Since you're not ditching the belt, keep it close to your body because holding it away tends to pull you over in the water. If you were ditching it, you would hold it well away before letting go. Keep in mind that once you release your weight belt, your center of buoyancy changes and you'll probably feel yourself trying to orient differently in the water. When working with your weight belt, remember to hold the free end (the end without the buckle) so the weights can't slide off.

Whether you're at the surface or on the bottom, you can use two methods to replace a weight belt. Breathe through your regulator even if you're at the surface so you can maneuver in the water without having to worry about flooding your snorkel.

To use the first method, stretch out horizontally face up. Hold the free end of the belt in your right hand and

Confined Water Dive Five

Skill Requirements

Here's what you'll be able to do when you successfully complete Confined Water Dive Five:

1. Remove, replace, adjust and secure the scuba unit and weights at the surface, with minimal assistance, in water too deep to stand up in.
2. Remove, replace, adjust and secure the scuba unit on the bottom, with minimal assistance, in water too deep to stand up in.
3. Remove, replace, adjust and secure weight belt on the bottom in water too deep to stand in, or for students using weight integrated BCDs or weight harness systems, in shallow water, remove weights while underwater.

Roll on.
To don a weight belt using the roll method, hold the free end in your right hand and place it against your right hip. Roll to the left so you're face down and the belt should roll around your hips and fall into place across your waist.

place it against your right hip. Now roll to the left so you're face down. Your weight belt should roll around your hips and fall into place across your waist, though you may have to guide it under your cylinder. Lean forward slightly, and the belt will slide into the small of your back. Allow the weight to drape across your back, check for twists, push any misadjusted weights into place and secure the buckle.

For the second method, hold both the free end and the buckle end in one hand so the belt forms a loop. Reach with the belt behind yourself, below your cylinder, and with your free hand, take one end so both hands have an end. Be sure that your right hand ends up with the free end and your left hand ends up with the buckle so you have a right-hand release when you're done. Once you have an end in each hand, lie horizontal face-down and drape the belt across the small of your back while you adjust and buckle it.

With either method, you'll probably find that your mask and BCD interfere with seeing the buckle while you're trying to release or fasten it. Practice operating the buckle by touch, rather than by sight.

If you're using a weight integrated BCD, for the purposes of disentangling, adjusting, etc., removing and replacing your scuba unit accomplishes removing and replacing your weights. To provide practice in using your emergency release system, your instructor will have you release your weights using your quick release in shallow water.

Again, left gets it right.
To using the loop method, hold both the free end and the buckle end in one hand so the belt forms a loop. Reach with the belt behind yourself, below your cylinder, and with your free hand, take one end so the buckle ends up in your left hand.

Scuba Unit Handling

As with your weights, there may be times when you remove and replace your scuba unit. Underwater, your scuba unit may need adjustment

Left, right. Right, left.

You may find it easiest to remove and replace your scuba unit like a sleeveless coat. Vent all the air from your BCD, release the waist strap and take your left arm out of the BCD so you don't pull the second stage out of your mouth. To replace it, hold the unit upright and be sure the straps are clear, then put it on like a coat, starting with your right arm. Once it's in place, fasten and adjust the waist strap and any other straps.

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 (as you may have already practiced) take it off
before exiting.

Underwater, you may find it easiest to remove and replace your scuba unit like a sleeveless coat. First, be sure to vent all the air from your BCD so it won't float away when you take it off. Release the waist strap. Then take your *left* arm out of the BCD, swing it behind you and take it off your right arm. Be sure to start with the left arm, or you'll stretch the regulator hose and possibly pull it out of your mouth. There's no reason to take the second stage out of your mouth during this skill.

After it's off (you'll find it easy to handle because scuba cylinders weigh very little in water), you would adjust/untangle whatever and then replace it. Hold the unit upright and be sure the straps are clear, then put it on like a coat, starting with your *right* arm first (same reason — so you don't pull the second stage out of your mouth). Once it's in place, fasten and adjust the waist strap and any other straps.

You can also put it back on over your head. Lay the unit in front of you, with the valve toward you and the jacket facing up. Put your arms in the jacket up past your elbows. Keep the hose to your mouthpiece between your arms (if it is outside your arms, you'll pull the second stage out of your mouth as you swing it overhead). Next, raise the cylinder over your head and gently lower the cylinder into place. Finally, make sure all your hoses are clear before you fasten the waist strap.

On over your head.

To don overhead, put the unit in front of you with the valve toward you and the jacket facing up. Put your arms in the jacket up past your elbows. Keep the hose to your mouthpiece between your arms. Raise the cylinder over your head and gently lower the cylinder into place. Finally, make sure all your hoses are clear before you fasten the waist strap.

You can follow the same procedure for removing your scuba unit at the surface as you did underwater. A popular donning technique is to sit on the slightly buoyant unit with the cylinder between your legs. Put the bottom of the cylinder in front of you, the valve behind you, and the jacket open beneath you. Put your arms into the jacket sleeves on each side, and then let yourself slip forward. The unit slides up, you slide down and presto! You're in the jacket.

Open Water Dives 3, 4 and Optional Skin Dive

Here's a preview of the skills and procedures you'll practice during your second two Open Water Dives. The sequence within each dive will vary, depending on the logistics, and your instructor may sequence some skills in different dives. Before each dive, your instructor will brief you about what you're going to do and when, along with other information you need for the dive, like communication signals, an environmental orientation, emergency procedures, safety rules, and so on.

There's also an Optional Skin Dive, which your instructor or an assistant will lead you on if logistics permit. Your instructor will schedule this for the most appropriate time amid your scuba dives depending on logistics, local conditions and your needs.

Open Water Dive 3 Overview

Briefing
Equipment preparation
Don and adjust equipment
Predive safety check
Entry
Buoyancy/weight check
(50 metre/yard straight line surface swim with compass)*
Free descent with reference to 6-9 metres/20-30 feet (max dive depth 18 m/60 ft)
Achieve Neutral Buoyancy-oral inflation
Complete mask flood and clear
(CESA)*
Underwater exploration
Safety Stop*
Ascent
(Remove and replace weight system at the surface)*
(Remove and replace scuba unit at the surface)*
Exit
Debrief and log dive

Open Water Dive 4 Overview

Briefing
Equipment preparation
Don and adjust equipment
Predive safety check
Entry
Buoyancy/weight check
Free descent without reference no deeper than 18 metres/60 feet
Buoyancy control — hovering
Mask removal, replacement and clearing
(Underwater navigation with compass)*
Underwater exploration
Safety Stop*

Ascent
Exit
Debrief and log dive

Optional Skin Dive Overview

Briefing
Equipment preparation
Suiting up
Equipment inspection
Entry
Buoyancy/weight check
Surface swim
Surface dives and underwater swimming
Displacement snorkel clear
Underwater exploration
Exit
Debrief and log dive

* These skills may be sequenced in other dives, depending on logistics.

Enriched Air Nitrox

In many areas, diving with enriched air nitrox has become popular. Enriched air nitrox (a.k.a. enriched air or EANx) is simply air with extra oxygen added to it to decrease the proportion of nitrogen you breathe. As you learned in Sections Four and Five, nitrogen limits the amount of time you can spend at a given depth, so enriched air lets you stay longer, all else being equal, though it has some special considerations you need to be aware of. Your instructor may give you the opportunity to try diving with EANx in Open Water Dive Four, and you may credit this (at your instructor's discretion) toward the PADI Enriched Air Diver certification.

Dive Safety Practices Summary

The following summarizes the safe diving practices you've learned during this course. Review it periodically and keep them in mind when diving.

Preparation

1. Stay healthy and fit for diving. Eat right, exercise regularly and get adequate rest.
2. Have approval for diving from a physician who has given you a thorough medical examination and have one every two years.
3. Be recently trained in first aid and cardiopulmonary resuscitation (CPR). To acquire training in these areas, take the Emergency First Response program offered by PADI Instructors, Dive Centers and Resorts.
4. Maintain your dive skills by diving as often as you can, by continuing your diver education. Refresh your knowledge and skills with Scuba Review after long periods of inactivity.

5. Get an orientation to new diving conditions, activities or areas. When planning a dive in a new, unfamiliar area, participate in a Discover Local Diving experience. Remember that you should have special training for some activities.
6. Always have and use all the equipment needed for the conditions and environment.
7. Have your scuba equipment serviced annually, or as recommended by the manufacturer. Have scuba cylinders visually inspected regularly and pressure tested at required intervals. Maintain your equipment in good condition and inspect it before diving.
8. Only fill scuba cylinders with pure, dry compressed air from reputable air stations.

Predive

1. Dive only when feeling well, both physically and mentally. You should feel confident about the dive. Be sure the dive and its activities are within your capabilities. Remember — diving is supposed to be fun. If you don't think it will be safe or fun, don't make the dive.
2. Know the dive site. Evaluate conditions and check for possible hazards.
3. Check the weather forecast before diving. Evaluate the dive conditions, those present and expected, and dive only when the conditions are as good as or better than those in which you have experience and/or training. Don't dive in poor conditions.
4. Refrain from alcohol, smoking or dangerous drugs before or immediately after diving.
5. Plan your dives with your buddy. Agree on objectives, direction, and depth and time limits. Review underwater communications, emergency procedures and what to do if you become separated.
6. Always plan for no decompression diving. Consult the Recreational Dive Planner and allow for a margin of safety. Avoid diving to the maximum time limits of the RDP or your computer. Make your deepest dive of the day first. Know how to perform an emergency decompression stop, but avoid having to do so. Plan to make safety stops whenever possible. Be aware of the effects of flying after diving and diving at altitudes greater than 300 metres/1000 feet.
7. Inspect both your and your buddy's equipment. Know how to operate each other's equipment. Always conduct a predive safety check: Begin With Review And Friend (BWRAF — BCD, Weights, Releases, Air, Final okay).
8. Be prepared for emergencies. Have local emergency contact information on hand, just in case.

Diving

1. Properly weight yourself for neutral buoyancy. Check your buoyancy at the surface and avoid being overweighted. If you check buoyancy with a full cylinder, add enough weight to offset the air you use (typically about 2.5 kg/5 lbs with a single cylinder).
2. Always wear a proper buoyancy control device (BCD). Use your buoyancy control device to regulate your buoyancy. Avoid contact with the bottom by staying neutrally buoyant — for your benefit and the benefit of the aquatic environment. Inflate your BCD at the surface to provide ample positive buoyancy.
3. Display the appropriate local dive flag and stay near it.
4. Begin dives against the current, and/or take into consideration the effect the current will have during the dive. Plan your dive so you don't have to fight the current to reach your exit point.
5. Equalize pressure early and often during descents. If you feel discomfort in a body air space, ascend until the discomfort goes away, equalize, then continue the dive. If you can't equalize, abort the dive.
6. Stay with your buddy throughout the dive. Know how to reunite if you accidentally separate.
7. Limit your depth to 18 metres/60 feet or less as a new diver. Remember that 18 metres/60 feet is the recommended limit for new divers. Shallower diving conserves your air, increases your bottom time and helps reduce the risk of decompression sickness.
8. Spear guns are dangerous weapons. Do not load them out of water and always unload them before leaving the water. Treat them as though they're always loaded – never point them at another person.
9. Avoid contact with unfamiliar aquatic plants and animals.
10. Be alert for possible problems and avoid them. Check your equipment frequently while underwater, especially your gauges: depth gauge, timing device and submersible pressure gauge, compass and dive computer.
11. Exit the water with a minimum of 20-40 bar/300-500 psi in your cylinder, or more if the dive plan or conditions warrant an extra margin of conservatism.
12. Pace yourself. Avoid overexertion and breathlessness. If you become breathless, stop, rest and recover before proceeding.
13. Breathe properly — slowly, deeply and continuously. Never hold your breath while scuba diving. Exhale slowly and continuously any time the regulator is not in your mouth. Avoid excessive hyperventilation when skin (breath-hold) diving.

14. In an emergency, stop, think, get control and then take action. Act based on your training, don't react based on instinct.
15. Ascend carefully and correctly. Reach up and look up during the ascent. Come up no faster than 18 metres/60 feet per minute. Plan a 3-minute safety stop at 5 metres/15 feet whenever possible. Listen for boats as you come up, and establish buoyancy as soon as you reach the surface. Be a S.A.F.E. Diver — Slowly Ascend From Every dive.
16. Stop diving when you're cold or tired. Don't overextend yourself.
17. Stick to your dive plan underwater. Don't revise a dive plan underwater.
18. Stay out of overhead environments unless you're properly trained and equipped for that overhead environment.

General Dive Safety Practices

1. Be an active diver. Dive frequently to maintain your proficiency.
2. Build your experience and capabilities gradually under safe conditions.
3. Keep a dive log. This records your training and experience and is a valuable reference for future dives.
4. Don't lend your equipment to untrained persons. Never attempt to teach another person how to dive. Teaching diving requires specialized training and skills. Leave instruction to trained professionals.
5. Continue your diver education. Remember that a good diver never stops learning.

Knowledge Review

Chapter 5

(Answer all questions, regardless of which Recreational Dive Planner you are using — eRDPML or table version.)

1. Describe the three required situations in which a safety stop should be made.

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

2. Check one. If you accidentally exceed a no-decompression limit or an adjusted no-decompression limit by no more than 5 minutes, you should slowly ascend at a rate not faster than 18 metres/60 feet per minute to 5 metres/15 feet and remain there for _____ minutes prior to surfacing. After reaching the surface, do not dive for at least _____ hours.

   ☐ a. 8 minutes, 6 hours ☐ b. 15 minutes, 24 hours

3. State the altitude (metres/feet) above which the Recreational Dive Planners should not be used unless special procedures are followed.

   _____ metres/feet

4. True or False: To reasonably assure you remain symptom free from decompression sickness when flying in a commercial jet airliner after diving, wait 12 hours. _____

5. Explain the procedure you must follow when planning a dive in cold water or under strenuous conditions using the Recreational Dive Planner.

   _____

   _____

6. What is the minimum surface interval required between a dive to 18 metres/60 feet for 40 minutes followed by a dive to 14 metres/50 feet for 60 minutes?

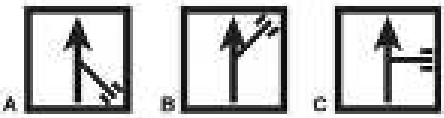
   Minimum Surface Interval =_____

7. What is the minimum surface interval required between a dive to 20 metres/70 feet for 29 minutes followed by a dive to 14 metres/50 feet for 39 minutes?

   Minimum Surface Interval =_____

8. With reference to the compass heading shown in Figure 1, select the figure letter that indicates a reciprocal heading.


Figure 1



   Reciprocal heading is shown by figure letter: _____

9. What's the purpose of the PADI System of continuing education?

_____

_____

10. State the purpose of a PADI Discover Local Diving experience.

_____

_____

11. When should you consider taking a PADI Scuba Review course?

_____

_____

12. What's the relationship between Adventure Dives, Advanced Open Water Diver course dives and Specialty Diver courses?

_____

_____

_____

13. What is a Course Evaluation Questionnaire (CEQ), and what is its purpose?

_____

_____

_____

Student Diver Statement: I've completed this Knowledge Review to the best of my ability, and any questions I answered incorrectly or incompletely I've had explained to me, and I understand what I missed.

Name _____ Date _____

Appendix

Dive Planning Checklist

Advance Planning

- ☐ Dive buddy(s) _____
- ☐ Date and time (check tide tables) _____
- ☐ Dive objective _____
- ☐ Location _____
- ☐ Alternate location(s) _____
- ☐ Directions _____
  _____
- ☐ Meeting place and time _____
- ☐ Any special or extra gear needed _____
- ☐ Precheck of weather and water conditions _____

Preparation

- ☐ Cylinder(s) filled
- ☐ Equipment inspected
- ☐ Equipment marked (ID)
- ☐ Spare parts inventoried
- ☐ Weights adjusted
- ☐ Equipment packed
- ☐ Transportation arranged
- ☐ Obtain information on new location
- ☐ Get local emergency contact information

Last Minute

- ☐ Make sure you are healthy, rested and nourished.
- ☐ Have a good, confident feeling about the dive.
- ☐ Check weather and water conditions.
- ☐ Pack food, snacks, drinks.
- ☐ Leave dive plan information with someone not going.
  (dive site, expected return time, what to do if you do not report back by agreed time, etc.)
- ☐ Be sure you have
  - ☐ Tickets
  - ☐ Money
  - ☐ Medications
  - ☐ Directions
  - ☐ Swimsuit
  - ☐ Towel
  - ☐ Jacket
  - ☐ Sunglasses
  - ☐ Other _____

Pre-Dive Planning

- ☐ Evaluate conditions decide whether or not to dive.
- ☐ Locate and check nearest communications (telephone, radio).
- ☐ Select entry/exit points, alternates, methods.
- ☐ Discuss buddy system techniques.
- ☐ Agree on
  - ☐ Pattern or course for the dive
  - ☐ Limits for the dive (depth, time, minimum air)
  - ☐ Emergency procedures

Problems? Call _____ or _____

Open Water Equipment Checklist

Basic Equipment

- ☐ Gear Bag
- ☐ Fins, Mask, Snorkel
- ☐ Wet Suit
  - ☐ Jacket
  - ☐ Pants
  - ☐ Vest
  - ☐ Hood
  - ☐ Boots
  - ☐ Gloves
- ☐ Weight Belt
- ☐ BCD *(Buoyancy Control Device)*
- ☐ Cylinder *(filled)*
- ☐ Regulator *(with SPG and alternate air source)*
- ☐ Compass
- ☐ Depth Gauge
- ☐ Knife
- ☐ Watch
- ☐ Surface Signaling Device

Accessory Equipment

- ☐ Float and Flag
- ☐ Thermometer
- ☐ Dive Light
- ☐ Slate and Pencil
- ☐ Marker Buoy
- ☐ Buddy Line
- ☐ Camera and Film
- ☐ Lift Bag

Spare Equipment

- ☐ Cylinders (filled)
- ☐ Weights
- ☐ Straps
- ☐ O-ring
- ☐ Tools
- ☐ Regulator HP Plug
- ☐ Bulbs and Batteries
- ☐ Nylon Line

Personal Items

- ☐ Swimsuit
- ☐ Towel
- ☐ Jacket
- ☐ Extra Clothes
- ☐ Money
- ☐ Tickets
- ☐ Certification Card
- ☐ Log Book
- ☐ Dive Tables
- ☐ Sunglasses
- ☐ Suntan Lotion
- ☐ Medications
- ☐ Toilet Articles
- ☐ Lunch, Thermos
- ☐ Eating Utensils
- ☐ Ice Chest
- ☐ Sleeping Bag

English-Metric Conversions

Length

1 inch	=	2.54 centimetres	1 centimetre	=	0.39 inches
1 foot	=	0.30 metres	1 metre	=	3.28 feet
1 yard	=	0.91 metres	1 metre	=	1.09 yards
1 fathom	=	1.83 metres/6 feet	1 metre	=	0.55 fathoms
1 statute mile	=	1.61 kilometres/5280 feet	1 kilometre	=	0.62 statute mile
1 nautical mile	=	1.85 kilometres/6080 feet	1 kilometre	=	0.54 nautical mile

Capacity

1 cubic inch	=	16.38 cubic centimetres	1 cubic centimetre	=	.06 cubic feet
1 cubic foot	=	.03 cubic metres	1 cubic metre	=	35.31 cubic feet
1 cubic foot	=	28.32 litres	1 cubic metre	=	1.31 cubic yards
1 cubic yard	=	0.76 cubic metres	1 litre (1000cc)	=	.04 cubic yards
1 pint	=	.57 litres	1 litre	=	.22 gallons
1 gallon	=	4.55 litres	1 litre	=	1.76 pints

Weight

1 ounce	=	28.35 grams	1 cubic ft. fresh	=	62.4 pounds
1 pound	=	.45 kilogram	1 cubic ft. salt	=	64 pounds
1 kilogram	=	2.21 pounds	1 litre fresh	=	1 kilogram
			1 litre salt	=	1.03 kilograms

Pressure

1 pound per square inch	=	0.07 kilograms per square centimetre
1 kilogram per square centimetre	=	14.22 pounds per square inch
1 atmosphere	=	14.7 pounds per square inch
atmosphere	=	1.03 kilograms per square centimetre

Temperature

To convert degrees Fahrenheit to Centigrade, deduct 32 and multiply by 5/9.
To convert degrees Centigrade to Fahrenheit, multiply by 9/5 and add 32.

Conversions *(approximate)*

Miles to kilometres	multiply by 8/5
Kilometres to miles	multiply by 5/8
Statute miles to nautical miles	deduct 1/8
Nautical miles to statute miles	add 1/7
Pounds per square inch (psi) to atmospheres	divide by 14.7
Water depth (feet) to bars absolute	divide by 33, add 1 bar
Water depth (metres) to bars absolute	divide by 10, add 1 bar
Bars absolute to feet of water depth	subtract 1 bar, multiply by 33
Bars absolute to metres of water depth	subtract 1 bar, multiply by 10

Wind Direction, Speed and Measurement

Direction is specified always as the direction from which the wind blows.
(For example, a westerly wind blows west to east.)
Speed is in knots by mariners/airmen, in mph by landsmen/coastal navigators.

Measurement:	1 knot = 1.7 feet/.51 metres per second	1 mph = 1.61 kph
	1 foot per second = .3 metres per second	1 kph = 5/8 mph

Get Academic Credit for your PADI® Education

PADI courses have the unique distinction of meeting academic excellence criteria as established by university and vocational accreditation bodies. Find out how you can get credit for your PADI education!

Australia

PADI Divers may receive credit toward various certificates and diplomas for several PADI courses within the Australian national training system. The following training providers recognise certain PADI and Emergency First Response (EFR) courses — Technical and Further Education, South Australia; Australia Fisheries Academy, South Australia; Victorian Tertiary Admissions Center, Victoria; and the Western Australia Curriculum Council. For more information, go to: www.padi.com/scuba/scuba-diving-guide/start-scuba-diving/scuba-lessons-for-college-credit/default.aspx

Canada

The British Columbia Ministry of Education (External Credentials Program for Industrial and Occupational Courses) has approved the PADI Open Water Diver (2 credits), PADI Advanced Open Water or Adventures in Diving Program (4 credits) and PADI Rescue Diver (4 credits) courses for school credit. Grade 10, 11 and 12 students who have been certified in these PADI courses simply present their PADI certification card to the school administration to apply for credit. For information on receiving credit contact your school's administration. On an individual, merit-base case, divers in Canada may also receive credit for PADI courses through the USA-based American Council on Education's College Credit Recommendation Service as noted under "United States."

England, Wales and Northern Ireland

PADI Open Water Scuba Instructors can apply to PADI for the Certificate in Scuba Instruction, a Vocationally Related Qualification (VRQ) accredited at level 3 on the National Qualifications Framework in England, Wales and Northern Ireland, by the Qualifications and Curriculum Authority (QCA) for England, Department for Education, Lifelong Learning and Skills (DELLS) for Wales and the Council for the Curriculum, Examinations and Assessment (CCEA) for Northern Ireland. The certificate may be accepted by Further Education institutions as proof of eligibility for attendance at higher level courses. Contact ie@padi.co.uk for an application form.

Europe

Divers have received credit for PADI courses in mainland Europe academic institutions and through the military, but since there is no formal recognition process, these have been individual cases. For more information or for a specific request, contact PADI Europe at training@padi.ch

Japan

Those who want to teach diving in Japanese school systems (colleges, universities, vocational schools, etc.) undergo general and specialized course work and testing to become authorized by the Japan Sports Association (JASA), under the jurisdiction of the Ministry of Education, Culture, Sports, Science and Technology. PADI Open Water Scuba Instructors are exempt from this specialized course and test, and can obtain JASA authorization by taking a general course and certification test. For more information go to: www.japan-sports.or.jp/english/

New Zealand

PADI Divers may qualify to receive recognition through a New Zealand Qualification Authority accredited provider. Open Water Diver, Advanced Open Water Diver and Rescue Diver qualify for the National Certificate of Diving: Foundational Skills; Divemasters and Open Water Scuba Instructors qualify for the National Certificate of Diving: Leadership; and Specialty Instructors qualify for the National Certificate of Diving: Instruction. For more information, go to www.padi.com/scuba/scuba-diving-guide/start-scuba-diving/scuba-lessons-for-college-credit/default.aspx

United States

The American Council on Education's College Credit Recommendation Service (ACE CREDIT) has evaluated and recommended college credit for 15 PADI courses, 3 DSAT courses, and 1 Emergency First Response course. The American Council on Education, the major coordinating body for all the nation's higher education institutions, seeks to provide leadership and a unifying voice on key higher education issues and to influence public policy through advocacy, research, and program initiatives. For more information on ACE CREDIT recommendations, and to order an official PADI transcript, go to www.padi.com/scuba/scuba-diving-guide/start-scuba-diving/scuba-lessons-for-college-credit/default.aspx or contact PADI Americas at training@padi.com

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The Way the World Learns to Dive®

If you live life on the edge or find pleasure in a pure adrenaline high . . . you should be a PADI Diver.* Whether exploring the secrets of a sunken wreck at a nearby lake, venturing through hidden underwater caverns, or experiencing close encounters with fascinating species in exotic corners of the globe, you'll find adventure on every dive – and meet others who share your quest for unending excitement.

Have you ever experienced PADI's Discover Scuba Diving program? Then you've already taken the first step toward becoming a PADI Diver. This performance-based adventure program is designed to lead you step-by-step in your future exploration of the underwater world.

Begin your adventure today!

PADI's home study materials allow you to learn at home, at your own pace. Ask a PADI Dive Center, Resort or Instructor about this and other quality PADI products.

* This manual may be used for both the PADI Scuba Diver and PADI Open Water Diver programs.

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