FOUR

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.

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 the

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?**

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 he 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

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?**

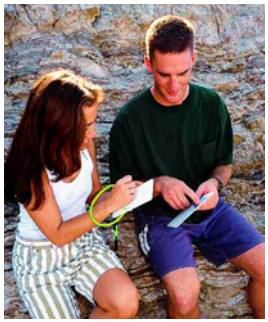
7. **What are two reasons for carrying an underwater slate as a regular part of your dive gear?**

looking 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.

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

See?
Besides their usefulness for diving in the dark at night, you'll find underwater lights have uses in broad daylight.

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 the PADI Data Carriers that come with The Wheel, 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 tank 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.

MAIN Objectives

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.)

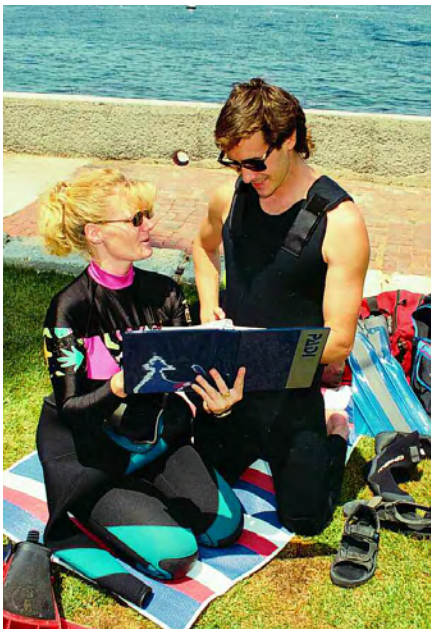
Your instructor can suggest other items for your spare-parts kits.

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 tank is essentially the same as the air

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?

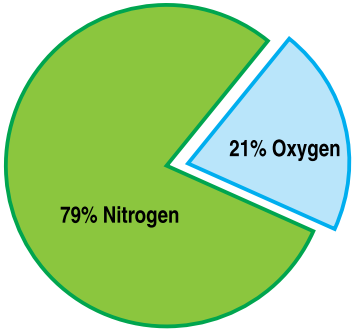
20. How do you prevent problems with contaminated air?

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*

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.

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 tanks 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 tanks (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 tank 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 tanks 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 tank, 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 tank 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 tank 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 tank 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 tank 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 tank 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

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.

drink or use drugs before diving).

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.

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.

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.

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?**

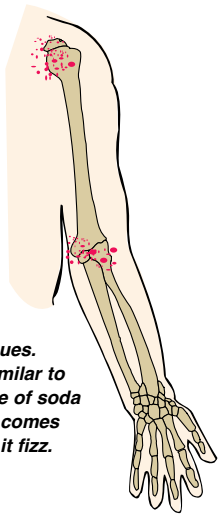
As long as you keep excess nitrogen within reasonable limits, your body eliminates it without complication. To keep within these limits, you use dive tables and dive computers, which give you maximum times at a given depth based on how much nitrogen your body theoretically absorbs and releases.

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.

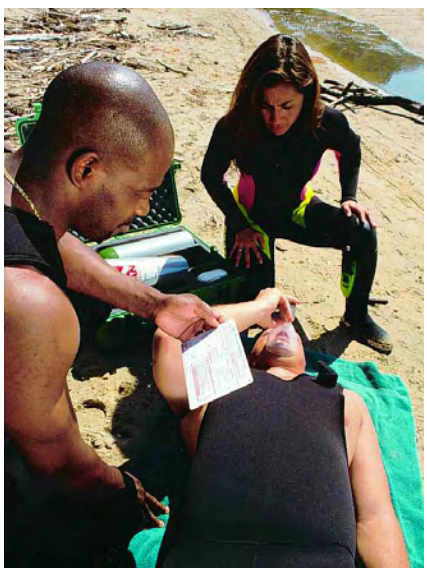


Watch your limits.
If you stay underwater beyond established limits, when you surface excess nitrogen dissolves out of your body tissues and forms bubbles in your blood vessels and tissues. The phenomenon is similar to when you open a bottle of soda and the dissolved gas comes out of solution, giving 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.

PADI Diver Protection Program 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 tank 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 to

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?

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* div-

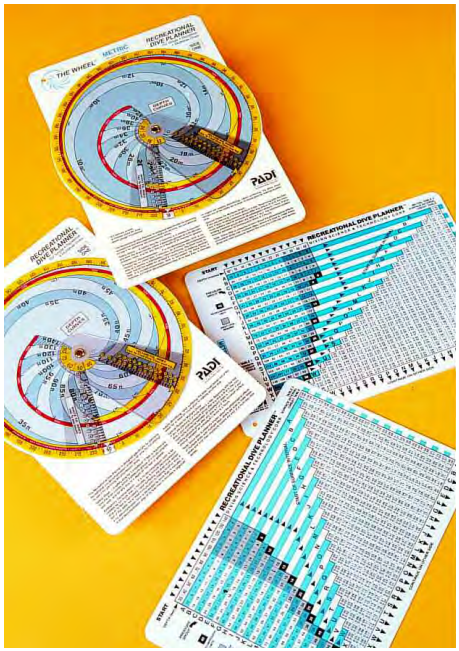
ing. Decompression diving means that the divers absorb so much nitrogen (or other gas) during a dive that it's not possible to ascend directly to the surface without a substantial risk of DCS. Instead, the diver makes a series of stops, each progressively longer, to allow sufficient time for the body 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).

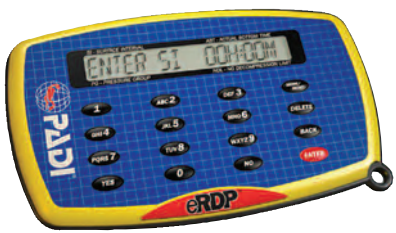
Until 1988, the dive tables recreational divers used were really hand-me-downs from commercial and military diving. Although they were adequate for planning recreational dives, they were tables for decompression diving and had to accommodate large amounts of theoretical nitrogen, and consequently "penalized" recreational divers, who by making no decompression dives, had far less theoretical nitrogen. Further more, 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.

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 (conventional) format, and in The Wheel (circular slide rule) format, 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 The Wheel. The eRDP, introduced in 2005, is an electronic dive table that gives you the same information that the RDP Table does. Many people find the eRDP's calculator-type format more familiar than a table. You'll be learning to use one of these three versions of the RDP as part of this course.



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 Wheel 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 Wheel.)

Milestones.
In 1988, Diving Science & Technology introduced the Recreational Dive Planner, which were the first dive tables designed for planning and making no decompression recreational dives. The eRDP, introduced in 2005, was the first electronic dive table exclusively for recreational diving.

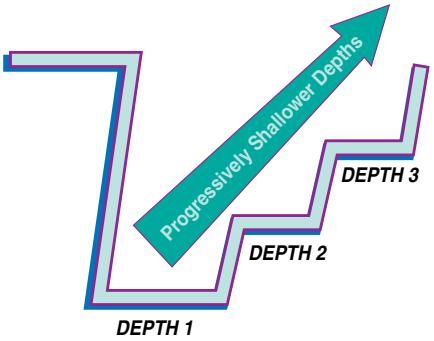
- They track your theoretical nitrogen throughout the course of an entire dive dive (and often longer). With tables, you have to calculate different allowable no stop times for each successive dive, which depends upon the depth and time of prior dives and how long you've been out of the water. Using 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 you

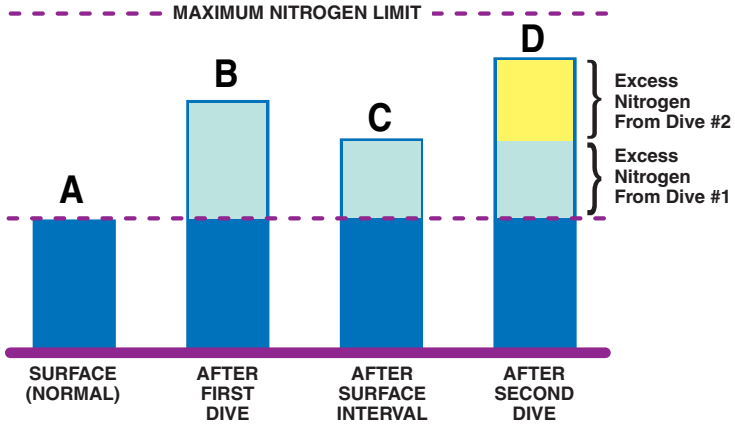


Go up for more down time.
Dive computers give more no stop time on multilevel profiles. As you ascend, you take up nitrogen more slowly and dive computers credit you for this by increasing your no decompression time. The Wheel version of the RDP also provides additional no decompression time on multilevel 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.

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 elimin-ated 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 resi-dual 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 Wheel 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.

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.

Depth Limits

- **18 m/60 ft Novice**
- **30 m/100 ft Recommended**
- **40 m/130 ft Absolute**

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.

4. 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 tank 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 Wheel 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 Wheel, read the first five sections 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 Wheel), 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.
6. Buddy breathe sharing a single air source for a distance of at least 15 metres/50 feet underwater both as a donor and a receiver. (optional skill)

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.

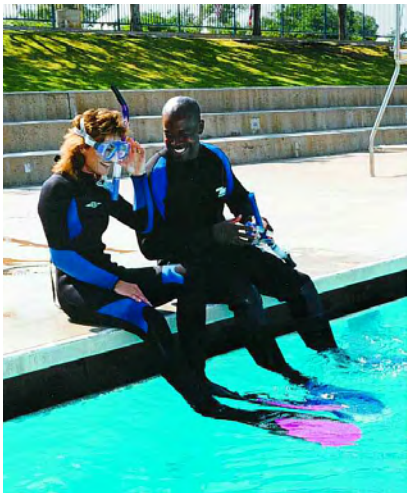
Excessive hyperventilation — more than three or four breaths — can be dangerous because you can lower your carbon dioxide levels so far that your body runs out of oxygen before you get the urge to breathe. This would lead to sudden unconsciousness — without warning — and drowning. Don't hyperventilate 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.

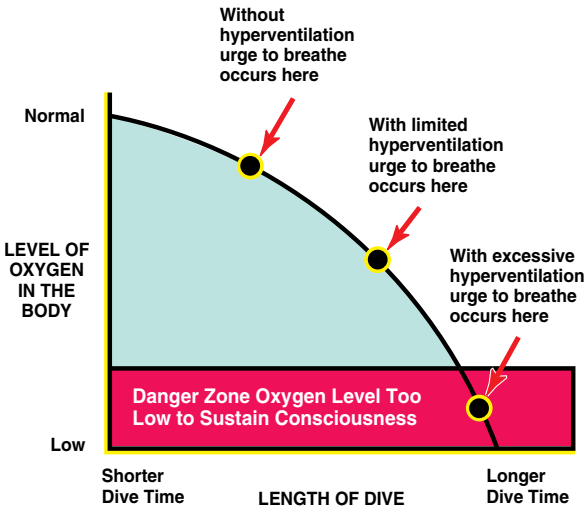
You may be familiar with *unintentional* hyperventilation, which results from anxiety or stress, and causes someone to breathe rapidly and shallowly. This leads to respiratory difficulty, and contributes to the overexertion and air starvation problems you learned about earlier. By using proper diving 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



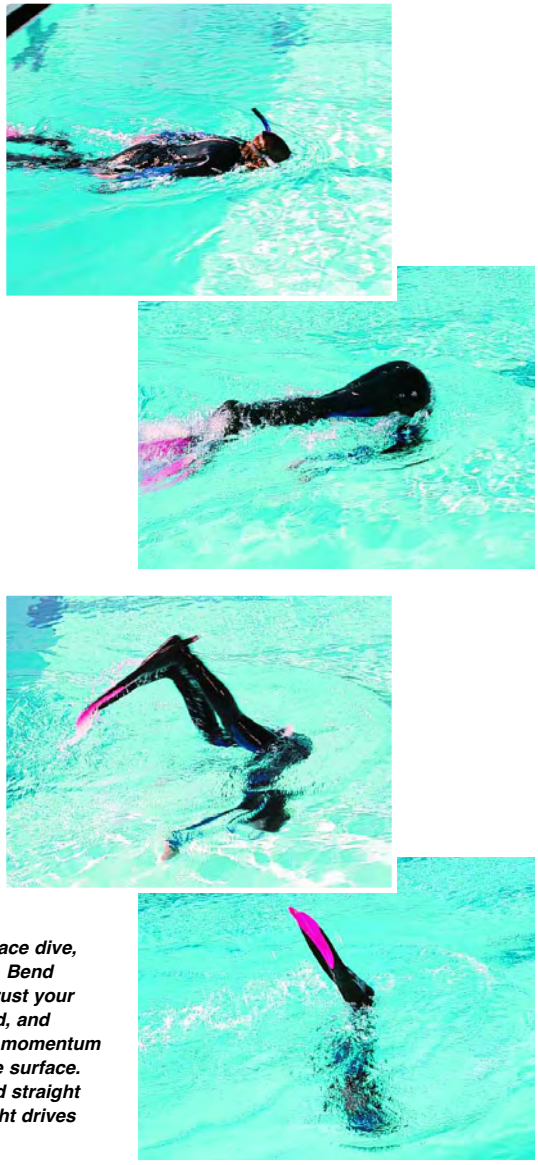
Sans scuba.
For skin diving, you'll use all your equipment except your scuba unit, and you'll either use less weight so you're positively buoyant, or a snorkeling vest.



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.

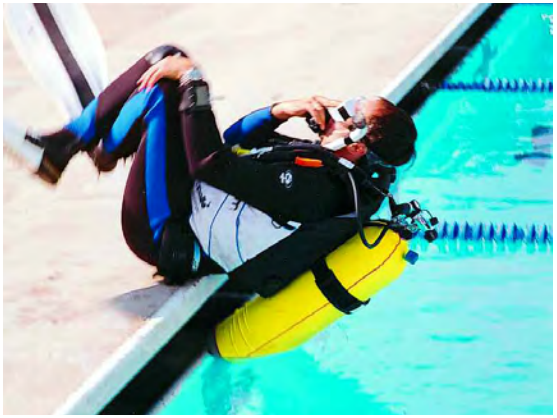
When you reach the surface, continue to exhale as you roll your head forward into the surface swimming position. The snorkel will be clear of water, though you'll use airway control and take your first breath cautiously, in case a few drops of water remain.

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



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.

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.

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

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

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.

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.

Buddy Breathing

In Section Three, you learned about the options you have in the unlikely event you run out of air, and you've practiced your two primary options, using an alternate air source or making a controlled emergency swimming ascent. Another option you *may* practice (at your instructor's discretion) is buddy breathing, which requires you and your buddy to share a single second stage.

Buddy breathing is a less desirable option than the other options because it is a more complex skill, which increases the possibility of error. By remaining close to your buddy and making certain you and your buddy always equip yourselves with alternate air sources, you shouldn't ever need to buddy breathe. However, it remains a practice in a few areas, so your instructor may have you learn it.

To initiate buddy breathing, swim to your buddy and signal "out of air" and "share air." Your buddy should respond by passing you the second stage and allowing you to take two breaths. Your buddy

will not let go, but will hold the second stage by the hose near the mouthpiece without covering the purge button (so you can use it if you need to).

Two, then two.
When buddy breathing, remember not to hold your breath and to blow bubbles, when the regulator isn't in your mouth. Your buddy takes two breaths and returns it to you for two breaths.

As you begin buddy breathing, you and your buddy grasp each other face-to-face for stability. Your buddy holds the second stage with the right hand and grasps your BCD or tank straps with the left. You grasp your buddy similarly with your right hand and guide the second stage to your mouth with your left.

After your two breaths, your buddy takes the second stage back. Remember not to hold your breath and to make an *aaaahhh* sound, blowing bubbles, when the regulator isn't in your mouth. Your buddy takes two breaths and returns it to you for two breaths. Continue the exchange back and forth until you and your buddy establish a natural, relaxed rhythm.

Once you've got the rhythm set, you and your buddy would ascend to the surface, buddy breathing all the way. Your instructor may have you practice buddy breathing first in a stationary position, and then swimming along the bottom to simulate how long it would take to ascend while buddy breathing.