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?**

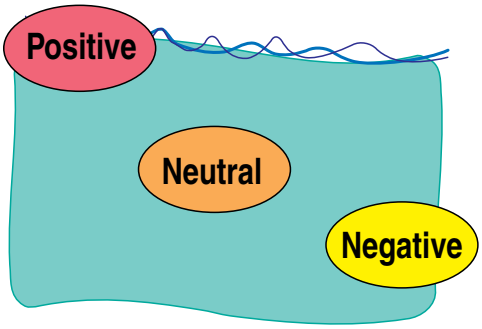
ONE

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

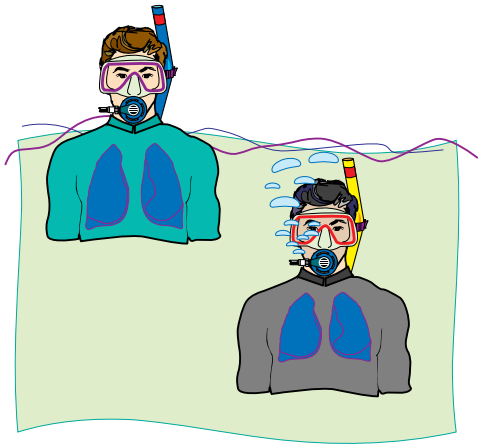
Have you ever wondered why a large steel ocean liner floats, but a small steel nail sinks? The answer is surprisingly simple: The ship's steel hull forms a shape that displaces — pushes aside — much water. The same amount of steel reshaped into a giant nail would sink, of course, like the regular sized 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

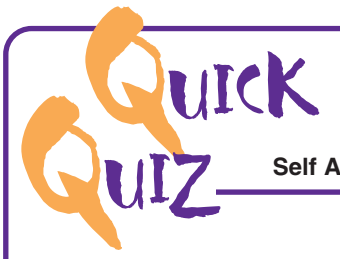
lets you control where you are in the water. For instance, you'll learn to establish positive buoyancy at the surface so you can save energy and rest. Underwater, you'll remain neutrally buoyant most of the time — almost weightless, like an astronaut — so you can swim effortlessly and move freely in 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.



HELP

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.

Play Video

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

HELP

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.

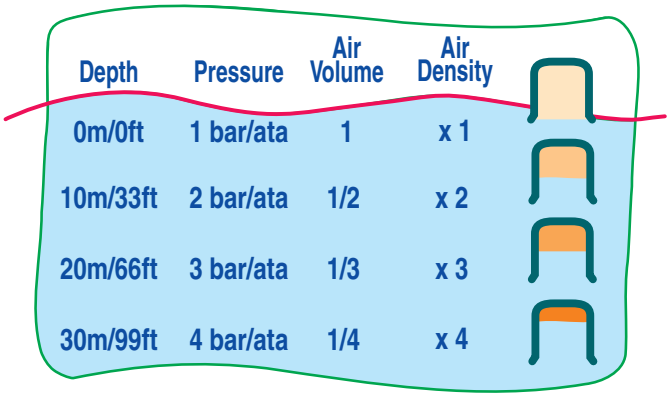
2. Pressure changes in water for a given ascent or descent are much more substantial than the same distance ascent or descent in air because water weighs more.
   - ○ True ○ False

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.

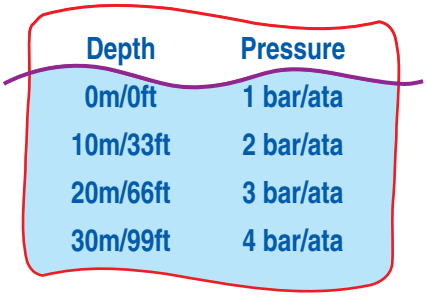
MAIN Objectives

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?**

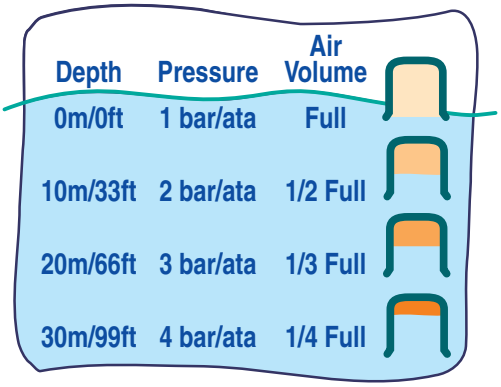


Air and water.
Ten metres/33 feet of sea water exerts the same pressure as one atmosphere, or one bar/ata. Therefore, you add one bar/ata pressure for every 10 metres/33 feet you descend.

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.

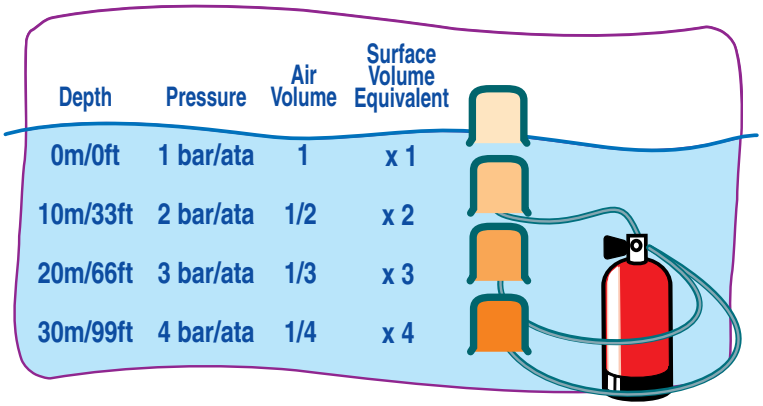
Density also changes proportionately when pressure changes. When you double the pressure and halve the air volume, the volume reduction comes from squeezing the same number of air molecules into half the space. So, the density doubles. When you triple the pressure (20 m/66 ft), you triple the density.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



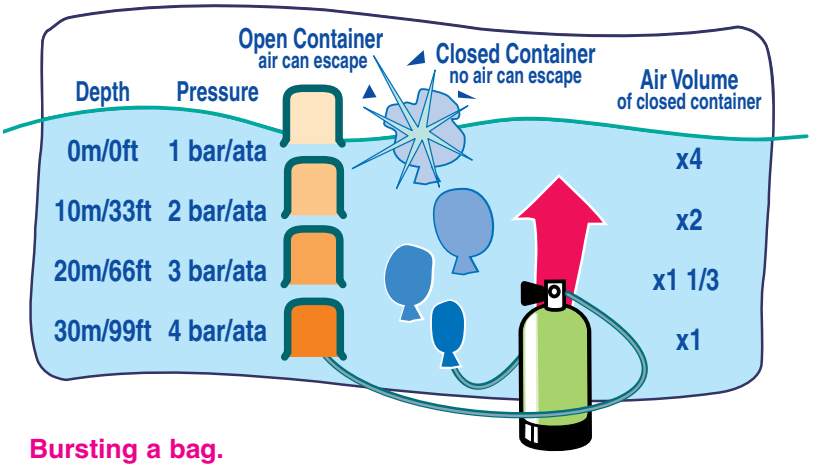
Think thicker.
Air density also changes proportionately when pressure changes.

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.

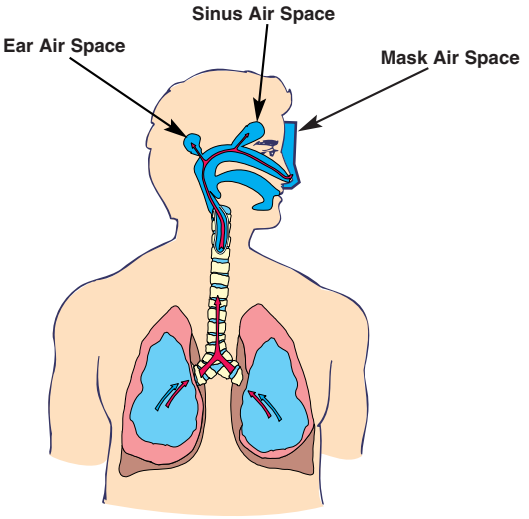
During descent, water pressure increases and compresses the air in your body air spaces. As the volume decreases, the pressure pushes body tissues in, toward the air space, which you feel in your ears, sinuses and mask. If you continue to descend, this becomes uncomfortable, and with continuing descent, 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

HELP

Self Assessment 3

Complete the following chart for a sealed flexible bag full of air at the surface. Click on an empty field to type in it. Use the TAB key to move from field to field.

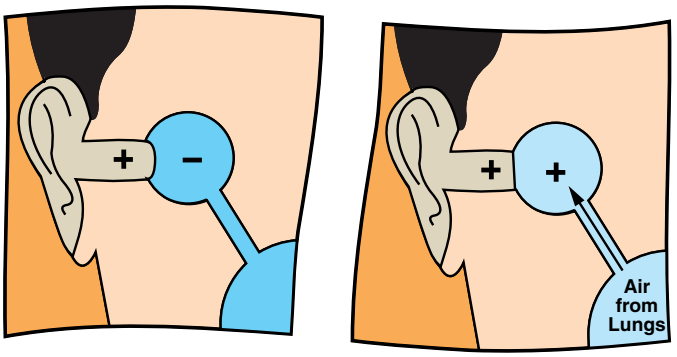
Depth	Pressure	Volume	Density
0m/0ft		x 1	x 1
10m/33ft	2 bar/ata		
30m/99ft		1/4	
40m/132ft	5 bar/ata		x 5

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.

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.



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.

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?

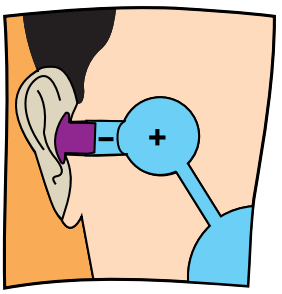
15. How often should you equalize during descent?

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.
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 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 ear plugs while diving. The only exceptions are special ear protectors 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

HELP

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 expansion (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

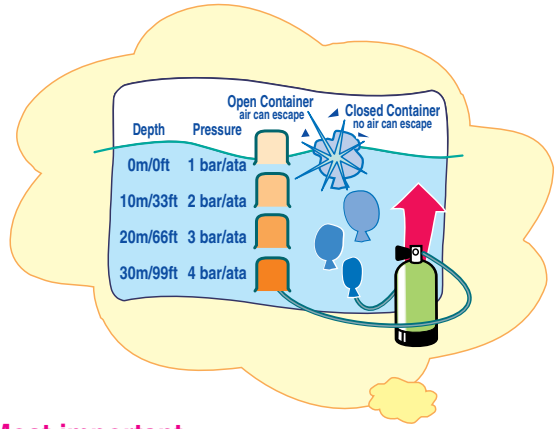
Underline/highlight the answers to these questions as you read:

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

18. What are the consequences of breaking the most important rule in scuba diving?

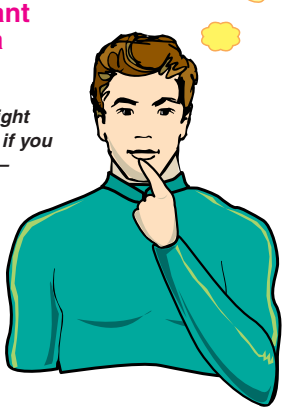
19. What is a "reverse block"?

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.



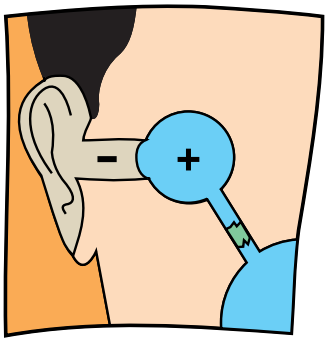
will occur unless you permit the pressure to equalize by breathing normally at all times. *Lung over expansion* can force air into the bloodstream and chest cavity, which can lead to severe injuries including paralysis and death.

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 tank. A polite answer is, "Oh, around an hour, give or take," but as you'll see, the technically correct

Quick Quiz

HELP

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:

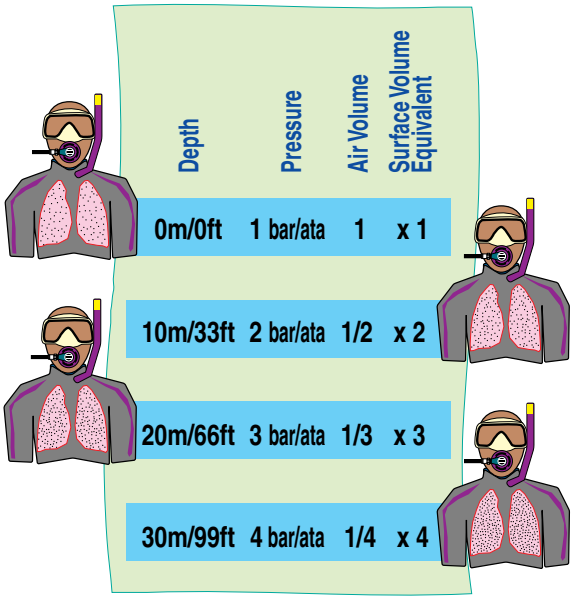
21. How does increasing depth affect how long your air supply lasts?

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

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 tanks, 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 HELP

Self Assessment 6

1. As you go deeper, you consume air from your scuba tank:
   - ○ 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.

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.

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.

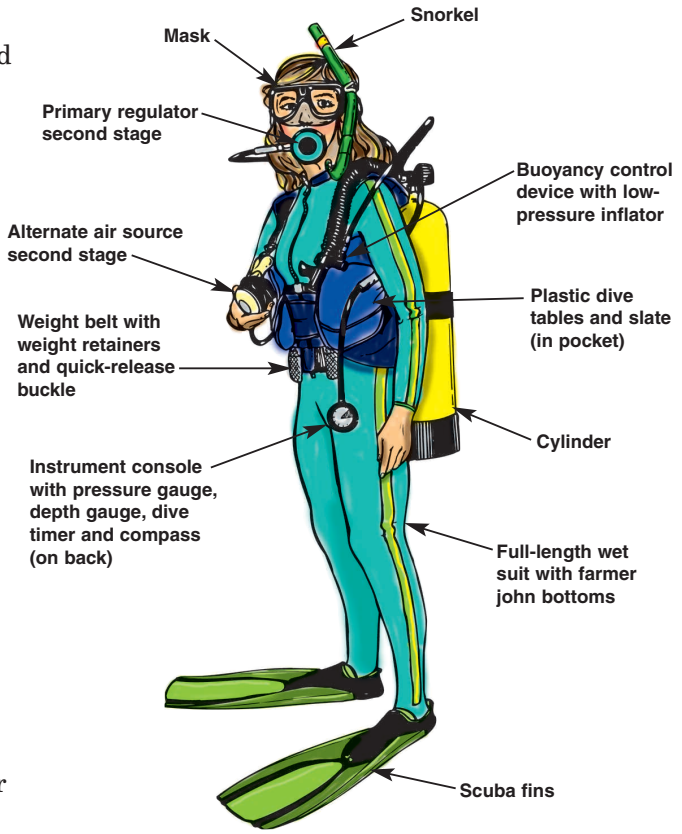
Features. Masks intended for scuba diving have these features:

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.

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.

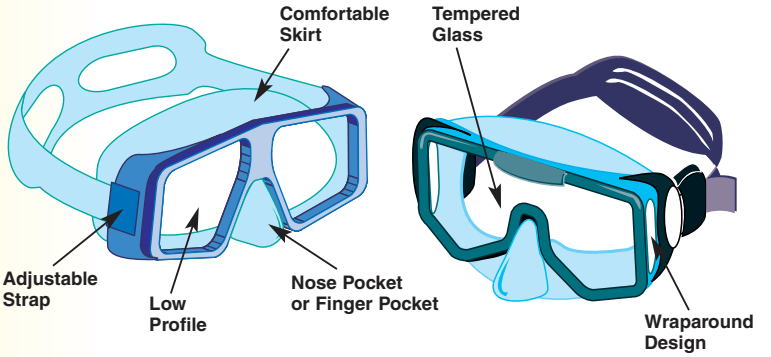


4. Low-profile. The lower the profile of the mask, the less air you need to equalize it and to clear if it floods, but the main benefit is that it gives you a wider vision field.

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.

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.

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.

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 HELP

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 six 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 tank 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 tank 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 tank 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:

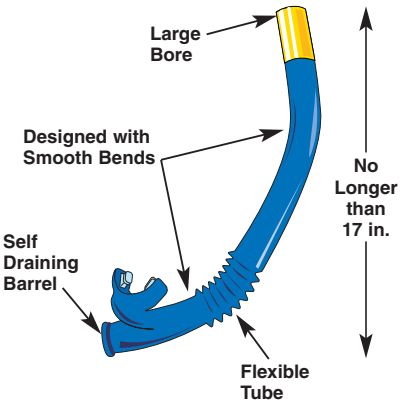
1. A large bore — so it's not like trying to breathe through a soda straw.

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.

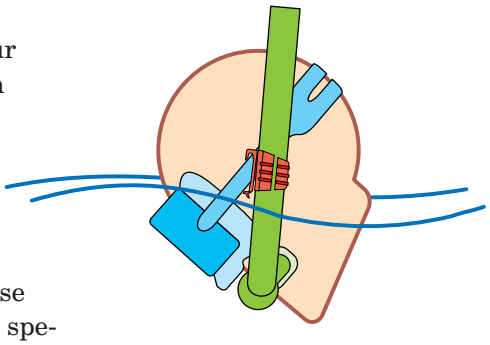
Preparation for Use. Attach the snorkel to the *left* side of your mask (because your regulator comes from the right). You do this with a clip or slot on the snorkel, or with a snorkel keeper that comes with it. Adjust the snorkel and snorkel keeper so the top of the snorkel sits at the crown of your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

Quick Quiz HELP

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 tank.

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 made from

Main Objectives

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

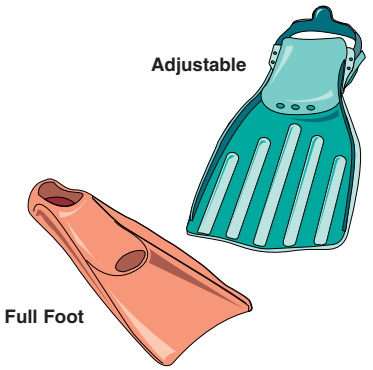
33. Why does a diver need fins?

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.

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 HELP

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 tank (with valve) and the regulator. Let's look at each, beginning with the BCD.

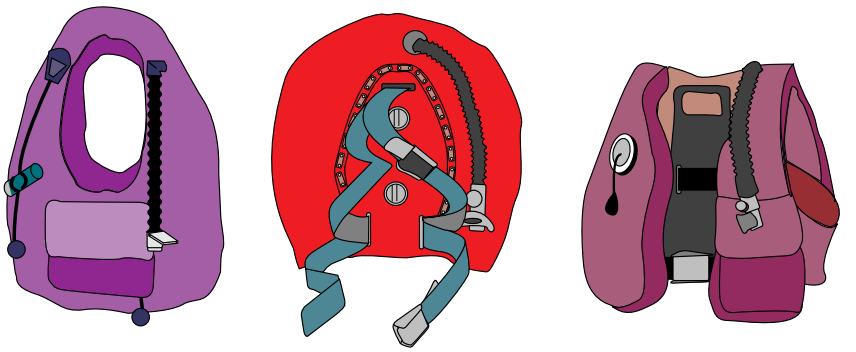
BCDs

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 tank. To decrease buoyancy, you deflate the BCD through a hose or valve.

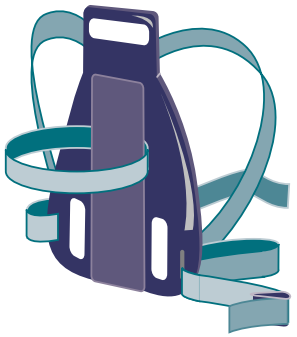
Besides allowing you to regulate your buoyancy underwater, the BCD provides positive buoyancy for resting, swimming or lending assistance to others. As you might imagine, it's considered standard equipment mandatory for scuba diving.

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 tank 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.



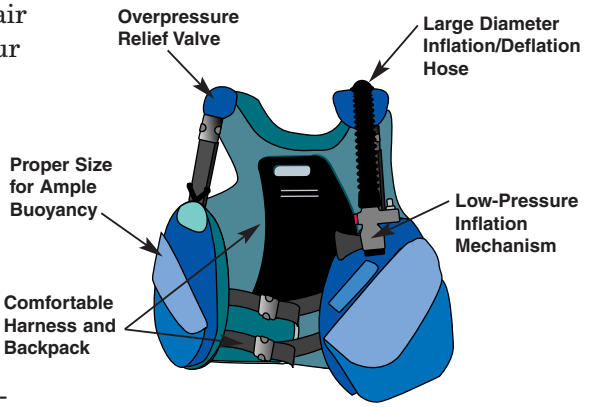
On your back.
You need a backpack to hold the tank on your back, but today the jacket BCD integrates the backpack into its design.

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

Back-mounted BCDs are also relatively uncommon, though they're still used in double tank 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 tank 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 tank. 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 HELP

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 Tanks and Valves

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

Purpose. Even a nondiver knows that a scuba tank 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 tank valve, which is to control air flow from the tank. Sounds simple, but what you may not realize is that there are *different types* of tanks and valves to handle these two simple jobs.

Tank Styles and Features — Tanks come in a variety of air capacities, depending upon their pressure rating and size. In the metric system, you express tank 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 have if you released it

MAIN Objectives

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

44. Why does a diver need a scuba tank?

45. What does a tank valve do?

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

47. What are the three common sizes and the two materials for scuba tanks?

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

49. What are the two basic types of tank 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?

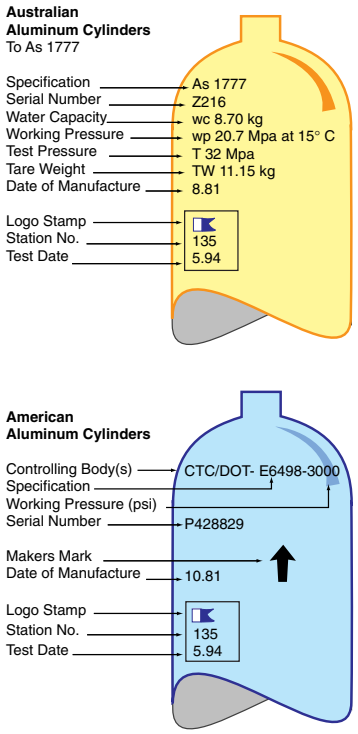
52. What is the purpose of a burst disc?

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

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

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

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



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

all at the surface. The three most common tank sizes are 50, 71.2 and 80 cubic feet, although other sizes are available.

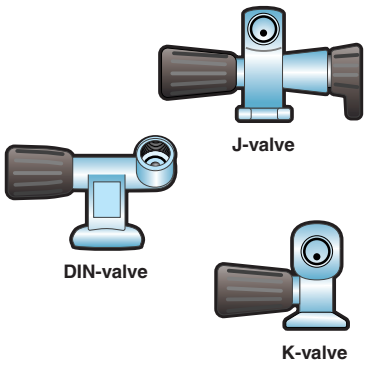
The standard 12 litre/ 71.2- or 80-cubic-foot tank contains about the same air you have in a walk-in closet, compressed into a space about 600 mm/two feet long and 150 mm/half a foot in diameter. As this air is compressed into the tank, its pressure increases. The pressure in scuba tanks may be higher 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.

Tank Materials. Scuba tanks 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 tanks must pass periodic pressure tests (discussed below) mandated by these agencies.

Both steel and aluminum are equally acceptable materials, with different advantages and disadvantages. Aluminum holds up against corrosion in wet climates, whereas steel typically holds the same amount of air in a smaller tank at a lower pressure.

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

Valve Types. Virtually all scuba tank valves are made from chrome-plated brass. Historically, divers identified tank 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 tank pressure until the pressure drops to approximately 20-40 bar/300-500 psi. When the tank 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 tank pressure is to use a submersible pressure gauge (SPG), which you'll practice using during your confined water dives.

Today, you can identify tank 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 tank 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 tank over pressurization which can happen by accidentally overfilling the tank, or exposing it to excess heat. If the pressure gets too high, the burst disk ruptures, releasing the air well before the tank would explode. In some countries, tank valves do not have burst disks.

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

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

Preparation for Use. Aside from assembling it with the rest of your scuba gear, the only preparation required for a tank 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 tank will come with the valve installed, so you don't have any preparation requirements there.

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

Handling. Out of water, scuba tanks 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 tanks, or having your tanks 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 tanks 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 tanks in your car, lay them down horizontally and block or tie them.

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

Your tank 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,

Dive Equipment
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close it all the way gently. Always close valves gently and avoid over-tightening.

Your dive operation fills your tank 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 tank. The best way to do this is to never allow it to completely empty. If you do empty the tank completely, close the valve immediately to keep moisture out. Water can even enter an empty tank by backing up through a regulator, so having the regulator attached doesn't guarantee a dry interior. Also, bleeding the air from your tank quickly can cause internal condensation and corrosion.

In recreational diving, scuba tanks 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). Tanks should only be filled to the rated pressure, since overfilling can lead to metal fatigue and shorten the life of the tank.

One Stop Equipment Care

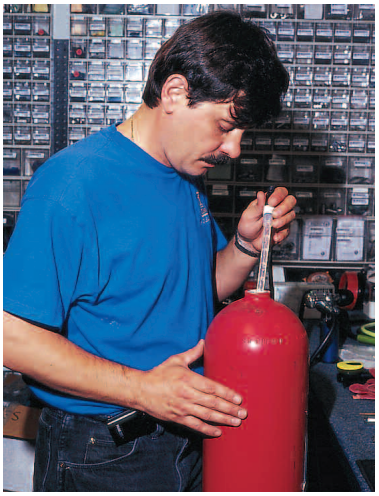
Although you have several considerations for taking care of your scuba equipment, your PADI Dive Center or Resort makes life easy: Apart from rinsing after use, drying and storing properly, they can complete preventative maintenance and repair so you don't have to trek to twenty different places. Look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

- Regulator overhauls and adjustment
- Quality air fills
- Tank 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 tank may have a rubber or plastic boot, which allows the tank 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 tank 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 tank yourself.) Once the tank 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 tank without a current visual inspection sticker.

Because tanks 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 tank 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 tank 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 tank hydrostatically tested every five years. In central Europe, steel tanks 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 tank at least once a year.

You also need to store your tanks properly. Keep them in a cool place, especially when full, because the pressure of compressed air rises when exposed to heat. Full scuba tanks left in a hot environment, for example, can rupture the valves' burst discs. Store tanks with between 10-20 bar/100-300 psi of air to keep moisture out. If you store a tank without using it longer than six months, have the

tank 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 tank and valve can last many years. And you can buy tanks in a wide variety of colors, including some with patterns and pictures.

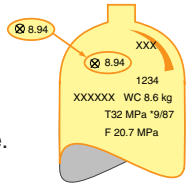
Quick Quiz

HELP

Self Assessment 11

1. The two metals scuba tanks are commonly made from are:
   - ○ a. aluminum and copper.
   - ○ b. aluminum and steel.
   - ○ c. copper and steel.

2. The circled marking on the tank 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 disc:
   - ○ a. relieves pressure from an overfilled or heated tank.
   - ○ b. is required for your regulator to seal to the valve.
   - ○ c. None of the above.

6. When transporting tanks (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 tank:
   - ○ 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 tank.
   - ○ 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 tank. It reduces the scuba tank'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."

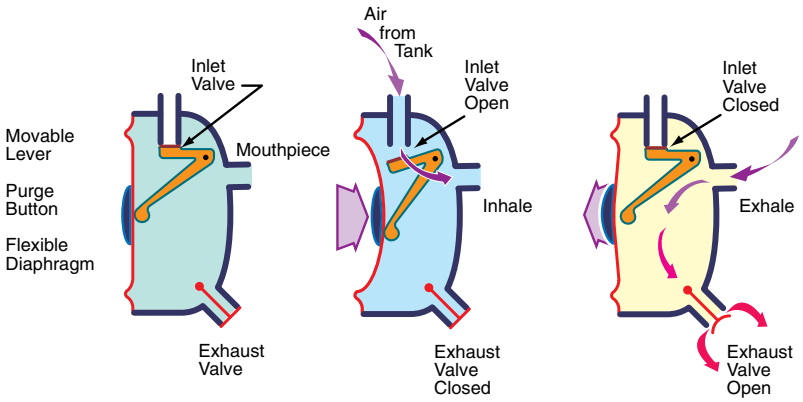
Styles and Features. The modern scuba regulator is a simple and reliable device with only a few moving parts. It has two stages: a first stage, which you attach to the scuba tank valve and a second stage that has a mouthpiece. The stages reduce high-pressure air from the scuba tank sequentially. The first stage reduces the high tank 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.

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

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.

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.)

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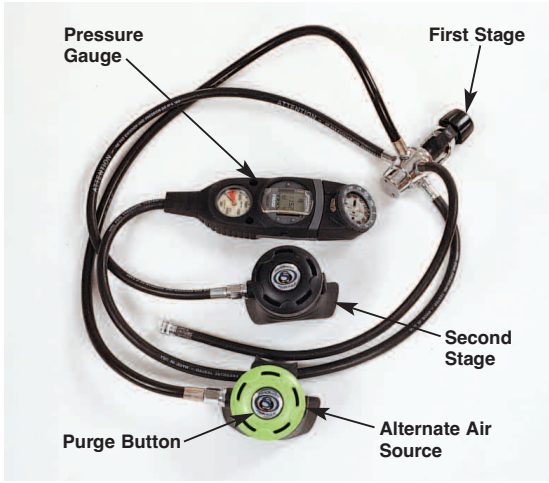
The alternate air source simplifies sharing air with another diver, should the need arise. The alternate air source usually has a longer hose and a bright color so you can find it easily. You'll pick up more detail on alternate air sources in Section Two of this manual, and you'll get practice using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

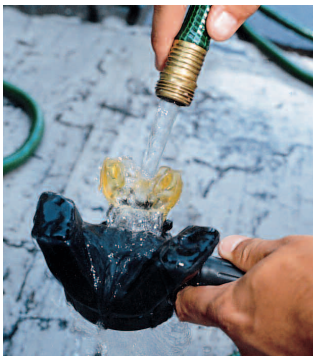


Besides these, your regulator will have a hose with a coupling device at the free end. This hose connects to the low-pressure inflator on your BCD. If you're using a dry suit, you'll have two of these; the longer one generally goes to your dry suit.

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 thFe style of your mask, fins, snorkel, BCD and tank.

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.



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.

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 tank, then rinse it with running water. If rinsing your regulator after it's been removed from your tank, 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 tank 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 attach the regulator to the scuba tank after rinsing and to

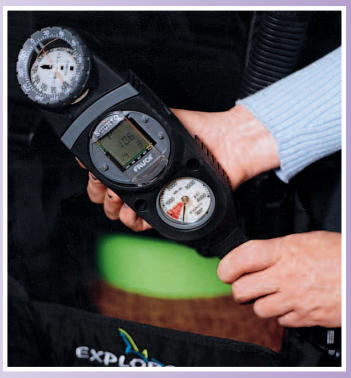
The Integrated Approach to Buying

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.

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.

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

Quick Quiz HELP

Self Assessment 12

1. A regulator reduces high pressure tank 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 gentle 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?

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 tank 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.

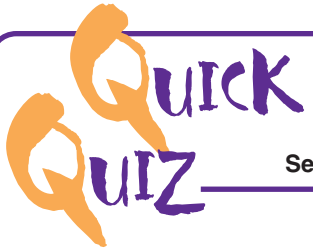
Because the SPG (or transmitter) remains attached to your regulator, simply rinsing and soaking it along with the regulator takes care of its maintenance. When you take your regulator in for annual servicing, be sure to have your dive professional take care of your SPG as part of the servicing.

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.

Marking your equipment prevents frustration and confusion when you're around other divers using similar equip-

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



HELP

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.

ment, 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 HELP

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 tank needs an annual visual inspection, and periodic pressure (hydrostatic) testing.
- You never leave scuba tanks standing unattended. You block/secure them when transporting so they can't fall or roll.
- Regulators reduce tank 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 tank, 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 tank. If you bought a brand new BCD, wet the nylon tank 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 tank from the top.

2. Turn the tank 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 tank 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 tank 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 tank bands; tighten and secure both.

4. Now check that it's secure. See if the band slides up and down on the tank. If not, you can lift the tank 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 tank and BCD down, with the BCD up, before you go get it.

1. The tank 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 tank 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 tank 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 tank 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 tank between your legs and the BCD away from you, put the first stage on the tank 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 tank and compare it to the SPG, and you'll have an idea how full the tank is. You'll quickly learn the full pressure for most tanks 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 tank 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 tank 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 tank 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.

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

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

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.

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.

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

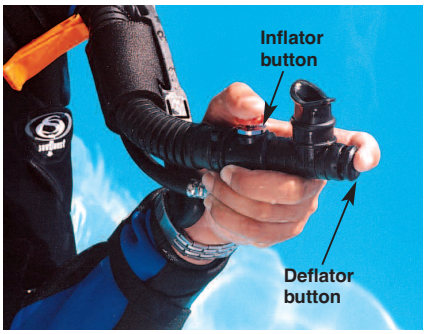
Once you're comfortable with breathing underwater, your

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.

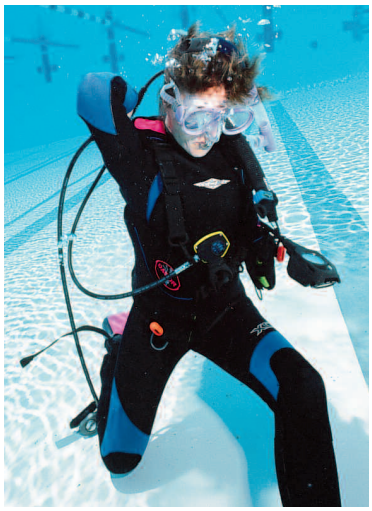
Remember the most important rule.
You need to develop an important habit while you practice regulator clearing. When the regulator's not in your mouth underwater, always blow a small, continuous stream of bubbles by making an aaaahhh sound. This is so you never hold your breath while scuba diving.

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 tank, 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 tank, 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 tank 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.

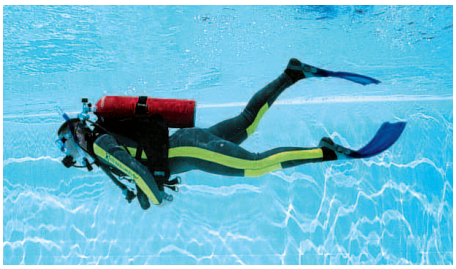
With a purge valve, hold the mask snugly against your entire face and look down, making the purge valve the lowest point in the mask. Exhale through your nose. The air forces the water out through the purge valve.

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

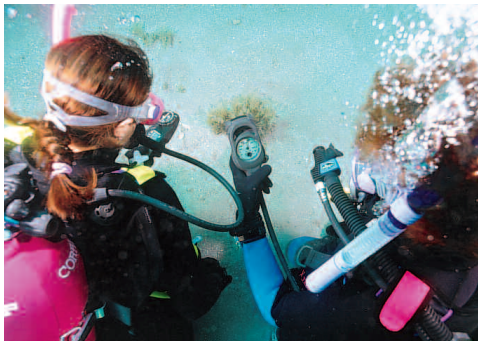
To get used to equalizing and changing depth, you'll swim back and forth from shallow to deeper water. Relax, swim slowly to conserve air and energy. Equalize your ears as soon as you submerge and frequently (every metre/few feet) as you move to deeper water. Don't forget to equalize your mask by blowing 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.

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.

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.

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 tank 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 tank 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 tank band and slide off the BCD. Lie the tank 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 tank.

_____

_____

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 _____