The Air Line

Welcome to SASS
Surface Air Supply Systems

A recreational hookah-diving, home study course.

An entry-level instructional vehicle for SASS diving to a maximum depth of 33 feet.

Starting with the obvious. What is recreational hookah diving?

For purposes of this course, we will restrict the definition to compressor on the surface, either floating or deck mounted, usually powered by a gas engine, that pumps air to the divers below through a hose system and ending at a demand regulator in the diver's mouth. More on the mechanics later.

Are there risks associated with recreational hookah diving?

Diving from ANY air source has some risks.

- ✓ Although hookah diving is inherently safer because little gear is worn, and there is always a safety link to the surface through the hose system, you must fully understand the risks and be prepared to deal with them. The specific risks and how to handle them will be discussed later.
- ✓ Although serious injury or death from diving is extremely rare, you need to recognize, from the start, that risk exists; you must accept it and take responsibility for your own actions.
- ✓ In simple terms, the primary risk is summed up in one word: Ignorance. Even if you have tried diving before, forget all you think you know and start with an open mind.
- ✓ You will be asked to sign an **Assumption of Risk waiver** which explains the risks of diving.

So, let's get started!

For simplicity, we will use the nouns and pronouns, "he", "his" and "him" generically when discussing a particular diver.

You will find that recreational hookah diving is one of the most rewarding activities in which you will ever engage. By learning to do it properly you will be engaging in many exciting new adventures with memories to last a lifetime. Make it a looong lifetime.

Health and Fitness

Diving usually requires less physical activity than swimming, but the participant still needs to be in reasonably good health and be reasonably fit to enjoy the sport with safety and confidence. There may come a time when you will need to assist a fellow diver, or make a long swim back to boat or beach. Being healthy and fit, along with acquired skills and knowledge, will be needed to deal with any stressful situation.

I know you're tired of hearing it, but it might be a bit more germane here: Eat right; exercise; get adequate rest; drink alcohol moderately, and never before a dive; stay away from controlled substances.

Although hookah gear is lighter and less cumbersome than scuba, there is still a bit of lifting involved in the set up, deployment and retrieval.

If you are recovering from an illness or injury, or taking medication, over-the-counter or prescription, you should not engage in diving unless cleared by a physician. Although you might be feeling better, your judgment could be impaired. It could be very dangerous to dive with a cold. The overall malaise, including fever, could restrict your ability to perform. A sneeze at depth could have serious consequences.

What have you learned so far?

- Briefly define hookah diving.
- What is the single main risk for a diver?
- Explain why good health is important for diving.
- State when a person should refrain from diving.
- Name the best way to maintain fitness for diving.
- Explain why, even if medication makes you feel better, you should refrain from diving.

Basic Diving Equipment

Comfort and fit are extremely important! Fidgeting with the wrong gear can ruin the dive, and worse, distract you from your responsibility to your fellow divers. Developing good Skin Diving (*breath hold*) skills is fundamental to being a good diver. The proper use of snorkel, mask, fins and weight system is fundamental in enjoying any form of diving.

- Snorkel
- Mask
- Booties
- Fins
- Gloves
- Weighting system

Lets spend some time on each

The Snorkel:

Three components:

- ***mouthpiece***
- ***tube***
- ***snorkel keeper***

The snorkel is an important tool for any diver. It might seem like an unnecessary piece of equipment when air is being provided by a compressor, but there will be times when you might have to make a surface swim back to the boat or beach. Then you will fully appreciate the service it provides. You can comfortably swim back in a relaxed horizontal position without having to keep your head out of the water.

The snorkel is kept on the left side of the mask so as not to interfere with the regulator. It is retained by a snorkel-keeper: a device on the mask strap. The keeper will keep the snorkel securely on the mask strap, but should allow easy adjustment of the snorkel height and position. As with any piece of equipment, comfort and fit are the two key elements. Concerning comfort, the snorkel must allow unrestricted breathing, as the breathing rate will be heavier from the swimming activity. The tube length should be 12-14 inches; the inside diameter should be no less than ¾ inches.

More on the Snorkel

Select a snorkel for comfort and ease of adjustment. You can't try every mouthpiece in the store, nor do you have to. A visual inspection, and the help of a store employee, will get you started. Make sure that the tube can be turned without affecting performance. There will be times when you will want to alter the tube direction so it takes on a minimal amount of water.

There are two ways to clear the snorkel quickly and efficiently:

- **Blast clearing.**
  - You perform the blast clear by exhaling air from your lungs forcefully as you surface from the dive.
- **Displacement clearing.**
  - This method uses the least amount of energy.
  - Water is removed by air expansion when a small amount of air is exhaled at depth during ascent.
  - A variation is when you exhale just before and through surfacing.

The Dive Mask

Essential elements*:*

✓*Frame*

✓*Window made of tempered glass*

✓*Skirt & Nose pocket*

✓*Buckle*

✓*Strap*

✓*Strap Glide*

Optional features:

✓*Purge valve*

✓*Peripheral vision windows*

✓*Prescription lenses*

✓*Neoprene straps*

Go for fit and comfort! All else is secondary.

Each time you don your mask you will need to prepare it.

Assuming you have cleaned off the protective film, you now want to prevent the mask from fogging. The simplest way is to spit on the inside lenses, massage it into the lenses and rinse. There is, also, a large assortment of commercially available defogger/antifog products.

Fit is extremely important, as the most expensive mask made is worthless if you are continually purging water that has seeped in. Ask the store employee about options, such as purge valves, which allow water to be purged without removal of the mask. But remember, the more work-saving features, the more things that can go bad.

More on the Dive Mask

The proper way to try a mask is to push the head strap out of the way, hold the mask to your face and inhale **slightly** through your nose. Take your hand away. You should be able to keep the mask on your face for 10-15 seconds on the one inhalation. Price is not a consideration except to the store.

The proper procedure, when diving, is to adjust the strap with just enough tension to keep the mask in place. You will learn about “mask squeeze” further on.

Booties or Boots

Booties and boots are made of neoprene rubber.

There are different sole thicknesses and textures, but probably only three types of foot protection. Fin socks are considered “booties” while the others are “boots”. Obviously light weight and not a good all-purpose choice.

Slip-on full boots. More protection to the ankle.
Boots with zippers. Easier to don and usually have a more substantial sole.

The boot should fit snugly, but comfortably. If you choose to wear a boot, you have probably chosen a heel-strap fin. You will find that this is the most practical way to go as you can remove the fins and still have protection for your feet. Bare feet can slip on a wet deck.

Fins **provide the way to propel yourself through the water**

The two basic types are: full-foot and heel strap

The size of the fin determines the size of the foot-pocket and the blade length and width. The blade being the flat portion that extends away from the foot pocket. Depending upon your physical limitations, how and where you plan to dive will guide the store personnel in helping you make a choice. The heel strap fin works best with a boot. Snug up the strap to where it is secure. The boot material will keep it in place without over tightening.

On a stable boat, putting on the fins is no great feat. When you have to walk in them though, it's a little bit different. We'll cover that in a little while.

Gloves have two obvious purposes: warmth and protection.

Your gloves should fit snugly. It is quite important that they allow you to move your fingers easily so that you can handle your equipment under any circumstance.

Choose them carefully. Consider what you will eventually be doing: photography, metal detecting, fossil and shell collecting?

Weights and Weight systems

You wear lead weights when you are diving to offset the buoyancy of your body, wetsuit and other equipment.

There are two types of weights used on a weighting system: hard and soft. Hard weights are solid lead pieces in various sizes, usually notched on opposite ends to allow threading onto a conventional weight belt. They are rarely used anymore. Soft weights are also lead, but they are tiny pellets encased in pouches, in various weight sizes, that fit into pockets on weight belts or weighting systems.

Maintenance

Maintaining your basic gear is simple:

✓You should rinse your gear with fresh water after every diving day
✓Do not leave the gear in direct sunlight
✓Make sure your gear is dry before storing it away
✓Inspect the gear regularly, especially before a dive trip.

✓Think twice about loaning gear or, better yet, don't loan it. It will NOT come back in the same condition as when it went.

What have you learned so far?

- Name two methods of clearing water from a snorkel.
- Name one feature not essential in a dive mask.
- Name two types of fins.
- What would be the problem with wearing an oversize glove?
- Briefly describe the difference between a hard and soft weight system.

So where do we go from here?

Exposure diving suits

The need for exposure suits varies from protection from stinging micro-organisms in the water (Skin suits), to moderate thermal protection (Wet suits), to cold-water thermal protection (Dry suits).

A brief description follows:

Skin suits are usually thin and made of stretchable material such as Lycra, and used as above. They are a good general purpose item to have in your gear bag for tropical water thermal protection, or as an undergarment in colder water situations for additional protection under a wet or dry suit. They also make donning the heavier suits easier as they provide some "slide". A skin suit should be a part of your gear.

Wet suits come in different styles and thicknesses depending upon the situation. They are usually made of neoprene rubber, which is a material that consists of tiny air cells, or bubbles. The bubbles are the insulating factor. The styles range from one-piece shorties to one-piece, full body, to various two-piece suits usually referred to as "Farmer Johns" as the inner suit resembles coveralls.

More on Exposure diving suits

Dry suits are just that: Loose fitting enclosures, sealed at the neck, wrists and ankles that can be filled with air, or in some cases, warm water for controlled temperature protection. Specialized training is needed in its use and the probable hostile conditions in which it will be worn.

In all of the above, a competent dive store employee will advise you based upon your projected needs. Fit is the most important feature as the suit must be snug, but not overly tight. If the fit of a skin or wet suit is too loose, it might seem to be comfortable out of the water, but when diving, water can intrude into baggy areas where it's volume cannot be warmed from body heat.

Rinse the diving suit with fresh water after every diving day. A common Air Line method is to fill the red cover of the compressor case with water, rinse the suit and other gear, and hang it in a shaded spot. Long exposure to heat and ultra-violet rays will eventually destroy soft goods, including the interiors of the second stage regulators.

Buoyancy Control Device (BCD)

Best suited for SASS

As a prelude to this section, a brief explanation of the purpose of the BCD and its relationship to the scuba and hookah diver will be helpful. As the name implies, it maintains the buoyancy of the diver under varied conditions.

The importance, in scuba, becomes clear when you understand that the weight of 3,000 PSI of air in a standard 80 CF, aluminum, scuba cylinder is six lbs. As the diver consumes the air, the cylinder becomes progressively lighter.

Here's where the "compensating" part comes in:

At the start, the scuba diver must inflate the BCD enough to offset the weight of the cylinder air. As the air is being consumed, the cylinder becomes lighter. If some of the air in the BCD is not purged, the diver will tend to rise to the surface.

More on BCD's

An interesting thing about hookah is that the balance between the negative element (weight) and the positive elements (natural and mechanical buoyancy) is much closer because the air source is on the surface, not on the back. There are other things that affect buoyancy, but a major one, the tank, is eliminated with hookah. A BCD is an important tool and will be helpful in maintaining buoyancy under certain task loads. Hopefully, you will need help in ascending with a bagful of tasty crustaceans.

Although most any BCD can be incorporated into the hookah system, perhaps the one best suited is called the Air Line Horse Collar.

More on BCD's

It has a very low profile, with no obstructions in the back. It is The Air Line's choice for its safety. When properly used it will support a diver in the face-up position rather than face-down or face-side as with some conventional scuba BCDs. It is a common misconception that a BCD is also a life jacket. True, it will float a non-traumatized diver properly at the surface, but a traumatized diver will have no control of the face position. A BCD's purpose is to maintain buoyancy while underwater. The Horse Collar has all the features of a conventional BCD, but is actually made for use with Air Line hookah. It is supplied with a special hose, called a power inflator, so that compressor air can be easily added.

Optional diving equipment

At the least, your dive bag should contain a water resistant watch, depth gauge and navigational compass. Many hookah divers will eventually opt for a wrist-mount computer, which eliminates guesswork when properly used and maintained.

Shown is a basic computer. An easy, dependable way to monitor and record your underwater history.

What have you learned so far?

- Name three types of exposure suit.
- Name three purposes of a Skin suit.
- What suit requires special training?
- Describe the roll of a BCD in scuba.
- Name two advantages of a Horse Collar.

Time now, to move on to the core: *The diving machine*.

There are two types of diving systems:
Dynamic and passive

A dynamic system is one where the air is provided through the use of a mechanical device, such as a compressor driven by a motor, which could be gas or electric.

A passive system is one that has no moving parts, but utilizes a compressed air reservoir, such as a scuba cylinder to move air. All scuba systems are typically, passive.

A floating, gas-powered, Air Line system will consist of five major components:

✓The compressor/engine assembly mounted onto a red, polypropylene pan, with storage cover.

✓The float (Comprised of a Cordura covered agricultural inner tube).

✓The hose system.

✓The weight/towing system.

✓The second-stage, demand regulator.

It will also include a "diver down" flag which is mandatory in any navigable U.S. body of water.

The gas engine will have a number of components with which you will have to become familiar:

- ✓ The gas tank.
- ✓ The fuel on/off switch.
- ✓ The oil reservoir.
- ✓ The electrical on/off switch.
- ✓ The choke.
- ✓ The throttle.
- ✓ The pull-cord.
- ✓ The carburetor air intake.
- ✓ The muffler.

1.

What have you learned so far?

- Describe a “passive” dive system.
- List 4 components for an Air Line floating hookah system.
- List at least eight components of the gasoline engine.

Moving on to the Heart of the machine: *The Compressor*

The heart---The compressor

Although all the parts of a dynamic system are important, you would not be wrong to say that the compressor is THE most important. Why? The compressor supplies the air on which you will be dependent. More importantly an Air Line compressor will supply air from a machine that has been tested to comply with a specific breathing air standard: Compressed Gas Association of America - Grade-E.

To further ensure quality and performance the compressor is made with proprietary features. It is important for you to know them so that you will be prepared to properly maintain the equipment. It is, after all, life-support gear.

An Acrylic Electrocoat of the housing, head, piston rod top and valve plate. The purpose of this is to provide positive protection against the effects of a hostile marine environment (i.e., salt,).

More on The Compressor

A **vented cover**, which allows heat to escape, preventing overheating of the bearings, and allows fresh water rinse out.

Working with the vented cover is a **cooling fan** on the engine shaft. This further provides cooling. Cool running extends compressor life.

Other important indirect compressor features are an intake staff to draw breathing air from above the engine. (*On the floats the staff acts as the flag support as well*) The staff is supported by a black socket screwed into the compressor head. Attached at the base of the socket, by a wire, is a black cap with a smaller red cap inside it. The black cap is a dust cap and must be in place whenever the compressor is inactive. The red cap will be discussed later.

And more on The Compressor

The overpressure valve (known as the **Quiet Valve** on Air Line systems). The function of the valve is to gently evacuate unconsumed air so that there is no excessive pressure building up in the compressor head.

You know about the intake staff, but the compressed air has to go someplace. There is a black hose also attached to the compressor head and this hose actually begins the air delivery.

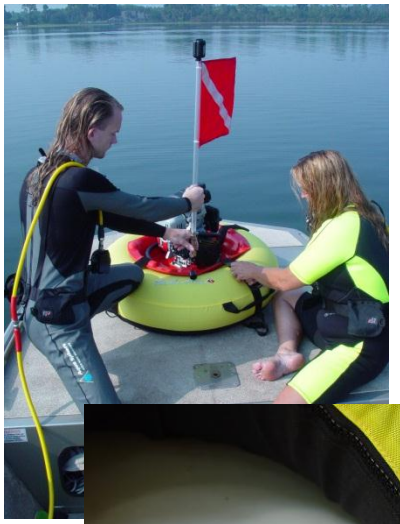
What have you learned so far?

- State what breathable air standard your hookah must meet.
- List 3 proprietary features found on the compressor.
- What 2 purposes does the air intake staff serve?
- What is The Air Line name of the overpressure valve?

Next Section: ***The rest of the RHD machine parts.***

The immediate parts

The **compressor/engine assembly** will nestle into the inflated float. (*It can also be used as deck mount due to the white, rubber feet on the bottom of the mounting pan*.) A short hose is included to inflate the float using the compressor. There is, what appears to be, an ordinary automobile inflator valve on the inside of the float.



The short hose attaches onto the black compressor hose. With engine running the float is filled to where it will have about ¾" of pinch in the cover to allow for expansion and contraction. An advantage to the float valve is that it can be unscrewed to evacuate excess air, or to flatten the float for storage.

The **Cordura float cover** has a large, nylon zipper to secure the **inner tube** inside the cover. The cover is black on the bottom to hide discoloration from dirt, and makes the float easily visible from below against the light sky background .

The upper part is bright yellow for high visibility.

With the **diver-down flag** attached as well, the position of the divers is always known to the boat tender, or observers on the beach.

More on the parts

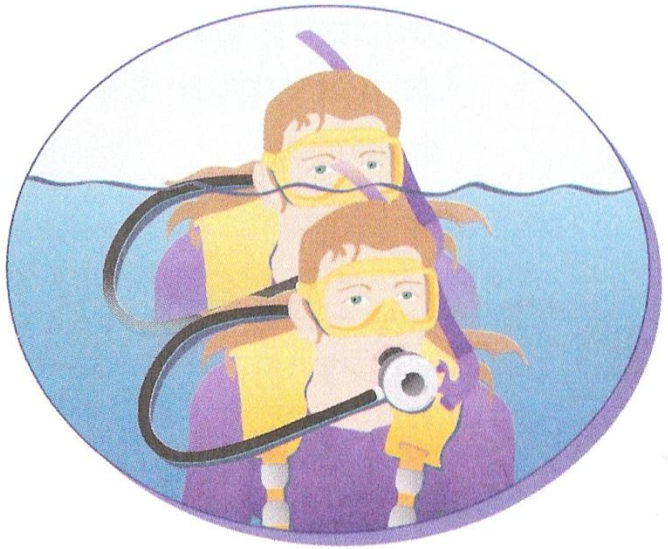
Single or multiple **"Y"** dividers are provided to distribute air to various participants. For each diver there will be a 60 foot**,** or longer, yellow, down hose, with a 38 inch hose, known as a "whip", to which the second stage regulator will be attached.

Between the down hose and the whip is a short strap with a male, pronged fitting that clips into a female fitting on the tow belt to retain the hose to the body.

The weight pockets on the separate pocket weight belt will hold your dive weights.

Weighting and its importance

How you set-up your weight system is important because it effects your comfort and safety.



➢**Determining how much weight you should wear:**

The proper way to determine the amount of Ballast (weight) you will need, when in the water, before the dive, and with all your equipment on, is to:

- In the upright position, inhale and hold. Your head should be at eye level to the water surface.
- Exhale and hold. You should start to sink slowly.

➢**Distributing the weight:**

Weights should be distributed evenly on each side, toward the front, and toward the back. In the event that you have to ditch weights, it could be unsafe to ditch all the weights, as you would risk ascending at an unsafe rate. The only time you **might** have to ditch would be in an emergency situation. If there was air in a BCD and you ditched all the weights, you might not have the presence of mind to vent some of the BCD air and the ascent rate would be too quick. The correct procedure is to ditch the some of the weights closest to the front, on both sides, where they are easily accessed. Only enough weights should be ditched to make the diver slightly positively buoyant so that that they can ascend at a proper controlled rate.

What have you learned so far?

- State the proper procedure for determining weight.
- Describe the correct way to balance the weights.
- Under what circumstance would you have to ditch weights?

A note about ascending on a hookah system :

It would be extremely rare to have to ditch weights with hookah. In a normal ascent, the divers would slowly swim upward at a rate of one foot every two seconds (one minute from 30 feet). In an emergency situation, the correct and safest way to ascend is to first, NOT ditch the weights, or, at least not all of them, grasp the air hose, and ascend, hand over hand, at the approximate rate of one foot every two seconds. (*NOTE: The hoses are not designed to be load bearing*.)

The pocket weight belt has six pockets. Each pocket will hold up to a 3 lb. pelletized weight sack or a 5 lb. solid weight. The pockets have flaps secured with wide Velcro strips. With the diver in the horizontal position, the pockets will also be pointed forward. Grasp the flap and pull forward to open. A slight tug on the weight will eject it. In a vertical position, it would be necessary to pull the weights out to ditch. The belt portion is standard 2 inch webbing with the typical cam buckle, which is also adjustable.

The separate tow belt that attaches the air hose to the diver should be positioned above the weight belt on the divers body when in a vertical position. This will insure that the weight belt will be clear of the air hose should the diver want to ditch the entire weight belt while vertical. However, it is STRONGLY advised to NOT ditch all your weights while submerged. Rather, ditch just enough weight to make yourself positively buoyant, so you can make a controlled ascent at the proper ascent rate (one foot every two seconds).

What have you learned so far?

- What is the purpose of the tow belt and where should it be positioned?
- Describe an alternate ascent that does not involve ditching.
- The pockets will hold what size weights?
- In a horizontal, swimming position, describe how you would ditch weights.

Next Section: ***Things you should know .***

Things you should know

Hoses not rated for breathing must never be used. They should be yellow, for high visibility, and clearly branded, or imprinted, with the words, "air breathing hose". Further, they must have a working pressure of at least 225 PSI. The exposed end of the hose is a ¾" female garden hose fitting. A conical, stainless steel filter is placed into it as a safeguard against debris entering the hose. The filter is washable and replaceable. It should be inspected daily.

The **second stage regulator** has its own features with which you must be familiar. It is known as a "demand" regulator, implying that you will only receive air upon inhalation, or demand. The part that goes in the mouth is, of course, the mouthpiece. You will note that it is fairly long. This is for comfort. Instead of biting down on it with mostly front teeth, the longer piece allows more teeth to balance the load. Aiding this is a **360 degree multidirectional swivel** on the housing. No matter how the diver's head is turned, the swivel will allow the hose to find the point of least resistance, thus eliminating jaw fatigue. On the opposite side is a knob. The inhalation resistance can be adjusted slightly by turning this knob.

Things you should know

Under extreme conditions of activity, the inhalation effort can be reduced by turning the knob counter clockwise. Under most conditions the regulator will not have to be adjusted and, in fact, no real difference will be felt except under extreme conditions.

The cover, where the logo is, is secured with a metal ring that can be screwed on and off. After the dive day, the cover can be removed to wash out the interior of the regulator so no potential problems will be presented. Always store the regulator out of the sun so the delicate rubber parts will not deteriorate. The front cover is soft. This is also known as the purge. When it is depressed the line pressure is released.

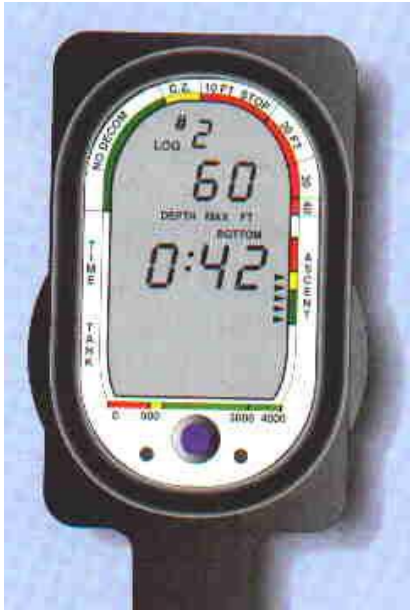
What have you learned so far?

- What should the minimum working pressure of the hose be?
- What's the advantage of a regulator cover that can be screwed off?
- The regulator cover has another name. What is it?
- Why is the regulator called a "demand"?

Next Section: ***Instrumentation***

Instruments that provide critical information
Digital Computers

The most accurate way to ensure that you are diving within the accepted parameters of time and depth (and recording your dive history). It replaces both a watch and depth gauge and, when properly employed, will give you the confidence of knowing that you are not testing the laws of physics.



The Compass

This instrument will get you generally where you want to go, but cannot be relied upon 100 percent. If the diver doesn't pay close attention, horizontal currents will move him about so that the target destination could very possibly be missed by a large margin. The compass is best used in conjunction with other acquired skills, such as sight bearings and allowances for the movement of water. Practice is the key. The compass is the rudder; skill is the steering wheel.

What have you learned so far?

- Among other things, what two important parameters does a computer monitor?

- A compass is an important navigational aid, but will, in some circumstances, not be entirely accurate without adding what human element?

Next Section: ***Contingency breathing air systems***

Contingency breathing air systems

There are two basic types of contingency systems, AKA:. back up systems:

- Small scuba cylinders, called ponies, that are actually full scuba sets, but with much smaller cylinders. The cylinders, however, are larger than the more compact Spare Air, so if, in fact, a larger reserve is important, they are excellent choices.
- A fully integrated system called, Spare Air, which is a very small scuba cylinder with the first and second stages built in so there are no hoses or gauges exposed to get in the way. For most shallow water diving the Spare Air should be adequate. Its integrated design also makes it very easy to hand off to a panicky diver in an out or air situation.

Important:

It is important to understand, however, that there are limitations to any breathing system, particularly to contingency systems, as they are necessarily smaller in design and capacity. Spare Air, particularly, might not bring a stressed diver, who is breathing normally (continually) up from 30 feet. (You will learn in the Science section that the available air in a contingency system will be reduced in direct proportion to depth. You will not have the same air volume at 30 feet as you will at the surface.) The use of back-up systems requires a thorough knowledge of the laws of physics, as they apply to diving, together with planning and experience.

A back up system will not do you or your diving companions any good if it cannot be easily located. Place it where it is easily accessible by any member of the group. On the tow belt it is usually positioned on the back. It has small straps that can be adjusted to fit the tow belt. You must become entirely familiar with the position and be able to retrieve it without hesitation. Practice, practice.

What have you learned so far?

- Name two types of contingency systems and give brief description of each.
- Name one advantage to a pony system.
- Name one disadvantage.

Next Section: ***Skin Diving (breath hold) Skills***

Skin Diving (breath hold) Skills

Developing good Skin Diving skills is fundamental to being a good diver.
The proper use of snorkel, mask, fins and, possibly, a weight system is fundamental in enjoying any form of diving.

The Snorkel will be attached to the left side of your mask strap with a snorkel keeper. You may be used to having it on the right, but when you use a compressed air source, the regulator will take the right side position.

To prepare your fins.

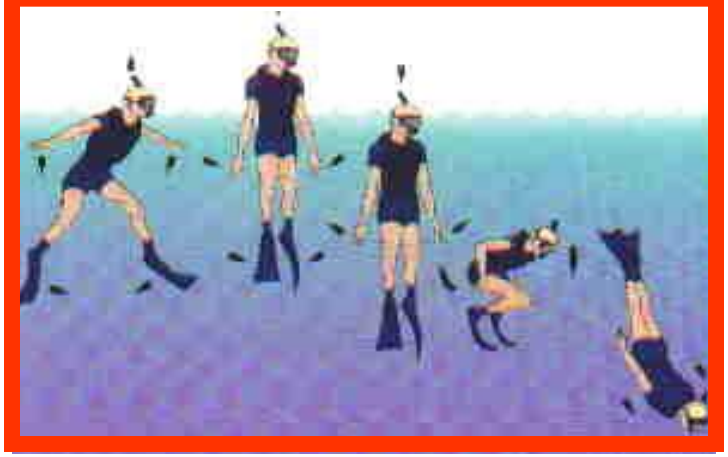
- Take any store inserts out of the foot pockets.
- For a heel strap fin, adjust the straps around the heels for a snug comfortable fit.

More Skin Diving Skills

With the limited amount of air in the lungs, the key to a successful breath-hold dive is to get as much of your body out of the water, as quickly as possible, on the outset, so that the body's weight in air pushes the diver downward initially, rather than exertion from the diver. This reduces oxygen consumption and allows the diver to stay down longer.

Head first dives:
The head first dive starts in a vertical position. It involves tucking the torso downward and lifting the legs. The weight of the legs, out of the water, starts your diving momentum. Start kicking when the fins submerge. Requires the least work by the diver, so uses less oxygen.

Feet first dive:
This dive starts in the upright position, and is a less effective skin diving practice, because it requires more effort (i.e., more oxygen consumption). Push your body upward and allow your weight to start your diving momentum. When fully submerged, rotate body downward.



Use of a weight system for skin diving

Using weights can be very helpful in compensating for the body's natural tendency to float. Extreme care must be taken, however, to be sure the weights will not make the skin diver negatively buoyant. The skin diver should always be at least slightly positively buoyant.

It will be helpful to understand that, at the surface, at the conclusion of a breath-hold dive, the air volume in the lungs is exactly the same as when the dive commenced. (*Important: Breath holding is never an acceptable procedure when using a compressed air source like a hookah compressor or scuba tanks.*)

What have you learned so far?

- The snorkel should be attached to what side of the mask? Why?
- Of two methods of descending, which one is most effective and why?
- What would be the consequence of over weighting for a skin diver?

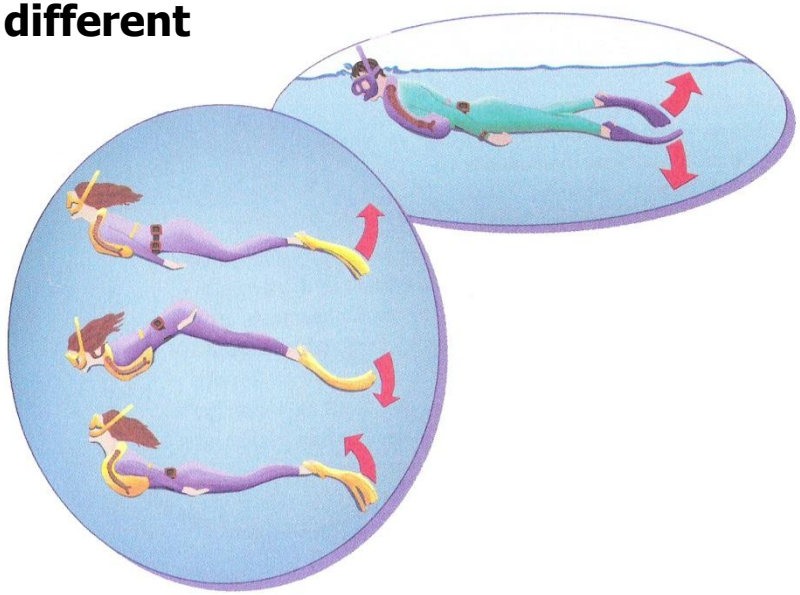
More on: ***Skin Diving (breath hold) Skills***

Using Your Fins

Your fins provide you with thrust and stability in the water. There are several kicks that require different muscles.

Common kicks include:

- Flutter Kick
  - Most Common. Up and down.
- Frog Kick
  - Sideways motion.
- Dolphin Kick
  - Ankles together and kicking in tandem. Good kick to practice if you ever lose a fin in the water.



When replacing a fin in the water, use the same partner-support position you use to don your fins.

What have you learned so far?

- Name the three common kicks.
- Describe how you would propel yourself if you should lose a fin. And why it would be the most effective.

This section is essentially about skin diving, but as you will possibly do both we add it here as part of your information arsenal.

Breathing with the Snorkel:

- Using the snorkel will help you conserve energy.
- Breathe slowly and deeply when using a snorkel so that you will get a good air transfer through the tube.

Shallow Water Blackout.

**** This one's in red on purpose. ****

When free diving, hyperventilating excessively before the surface dive is dangerous.

- Higher levels of carbon dioxide ($C0_2$) in the lungs give our body the stimulus to breathe.
- Breathing deeply more than three times lowers the CO_2 level in the body to an unnaturally low level.
- Hyperventilation cannot raise the oxygen (O_2) level in the body.

When you dive:

- O_2 levels decrease with exertion.
- CO_2 levels increase.

If the O_2 level is depleted before the CO_2 level builds up enough to a point that you feel the need to breathe (*i.e., because you hyperventilated at the surface and thus had an unnaturally low CO_2 starting level*), then you can lose consciousness from lack of oxygen. This is called shallow water black-out because it is most likely to happen near the surface.

Shallow water black out is easy to prevent.

- Breathe in and out deeply before the dive no more than 3 times.

What have you learned so far?

- What stimulates the need to breathe?
- What happens to O_2 and CO_2 levels when you skin dive?
- What causes shallow water blackout?
- How is it prevented?

More on: ***Checking your equipment and more***

Checking your Equipment and more

Have a reliable partner. Always check out each other's gear before entering the water.

SEALBAG: an easy way to remember dive planning

- ***Site Survey***
- ***Emergency Planning***
- ***Activity Planning***
- ***Limit activity to depth/time training***
- ***Buoyancy***
- ***Air***
- ***Gear and Go***

Entering the Water

The only objective for an entry is to get into the water with minimal effort and effect on both you and your equipment. As a prelude to this section, you will have established a dive plan by this time. (Briefly, a dive plan will consist of an agreed-upon strategy including who will be the dive leader.)

- **General rules that apply to most boat and platform entries:**
  - If wearing a BCD, it should be partially inflated to provide buoyancy.
  - You should hold your mask firmly in place to avoid flooding it or having it come off.
  - You should breathe from your snorkel or regulator during the entry.
  - You should make sure the entry area is clear and sufficiently deep for the entry you are using.

Entering the Water

Three entry procedures.
Giant stride entry:
You can use this entry from a boat or platform where there is an unobstructed distance of at least 2 meters (~6 feet). It involves standing on a stable platform, holding mask in position with one hand, and holding the cam buckle of your weighting system in position with the other. Don't attempt to enter the water while carrying other gear. It will be handed to you once you are secure. Position one leg out (a giant stride) and push off with the other leg with sufficient force to ensure that you are clear of the boat/platform. Use as large a stride as possible. Your air hose will have been deployed prior to this with enough slack so that it will not inhibit your entry. If you flutter/scissor kick your legs together as both legs submerge, your entry will be gentler.

Entering the Water

Back roll entry:

You use this entry if standing up in a boat is not safe because of its movement. Common on small craft.

Again, make sure that your hose will not hang up on you. Sitting on the gunwale, facing inward, hold the mask and cam buckle in place. With knees bent, sidle out to where your buttocks are on the outer edge of the gunwale and simply fall (roll) backwards. Once in the water, calmly gain the upright position.

Entering the Water

Seated entry:
You can use this entry from a low platform such as the side of a swimming pool, a ledge at the water level in a quarry, or from a boat dock, or swim step of a boat.
From a seated position, turn around 180 degrees as you are immersing the lower half of your body. (You will be facing the platform) Keep your hands on the platform and then push away.

Entering the Water

A beach entry.
Beach or shore entries are very different depending on your location.

Calm water:
Put the unit in the water to where it will float. Carry you fins and walk into the water until it is chest deep taking the float with you by the handles. At this depth, your buoyancy helps in keeping your balance while donning the fins. Use your dive partner for support.

Surf:
Before attempting a surf entry it is advisable to gain experience and confidence in the more controlled environment of entering from a boat. Surf entry requires additional skills, but once mastered, provides additional venues for your diving pleasure. You will, probably, not want to don fins near the surf as stability is questionable. The recommended procedure is to bring the float to the water line, don your fins using your partner for support, start walking backwards into the water, pulling the float with you and making sure it does not get away from you. If the surf takes it, the breaker will undoubtedly turn it over. Not a good way to start the dive.

Entering the Water

Surf Continued:
Once past the surf line, start the unit again (you will have tested it on shore previously). Either you or your partner will then dive near the bottom for control and swim out to where the hose slack is taken up so the unit will not drift back. The person at the float can then descend and follow the first diver's hose. It will be easy to catch up. Then follow the plan.

Rock jetties or breakwaters:
Simple: When RHD diving, avoid these areas.

Beach Entry

We need to talk a bit about beach diving. As mentioned above, a surf entry shouldn't be attempted without experience. There are potential risks with beach diving, particularly in an ocean, that are not present with boat diving. For starters, you will probably be much further away from the security of the exit point, and a monitor on the beach will have little if any value. The distance back to the shore, combined with weather and sea conditions, will add additional problems, which need to be dealt with. Dealing with equipment failure and a stressed buddy will be made even more complex without support from a nearby monitor on a boat.

Beach diving should never be tried without the use of BCDs and contingency air systems. The participants should all be strong swimmers and the dive plan must be strenuously applied. Particular attention is to be paid to preparation and the implementation of emergency procedures,

What have you learned so far?

- On a boat entry, what gear does the diver protect?
- Name three entry procedures.
- When making a beach entry, explain when you would don your fins for calm water and when for surf.
- On a surf entry, cite two ways to keep the float from flipping.

Next Section: ***Exiting the Water***

Exiting the Water

The only objective for an exit is to get out of the water with minimal effort and effect on you, your diving companions and your equipment.

General rules that apply to re-entering the boat :

Evaluate the exit area before getting out of the water.

Make sure all your equipment is in place and secure as you approach the exit area.

Think out the steps of your exit in advance. Keep your fins in place as long as you are in the water.

Ladder.

- Don't crowd the ladder. If there is some chop, you don't want to be banging into each other. One at a time is the key.

Boat transom platform:

- You must coordinate your approach to a swim platform with the wave action. With practice, you will learn how to let the water movement help lift you on to the platform.

Calm water beach exit:

- You can swim towards the shore until waist deep.
- Stand up, remove your fins and walk out.

Exiting in surf:

- Keep control of the floating compressor.
- Stop before you reach the surf zone. You should be able to stand up.
- If you can stand, turn off the motor. If it should get turned over, it will not suck water into the compressor.
- Walk backwards, holding onto the float.
- Guide it carefully through the surf zone.
- Remove fins when the float is completely ashore.

What have you learned so far?

- You're carrying extra, hand-held gear. As you reach the exit zone of the boat (where you will be re-entering the boat), describe what you think the procedure should be.
- In beach exits you would remove your fins under what conditions?
- Why do you think you would walk backwards while wearing your fins?

Next Section: ***Mask Skills***

Mask Skills

There are a number of ways that water can get into the mask during your dive.

- **Clearing water from your mask:**
  - To clear a mask you must replace the water with air.
  - Exhaling air through the nose into the mask forces the water to flow out of the bottom of the mask. Push inward on the top of the mask and exhale through your nose. As you exhale, tilt your head back slightly while keeping pressure against the top of the mask. As you exhale from your nose, the air will rise and push the water down and out at the bottom of the mask. So it is important to only hold the top of the mask against the face, so the bottom can release the water as it is displaced by the air.
- **Purge masks:**
  - With a purge valve in your mask, look down, and simply exhale into the mask.

More Mask Skills

Removing and replacing the mask.

- **If your mask comes off, you must be able to calmly locate it and put it back on.**

Don't panic. Your air supply is still working. You will just feel strange the first few times you practice the maneuver. Calmly locate the mask. Use a rinsing motion to ensure that there is no sand or debris in it. Position it back on your face and do the mask clearing procedure described previously. (Note: Contact lenses are not always the best visual aid when diving. If the mask gets knocked off you run the risk of having one or both lenses wash away. A prescription mask might be a better choice.)

What have you learned so far?

- What medium does a mask employ that allows us to see underwater? Why not just open our eyes without a mask?
- In clearing a small bit of water from a mask, what is the purpose of the slight head tilt?
- The purge seems like a good idea. Think of at least one disadvantage,
- Give two reasons why you would have to replace a mask while underwater.

Next Section: ***Regulator Skills***

Regulator Skills

Learning to dive includes more than just learning how to breathe from a regulator.

- **Breathing underwater:**
  - When diving on compressed air you will breathe from your mouth.
  - You must be able to do this without a mask on (See also, Mask Skills).
- **Clearing the regulator:**
  - Whenever the regulator is out of your mouth, you must continually exhale i.e., blow bubbles so that water does not enter your mouth. The natural tendency will be to hold your breath. By exhaling a slight stream of bubbles you will be applying positive pressure, disallowing the intrusion of water into your mouth. If the regulator cannot be cleared, you will already have established the process of exhaling during an emergency ascent. There are two primary ways to clear your regulator:
    - Exhale through the flooded regulator, or…
    - Depress the purge button.

But, before you can do this you must learn:

How to Recover a Regulator

The easiest (and recommended) method is as follows:

- **Reach method:**
  - Always remember to exhale, slowly and continually, when your regulator is out of your mouth. Just a slight stream of bubbles is sufficient. You don't want to exhaust all the air in your lungs with one, hard exhalation. The exhalation of bubbles will also reinforce the habit of never holding breath when underwater, particularly on ascent.
  - If you have a contingency air system you can always use it until you locate your primary regulator, but this should be unnecessary.
  - Reach back with both hands.

How to Recover a Regulator

The easiest (and recommended) method is as follows:

- **Reach method:**
  - Locate where the diver hose connects to the tow belt. You will easily be able to discern the down hose (it will be going above) from the whip hose (which will be hanging down).
  - Grasp the whip hose on the right side.
  - Slide your hand along the hose until you have the regulator in hand. It will be under your arm. With your left hand, grasp the regulator and swing it over your right shoulder and place in the mouth. Clear the water as shown above in Regulator Skills.

What have you learned so far?

- **If the compressor is supplying positive pressure, why is it necessary to either; exhale through the flooded regulator, or depress the purge?(You won't find this above, but this would be a good time to open a reg. and look inside.) (If you don't have one handy, think about the word, "demand" and how it might affect your answer.)**

Next Section: ***Monitoring your air***

Monitoring your Air

Unlike SCUBA, the SASS diver does not have a gauge to monitor air.
It is important that the SASS diver monitors dive time.

- The SASS diver is advised to always start with a full fuel tank.
- With the extended run times, you should refuel after each dive to be absolutely certain.
- The best advice is to always carry a contingency air supply. This is your insurance policy in any out of air scenario.

What have you learned so far?

- **With a gas-powered compressor, assuming it's in perfect running order, what is the one, convenient way of ensuring that it will operate for as long as you want it to?**

Next Section: ***Buoyancy Skills***

Buoyancy Skills

Proper buoyancy control determines a person's ability to dive without struggling to maintain neutrality (i.e., hover at a particular depth without effort).

- **Many factors affect your buoyancy in the water.**
  - Type of protective suit you wear.
  - Amount of weight you wear.
  - Amount of air in your BC or dry suit.
  - Amount of air in your lungs.
  - Body Mass Index
- **You must begin your dive properly weighted.**

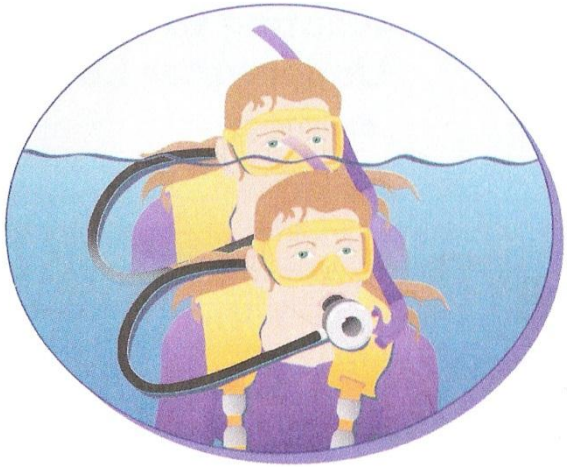
Checking Buoyancy

T*est your buoyancy at the surface before you begin your dive.*

Without a BCD.

- With some small amount of weight in your weight belt, assume an upright position in the water.
- Take in a deep breath and hold it while you hang in the water motionless. You should float eye level to the water.
- Exhale completely. You should start to slowly sink. If you are too light or too heavy, adjust weights in small increments, and repeat the buoyancy procedure. Take the time to do it properly here as needing to adjust weights when the dive has commenced is bothersome to all.

With a deflated BCD it is exactly the same You can control your buoyancy during the dive by adding or removing air to/from your BC.



What have you learned so far?

- **Think of at least two reasons why you would re-test your buoyancy?**

- **When checking buoyancy with a deep breath, why is it important to be in an upright position? When you're swimming, you'll generally be in a horizontal position, why not check it that way at the surface?**

Next Section: ***Descending***

Descending

Being able to descend easily in the water is an important skill.

Some of the general steps for descending:

- Note the exact time that you leave the surface. You might want this for logging your dives. At 2 ATM, or less, down time is much less important. (The Science Section will cover this.)
- Equalize your ears.
- Exhale and begin your descent.
- Stay close to your buddy during descent.

Without a BCD. Have your regulator in your mouth. Point your fins downward. In an upright position, paddle your flattened hands and arms upward to provide locomotion for the descent. Otherwise, follow the same procedures found in *Skin Diving Skills.* Exhalation will assist the effort.

With practice, a head first descent will be possible, but in any event, your rate of descent should not be rapid. The recommendation is to not exceed a rate of 23 meters (75 feet) per minute. For simplicity, figure one foot per second.

Descending

With a BCD Deflate it. The descent will be identical as without. The act of adding or removing air from a BCD is much less likely to be needed on hookah during descents and ascents. However, you need to be familiar with how everything works.
The black, corrugated hose is multi-functional. At the end is a distinct mouthpiece for oral inflation. The large button immediately adjacent to it will open the valve for allowing the oral inflation. It is also used to deflate by holding the hose up, over the head and depressing the valve. There is a button exactly where the power inflator hose is attached. Depressing it opens that valve to allow air from the compressor in. Deflation is also accomplished by pulling the knobbed cord on the right side to open a dump valve. Most BCD's also have a dump valve at the top of the corrugated hose which can be opened by tugging on the corrugated hose. There are some situations where using a BCD will be beneficial, so becoming familiar with its functions will be important.

Some other thoughts on Descending

As your wetsuit compresses as you descend, you may need to adjust the weight belt. Adjusting the belt is as simple as loosening the cam buckle with a right hand while holding the loose end of the strap; pull the loose end to where it is tight and close the cam buckle. This is best done in a face-down horizontal position, so the weight belt is draping over your back and thus less likely to slip off. Use your fins as little as possible during descent until you have mastered a controlled, head-first descent. Control your descent, for the most part, by buoyancy not by kicking. Keep in mind that a feet-first descent allows you to see what's going on more clearly.

An interesting phenomenon about hookah diving with a wet suit:

As the cells (bubbles) in a wetsuit compress when descending, the suit will have diminishing positive buoyancy. The tendency would, therefore, be for the diver to sink at a rate commensurate with the volume of the air in the cells. This becomes very apparent with scuba. But what happens on hookah is that, as the diver descends, he is pulling more of the buoyant air hose in with him. That small volume of the 3/8 inch ID hose has the effect of offsetting the negative tendency of the compressing suit. Kind of a self-regulating buoyancy control.

Controlled Descent

Doing a controlled descent will allow you to concentrate on :

- Equalizing your ears.
- Maintaining buddy contact.
- Controlling your buoyancy.

You will receive comprehensive training on ear equalization in the Science Section of this course and hands-on attention when you are ready to venture into the water under the guidance of an instructor. For your safety and comfort we'll have a brief discussion on an important technique which, when mastered, will become second nature. At just below the surface, grasp the nose to seal off the nostrils and gently blow into the sinuses (*without exhaling*) to add a slight bit of air into the Eustachian tubes to effectively apply the same pressure on the inside of the ear as the outside. The trick is to **start before you feel pain or pressure.** Repeat this procedure regularly during your descent. The more frequently you do this during the descent, the less likely you will have problems equalizing.

What have you learned so far?

- **What is the main reason you would make a descent?**
- ***What is the preferred position for making a descent?***
- ***Think of two reasons why?***
- ***What is the recommended rate of descent?***
- ***With a deflated BCD, what is different from descending without a BCD?***
- ***Identify at least four features found on a BCD?***

Next Section: ***Ascending***

Ascending

Some general procedures for doing an ascent:

- Stop a minute and secure any accessories.
- Give your buddy the up signal. Maintain occasional eye contact with your partners.
- Start swimming slowly towards the surface, or climb the hose..
- Remember to look up and breathe normally.
- Your rate of ascent should not exceed 9 meters (30 feet) per minute; one foot per two seconds.
- Remember one of the prime rules: **Never hold your breath while ascending**.

Ascending

Without a BCD, you can do a swimming ascent with very gentle and slow fin kicks. This should only be done after considerable experience in determining rate of ascent. Generally, the safest way to ascend is by grasping the air hose and going, hand over hand, with an estimated one foot separation. Calculate the 30 foot per minute ascent rate by silently saying, one-thousand-one, one-thousand-two, per one foot of ascent. Monitor your dive partner(s) and advise by hand signal if their ascent rate is too fast.

With a BCD. Find your power inflator hose, deflator button, and hold it over your head, or be prepared to release air using the dump valve at the top of the BCD hose. Air expands as you ascend so you will want to be prepared to deal with an accelerated rate of ascent by releasing air from the BCD.

- Control your buoyancy and your ascent by venting air from the BCD.
- Maintain the correct ascent rate as without a BCD.
- Stop at a depth of 5 meters (15 feet) for three minutes. (This is called a safety stop. It allows nitrogen, which has built up in your system to dissipate.) Patience. More on this later.
- Make sure your automatic exhaust valve will open if you are wearing a dry suit.

What have you learned so far?

- Your opinion on why all the divers should ascend at the same time.
- Following the rules, how far should you ascend in 10 seconds?
- A three minute stop at 15 foot is called what? Why do you do it?

Next Section: ***Safety Skills***

Safety Skills

Though unlikely and, in most instances, preventable, Out of Air Scenarios can happen.

- **Out of Air Scenario**
  - RHD divers might find themselves out of air if;
    - The dynamic system runs out of fuel or has a mechanical failure.
    - A hose connection was not secured and began to leak.

- **There are two ways to ascend in an Out of Air scenario**.
  - Emergency Swimming Ascent (ESA)
    - Used if you do not have an emergency redundant air supply
  - Ascent using an emergency redundant air supply

******(Think about it. Which one would you rather do?)***

Safety Skills (continued)

More on ascending in an Out of Air scenario.

If you do not have access to a redundant air supply (contingency scuba), you must make an independent ascent to the surface. (Swimming or Buoyant)

- **Emergency Swimming Ascent** (**ESA**):
  - Emergency Swimming Ascent is done from shallower depths of 18 meters (60 feet) and less.
  - Look up to maintain an open airway.
  - Keep the regulator in your mouth.
  - Exhale, slowly and continually (a steady stream of bubbles) as you ascend, while climbing up your air hose. You must still ascend at a proper controlled rate.
  - **You will discover that the expanding air flows out from your lungs almost naturally with very little effort on your part. Never, ever hold your breath while making an ascent, even in an emergency.**
  - If worn, be ready to vent the BCD to control your ascent rate.

  NOTE: The air in the long hookah down hose will expand as it ascends with you, so you will likely get another breath or two from the hose after you have ascended somewhat. *Even so, you are still much better off having a backup redundant air supply.*

Safety Skills (continued)

More on ascending in an Out of Air scenario.

If you have access to a redundant air supply (contingency scuba), you can use it to make a controlled ascent with it, just as you would with the primary air supply.

- **Ascent with a backup redundant air supply**:
  - Switch to the regulator from the redundant backup air supply and clear it.
  - Look up to maintain an open airway.
  - Remain calm so you can breathe sparingly to prevent exhausting the backup air supply.
  - You must still ascend at a proper controlled rate.
  - **You will discover that the expanding air flows out from your lungs almost naturally with very little effort on your part as long as you maintain an open airway. Never, ever hold your breath while making an ascent, even in an emergency.**
  - If worn, be ready to vent the BCD to control your ascent rate.

More Safety Skills

What if my buddy's redundant air supply (contingency scuba) is empty?

- **If your buddy's contingency scuba fails, he can share yours:**
  - You share air by passing your contingency scuba.
  - This procedure is simple but requires a higher level of skill from you and your buddy.
  - Take a breath from the contingency scuba before passing it, and maintain an open airway while ascending.
  - Get control of your buddy.
  - Pass the contingency scuba while maintaining control of it.
  - Allow your buddy to take two breaths, then pass it back to you.
  - When both of you are ready, make a normal rate of ascent. Being certain that you follow the same procedure as with the Emergency Swimming Ascent, i.e. NEVER hold your breath on ascent.
  - For overall safety, never boat dive without a responsible surface tender who can monitor activity and react when needed. The monitor will also be valuable in tugging the air hoses if the equipment malfunctions, or weather conditions change. The boat tender should be an integral part of the Dive Plan.

What have you learned so far?

- What are the two methods of ascent during an out-of-air situation?
- During a swimming ascent the stream of air escaping from your lungs seems easy and natural. Why is that possible?
- The warning: ”Never hold your breath during ascent” is related to the question immediately above. Why is that so?

A Safety Issue

A caveat: You are engaged in an entry-level course. You are, therefore, cautioned to restrict your diving depths to ata 2 (33 feet) All references to depths greater than this are offered for informational purposes only. The knowledge will prepare you for Advanced RHD, or equivalent diving, if you elect to go to the next level.

The hoses provided on the float models are 60 feet in length for a purpose. They float and arc down to the diver because of the volume of air contained therein. To comfortable tow the float the diver will, therefore, be restricted to a depth of about 35 feet.

Buddy System

Diving is certainly fun, but you won't think so if you are continually searching for your buddy.

- **The following points help you keep track of your buddy:**
  - Agree on a leader.
  - Discuss the dive before you get in the water.
  - Maintain your same position relative to one another for the entire dive.
  - Establish your direction.
  - Use the lost buddy procedure if you lose visual contact. In lower visibility, should you lose contact, you will still, probably, be able to see the float. Ascertain the direction of the lost buddy's position from his hose and swim in that direction until contact is made. If there are more than two of you, with hand signals, make sure the others follow until you are regrouped.

    If conditions are such that you cannot estimate the lost diver's position, ascend safely to the float. Determine which hose belongs to the missing one and descend down that hose. As before, make sure all the other participants are with you.

Communication

There are standard signals you need to know to communicate under water as well as on the surface.

- Remember, for a signal to be effective, all concerned must discuss it and agree upon it before you start the dive.
  - When you give a hand signal, you must display it distinctly and you must wait for a response from your buddy.
  - Always remember to review your hand signals with your buddy before each dive.
  - You can write messages to your buddy on an underwater slate.

What have you learned so far?

- Successful completion of this course will equip you to safely dive to what depth?
- Before entering the water, your group makes certain decisions. What is the conclusion called? (You've heard the expression before)
- List two ways to locate a lost buddy.
- Name two methods of underwater communication.

Next Section: ***Navigation Skills***

Navigations Skills w/o a Compass

When you are out of the water you are constantly using navigation skills (Maps, street signs and landmarks).

- **Natural navigation Learn to observe:**
  - Ripple marks in the sand on the bottom form parallel to the shore.
  - Sea Fans are also usually parallel to the shore.
  - The back and forth movement of the water close to shore is known as surge. Sea fans and soft corals are helpful in detecting this movement.
  - Depth of the water.
  - Prevailing currents.
  - Underwater landmarks, such as rock formations, large and unique. Memorize the landmarks you have seen and use them in reverse to return to the point of origin

Navigation Skills

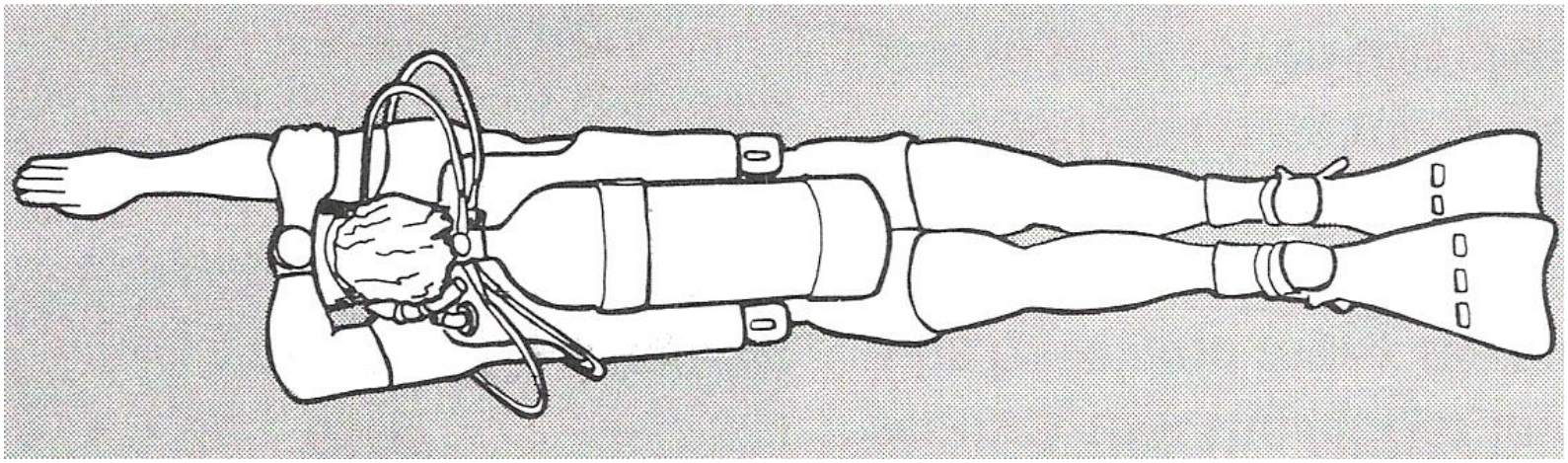
When you dive in limited visibility, natural aids are not as helpful.

- **Compass navigation:**
  - Using a compass allows you to navigate by dead reckoning, which can be very accurate if you haven't drifted, horizontally, too far from the original route. If at all possible use the compass in conjunction with some remembered landmarks.
  - A diving compass must:
    - Be filled with liquid.
    - Have a reference line, called a lubber line.
    - Rotating bezel to show the select bearings.
- **Because the compass is magnetic, iron or steel objects close to it will effect it.**

Navigation Skills

If you need to navigate precisely, you must reference the compass frequently.

- **When you use a compass:**
  - Keep the lubber line aligned with the centerline of your body and the compass level.
  - The compass needle always points to magnetic north.
- **Reciprocal course:**
  - This is made when your outbound course is a straight line and halfway through the dive you make a 180 degree turn.
- **Simple navigation skills make diving more enjoyable.**



What have you learned so far?

- Name at least three aids to natural navigation.
- Is compass navigation always 100% accurate? Why?
- List three necessary features of a compass.
- The lubber line always points in the same direction as the compass needle. True or false? Explain.

Next Section: ***Diving Science***

Diving Science

Pressure/density relationships and characteristics.
Density is defined as mass of an element per unit volume.

Air and water are, of course, different in their density. The density of water is what allows us to be suspended. Density can be described, further, in terms of weight. The weight of air is 0.08 lbs per cubic foot. The weight of sea water is 64 lbs. Sea water, therefore, weights 800 times more than air.

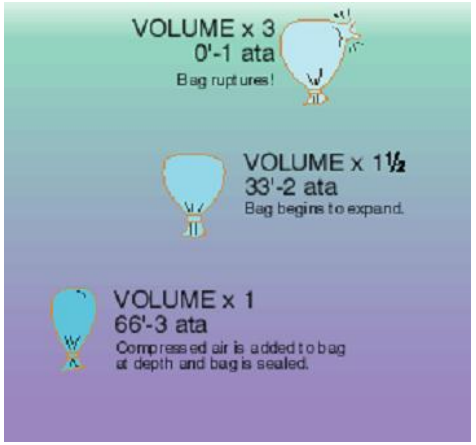
Air is comprised of 20.9% oxygen, 78% nitrogen and about 1.1% of miscellaneous gases, of which oxygen is the most important. You have heard many times that water is H_2O: two parts hydrogen, one part oxygen.

When pressure is applied to air it can be forced to occupy a smaller area. The air surrounding the earth at sea level is compressed by the weight of the air above it. The air at sea level is denser than the air at higher elevations. The effects of this can be felt during air travel. Because of water's density, it is not easily compressed.

Diving Science

When we descend in water the force from the combined weights of air and water will increase. That force is called pressure. At sea level we are said to be at atmosphere 1 (ata1). The pressure at ata1 is 14.7 pounds per square inch (PSI) Each 33 foot of depth is equal to one additional atmosphere and will add more pressure in relation to depth. It can be viewed as follows:

Levels	Depth	Pressure
ata1	00’	14.7 PSI
ata2	33’	29.4
ata3	66’	44.1
ata4	99’	58.8

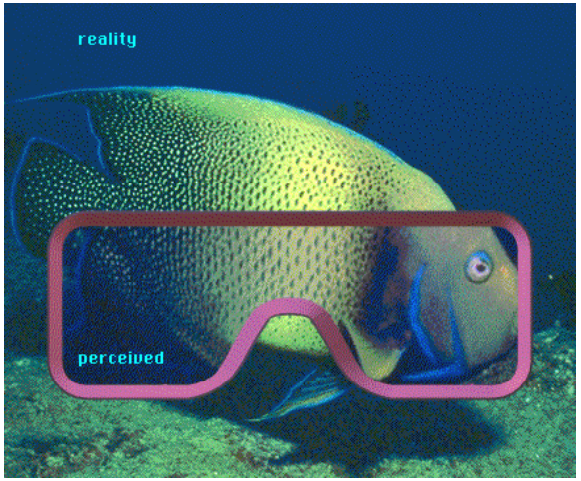


You will note that at ata2 the pressure is 100% greater than at ata1. For purposes of this course it is important to understand that during an ascent from ata2 to ata1 (sea level), the pressure will decrease by 100%. Conversely, if your breath were held from 33’ to the surface, the air in your lungs would expand by 100%. This is the science that explains the rule, “Never hold your breath upon ascent.” To further make the point, if you took a plastic bag down to 33 feet and filled it with air, as you ascend, the air will expand to where the bag will burst. Think of this in terms of your lungs.

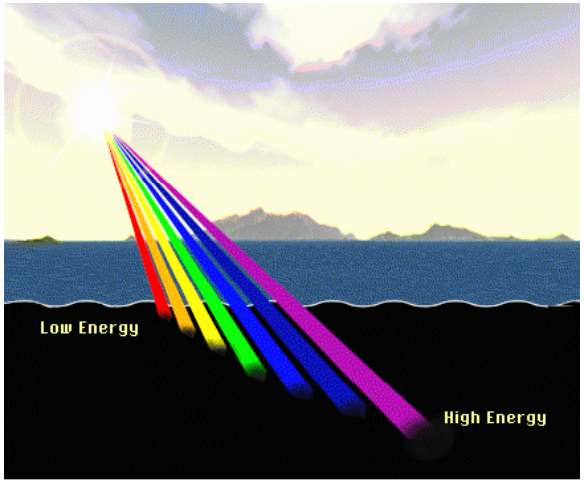
Diving Science

Some effects of density.

- **Vision:**
  - The human eye is designed to focus light rays in air.
  - Objects underwater appear blurry.
  - The mask allows you to put an air space in front of your eyes to see without the blur.
  - Objects appear 1/3 closer and larger under water.



- **Colors:**
  - Colors look much different under water.
  - As light passes through the water, the water absorbs the colors of the spectrum of the sunlight.
  - The first to be absorbed is the color red followed by orange.
  - You need artificial light to see the true colors underwater.
  - Because of the greater density of water compared to air, sound waves travel about 4 times faster in the water than they do in air.
  - You can hear sound getting louder or softer, but you can not tell its direction.



Diving Science

Heat Loss:

- Heat can be conducted out of your body by direct contact with water at a rate of about 25, or more, times faster than by air.
- The colder the water, the faster the rate of conductivity.
- When you start to shiver on a dive, you must end your dive and get out of the water to re-warm.

Density and pressure as contributors to buoyancy.

Archimedes Principle:

An object in a fluid is buoyed up (lifted) by a force equal to the weight of the fluid it displaces.

Positive Buoyancy:

If an object floats, it means the object displaces an amount of water that weighs more than the object does. Alternatively, the object has a lower density than the fluid it displaces.

Neutral Buoyancy:

If an object hovers, it means the object displaces an amount of water that weighs the same as the object does. Alternatively, the object has an equal density as the fluid it displaces.

Negative Buoyancy:

If an object sinks, it means the object displaces an amount of water that weighs less than the object does. Alternatively, the object has a higher density than the fluid it displaces.

What have you learned so far?

- What will be the percentage of expansion from ata2 to ata1?
- Explain why, on a skin (breath hold) dive, you would not injure your lungs if you held your breath on ascent.
- As a reference, let's say for photography, what allowance would you make for distance?
- Sound, in water, travels about 4 X faster than in air. Can you think of why that might be?

Next Section: ***Exploring Pressure Further***

Exploring Pressure Further

Your Body

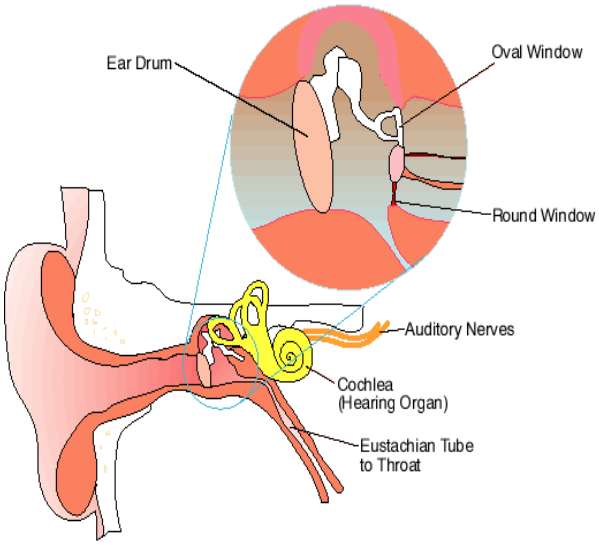
When you dive, the pressure of the water affects your air spaces as well as your breathing.

- **How pressure affects your air spaces.**
  - The air spaces in your body include your lungs, sinuses, and middle ears.
- **Squeezes:**
  - Whenever the pressure outside an air space is greater than the pressure inside an air space, the situation is called a squeeze and it can cause damage to your body.
  - This type of injury is called barotrauma (pressure injury).
- **Blocks:**
  - A block is the opposite of a squeeze.
  - Air is trapped inside an air space and the air tries to expand as the surrounding pressure decreases.

Effects of Pressure

The Middle Ear
You must be able to equalize the pressure inside your ears to comfortably and safely dive.

- **Anatomy of the ear:**
  - Your ears are divided into 3 sections:
    - **Outer ear**
    - The outer ear is the ear canal
    - The ear drum separates the outer and middle ear
    - **Middle ear**
    - Contains a series of 3 small bones that transmit sound waves from the ear drum to the inner ear.
    - Contains the airway link called the Eustachian tube.
    - **Inner ear**
    - Contains the balance mechanism.
    - Sudden changes in pressure or temperature in one ear and not the other will cause dizziness or vertigo.



Effects of Pressure

Middle Ear Squeezes

Occurs when the air or water pressure in your outer ear is greater than the air pressure in your middle ear.

- **Equalizing your middle ear involves:**
  - Moving air from your throat through the Eustachian tube into your middle ear.
  - For most people this is not an automatic process.
  - If you cannot equalize your ears during a dive, you must end the dive and return to the surface.

Before you feel the slightest pressure in your ears, you need to equalize.

Never forcibly equalize your ears. You could cause serious damage.

- **The key to successful ear equalization:**
  - Keep the pressure differences between the water and the middle ear to a minimum.
  - This means that you must equalize early and often during your descent, starting at just beneath the surface.
- **If problems occur:**
  - Take your hands away from your face. You'll want to be able to concentrate without influence.
  - Ascend a few feet to reduce the pressure, and attempt to equalize again.
  - Descending feet first makes equalizing much easier for most people.
  - Never try to equalize the pressure by performing forceful blowing.

Effects of Pressure

Equalizing techniques.

You have no doubt flown in a plane so you are familiar with what the pressure differences feel like as you ascend. It is just the opposite from when you descend, either in air or in water. In flight, usually just swallowing, or jaw movement is sufficient to equalize because the density of air is so much less than water. If you are lucky, that might be enough to equalize when diving. Most people, however, have to rely on another procedure. It involves grasping the nose to seal off the nostrils and gently blowing into the nose to add a slight bit of air into the Eustachian tube to effectively apply the same pressure on the inside of the ear as the outside.

The trick is to start before you feel pain or pressure. Start the procedure just below the surface and repeat every few feet until you reach depth. A combination of gently blowing and swallowing seems to work for everyone. If you feel pain or pressure, ascend a few feet until it stops. Add the internal pressure at that point before descending any further and then continue the procedure.

At depth you might feel pressure from time to time, usually because you have descended further while following a bottom's contour. Just repeat what you have been doing to clear.

If you have a head cold, you must not attempt to equalize by any method.

Effects of Pressure

Middle Ear Blocks

A block is the opposite of a squeeze. It occurs when the pressure in the ear is greater than the pressure of the ambient water. If you begin to ascend and your ear hurts and feels "full", stop your ascent and descend until the feeling goes away.

- **If the block does not equalize:**
  - If you must surface, close your nose and mouth and attempt to breathe in, without actually breathing. This will be the reverse of equalizing a squeeze as it will be pulling ear pressure inward instead of pushing pressure.
  - If nothing works ascend as slowly as possible.
  - If the block releases quickly and there is a sudden change in your middle ear pressure, you might experience dizziness.
  - It will pass quickly. Hold on to something if you experience vertigo.

Effects of Pressure

Sinuses

Your sinuses are air cavities lined with mucous membranes and surrounded by the bones of your head.

- **Sinus squeeze and blockage:**
  - If air is trapped inside a clogged sinus, and you attempt to dive, you will feel pressure on your sinuses.
  - This is painful and can cause blood to flow into the sinus to fill it.
  - During ascent the air in the sinus will try to expand to its original volume but it can not because of the fluid.
  - Blood can be forced into your nose, mouth, or mask.

Diving Science

Other Air Spaces

Any air space trapped in or around your body will be affected.

- **Stomach and intestines**
  - Any gas that forms in your stomach or intestines during your dive will expand during ascent. This will not present a problem because of the elasticity of the chambers.
- **Teeth**
  - There is nothing you can do to equalize air pressure in a tooth.
- **Mask space**
  - When you feel the mask pushing into your face, simply exhale a small amount of air through your nose into the mask.
- **Dry suit**
  - To keep the suit from squeezing, simply add air to the suit using the power inflator valve.

What have you learned so far?

- What are the three primary air spaces a diver needs to be concerned about?
- What is the difference between a squeeze and a block? Of the two, which would most commonly affect a diver's ears?
- Describe the correct equalization process for descending.
- If you experience middle ear block, what would the initial procedure be?
- Explain why you would get a mask squeeze and how it is relieved.

Next Section: ***The Anatomy of Your Lungs***

The Anatomy of Your Lungs

Your lungs consist of millions of tiny air sacs, called alveoli.

Lung over-expansion injuries:

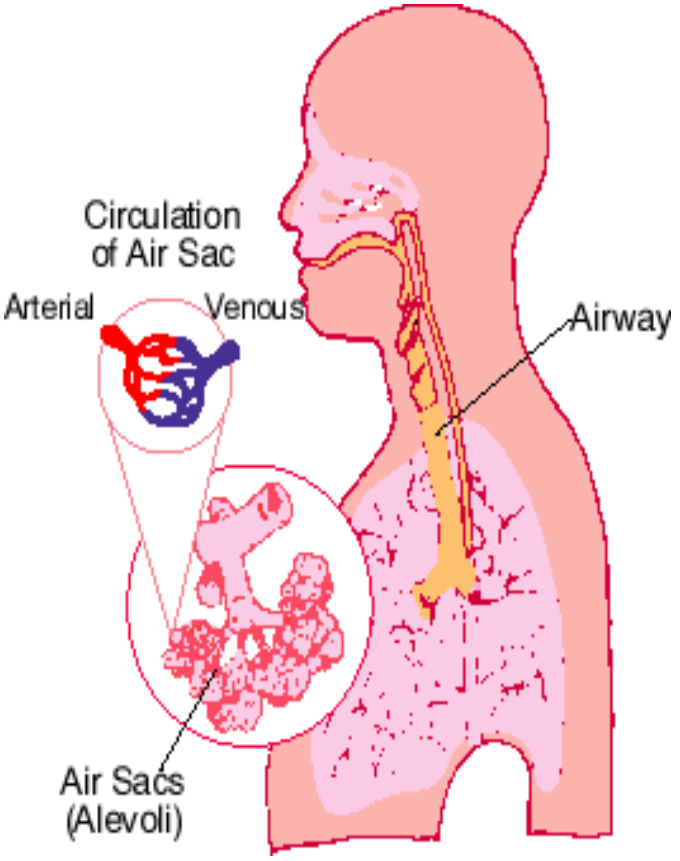
With your airway closed, the air expanding in your lungs will cause the alveoli to rupture soon after they reach their full volume.

There is no sensation of discomfort that warns you when this rupture is about to occur.

This type of accident most commonly occurs when divers panic under water and make a rapid ascent holding their breath.

The best technique is to maintain normal lung volume during your slow ascent by breathing normally. Out of air, you must allow a steady stream of air to escape through the airway.

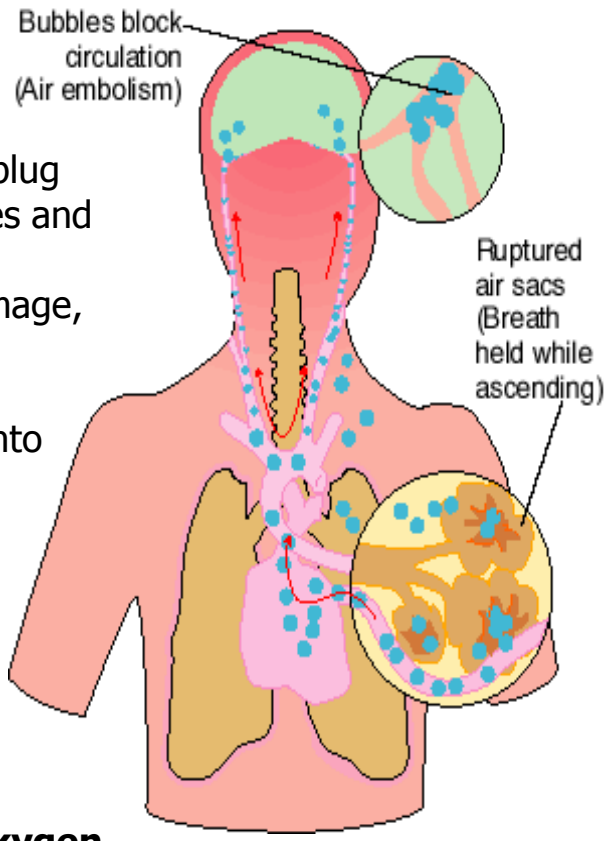
As long as you breathe normally during ascent there is little danger of suffering a lung over-expansion injury.



Over-expansion injuries

Lung over-expansion injuries There are three general types of injuries.

- **Air embolism:**
  - The most serious injury
  - The word embolism means plug. An air embolism refers to a plug of air in the bloodstream. It is caused when lung tissue ruptures and air bubbles pass into the bloodstream.
  - It can cause unconsciousness, paralysis, permanent brain damage, and even death.
- **Pneumothorax:**
  - When the air escaping a lung ruptures the lung, the air gets into the plural lining surrounding the lung, which collapses the lung.
- **Tissue Emphysema:**
  - Mediastinal emphysema
    - Air escapes into the chest cavity
  - Subcutaneous emphysema
    - Air collects under the skin, usually in the neck area



Hyperbaric Treatment

- **If you suffer an air embolism, you will need first aid oxygen and to be treated in a recompression or hyperbaric chamber.**

You should never go back under water to try to relieve symptoms.

What have you learned so far?

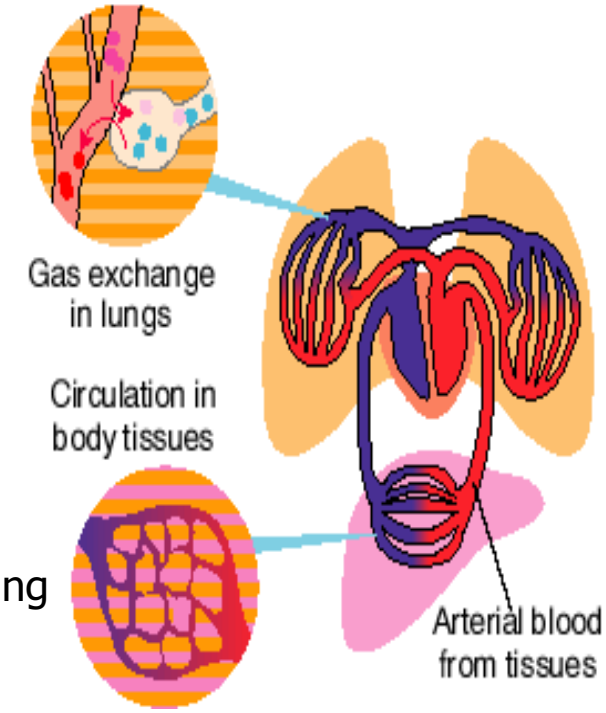
- You have learned that when the alveoli are about to rupture that it causes no discomfort and gives no warning. Why do you suppose this is, and why is it particularly dangerous?
- What precautions and procedures must be followed to prevent this?
- Name two over-expansion injuries.

Next Section: ***Breathing and Circulation***

Breathing and Circulation

Transporting oxygen through your body is a vital function of the circulatory system.

- **Carbon dioxide (CO_2) controls your breathing.**
  - Your breathing rate is controlled by the amount of carbon dioxide in your bloodstream.
- **How to breathe under water.**
  - For maximum efficiency, your breathing should be slightly slower than normal and deeper than you usually breathe.
- **Shallow breathing.**
  - If you breathe too shallowly, you do not exchange enough air with each breath.
  - Be especially sure to exhale fully with each breathing cycle
- **Hyperventilation:**
  - Deliberately breathing deeply and rapidly.
  - As you have learned before, deliberate hyperventilation can be hazardous when you follow it with a breath-hold dive.



Breathing and Circulation

- **Skip breathing:**
  - When a diver skip breathes, he holds each breath for an extended period of time rather than breathing normally.
  - Two dangers: lung over-expansion injury and build up of carbon dioxide in the body. One symptom of CO_2 build up could be a headache, which should be soothed when breathing is returned to normal.

- **Air Starvation:**
  - Regulators have a limit as to how much air they can give you.
  - If you feel starved for air, and you feel that your regulator is not supplying you with the amount of air you need:
    - Stop what you are doing, rest, and breathe slowly and deeply until you recover, being sure to exhale fully with each breath.

What have you learned so far?

- For maximum efficiency, what is the correct breathing procedure?
- If, for whatever reason, you feel starved for air, what is the recovery procedure?

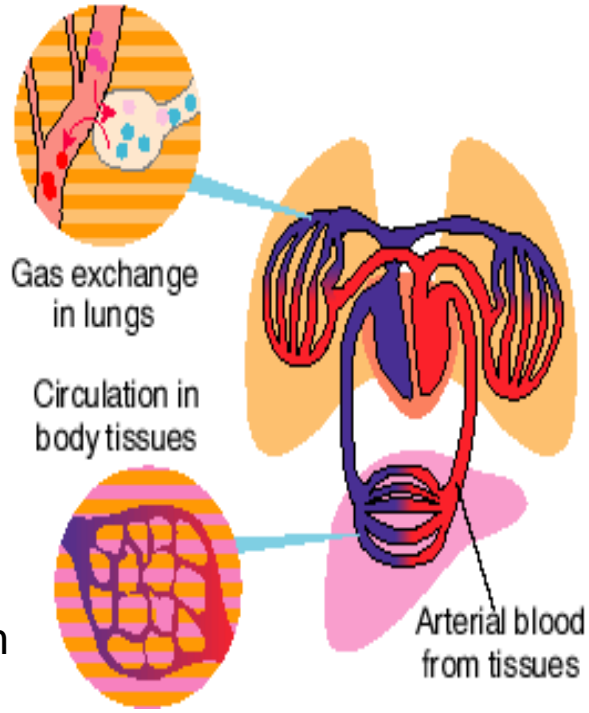
Next Section: ***Indirect Effects of Pressure***

Indirect Effects of Pressure

These indirect effects of pressure impact divers by means of the gases in the air we breathe while diving.

Ingassing and offgassing:

- Approximately 80% of the air we breathe is nitrogen.
- Nitrogen is an inert gas, but is absorbed and dissolved in solution in the bloodstream and tissues.
- Normally, the pressure of nitrogen is balanced between the air and your body. This state is called equilibrium.
- Under increased pressure, the air you breathe is denser which means that the partial pressure of nitrogen you inhale with each breath is increased. In simple terms, the deeper you dive, the more nitrogen is absorbed.
- When you dive, changes in the ambient pressure on your body cause ingassing or offgassing until the nitrogen is balanced between your air supply and your body.



Indirect Effects of Pressure

Decompression Sickness

Can occur if you fail to follow the time/depth limits prescribed in the Dive Tables. Excess nitrogen will have been absorbed and must be allowed to dissipate through slow ascension and calibrated stops called, decompression stops. This is offered for your information. Your training for ata2 will preclude the need for decompression stops except in extreme situations. For instance, at ata2, your single dive limit would be 205 minutes. BUT, with a 10 minute break (Surface Interval Time), a second dive to 35 feet would restrict your bottom time to just 53 minutes. Unlikely that you will do this, but it's important to understand how seriously pressure can affect the body.

- It takes time for nitrogen to enter and to leave the body. The rates of ascent and descent directly impact the body's ability to regulate nitrogen.
  - When you ascend your body begins to eliminate nitrogen.
  - If too much is still present after you surface, the excess nitrogen forms bubbles in your body.
- **When bubbles form in your blood, they can create microscopic clots that impair your circulation.**
  - Symptoms of DCS can range from skin rash, extreme fatigue, coughing and painful joints to paralysis and unconsciousness.

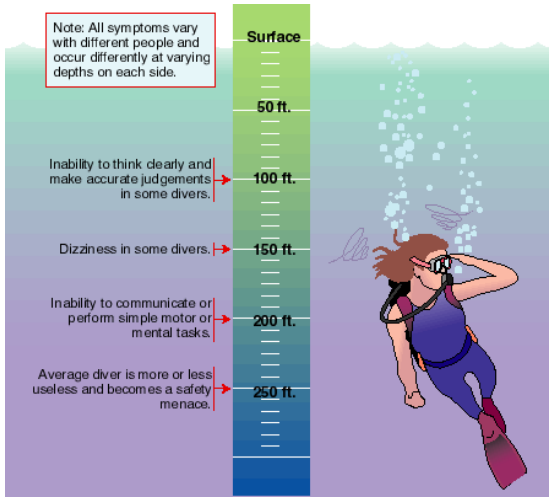
If you do suffer DCS you will need first aid oxygen and to be treated in a recompression chamber.

- ***The chamber is pressurized to cause the nitrogen bubbles to go back into solution, where they are then slowly released.***

Other Indirect Effects of Pressure

Some other diving sicknesses.

When nitrogen is under pressure it can produce an effect on your body called nitrogen narcosis, sometime called, "rapture of the deep".



- ✓**At depths approaching 24 meters (80 feet).**
  - ✓Nitrogen can be intoxicating, impairing judgment.
  - ✓Recovery is as simple as ascending to a shallower depth if you are still in control of your mental state. Nitrogen narcosis is an intoxication. The more intoxicated you are, the less control you will have over your mental abilities.
- ✓**Oxygen toxicity:**
  - ✓Would occur by consuming pure oxygen at depths below 7.5 meters (25 feet). (*This is not relevant to hookah diving, but is offered for general information*.)
  - ✓The percentage of oxygen in regular air is not toxic until well below the sport diving limit of 40 meters (130 feet).

More on diving sicknesses

✓**Carbon Monoxide Toxicity:**

✓Is formed by incomplete combustion of a petroleum product such as gasoline or oil.

✓Symptoms include nausea, blue lips and nail beds, confusion, headache, and unconsciousness. It is extremely unlikely that you will ever experience this with Air Line hookah, however you must understand the precautions:

✓The gas engine must never be used in an enclosure.

✓When deck-mounted, care must be taken to position the exhaust to where it cannot enter the breathing air system.

✓Whether deck-mounted or floating, the position of other boats with motors running, or businesses emitting exhausts must be considered. You do not want to be compressing exhaust gases for consumption by the diver. When in doubt, move.

✓Pure oxygen and medical attention are the proper treatment.

Thermal Effects of Diving

You loose heat under water in several ways.

- ✓**Water conducts heat away from you body rapidly.**
  - ✓Even in tropical waters in the mid 80 degree range, the ambient water temperature will still be lower than that of the body, and body heat will be conducted away. An obvious symptom will be shivering. Abort the dive, get out of the water, put on warm clothes and rest until comfortable. Loss of body heat is controlled by use of an appropriate exposure suit (e.g., wetsuit, drysuit).
- ✓**Humidity and temperature:**
  - ✓Humidity is the amount of water vapor in the air.
  - ✓If the air containing the water vapor is cooled, the water vapor condenses.
  - ✓When water condenses on the lens of a mask, it forms beads of water. (fogging)
  - ✓Defogging solution reduces the surface tension of the water.

What have you learned so far?

- Of the two essential gases that comprise air, which is the one that the diver must be most concerned about?
- Under what conditions might you encounter carbon monoxide toxicity?
- Will a Skin Suit afford adequate protection in tropical waters?

Next Section: ***Buoyancy***

Buoyancy

By understanding buoyancy, you can control it to your advantage for diving.

Factors Affecting Buoyancy

Your weight and your volume affect your buoyancy.

- **Your Weight includes the weight of your body and the gear you wear.**
- **Your volume depends on your body size, thickness of your suit, and your gear.**
  - As you dive deeper, the bubbles compress in a wetsuit. It will displace less water and therefore, lose some of its buoyancy, tending to make the diver sink faster. Interestingly, with hookah, this tendency is countered by the fact that, as the diver goes deeper, slightly more of the positively buoyant hose is being pulled into the water offsetting the loss of buoyancy in the suit.
  - To compensate for the loss of buoyancy when wearing a BCD, you may need to add air into it.
  - Conversely, to compensate for too much additional buoyancy, you must vent air from your BCD to control your ascent. Uncontrolled ascents are extremely dangerous.

More about buoyancy

- **The density of the water in which you dive also affects your buoyancy.**
  - If you are weighted to be neutral in salt water and you dive in fresh water with the same amount of weight, you will sink, because fresh water is less dense than salt water.
- **Neutral buoyancy beneath the surface:**
  - Is your constant goal to protect delicate marine life by not touching it. Proper buoyancy and awareness are the keys. Ideally, you should be able to hover at any depth, without sinking or rising, with no effort. Practice this important skill.

Looking more closely at how pressure affects density.

You use your air faster when you dive deeper.

- ✓**Increasing pressure:**
  - ✓The increasing pressure under water not only affects the volume of air, it also affects the density of the air.
  - ✓As the pressure increases, the air compresses to a smaller volume.
  - ✓As the air compresses, it becomes denser.

Pressure and Air Consumption

The rate at which you consume the air is directly proportional to the depth you dive.

- ✓**Other air consumption factors:**
  - ✓Your activity level during your dive
  - ✓Your mental state.
  - ✓Your body size.
  - ✓The warmth of your diving suit.
  - ✓Your level of physical fitness.
- ✓**Physical activity has the greatest effect.**
  - ✓You can use up 4 times as much as air exerting yourself than when resting. This is not a consideration with hookah as the engine runs at a fixed speed and will always supply air for as long as the engine is running, and, providing you have not exceeded the capability of the compressor.
  - ✓Develop a slow and relaxed breathing pattern.

What have you learned so far?

- Buoyancy is determined, to some degree, by weight and volume. In this context, what is meant by each?
- All things being equal, explain why you think you would sink faster in fresh water than in salt.
- A slow and relaxed breathing pattern and breathing rate will prevent what condition?

The following section deals with the effects of time and depth, and the body's ability to disburse residual nitrogen.

At the successful conclusion of this course, you will be qualified for dives to 2ata (33 feet). Although it is unlikely that you will ever have to work with dive tables unless you proceed to an advanced diving program, it is important that you at least have an understanding of the use of the tables and the limits they impose.

Residual Nitrogen

To properly use dive tables and dive computers, you must understand the concept of residual nitrogen.

- ✓**Residual nitrogen** reduces your time limits for any given depth on your next dive.
  - ✓On a dive to any depth, your body will build up nitrogen because it is being breathed under pressure therefore, much denser that at the surface. As you have learned, it is an inert gas and does not get assimilated into the body in the same way that oxygen does. You must always take the nitrogen remaining in your system from any previous series of dives into account when planning your next dive.

Dive Table Overview

The following information is offered, primarily, to alert you to the need for advanced training when you decide to go beyond ata2 depths, or repeated ata2 depths under certain conditions. Such as, if you dove, on your first dive, to 35 feet for the maximum allowable no-decompression time of 205 minutes (*improbable and virtually impossible with the continuous operating time of the gas engine*), and then took a 10 minute break at the surface, your second dive to the same depth will be limited to just 53 minutes. However improbable, this example clearly indicates the need to understand pressure/density/time relationships.

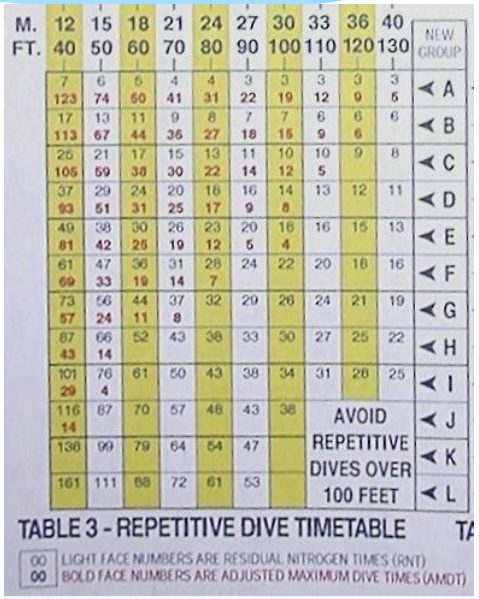
More realistically, assume that your first dive is to ata2 (35 feet) for 90 minutes. A 20 minute surface break would allow a second dive to the same depth of 138 minutes. The safest rule will be to allow a surface interval of, at least, 20 minutes and then dive to a shallower depth.

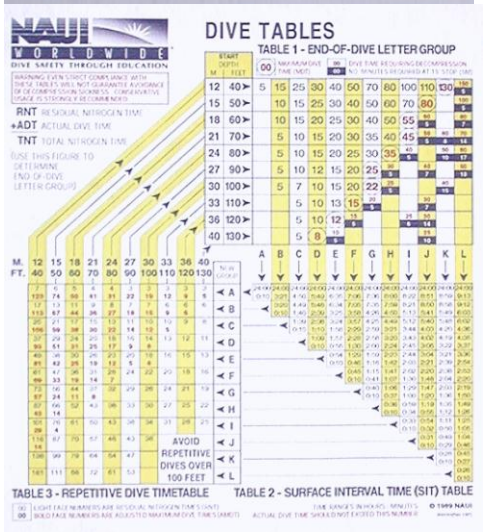
Dive Table Overview

The Dive Tables use a Letter Group designation to express the amount of residual nitrogen in your body.

✓The letters range from A to about L, depending upon the training agency.

- ✓The smaller letters represent the least amount of nitrogen. Nitrogen levels increase as you progress to the higher letters.
- ✓Spending time on the surface allows you to outgas and lowers the letter.
- ✓When you dive again, the Group Letter at that time determines the time representing the residual nitrogen in your body.





Dive Table Terms

The following apply to all Dive Tables although exact terminology might differ:

- ✓**Dive schedule.**
  - ✓This is an abbreviated statement giving the depth and time of the dive. It is expressed as depth/time.
  - ✓It is also called a dive profile, especially when it is one dive in a sequence of dives
- ✓**Maximum Dive Time (MDT).**
  - ✓This is the maximum time you can spend at a given depth without having to do a required decompression stop during ascent. This time is also known as the Maximum Allowable Dive Time (MADT), or No Decompression Time Limit.
- ✓**Decompression Stop.**
  - ✓This is a point in a dive where you stop at a specified depth for a specified time during ascent to allow nitrogen outgassing before continuing your ascent or surfacing.

Another important terms:

Precautionary decompression stop (Safety Stop).

✓This is a stop at 5 meters (~15 feet) for 3 minutes as a safety precaution when you have not exceeded the Maximum Dive Time. You should perform such a stop at the end of every dive. It is also known as a safety stop.

Special Rules

There are a number procedures you must learn to handle special situations.

- ✓**Decompression diving:** Intentionally exceeding the Maximum Dive Time is unwise, unsafe, and discouraged.
- ✓**Precautionary decompression stops:** You should stop at 5 meters (15 feet) for 3-5 minutes at the end of each dive for a precautionary decompression stop. Taking this action is recommended to help prevent DCS and to maintain control of your ascent near the surface.
- ✓**Required decompression stops:** If you accidentally exceed a Maximum Dive Time or Adjusted Maximum Dive Time, you must decompress by stages. You must stop at 5 meters (15 feet) during your ascent and stay there for a specified time to allow your body to outgas nitrogen. You must keep your physical activity to a minimum during your decompression stop.

Flying after diving;

can be harmful for a diver saturated with nitrogen because commercial airline airplane cabins are pressurized, but not pressurized to sea level. (That's why you have to swallow to equalize ear pressure) This would be especially critical if the airplane cabin suddenly lost pressure.

It is recommended that you wait 18 hours before flying in a pressurized cabin and 24 hours before flying in a non-pressurized plane. This would include even driving above 8,000 feet.

Using Dive Computers

The easiest way to determine how long you can dive is to use a dive computer.
Both dive tables and dive computers are only theoretical models of what happens in the human body.
The computer constantly recalculates as your depth changes during your dive.
BUT, a dive computer is an electronic device that can fail without warning. If it does you will have assured your safety by choosing a site in waters of ata2, or less.

If you elect to use a dive computer even for your ata2 dives, you will become familiar with the functions and terms by reading the manual and asking questions of the store employee who sold it to you. Computers usually have memory, and some are downloadable. Recording your dive history adds to the fullness of the experiences.

What have you learned so far?

- Describe how ingassing and offgassing of nitrogen affects the amount of time you can spend underwater.
- Describe the concept of residual nitrogen.
- State the procedure for a precautionary stop (Safety Stop).
- List at least three benefits of using a dive computer.

Next Section: ***Dive Planning and recording***

Dive Planning and Recording

Long Range Planning
If you wait until the night or even the week before a dive to start planning, it may be too late to pull everything together.

- ✓**Plan the objective:** you might want to practice your navigation skills or try out a new underwater camera. Your objective might also be to see a new area of the world and the diving it has to offer.
- ✓**Select the location:** Your location could be anywhere in the world, and take from a few minutes to a number of days to reach. You should also discuss an alternate location in case conditions are unacceptable at your primary location.

Short Range Planning
Determine what you need, write it down, and get it in advance.

- ✓**Typical items:** Typical items include, film, sunscreen, seasickness medication, fishing licenses, light sticks for night diving, and defog for your mask. Your list should also include spare parts for your diving equipment. (*For instance, a service kit for your compressor*)
- ✓**Check conditions:** One or two days before your trip check the weather trends, water conditions, tides, and the long-range weather forecast.

Preparing to Dive

The day or evening before, gather all your equipment and personal articles in one place.

✓**Pack your gear into two bags:**

- ✓One for your dive gear, which will have been included with your Air Line system, and one for personal items. Your personal items include your towel; dry clothing, such as a jacket; snacks; a camera and so on.
- ✓Do not pack your weight belt with your dive gear. The weights will make your bag too heavy and could damage the bag, or other gear in it.

Conducting The Dive

SEALBAG is an easy way to remember the series of steps to planning your dive. It is simply a review of many of the things that you have already learned

- **Site Survey**
- **Emergency Planning**
- **Activity Planning**
- **Limit activity to depth/time training**
- **Buoyancy**
- **Air**
- **Gear and Go**

- ✓Before you even suit up, evaluate the conditions at the site to determine if they are acceptable for your planned activity.
- ✓If the conditions are bad, travel to an alternate location or do not dive. Never be afraid to say that you do not feel good about diving in poor conditions.
- ✓The purpose of a dive is enjoyment, and there is no fun if the conditions are bad.

Diving Your Plan

You must carry out the plan you have made for your dive.

- ✓**You and your buddy must be in accord when you dive**
  - ✓This can be difficult to do even when you agree on your plan before the dive.
  - ✓If one team member varies from the plan, confusion results.
- ✓**Plan ahead when you dive**
  - ✓Accomplishing what you set out to do and ending a dive exactly where you planned is very rewarding. Just getting wet is only part of the fun.
  - ✓Consider dive planning and the ability to execute your plan as a challenge.
  - ✓This will add to your enjoyment of the dive and reduce any risks.

Contingency Planning

Contingency planning is an important part of dive planning.

- ✓**Choosing your site**
  - ✓When you choose your site, also choose an alternate site or an alternate activity for the day in case conditions are not right for diving.
- ✓**Planning your route**
  - ✓When you are planning the direction of your dive, be sure to consider an alternate route or alternate exit point to be used if conditions change while you are on your dive.
  - ✓Be sure to consider what you will do if your buddy has a problem under water.

Logging your Dive

After each dive, you should record information from your dive in your logbook. This will provide you with a historical record that you can refer to in the future should you decide to re-visit a site, of if data is needed for treatment of Decompression Sickness.

Spaces on the logbook pages

- ✓There are spaces on your logbook pages in which you record:
  - ✓The number of your dive. (A sequential number of which dive in your total history.)
  - ✓The date.
  - ✓The water visibility.
  - ✓Weather conditions
  - ✓Sea conditions
  - ✓Your deepest depth.
  - ✓Duration of dive
- ✓**Recording diving hours**
  - ✓**Logbook pages will have boxes for recording your diving hours. Use these to keep a running total of your dive time**

What have you learned so far?

- What purpose(s) does long range planning serve?
- Name three objectives of "Diving Your Plan".
- Name at least six items to be recorded in your logbook.
- Name at least two purposes for keeping a logbook.

Next Section: ***Problem Solving***

Problem Solving

You can deal with most situations if you stop to analyze and cope with them calmly.

- ✓**General Method:**
  - ✓There are three steps to solving a problem under water:
  - ✓Stop your activity.
  - ✓Get firm control of yourself and analyze the situation.
  - ✓Take action based on your analysis.

Problem solving for divers generally encompasses five areas:

- ✓Assisting Other Divers.
- ✓Rescues.
- ✓Emergencies and First Aid.
- ✓Safety Summary.
- ✓Responsible Diving Practices.

Problem Solving

As a diver you have two responsibilities to your buddy: Keep problems from occurring and overcome problems that do occur.

- ✓**Establishing buoyancy:**
  - ✓It might be necessary to help him inflate a BC, drop weights, locate a spit-out regulator.

(Regardless of what you think your buddy's reaction to a stressful situation might be, actually practice and review procedures while still on the boat.)

- ✓**Resting and breathing:**
  - ✓Once your buddy has flotation, you must get your buddy to rest and breathe deeply. Exhaling deeply will vent Carbon Dioxide build-up and will help considerably in reducing stress.
- ✓**Providing assistance:**
  - ✓Try to get your buddy to solve his own problem.
  - ✓If this is not possible, or your directions are not followed, you will have to provide direct assistance.
  - ✓The best assist is one done casually – even unnoticed.

Rescues

Most emergencies in the water are preventable, and many occur because divers violate safety rules. Effective rescues can only be achieved through training. You are encouraged to obtain a dive textbook that covers the subject for your general knowledge. There are specific, separate procedures for rescuing a diver at the surface and under water. Having a general knowledge will be beneficial, but will not take the place of formal training.

Emergencies and First Aid

You might be the only person available to offer immediate assistance. As with Rescues, specific training is recommended. Basic first-aid courses are available through non-diving facilities, such as Red Cross. Some general points:

- ✓**Be prepared**
  - ✓To prepare yourself to handle emergencies, you need training, emergency equipment, emergency contact information and plans, and the determination to act.
  - ✓The first rule is to "Do No Further Harm."
- ✓**Basic first aid**
  - ✓First aid must include the following:
    1. A quick examination of the victim to determine the seriousness of the injury.
    2. Immediate treatment for life-threatening emergencies such as cessation (stopping) of breathing or arterial bleeding.
    3. Treatment for less serious injuries and shock.
    4. Arrangements for medical care and transport.

What have you learned so far?

- State the three general methods for solving problems.
- Name two responsibilities a diver has to his dive partner (buddy).
- What is the proper preparation for handling rescues and emergencies?

Next Section: ***Avoiding Panic Situations***

Avoiding Panic Situations

A panicky diver is a danger to himself and others. Understand the causes of panic.
Breathing distress can be caused by equipment failure, or by inadvertently diving deeper than what the compressor was designed for.
Carrying an alternate breathing system and/or following your learned ascent procedures, together with the knowledge that the air hose is a link to the surface, should provide the security tools to prevent panic. If breathing is labored, usually ascending to a shallower depth reduces ambient pressure on the body and allows easier, unrestrictive breathing. (If you need to, review the sections on pressure and density)
Sense of danger can be realized from encounters with sea creatures such as sharks, barracudas and eels. Understanding (and appreciating) all sea life including the beauty and behavior patterns of even the largest creatures will soon make you realize that Hollywood is not in the education business. You are not an acceptable tidbit in a shark's diet. Shark attacks happen near surf zones to people like surfboarders whose outline looks like a predator's natural food.
Spear fishermen sometimes put themselves in harms way by not handling a speared fish with some distance between the fish and the diver's leg. Painful and dangerous, but not the shark's fault. (That's why there are things called, stringers.)
The best way to handle encounters is respect. Avoid aggressive moves. These are wild creatures and usually will only inflict damage if they feel threatened.

Be prepared to recognize the panic response. Some signs:

- **Erratic, uncoordinated movements.**
- **Wide-eyed, fearful look.**
- **Erratic breathing pattern.**
- **Ineffective kicks.**
- **Flailing arms.**
- **Difficulty maintaining positive buoyancy on the surface.**

Avoiding Panic Situations

If you observe signs of panic in your buddy while at depth:

- ✓ Approach your buddy and identify the source of the problem.
- ✓ Face your buddy to get his attention. Your concerned, but confident, demeanor will sometimes be all it takes to ease the situation.
- ✓ In an out of air situation, use and share an alternate air system, if available.
- ✓ Without an alternate system, keep eye contact and maintain a calm demeanor, grab your hose and start a safe swimming ascent as an example of the correct procedure. There will still be urgency, but the panic will be reduced by your example.
- ✓ If your buddy's behavior is so erratic as to present a threat to you as well, back off until he calms down and then proceed with the proper response. Do all you can without endangering yourself.

Avoiding Panic Situations

If you observe signs of panic while at the surface:

- ✓ Talk calmly to your buddy to show that the situation can be controlled.
- ✓ Assist with filling a BCD, if worn, otherwise show the buddy the large straps on the compressor float that can be held onto.
- ✓ If it will help in reducing panic, either ditch some of the weights in the buddy's weight belt pockets, or place the weights on the float pan on the opposite side of where the buddy is hanging on. Be careful, of course, of a hot exhaust.
- ✓ Signal the boat that an exit is required.
- ✓ If it is a beach dive, talk to the buddy to where he is fully calm, rested and breathing has returned to normal. Make a plan for a relaxed swim back to the shore, using the snorkel. Maintain regular eye contact and signal to elicit an OK response.
- ✓ When safely back in the boat, or on the shore, review the situation with a non-deprecating attitude so that a learning episode is imbued for prevention and preparation of future episodes.
- ✓ Remember, YOU might be relying on your buddy at some time.

What have you learned so far?

- Name two situations that might cause panic.
- Name at least five signs of panic response.
- Identify five ways you can help a panicked buddy at depth.
- Identify five ways to help at the surface.
- Identify two reasons why you would review the situation with the panicked buddy after the episode is over.

Next Section: ***Safety Summary***

Safety Summary

Diving safety is primarily a matter of knowing the rules, following them, and being prepared.

✓**Diving safety involves attitude. By that is meant being open-minded and willing to learn, and use, what you have been taught.**

- ✓Being aware of safe diving practices, both generally and locally, and following them will do more than anything else to ensure your safety.

✓**Diving safety is no accident**

- ✓You have many years of experience with problem solving at the surface. Many reactions are spontaneous. The underwater world will offer other challenges in an environment with which you have limited experience. Know and practice safe, responsible diving practices.
- ✓By applying these principles, you will see for yourself that the saying *"Diving safety is no accident"* is not merely a play on words.

Summarizing Safe Diving Practices

You must be trained for what you plan to do.

✓**Your training should continue.**

- ✓Full enjoyment of the sport of recreational hookah diving will be achieved with continued education in advanced skills, specialty skills and a refresher course if you should stop diving for a long period of time.
- ✓Only dive when you are feeling well, mentally and physically.
- ✓Annual physical examinations are important.
- ✓Do not dive under the influence of drugs, including prior indulgence in alcohol.
- ✓Keep yourself in good physical condition, know your limits, dive within them, and maintain a reserve of energy and air as margins of safety.

What have you learned so far?

- We often hear "attitude" as a negative thing: "That person has an attitude." How does the word apply to diving?
- Why is skill practice particularly important for a diver?
- If you have successfully completed a course and have several dives logged, why would a refresher be of any value if you were out of the sport for a period of time?

Next Section: ***A look at other diving situations***

A look at other diving situations

You can deal with most situations if you stop to analyze and cope with them calmly.

✓**Disorientation** can be caused by things such as low visibility (claustrophobia), cold, entanglement and loss of contact with a buddy. One of the results could be dizziness.

- ✓To overcome dizziness, hold onto a solid object or hug yourself until the dizziness passes.
- ✓Do not close your eyes.
- ✓To know which way is up, look at the position of the hose, it will always be in the direction of the surface. Also, look at your bubbles; air always rises.

The Diving Environment

Physical Characteristics of a Site
The characteristics of a site will dictate how you enter and exit the water as well as how you dive.

➢**Type of sites:**
Divers will dive almost anywhere there is water, but they are mostly, and understandable, attracted to interesting underwater formations both natural and man-made. Understanding your limitations in training and the attributes of your gear will tell you how a particular site should be approached and managed. For instance you will never attempt a wreck, oil-rig or cave penetration on a hose system. Always be aware of obstructions and potential hose entanglement situations. Should the hose become entangled in some obstruction, consider it to be a minor inconvenience. Don't keep tugging in the hope that it will free itself, but simply follow the hose to the obstruction and deal with it. If it is a wrap that can be undone by hand, do so. If there are many hose loops, use the swivel at the junction of the down hose and whip hose to spin the hose in the opposite direction of the loops. The loops will probably work themselves out under tension, but the untwisting will ensure the integrity of the hose.

Water Conditions

Temperature and visibility are probably the two most important factors in determining the ease and comfort of your dive.

Visibility:

- ✓The locale, seasons, weather, water movement, composition of the bottom, and other factors affect underwater visibility.
- ✓Several problems relate to visibility.` The most common is disorientation.
  - ✓With limited visibility, you can become disoriented and dizzy from a lack of visual references while you are submerged. (*Managing disorientation is discussed above*.)
  - ✓In extremely clear water, estimating distances can be difficult.
    - ✓The surface, your boat, and other things appear closer than they are.

Low visibility does not mean a ruined dive. High visibility and extraordinary visual formations every time would be great, but make the best of what you've got. Being careful of what you touch, other rewards might and will await you: an unusual shell, a strange fish in a hole, a discarded artifact.

Moving Water and its Effects

Understanding what sets water into motion, how the water moves, and how to function effectively in moving water.

✓**Waves:**

- ✓As wind blows across the water, it transfers its energy to the ocean.
- ✓The water starts to push into peaks and valleys to become waves.
- ✓In the open ocean, these waves are called swells. With increasing wind, or as the wind blows for a longer time, larger swells forms.
- ✓As waves enter shallow water and are affected by the bottom, they break and form surf.
- ✓The larger the waves, the larger the surf.
- ✓The *surf zone* is the area where waves are breaking as the water gets shallower closer to shore.

Conservation

As a diver, you can have a profound effect on the underwater world. You are a visitor and have an obligation to your host: the earth.

✓**Negative impacts.**

- ✓If you are careless about your buoyancy control, it is easy to break off pieces of coral.
- ✓Once you break coral or touch it, it dies.
- ✓If you stir up large clouds of sand or silt, it can smother the polyps, which are the living organisms that make up coral.
- ✓Collecting shells is one of many diving activities. Collect only empty shells, although the temptation might be great to do otherwise. Every living creature taken from the sea impacts the resource negatively.
- ✓Do not disturb wildlife. Spear fishing is a hunting sport and should be done selectively. If done intelligently, it can have less of a negative impact than using fishing tackle.

✓**Positive impacts**.

- ✓To have a positive effect on the environment, you must develop good personal diving skills and habits.
- ✓Strive, and practice, to perfect your buoyancy control so you always remain a few feet above the reef or bottom.

✓**Cleaning up the environment**.

- ✓Synthetic materials such as plastics can last for years in the marine environment and harm numerous animals.
- ✓Plastic trash bags are especially harmful to sea turtles. These animals regularly feed on jellyfish as part of their diet, and a plastic bag floating in the ocean resembles a jellyfish closely enough that a sea turtle will eat it.

A final quiz.

- **Name three things that can cause disorientation.**
- Name two ways to overcome disorientation.
- What happens when you touch coral? And why?
- Name two ways that you can positively affect the environment.

Congratulations! You've reached the first objective in your quest to be a recreation hookah diver. The exciting part is yet to come: Using your skills in the water. Enjoy the experiences, but take what you've learned seriously.

You will now be in the hands of a professional instructor who will sharpen your skills with practical applications. When you complete that part of your training and are awarded your certification, you are still not finished. Every dive should be a learning experience. Observe, talk to your diving associates, exchange information, ask questions, answer questions. Above all, BE RESPONSIBLE.