



## Rocky Mountain Aquatics School of the Dolphins P.D.I.C. Training Center

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**NOTE:** Go to YouTube and search for Lee Burnham  
Watch the Scuba Basics Video as an Introduction  
Watch the Dive Table Video with the Study Guide  
In front of you.

**Basic Course Cost           \$240.00**

Track our schedule and pay fees at <http://www.scubalee.com>

### **SCUBA STUDY GUIDE PACKET - Available online:**

The following material has been put together to assist you to gain all the information that you need in order to pass the final examination. The following must be completed before you can be scheduled for your Open Water Experience:

1. All forms completed and signed
2. Written Examination passed.
3. All fees paid.
4. Pool performance test completed

**RESOURCES:** Go to YouTube and search for "Lee Burnham" There you will see two Videos: "Scuba Basics" and "Dive Tables" These two videos will contain most of the materials you need for the written test. Watch the Dive Tables Video with the Study Guide in your hands and follow the Dive Table problem in the Study Guide.

#### **ADDITIONAL FEES:**

1. Optional Text: *Scuba Diving* by Dennis Graver [http://www.pdic-intl.com/products/prod\\_desc.cfm?prod\\_id=60](http://www.pdic-intl.com/products/prod_desc.cfm?prod_id=60)  
(or Amazon.com \$9.00 to \$24.00)
2. Optional DVD: SCUBA made easy ([www.ScubaOnDVD.com](http://www.ScubaOnDVD.com)) or Amazon.com rent for \$1.99 or buy \$20.00
3. Fitness Center Entry: \$4.50 each time
4. Crater Entry Fee: \$21.00 each time + \$7.50 for your tank

In the Open Water portion of the certification process you will experience Open Water Dives on TWO different days. Make arrangements for Open Water by:

SENDING AN EMAIL TO [tlbclb@aol.com](mailto:tlbclb@aol.com) with OPEN WATER in the subject line (very important to keep it from being lost) indicating when you are available to go to the Crater. The schedule is from 10 to 12, 12 to 2, 2 to 4, 4 to 6 and 6 to 8.

Be sure to make arrangements for your Open Water date at least two weeks ahead and confirm your participation before the time. Students who schedule Open Water time and then do not participate on the scheduled dates will be charged an extra fee. Scheduling time at the Homestead Crater is difficult on Saturday.

**NOTE: Once you have completed all of the requirements for certification you will need to supply a digital picture by sending to [tlbclb@aol.com](mailto:tlbclb@aol.com) with PICTURE in the subject line.**

## SCUBA DIVING REVIEW PACKET

**T. Lee Burnham, Ph.D.**

Getting into the underwater world is called DIVING, and by our definition, no one is really a diver until he can function underwater in EASE, COMFORT and SAFETY. These three things are necessary to enjoy diving. If you find that it is hard, uncomfortable or dangerous you will not find it fun for recreation. Our goals are clear. The purpose of this introduction to snorkeling part of this course is to make diving EASY, COMFORTABLE and SAFE.

Our first problem is that we are land animals and we are dependent on air for survival. We are not designed to move very easily in the water. Air breathing mammals in the water, such as the porpoise and the whale, have adapted their bodies for life in the water.

WE USE EQUIPMENT TO ACCOMPLISH THE SAME THING. To a certain extent, we use EQUIPMENT to simulate what these animals have done through evolution. For example, to make breathing easy and efficient in the water, whales and porpoises move their noses to the top of their heads. This makes it possible for them to go to the surface and breathe without having to struggle to hold their head out of the water. We do the same thing with a snorkel. A snorkel moves our breathing apparatus to the top of our heads. That position makes it possible for us to REST on the surface and move with the same efficiency while we breathe. On the surface in the water, the only way a person can rest easily is with his head floating in the water. As soon as you try to hold your head out of the water, you have to work. You have to move your arms and legs to keep your head out of the water. A snorkel makes it possible for us to rest and relax on the surface and that IS VITAL to safe diving.

We use other equipment to adapt ourselves to the water. You have to LEARN how to operate each piece of equipment AUTOMATICALLY without having to THINK about it. Learning to use a piece of equipment automatically involves establishing certain habits. In each class in the pool, you will learn specific habits. A snorkel, for example, looks simple, but actually it is one of the more complicated pieces of equipment to learn to use. The reason is that to use a snorkel, you must change your breathing pattern.

Normally, we breathe in and out and then rest until we need another breath. This occurs because it is the presence of a high level of Carbon Dioxide that regulates our breathing. In and out and then rest is the normal pattern. Think about it for a moment! You have been accustomed to breathing that way ever since you began breathing. Now you have to change, and that's a challenge! With a snorkel you must blow the water out of the snorkel before you inhale. Since at least some of the water has to go uphill to get out of the snorkel you not only have to blow, you must blow with some power. You "pop" the water out with a forceful exhale the same way you shoot a bean through a beanshooter. The breathing pattern with a snorkel is a forceful exhale, immediate inhale and then rest with the lungs full.

Breathing through the snorkel is the first habit you will learn in the pool. There are other habits that you will also learn. While you are working on these new habits you have to be careful about picking up any bad habits that may cause you problems later on in the water.

When you are learning a new skill, it is very easy to pick up a particular way of doing something that seems good to you at the time. After repeating the action a few times, it becomes a habit ... it feels very natural to you to do the exercise in a particular way, and you do it automatically. This is good when the exercise you learn is right. Then you want it to become a part of your total automatic way of doing things in that particular skill. For example: the proper breathing pattern with a snorkel is a good habit.

The problem comes when you develop a habit that later on you find out you do not want, and you try to retrain yourself to do something different. While you are learning, do everything exactly as we tell you to do it and don't experiment with anything else.

FOR EXAMPLE: It may be the first time you have worn a diving mask for any period of time and you may find that it doesn't feel very comfortable. Your nose is inside, you have to breathe through your mouth and your vision is restricted. Because of this, after having your face in the water, when you bring your head up, you may have an urge to put the mask upon your forehead. "I can breathe better with it up there." You see something else you want to look at underwater. Your mask goes back on your face and when you come up again it goes back on your forehead. Repeat that process a couple of times and you have formed a habit of putting your mask up on

the top of your head every time you bring your face out of the water. In the ocean particularly, this is not a good habit.

It takes some doing to do it right. If you have the habit of putting your mask up every time your face comes up, you will find yourself repeating this process of seating your mask over and over again on a dive. This bad habit makes it very likely that the ocean will take your mask and snorkel away from you. Without a mask and a snorkel you are not in a condition to be safe in the ocean. The only way you can really rest is face down and breathing through the snorkel. With your mask on the top of your head, when you want to rest you must wait until you get your mask reseated before you can relax. If you are tired and working hard when this happens, the hassle of getting the mask back on can make a minor problem of fatigue much more serious.

So putting your mask on the top of your head is a bad habit. It is very inefficient. You will have a problem resting and a real good chance you will lose the mask.

To avoid forming this habit, keep the mask on your face. Get used to it on your face, that is where it belongs, so that it feels comfortable. The mask is NEVER worn on the top of your head. To help you with this just observe the rule: KEEP YOUR MASK ON YOUR FACE. REMEMBER, keep your mask on your face all of the time. No masks on foreheads at anytime.

This is just one of the many bad habits you might acquire. When you are learning something new, you form habits very quickly. This is good when they are good habits. Bad habits cause real problems in diving. To make the learning process quick and easy and as effective as possible, build good habits by practicing exactly what you are told to do.

As land animals you have inherited certain instincts which are designed to help you avoid drowning in water and to avoid hurting yourself in case you were to begin to fall. When you learn to dive, you are converting yourself from a land animal to a water animal. In fact, as a diver, your land animal instincts can actually interfere with your safety, and must be trained out.

To be safe in diving, we have to train out the SWIMMING instinct by learning to put our face down in the water and use the snorkel to rest. We don't use our arms. We leave them relaxed and free and use our fins to move. This sounds simple in the classroom but your swimming instinct is probably a little stronger than you realize.

All animals have a strong instinct to ESCAPE out of an area where they feel endangered, into an area where they feel more comfortable and out of danger. People trying to get out of a burning building will rush for the exits, trample on each other and trap themselves as a result of this urge to escape. In the water, if a person feels uncomfortable or insecure, his natural instincts will tell him to get out however he can and head for safety. In diving this is often the exact opposite of what you should do. The proper way to solve fatigue is to float face down in the water and rest, using the snorkel to breathe. The proper way to solve a problem under water is to STOP, THINK AND GET CONTROL. To rush to shore can lead to difficulties. As a land animal you will react immediately any time you feel you are in danger of being in any less than a vertical position. This reaction under water will cause more problems by making you wallow around and perhaps even force yourself to the surface. You must overcome this by simply letting your body find its own position. You might be slightly off center but in the water this cannot hurt you. We refer to this as a FIGHT FOR POSITION.

You will have a series of experiences to prepare you for open water training where you really learn the necessary diving techniques. In the open water, you learn by doing the skill. Direct experience. You cannot learn to dive by hearing about it in a classroom or doing a few things in a pool. You learn to dive safely by doing everything you will need to do in a controlled situation until you are confident you can do it in a real situation whenever necessary. That's what happens in the open water training classes.

In addition to training in the proper habits and training out instincts, and learning all the techniques to make diving easy, there is also some knowledge about diving that helps you make the right decisions. All the knowledge you need for enjoyable sport diving is included in the course material.

## **AREAS OF KNOWLEDGE THAT ARE IMPORTANT FOR SCUBA DIVERS:**

### **I. EQUIPMENT:**

1. SCUBA tanks should be stored with pressure in them to keep out moisture and other contaminants. They should be stored for any length of time in a carefully secured upright position with at least 100 psi of pressure.
  2. SCUBA tanks must have a visual inspection ONCE a year. They must have a hydrostatic pressure test every FIVE years.
  3. Oxidation in a steel tank produces rust which weakens the structure of the tank. Oxidation in an aluminum tank produces aluminum oxide which coats the aluminum preventing further oxidation, thus preventing structural damage.
  4. As a sport diver you use a SINGLE-HOSE, TWO-STAGE, OPEN-CIRCUIT, DEMAND, Regulator. Do not ever attempt to use a closed circuit system without very specialized training
  5. The simplest depth gauge is a capillary gauge. It is most accurate at shallow depths and corrects for altitude as far as the dive tables are concerned.
  6. Tanks are usually filled standing in water to keep them from over heating.
  7. The submersible pressure gauge is an important and necessary piece of equipment. Do not ever attempt to dive without one. Use it to keep track of your air consumption and never let it go below 500 psi before starting to ascend to the surface.
  8. A tank with a plus (+) on it following the manufacture date may be over-filled by 10% for five years.
  9. All equipment should be fastened with some type of quick release fastening.
  10. Your regulator should be cleaned in fresh water after every dive and serviced and inspected by a qualified person once a year. Always keep the dust cover in place and the purge valve closed when not in use and avoid getting water into the system.
  11. The markings on a tank tell you some important information. The first line of information contains three things.
    - DOT (The tank has been approved by the Department of Transportation)
    - 3AA (The type of metal used in the tank)
    - 2250 or 3000 (The working pressure of the tank)
- The next line contains the serial number of that specific tank  
The bottom line contains the manufacture and first test date of the tank.
12. If water temperature is 75 degrees or lower you will need at least a ¼ inch wet suit.

## II. HABITS AND PRACTICES:

1. When using scuba, always dive with a buddy and **keep within reaching distance.**
2. The depth limit for the experienced sport diver is 100 feet.
3. When separated from your buddy, look around for one minute and then surface and stay there.
4. When you are using mask, fins and snorkel without scuba you and your buddy should surface dive one at a time so that there is always a safety diver on the surface.
5. Remember that water takes heat away from the body 25 times faster than air.

## III. INCREASING PRESSURE AS YOU DESCEND IN THE WATER

Underwater, a big problem we have to face is changing pressure.

Normally, at sea level, a body is subjected to 14.7 pounds per square inch, or "P.S.I." of pressure. That's the weight of all the air in the atmosphere on one square inch at sea level. 14.7 pounds per square inch is one atmosphere of pressure.

Every 33 feet you go down underwater in the ocean, you add another atmosphere of pressure, or another 14.7 pounds per square inch.

UNDERWATER PRESSURE

<u>Depth</u>	<u>P.S.I.</u>	<u>Atmospheres of Pressure</u>
0	14.7	1
33	29.4	2
66	44.1	3
99	58.8	4

At 33 feet, the total or "absolute" pressure per square inch is the combined weight of the column of sea water (14.7) and the column of air above (14.7) for a total of 29.4 psi or two atmospheres.

If you were to take a balloon full of water underwater, no matter how far down it went, even 7 miles down and subjected to about 3 tons of pressure, it would still be the same size balloon.

On the other hand, if you were to take a balloon full of air and take it to a depth of 33 feet the balloon would be exactly half the size.

This illustrates the fact that the major difference between air and water is that air is compressible and water is not. Our body is mainly water and therefore is unaffected by pressure except where air spaces exist.

Any time pressure differences occur we refer to it as a "squeeze." There are three air spaces we must consider to prevent injury from "squeeze" as we dive down into pressure. These spaces are:

- MIDDLE EAR      Be sure to equalize as soon as you begin to descend. If problems occur, go up a few feet and attempt to equalize. Do not go immediately to the surface. Some methods that work are: Swallowing; Pressing your tongue to the roof of your mouth; and holding your nose and gently forcing pressurized air into your middle ears.
- SINUS              Usually caused by congestion. Don't force it. It will usually equalize automatically.
- MASK                Simply breathe air out into the mask through your nose.

So, to deal with Ear Squeeze, Sinus Squeeze or Mask Squeeze you must simply be sure that you equalize the pressure. If you are equalizing the pressure properly, your ears should feel completely normal at any depth. At any depth, if you feel some pressure, you should come up a little and try it again. Work at it very gently. If you go deep enough without equalizing, you can collapse the Eustachian tube, in which case you can't equalize until you come up enough to release some pressure. The amount of time you tolerate pressure without equalizing is an important factor. After ten seconds on the bottom you may have a slight swelling of the blood vessels. Thirty seconds, blood blisters have formed on the drum. Forty seconds on the bottom without equalizing and the person has a ruptured ear drum. **DON'T TOLERATE ANY DISCOMFORT IN YOUR EARS.**

If you were to break an ear drum it would not result in any permanent damage to the drum or your hearing. It heals over fairly soon, but you are usually advised to stay out of the water for a few weeks to give the ear drum time to toughen up again. Since you would have cold water running into the middle ear, the result would be extreme vertigo, which means complete disorientation and dizziness.

Just relax and get control. As the water warms up your balance will return. Signal to your buddy to assist you to the surface. **VERTIGO** is the only danger from a ruptured drum, as long as you understand what is happening and don't lose control. It is, of course, better to just learn to equalize so that you don't get an ear squeeze.

The next problem that can occur from going down into the water will only occur if you go deeper than 100 feet. At this depth and below the nitrogen in your breathing air will begin to act like nitrous oxide or laughing gas and make you act very silly. The impact of this condition is called **NITROGEN NARCOSIS** and by itself it is not

dangerous. What IS dangerous is what you might do while in this state. You might try to give your regulator away to a fish. You can avoid this condition by not going below 100 feet. If you did go too deep and begin to act silly - all you have to do to end the condition is to come up above the depth at which the condition began.

#### IV. PROBLEMS RESULTING FROM GOING TOO DEEP FOR TOO LONG

The problem that can result from accumulating too much Nitrogen in your body is called **DECOMPRESSION SICKNESS**. This can be a very serious condition. The breathing gas that we use on SCUBA is regular air which consists of 80% Nitrogen and 20% Oxygen. As a result of Nitrogen being present in the blood stream under pressure it slowly gets absorbed by the tissues of the body. This creates millions of tiny soda bottles in the body. With this gas under pressure, you have to be careful about how fast you come to the surface and how long you stay down. Problems can be avoided by knowing how to use the Dive Tables and using them. Some precautions are:

- A. Ascend at a rate of 60 feet per minute or slower with a much slower rate as you draw nearer to the surface.
- B. When diving at altitude, use the high altitude conversion tables or use a capillary depth gauge. It is wise to restrict your depth and time at altitude.
- C. Do not fly for 24 hours after a dive. Consider the altitude of any roads you will have to drive on after diving.

If you have been out of the water for 12 hours you can consider yourself to be starting a new dive sequence without any Residual Nitrogen Time. If you have not been out of the water for 12 hours you must still account for Residual Nitrogen Time from your last dive.

Professional Divers who regularly stay down for extended periods of time MUST use the decompression tables which indicate specific decompression stops at 20 feet and/or 10 feet for a period of time to allow the nitrogen to work its way out of the body. If you were to stay down longer than you should or come up faster than you should, Decompression Sickness or The Bends could occur. This means that Nitrogen Bubbles have formed in the tissues of your body. The symptoms of Decompression Sickness is commonly pain in the joints or extremities within a 24 hour period. The proper first aid for Decompression Sickness is to give oxygen and transport to a recompression chamber where the only treatment is available. Call the Diver Alert Network (DAN) at (919)684-2948 for information regarding serious diving emergencies.

#### V. THE OCEAN ENVIRONMENT:

1. You are the most dangerous animal in the water. Use caution and common sense.
2. If caught in a rip current, swim parallel to the beach.
3. A rip current reduces the size of waves.
4. A thermocline is an abrupt change in the temperature of the water. It is two layers of water at different temperatures.
5. When diving, start out against the current.
6. Sharks should be considered unpredictable. Stay together, move slowly, and keep the sharks in sight.
7. Cone shells can be poisonous. The poison barb comes from the small end. Pick them up from the large end.
8. Most (if not all) toxins used by marine animals are protein based and are either destroyed or neutralized by heat or by dilute ammonia.
9. Waves are caused by winds. In each location the specific wave sets that occur have been caused by the combining of a series of different wave patterns coming from different directions. Before beach diving, observe the particular wave pattern on that to know when the smaller wave sets are happening and time our entry accordingly.
10. On a beach that has a steep slope or a drop off, the waves will crash right on the beach. This can be a hazard if you are not aware.

#### A BRIEF DESCRIPTION OF WEATHER PATTERNS AND THEIR EFFECT ON DIVING :

Getting into the ocean from the beach poses a distinct set of considerations. A basic knowledge of weather and its effects is essential. You must know how to interpret the different CURRENTS, WINDS, WAVES, AND TIDES in order to choose the proper site for a particular day. The advanced diver learns not only how to interpret the weather but how to work with the winds, currents, and swells and incorporate them in his total dive plan.

The biggest problem shore divers face is not in the water or on the land. It's where the two meet! In other words, where the waves pound you into the rocks and grind you on the beach! Waves are caused by winds.

Winds blowing over water produce waves. The water is not moving laterally as it appears. It's merely moving up and down. Nevertheless, waves soon turn into swells and can cause severe loss. The main source of problems in this category for divers is not paying attention to wave patterns.

Another potential hazard to shore divers is CURRENT. Currents are the result of several factors. First let's discuss the effect of the tides.

**TIDES:** You should know that tides are caused by the gravitational pull of the moon on the earth's surface. It's more complicated than that, but basically the moon pulls the water away from the solid earth slightly as it travels around the earth. The sun also exerts a pull on the water but is not as noticeable as that of the moon. There are periods of extra high tides when the sun and moon line up about twice each month. The difference between high and low tides is regularly approximately 2 feet. As the tides rise and drop they cause the water to move. As the tide rises water moves toward the shore and vice-versa during periods of low tide. High tides are called flood tides and low tides are called ebb tides. Currents caused by tides seem to be the most serious threat to shore divers. Strong running tidal currents can be fast enough to outpace your rate of surface swimming. If you are forced to swim on the surface against it you may not be able to make any headway. The water may even be running one direction on the surface and the opposite underneath. Be prepared to adjust your dive plan accordingly after you see which direction the water is running. A little forethought can help eliminate the need for drastic measure. Whenever possible, head into the current on the way out and swim back to your exit point WITH the current.

**OCEAN AND TRADE WIND DRIVEN CURRENTS:** Both oceanic currents and those driven by the trades run an average of .5 to 1 knot in velocity. They can swirl around and create a somewhat confused picture. They're not usually as strong as the tidal currents and are much more predictable. Consequently, they pose less of a problem to shore divers. In the case of real emergency, when scuba diving, one can always pull him or herself along the bottom against strong currents. Grab something solid but try to avoid coral, since coral polyps are very fragile and are crushed easily by the diver's gloved hand.

Finally, to find out the prevailing weather conditions in the various locations, you need to utilize the services of the NATIONAL WEATHER SERVICE. The National Weather Service issues marine weather forecasts for all locations and updates them several times during the day. The forecasts may be obtained by listening to various radio broadcasts or by phoning for a recorded message.

Ideal conditions exist when the forecast calls for light and variable trade winds 5 to 15 mph and seas 2 to 4 feet in the coastal areas and 4 to 8 feet in the channels. Seas of 8 to 12 feet are becoming too large for safe entries unless you know of certain "protected areas". Use these phone numbers continuously to keep yourself on top of the entire weather picture during your stay and plan your dives accordingly.

## V. PROBLEMS FROM DECREASING PRESSURE AS YOU ASCEND

Lung Overexpansion: As you ascend, the pressure decreases and the air in your lungs expands. If you are breathing regularly this cannot cause you a problem. Lung Overexpansion occurs when you forcefully hold your breath. Looking up as you come up not only helps you to avoid coming up under something but also helps to keep the airway open. If this problem were to occur, the air that bursts out of the lungs can go to various places and cause the following problems:

- A.     **AIR EMBOLISM**           Where the air gets into the bloodstream and could get into the head where it would be fatal. This requires a recompression chamber to eliminate the air bubbles. Any time there is a suspected Lung Embolism you should assume that an Air Embolism may occur. It is the worst thing that can happen to a diver and is easily prevented.
  
- B.     **MEDIASTINAL EMPHYSEMA**       Here the air collects in the middle of the chest under the sternum. This would require removal of the air by a doctor.

- C. SUBCUTANEOUS EMPHYSEMA Here the air collects under the skin at the base of the neck.
- D. PNEUMOTHORAX Air gets between the lungs and the chest cavity causing a lung to collapse.

SYMPTOMS: Red frothy blood in the mouth and unconsciousness.

FIRST AID: Keep the victim laying down and give oxygen if available. Transport to medical attention.

#### VI. INDIRECT PRESSURE AND GAS PROBLEMS

- A. HYPOXIA A lack of oxygen to the system
- B. LIPOID PNEUMONIA Caused by oil in the breathing air
- C. CARBON MONOXIDE POISONING Carbon Monoxide in the breathing air. Symptoms are a nauseous headache and red lips and fingernails. Treatment consists of breathing fresh air.

#### VIII. PHYSICS: (SURFACE AND AT-DEPTH AIR CONSUMPTION)

1. To know your air consumption at depth you must know the atmospheric pressure at that depth. If you want to know the pressure in atmospheres at any depth you can use the following formula:

$$\frac{\text{Depth} + 33}{33} = \text{Pressure in Atmospheres}$$

EXAMPLE: A. What is the pressure in atmospheres at 45 feet?

$$\frac{45 + 33}{33} = 2.4 \text{ atmospheres or } 35.28 \text{ psi}$$

\* At 99 feet the pressures in atmospheres is 4.

- B. If you spent 10 minutes at 45 feet and used 500 psi, what would your surface consumption be?

Consumption = 50 psi/min at 45 feet

$$\frac{50\text{psi/min}}{2.4} = 20.8 \text{ psi/min at the surface}$$

2. All objects appear to be 25% closer and larger underwater.
3. Water conducts heat away from the body 25 times faster than air.
4. The first color to disappear with increasing depth is red.

#### IX. DIVE TABLES AND DIVE PLANNING:

1. Bottom time is officially measured from the time you start your descent to the time you begin your direct ascent to the surface.
2. Always make your deepest dive first.
3. The three different dive tables give you the following information:

TABLE #1- Tells you the no-decompression limits and the repetitive dive group letter after a dive. This letter symbol tells you the amount of Nitrogen stored in the cells of the body. In order to use this table you must know the depth (**D**) and your Total Bottom Time (**TBT**). Remember that Total Bottom Time (TBT) is found by adding the Actual Bottom Time (**ABT**) and the Residual Nitrogen Time (**RNT**) together.



- TABLE #2- Tells you what your new group letter is after a certain length of time on the surface. In order to use this table you must know the dive group letter at the end of your last dive and to have determined the maximum depth you will descend to on the next dive.
- TABLE #3- Tells you what your residual nitrogen time is for a certain proposed depth. It tells you that if you are a "D" diver and you want to go to a depth of 60 feet, it is as if you have already been diving for 24 minutes. In other words your residual nitrogen time is 24 minutes.

**SUMMARY OF DIVE PROBLEMS:**

Dive Problem	Prevention	Treatment
<p><b>SQUEEZE:</b> Any time a pressure difference occurs in an air space: Sinus, Ears, Mask.</p>	<p>Equalize the pressure, starting as soon as you begin to descend.</p>	<p>If not equalized a ruptured ear drum may result. It will cause momentary dizziness. Stay calm, seek medical treatment.</p>
<p><b>NITROGEN NARCOSIS:</b> By going below 100 feet you breathe nitrogen that is so heavy that it acts as laughing gas and affects your behavior.</p>	<p>Do not go below 100 feet.</p>	<p>Come up above 100 feet.</p>
<p><b>DECOMPRESSION SICKNESS:</b> At any depth below 30 feet you can stay long enough to accumulate so much nitrogen in the cells of your body that you cannot safely unload that nitrogen when you come to the surface. The nitrogen expands inside the cells of the body and causes cell damage.</p>	<p>Follow the Dive Tables carefully. Come up slowly (no faster than 60 feet per minute - which is no faster than your smallest bubbles) Pause below the surface before coming up the rest of the way.</p>	<p>Transport to a recompression chamber. Give Oxygen.</p>
<p><b>LUNG OVEREXPANSION:</b> Caused by holding your breath ascending.</p> <ol style="list-style-type: none"> <li>1. Air Embolism - Air in the blood</li> <li>2. Mediastinal Emphysema - Air under the sternum</li> <li>3. Sub Cutaneous Emphysema - Air under the skin at the base of the neck</li> <li>4. Pneumo Thorax - Collapsed Lung</li> </ol>	<p>Never Hold Your Breath! Breathe all the time! Come Up Slowly Look Up as You Surface</p>	<p>Make sure diver is placed in a horizontal position - preferred laying on the left side. Transport to a pressure chamber. Give Oxygen.</p>

## PREPARING FOR THE OPEN WATER EXPERIENCE:

The whole purpose of the work you have done so far in the classroom and the pool is to prepare you for the Open Water experience. The Open Water experience is required in order to receive your SCUBA certification. There must be 5 Open Water Dives on two different days. We go any weekday and/or Saturday since Rocky Mountain Aquatics does not ever go diving on Sunday. Although most divers complete their certification on a Friday-Saturday schedule, it is also possible to complete the sequence on different weekends. Be sure to work out your schedule in plenty of time to make appropriate plans.

**FIRST DAY:**    **Dive One Skills** (Without Scuba)  
                            Snorkeling  
                            Surface Dive  
                            Diver Rescue Methods

**Dive Two Skills:**  
                            Buoyancy Check  
                            Line Descent  
                            Regulator Clearing  
                            Mask Clearing  
                            Octopus Use  
                            Buoyancy Control

**Dive Three Skills:**  
                            Free Descent  
                            Octopus Ascent  
                            Emergency Ascent  
                            Vest Ascent  
                            Buddy Contact  
                            Buoyancy Control

**SECOND DAY:**  
                            **Dive Four Skills:**  
                                    Surface Compass Snorkel  
                                    Buoyancy Control  
                                    Surface Resting  
                                    Controlled Vest Ascent

**Dive Five Skills:**  
                            Free Descent  
                            Underwater Compass Navigation  
                            Mask Removal  
                            Buoyancy Control  
                            Controlled Vest Ascent

**Open Water requirements:** You will be responsible for all costs for transportation and housing if required for Open Water. Each location for the Open Water experience will be a little different. **If you are going to do any serious diving at all you should start with your own neoprene boots as an essential piece of equipment.**

**OPEN WATER EQUIPMENT: Mask, Fins & Snorkel.** This should be considered your basic personal equipment for diving. You will be much happier if you have your own personal equipment and you know that it fits you and is adjusted specifically for you. Try it out in the pool before going to Open Water to be sure your mask is comfortable and keeps out water.

**Wetsuit:** You will be responsible for providing your own wetsuit. You will be expected, however to take the wetsuit home with you after the dive and clean it. A wetsuit can be cleaned by rinsing in the bathtub with a little liquid detergent or shampoo and some liquid fabric softener. Be sure to get both sides of the suit.

DIVE TABLE WORKSHEET:    **D = Depth**            **ABT = Actual Bottom Time**            **RNT = Residual Nitrogen Time**

TBT = ABT and RNT added together

# 1.

[ ] 2:15 [ ]		[ ] 1:30 [ ]	
D = 60		D = 50	D = 40
ABT = 40		ABT = 40	ABT = 65
RNT =		RNT =	RNT =
TBT =		TBT =	TBT =

# 2.

[ ] 2:00 [ ]		[ ] 1:15 [ ]	
D = 75		D = 60	D = 40
ABT = 30		ABT = 21	ABT = 80
RNT =		RNT =	RNT =
TBT =		TBT =	TBT =

# 3. Use the safe time limits.

[ ] 1:50 [ ]		[ ] 1:00 [ ]	
D = 61		D = 50	D = 41
ABT = 40		ABT = 32	ABT = 14
RNT =		RNT =	RNT =
TBT =		TBT =	TBT =

# 4.

	[ ] 1:00 [ ]		[ ] 1:30 [ ]	
	D = 60		D = 50	D = 35
	ABT = 60		ABT = 33	ABT = 80
	RNT =		RNT =	RNT =
	TBT =		TBT =	TBT =

# 5.

	[ ] 2:15 [ ]		[ ] 1:30 [ ]	
	D = 70		D = 60	D = 40
	ABT = 50		ABT = 40	ABT = 65
	RNT =		RNT =	RNT =
	TBT =		TBT =	TBT =

# 6. You are making a lake dive at an altitude of 5,000 ft. You only have an oil filled depth gauge which tells you exactly how far below the surface you are but makes no altitude corrections. On your first dive your maximum depth is 50 ft for 20 minutes. After a surface interval of 1:15 you do a second dive to 50 ft. for 40 min. Complete a dive profile filling in all the times and group designations.

# 7. Plan the following three dives. 90 feet for ( ) minutes with 1:30 out of the water. Then 60 feet for ( ) minutes and 2:30 out of the water. A final dive to 45 feet for ( ) minutes. Plan how long you should dive at each of these depths.

ALTITUDE CONVERSION TABLE:

ACTUAL

DEPTH ALTITUDE CONVERSIONS

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10	10	11	11	12	12	12	13	13	14	15
20	21	21	22	23	24	25	26	27	28	29
30	31	32	33	35	36	37	39	40	42	44
40	41	43	45	46	48	50	52	54	56	58
50	52	54	56	58	60	62	65	67	70	73
60	62	64	67	69	72	75	78	81	84	87
70	72	75	78	81	84	87	91	94	98	102
80	83	86	89	92	96	100	103	108	112	116
90	93	97	100	104	108	112	116	121	126	131

**DIVE TABLE PROBLEM SOLUTIONS!** (Work out the problems first before checking here)

# 1.

[ G ] 2:15 [ D ]		[ I ] 1:30 [ F ]		K	
D = 60		D = 50		D = 40	
ABT = 40		ABT = 40		ABT = 65	
RNT = 0		RNT = 29		RNT = 61	
TBT = 40		TBT = 69		TBT = 126	

# 2.

[ G ] 2:00 [ D ]		[ H ] 1:15 [ F ]		L	
D = 75		D = 60		D = 40	
ABT = 30		ABT = 21		ABT = 80	
RNT = 0		RNT = 24		RNT = 61	
TBT = 30		TBT = 45		TBT = 141	

# 3. Use the safe time limits.

[ H ] 1:50 [ E ]		[ I ] 1:00 [ G ]		I	
D = 61		D = 50		D = 41	
ABT = 40		ABT = 32		ABT = 14	
RNT = 0		RNT = 38		RNT = 56	
TBT = 40		TBT = 70		TBT = 70	

# 4.

		[ J ] 1:00 [ H ]	[ L ] 1:30 [ H ]	M
	D = 60		D = 50	D = 35
	ABT = 60		ABT = 33	ABT = 80
	RNT = 0		RNT = 66	RNT = 87
	TBT = 60		TBT = 99	TBT = 167

# 5.

		[ J ] 2:15 [ F ]	[ L ] 1:30 [ H ]	M
			7 min at 10 ft Decompression	
	D = 70		D = 60	D = 40
	ABT = 50		ABT = 40	ABT = 65
	RNT = 0		RNT = 36	RNT = 87
	TBT = 50		TBT = 76	TBT = 152

# 6.

[ D ] 1:15 [ C ]		[ J ]	
D = 50/60		D = 50/60	
ABT = 20		ABT = 40	
RNT = 0		RNT = 17	
TBT = 20		TBT = 57	

# 7.

[ G ] 1:30 [ E ]		[ J ] 2:30 [ E ]		L
D = 90		D = 60		D = 45
ABT = 25		ABT = 30		ABT = 62
RNT = 0		RNT = 30		RNT = 38
TBT = 25		TBT = 60		TBT = 100



U.S. NAVY STANDARD AIR DECOMPRESSION TABLE:

NOTE: This is a brief summary of data that fill many pages. It is intended as a useful teaching tool and not to imply that any sport diver should under any circumstances ever consider doing a decompression dive.

DEPTH	BOTTOM TIME	20 ft. STOP	10 ft. STOP	REPETITIVE GROUP
40	200		0	
	210		2	N
	230		7	N
	250		11	O
50	100		0	
	110		3	L
	120		6	M
	140		10	M
60	60		0	
	70		2	K
	80		7	L
	100		14	M
	120		26	N
70	50		0	
	60		8	K
	70		14	L
	80		18	M
	90		23	N
80	40		0	
	50		10	K
	60		17	L
	70		23	M
100	50	2	24	L

\* NO-DECOMPRESSION LIMITS AND REPETITIVE GROUP DESIGNATION TABLE FOR NO-DECOMPRESSION DIVES

DEPTH	SLA F M E T	MLA I X M I T	GROUP DESIGNATIONS													
			A	B	C	D	E	F	G	H	I	J	K	L	M	
10	-	-	60	120	210	300										
15	-	-	35	70	110	160	225	350								
20	-	-	25	50	75	100	135	180	140	325						
25	245	-	20	35	55	75	100	125	160	195	245	315				
30	205	-	15	30	45	60	75	95	120	145	170	205	250	310		
35	160	310	5	15	25	40	50	60	80	100	120	140	160	190	220	
40	130	200	5	15	25	30	40	50	70	80	100	110	130	150	170	
50	70	100		10	15	25	30	40	50	60	70	80	90	100		
60	50	60		10	15	20	25	30	40	50	55	60				
70	40	50		5	10	15	20	30	35	40	45	50				
80	30	40		5	10	15	20	25	30	35	40					
90	25	30		5	10	12	15	20	25	30						

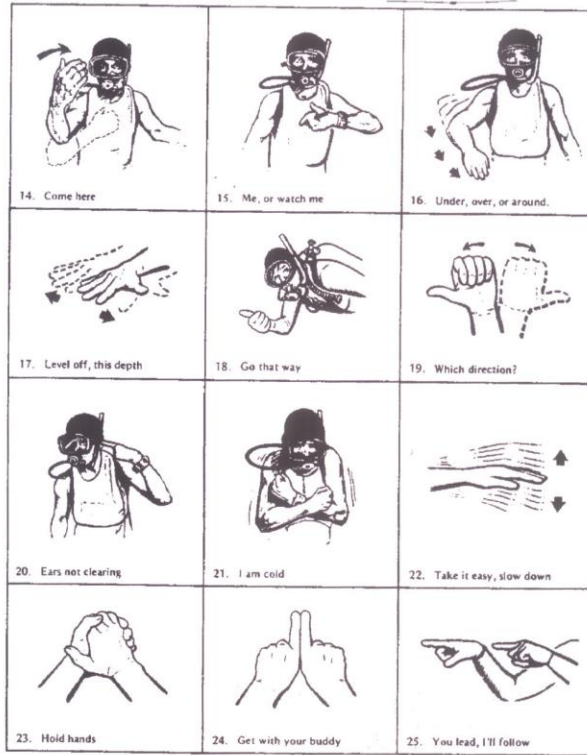
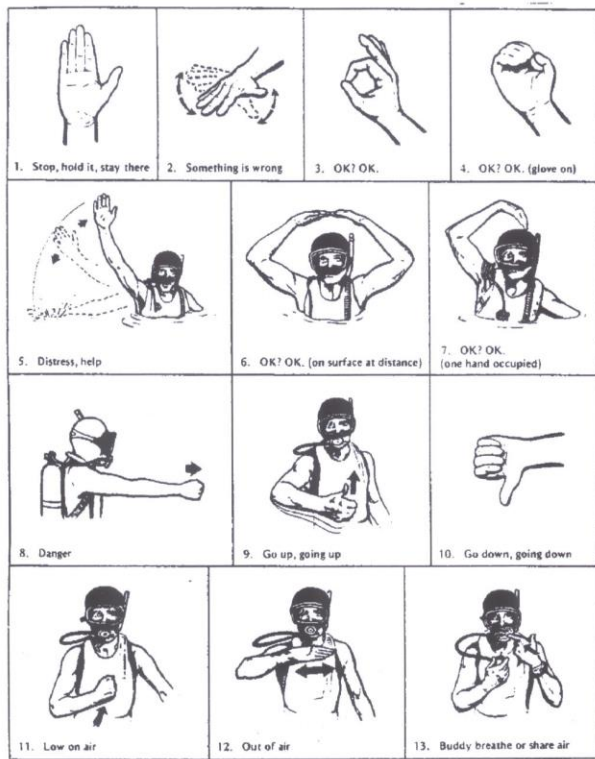
SURFACE INTERVAL CREDIT TABLE AND RESIDUAL NITROGEN TABLE															A	0:10 12:00
														B	0:10 2:10	2:11 12:00
													C	0:10 1:39	1:40 2:49	2:50 12:00
												D	0:10 1:09	1:10 2:38	2:39 5:48	5:49 12:00
											E	0:10 0:54	0:55 1:57	1:58 3:22	3:23 6:33	6:33 12:00
										F	0:10 0:45	0:46 1:29	1:30 2:28	2:29 3:57	3:58 7:05	7:06 12:00
									G	0:10 0:40	0:41 1:15	1:16 1:59	2:00 2:58	2:59 4:25	4:26 7:35	7:36 12:00
								H	0:10 0:36	0:37 1:06	1:07 1:41	1:42 2:23	2:24 3:20	3:21 4:49	4:50 7:59	8:00 12:00
							I	0:10 0:33	0:34 0:59	1:00 1:29	1:30 2:02	2:03 2:44	2:45 3:43	3:44 5:12	5:13 8:21	8:22 12:00
						J	0:10 0:31	0:32 0:54	0:55 1:19	1:20 1:47	1:48 2:20	2:21 3:04	3:05 4:02	4:03 5:40	5:41 8:40	8:41 12:00
					K	0:10 0:28	0:29 0:49	0:50 1:11	1:12 1:35	1:36 2:03	2:04 2:38	2:39 3:21	3:22 4:19	4:20 5:48	5:49 8:58	8:59 12:00
				L	0:10 0:26	0:27 0:45	0:46 1:04	1:05 1:25	1:26 1:49	1:50 2:19	2:20 2:53	2:54 3:36	3:37 4:35	4:36 6:02	6:03 9:12	9:13 12:00
			M	0:10 0:25	0:26 0:42	0:43 0:59	1:00 1:18	1:19 1:39	1:40 2:05	2:06 2:34	2:35 3:08	3:09 3:52	3:53 4:49	4:50 6:18	6:19 9:28	9:29 12:00
		N	0:10 0:24	0:25 0:39	0:40 0:54	0:55 1:11	1:12 1:30	1:31 1:53	1:54 2:18	2:19 2:47	2:48 3:22	3:23 4:04	4:05 5:03	5:04 6:32	6:33 9:43	9:44 12:00
O	0:10 0:23	0:24 0:36	0:37 0:51	0:52 1:07	1:08 1:24	1:25 1:43	1:44 2:04	2:05 2:29	2:30 2:59	2:59 3:33	3:34 4:17	4:18 5:16	5:17 6:44	6:45 9:54	9:55 12:00	
	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
40	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7	
50	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6	
60	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5	
70	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4	
80	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4	



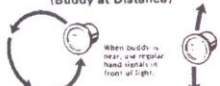







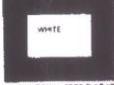
\* NO-DECOMPRESSION LIMITS AND REPETITIVE GROUP DESIGNATION TABLE FOR NO-DECOMPRESSION DIVES

D	S L	M L	GROUP DESIGNATIONS												
---	-----	-----	--------------------	--	--	--	--	--	--	--	--	--	--	--	--

E P T H	A I F M E I T	A I X M I T													
			A	B	C	D	E	F	G	H	I	J	K	L	M
10	-	-	60	120	210	300									
15	-	-	35	70	110	160	225	350							
20	-	-	25	50	75	100	135	180	140	325					
25	245	-	20	35	55	75	100	125	160	195	245	315			
30	205	-	15	30	45	60	75	95	120	145	170	205	250	310	
35	160	310	5	15	25	40	50	60	80	100	120	140	160	190	220
40	130	200	5	15	25	30	40	50	70	80	100	110	130	150	170
50	70	100		10	15	25	30	40	50	60	70	80	90	100	
60	50	60		10	15	20	25	30	40	50	55	60			
70	40	50		5	10	15	20	30	35	40	45	50			
80	30	40		5	10	15	20	25	30	35	40				
90	25	30		5	10	12	15	20	25	30					

SURFACE INTERVAL CREDIT TABLE AND RESIDUAL NITROGEN TABLE															A	0:10 12:00
													B	0:10 2:10	2:11 12:00	
											C	0:10 1:39	1:40 2:49	2:50 12:00		
									D	0:10 1:09	1:10 2:38	2:39 5:48	5:49 12:00			
							E	0:10 0:54	0:55 1:57	1:58 3:22	3:23 6:32	6:33 12:00				
					F	0:10 0:45	0:46 1:29	1:30 2:28	2:29 3:57	3:58 7:05	7:06 12:00					
				G	0:10 0:40	0:41 1:15	1:16 1:59	2:00 2:58	2:59 4:25	4:26 7:35	7:36 12:00					
			H	0:10 0:36	0:37 1:06	1:07 1:41	1:42 2:23	2:24 3:20	3:21 4:49	4:50 7:59	8:00 12:00					
		I	0:10 0:33	0:34 0:59	1:00 1:29	1:30 2:02	2:03 2:44	2:45 3:43	3:44 5:12	5:13 8:21	8:22 12:00					
	J	0:10 0:31	0:32 0:54	0:55 1:19	1:20 1:47	1:48 2:20	2:21 3:04	3:05 4:02	4:03 5:40	5:41 8:40	8:41 12:00					
	K	0:10 0:28	0:29 0:49	0:50 1:11	1:12 1:35	1:36 2:03	2:04 2:38	2:39 3:21	3:22 4:19	4:20 5:48	5:49 8:58	8:59 12:00				
	L	0:10 0:26	0:27 0:45	0:46 1:04	1:05 1:25	1:26 1:49	1:50 2:19	2:20 2:53	2:54 3:36	3:37 4:35	4:36 6:02	6:03 9:12	9:13 12:00			
	M	0:10 0:25	0:26 0:42	0:43 0:59	1:00 1:18	1:19 1:39	1:40 2:05	2:06 2:34	2:35 3:08	3:09 3:52	3:53 4:49	4:50 6:18	6:19 9:28	9:29 12:00		
	N	0:10 0:24	0:25 0:39	0:40 0:54	0:55 1:11	1:12 1:30	1:31 1:53	1:54 2:18	2:19 2:47	2:48 3:22	3:23 4:04	4:05 5:03	5:04 6:32	6:33 9:43	9:44 12:00	
O	0:10 0:23	0:24 0:36	0:37 0:51	0:52 1:07	1:08 1:24	1:25 1:43	1:44 2:04	2:05 2:29	2:30 2:59	3:00 3:33	3:34 4:17	4:18 5:16	5:17 6:44	6:45 9:54	9:55 12:00	
	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	
40	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7	
50	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6	
60	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5	
70	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4	
80	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4	



 CHECK, LOOK AT	<b>NIGHT DIVING SIGNALS</b> (Buddy at Distance)
 LOOK      WHAT TIME? WHAT DEPTH?	 <p>When buddy is here, use regular hand signals in front of light.</p> <p>OK. All is well. Large, slow circles with light.</p> <p>Something is wrong. Large, rapid up-and-down motions with arm extended.</p>
 I DON'T UNDERSTAND	<b>UNDERWATER TACTUAL SIGNALS</b>
 DON'T FORGET TO EXHALE	<p>These simple signals are easily remembered and can be transmitted by a hand squeeze or shake of a buddy line. The lack of a three pull signal allows rapid discrimination between routine "stop" and "go" signals and the more urgent "surface" and "come here quickly" signals.</p> <p>1 Pull - Stop 2 Pulls - Go, OK 4 Pulls - Surface 5 or more - Come here quickly</p>
 TIRED? TIRE! (Hands Remain on Chest)	<b>WHISTLE SIGNAL</b> In diving, whistles are used only in emergency situations. Five or more short blasts on a whistle is an international distress signal for immediate assistance.
 DO IT AGAIN	<b>UNDERWATER RECALL (SIREN, SPEAKER)</b> Surface and look to vessel for instructions.
 BOAT	<b>INTERNATIONAL FLAG SIGNALS</b>
	 <p>RED WHITE SPORT DIVER FLAG BLUE</p> <p>Divers below, stay clear. Displayed by sport divers internationally. Must be a different color from that bearing the official international flag below.</p>
	 <p>WHITE INTERNATIONAL CODE FLAG "A" BLUE</p> <p>Divers below, stay clear at slow speed. Displayed by all vessels and divers in international and foreign waters and by the U.S. Navy.</p>
	 <p>WHITE INTERNATIONAL CODE FLAG "P"</p> <p>Diver recall. Return to vessel immediately. Internationally recognized as the "Return-to-Skip" flag.</p>