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# Scuba Diver
# Course Notes

 

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# *Unit 1: The NAUI Scuba Diver Course*

***Objectives:***

- Welcome to the Course.
- What is Scuba Diving?
- What is Scuba Certification?
- What is NAUI?
- What are the risks of Scuba?
- What are Your Obligations?

***What is Scuba Diving?***

- Scuba diving is the most unique adventure sport on earth.
- In the underwater world, you can watch the delicate beauty of tiny fish as they dart around a colorful tropical reef.
- You can experience the thrill of swimming eye to eye with sea turtles, whales, or manta rays.
- To enjoy diving where you live, you will need to learn how to use the scuba equipment commonly used in your area.
- The equipment might appear intimidating at first, but it is very simple to use. Just like driving a car, you don't need to understand every aspect of the equipment to be able to use it.
- You might already know that the word scuba stands for Self Contained Underwater Breathing Apparatus.
- You scuba dive with a compressed air cylinder or tank that you wear on your back. The air is supplied to your mouth through a regulator that reduces the high pressure inside the tank to the same pressure as the water surrounding you.
- Throughout this textbook, the term air is used to indicate either compressed air or an enriched air mixture such as nitrox.

***What is certification?***

- Because there are no laws governing recreational scuba diving in most countries, the professional instructors who work in the scuba industry have agreed on certain minimum standards of training for sport divers. You must meet these standards to receive a certification card.
- Your certification card will enable you to receive scuba diving services, such as renting a cylinder or enjoying a day of diving on a charter dive boat.
- Different levels of diving certification signify special knowledge in diving.
- After you complete the NAUI Scuba Diver certification course, you will be eligible to take *specialty courses* to learn about the different special interest areas in diving.

***What is NAUI?***

- Your NAUI Scuba Diver certification course is being taught by an instructor certified through the *National Association of Underwater Instructors,* more commonly referred to as NAUI or NAUI Worldwide.

- NAUI was founded in 1960 and is one of the oldest and most respected diver certifying agencies in the world.
- You can take pride in your NAUI certification because NAUI courses are among the most thorough, routinely exceeding minimum standards.

***NAUI Courses:***

- The NAUI Advanced Scuba Diver certification course improves your overall knowledge and skills in the water. It is designed for newly certified divers and introduces you to the many different types of activities available to certified divers.
- The NAUI Master Scuba Diver certification course helps you acquire leadership-level academic knowledge and enables you to participate in exciting advanced diving activities in a challenging course.

***NAUI Specialty Courses:***

- NAUI instructors also teach many kinds of specialty courses.
- Some of the NAUI specialty courses you can take cover:
  - Rescue diving
  - Wreck diving
  - Deep diving
  - Underwater photography and video
  - Ice diving
  - Cavern and cave diving
  - Underwater hunting and collecting
  - Night diving
  - Technical diving

***What are the risks of scuba diving?***

- In any sport, there are risks: As in any activity, the ultimate risk in diving is of being injured or killed. Serious injuries and deaths caused by diving are extremely rare though, and most divers never suffer any type of mishap. However, you need to recognize that risk exists.
- As a diver, you must be willing to accept this risk and take responsibility for your own actions. You will be asked to sign an Express Assumption of Risk Associated with Diving and Related Activities which explains the risks of diving.
- A little apprehension is normal: Most people who have not spent much time swimming in the ocean or other open bodies of water have a little apprehension about learning to dive.
- You might have concerns about the strange equipment, the marine life, and the environment. This is normal and to be expected
- Misconceptions about diving: One of the most popular misconceptions about diving is that you can easily run out of air under water. The amount of air you have in your cylinder limits the amount of time you spend under water on any given dive.
- Another common misconception is that diving equipment is unreliable. Few divers ever experience an equipment failure in diving gear that has been properly maintained.

- Another common concern is that when you are diving in the ocean, you will always be under the threat of a shark attack. Few divers ever have the opportunity to even see a shark during normal scuba dives.

***What are your obligations?***

- Attendance: You have an obligation to attend, participate in, and satisfactorily complete every classroom and water session. If you do miss any sessions, it is your responsibility to arrange with your instructor to complete them satisfactorily. Be sure to take notes during all classroom sessions.
- Health: *Health* is the state of being sound in body and mind and is a prerequisite for diving. You will complete a Medical History form before you can participate in the water sessions for this course.
- Fitness: *Fitness* is the ability to meet the physical demands of a particular activity. You must be fit to dive. The best way to stay fit for diving is to dive regularly, or swim with mask, snorkel, and fins. Remember that your ability to dive safely is decreased by inactivity.
- Use of drugs and alcohol: Substances such as alcohol, marijuana, and cocaine, which alter your physiology and affect your ability to think clearly, can never be used before diving. If you are ill and do not feel well enough to dive without taking a drug, you should not dive, even if you feel fine with medication.

**Quiz:**

1. State the meaning of the acronym SCUBA.

2. Define scuba certification.

3. Describe NAUI Worldwide.

4. List other NAUI courses.

5. Explain the risks of scuba diving.

6. Describe your obligations for attendance, health, and fitness.

7. Explain why drugs, alcohol, and diving do not mix.

# *Unit 2: Diving Equipment*

***Objectives:***

- List the basic equipment you need to go skin diving.
- Describe scuba cylinders, including types and sizes, valves, maintenance, and inspections.
- Describe regulators and the equipment usually attached to the regulator.
- List the different types of diving instruments.
- Describe the types of buoyancy control devices and how to select one that meets your needs.
- Describe the use of weighting systems.
- List the different types of diving suits used for warmth and protection and describe how to choose the right suit for your diving conditions.
- List the accessory equipment that makes diving more enjoyable.

***Buying Equipment for Diving:***

- There are several reasons to go to a specialized retailer such as a NAUI dive store.
  - You can see and wear gear before you buy.
  - Scuba retailers can help you with adjusting the equipment.
  - Scuba retailers provide instruction for specialized gear.
  - Scuba retailers usually service equipment.
  - Scuba retailers rent equipment.
  - Scuba retailers are your source for scuba cylinder fills and last minute required items.

***Basic Personal Equipment:***

- Comfort and Fit are extremely important!
  - Mask
  - Snorkel
  - Booties
  - Fins
  - Gloves

***Masks:***

- The most important consideration when you select a mask is whether the mask fits your face. To check for fit: Place the mask gently against your face without putting the strap over your head. Inhale briefly through your nose and hold your breath, the mask should stick on your face.
- Essential features include:
  - A tempered glass lens to help resist breaking and avoid injury if the lens breaks.
  - A solid frame to hold the lens in position.
  - An adjustable, split headstrap that fits over a wide portion of your head.
  - The ability to block off your nose to help equalize the pressure in your ears.
  - A double feathered edge seal to help the mask fit to your face.

- Some popular optional features include:
  - Side windows to provide a wider field of vision.
  - A purge valve to help clear water from the mask.
  - A low-volume mask that fits closely to your face to give you a wider angle of vision. It is also easier to clear of water.
  - Prescription lenses.

***New Masks:***

- New mask lenses are covered with a thin film of lubricant.
- You can use toothpaste to remove this lubricant by using the following procedure:
  - Put a little toothpaste on the inside of each lens of the mask.
  - Rub the toothpaste over the entire lens with your fingers or a soft, wet cloth.
  - Rinse well with fresh water
- Each time you don your mask you will needed to prepare it. The most common way to prevent fogging used to be to spit in the mask, rub the saliva on the lens, and then rinse the mask. An alternative is to use commercially available anti-fog sprays, drops, or creams.

***Snorkels:***

- Have you ever noticed that you can lie face down on the surface of the water and float completely motionless? It's easy, and most people can do it. However, every time you need to breathe, you must lift your head out of the water and that takes exertion and gets tiring. A snorkel is the answer to this problem.
- There are many different features:
  - The basic snorkel is a "J" shaped tube with a mouthpiece at the curved end.
- Other features that can be added to the basic snorkel include:
  - Flexible hosing to enable the snorkel to fit comfortably in your mouth.
  - A purge valve to allow water to drain out of the bottom of the tube.
  - A swivel mouthpiece so you can adjust the mouthpiece in your mouth and swivel it out of the way when you switch to a regulator.
  - Baffles at the top of the "J" tube to keep water from getting into the snorkel at the surface.
  - A molded or soft mouthpiece for added comfort.

***Selecting a Snorkel:***

- Snorkels have both essential and optional features.
- The two most important things to consider:
  - Comfort
  - Breathing ease
- Other considerations:
  - The mouthpiece must fit comfortably in your mouth and should not be twisted when you place the tube or barrel of the snorkel over your left ear.
  - The snorkel itself should be between 30 and 35 centimeters (12 and 14 inches) in length.

- The inside diameter of the snorkel should be no less than 2 centimeters (¾ inch). If the diameter is too small, it is like breathing through a straw.

***Booties:***

- Booties provide protection and warmth for your feet.
- Booties are made from neoprene rubber.
- Some of the different types of booties you can find are:
  - Slip-on 3 millimeter (1/8 inch) booties that come up to your ankle for warm-water diving.
  - Booties with zippers that come up over your ankle. The zipper should have a backing to prevent water from entering directly through the zipper and to keep the zipper from rubbing your skin.
- The bootie should fit snugly but comfortably on your foot.

***Fins:***

- Fins provide the way to move yourself through the water.
- There are two basic types of fins: *full-foot* fins and *heel-strap* fins.
  - Full-foot fins are typically used for snorkeling and in warm water.
  - Heel-strap fins also have a foot pocket, but the back of the pocket is open and an adjustable strap goes across the opening. You must wear booties with heel-strap fins to protect your feet from blisters. You can use heel-strap fins for diving in any temperature water.
- Size of the fin determines the size of the foot-pocket and the *blade* length and width.
- Choose a fin that fits snugly without cramping your toes or pinching your feet
- If you are using fins that require booties, be sure to try them on at the same time.

***Gloves:***

- Gloves provide protection and warmth for your hands.
- Your gloves should fit snugly and allow you to move your fingers easily.
- You must be able to handle your equipment while wearing gloves.
- Be environmentally conscious!

***Floatation Device:***

- Divers should wear some kind of personal floatation device for snorkeling or skin diving.
- The most commonly used is an inflatable vest.
- The vest is designed to slip over your head and fasten at your waist with a strap.
- Most vests of this design also have some type of oral inflation tube.

***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.

***Scuba Cylinders:***

- Scuba cylinders allow you to store large amounts of air in a small place.
- Scuba cylinders are also known as bottles or tanks.
- They are regulated by:
  - Department of Transportation (DOT) in the USA
  - Canadian Transport Commission (CTC) in Canada
- The air in a scuba cylinder is highly compressed:
- The pressure ranges from 120 bar (1800 psi) to 310 bar (4500 psi)
- Most cylinders are made of aluminum or steel.
- **Aluminum cylinders** do not rust, which is an advantage over steel cylinders. However, aluminum cylinders are more easily damaged than steel cylinders on the outside and the threads where the cylinder valve screws in must be inspected regularly for cracks and other problems. If water enters an aluminum cylinder, the cylinder corrodes and forms aluminum oxide. Once aluminum oxide has formed, it slows further corrosion to the cylinder.
- **Steel cylinders** are more resistant to exterior damage. However, if water enters a steel cylinder, the cylinder corrodes and forms rust that can quickly ruin a steel cylinder. If you suspect that water has entered the cylinder, an internal inspection should be made at a qualified facility.
- Cylinders come in many different sizes.
- In the Metric system the size of the cylinder is expressed as the actual volume of the cylinder.
- In the United States the size of the cylinder is expressed as the volume of compressed air the cylinder will hold.
- Markings are placed on the shoulder of each cylinder and provide important information.
- The Markings:
  - **The serial number** of the cylinder, which is unique for each cylinder made by a single manufacturer.
  - **The name of the manufacturer** or their symbol.
  - **Government-required marks** to signify that the cylinder was manufactured according to its standards.
  - **The service pressure** of the cylinder, which is the pressure to which the cylinder can be filled (for example, 200 BAR or 3000 psi).
  - **The material of which the cylinder is composed** (for example, 3AL stands for a particular aluminum alloy).
  - **The hydrostatic testing date** of the cylinder (for example, 8 97 signifies that the cylinder was tested in August of 1997). In the United States, hydrostatic testing must be performed every 5 years. In Japan, hydrostatic testing must be performed every 3 years. In Australia, hydrostatic testing must be done every year.
  - **A "+" mark on steel tanks**, authorizing a 10 percent pressure overfill beyond the stamped service pressure. This mark will follow the current hydro date stamped on the cylinder.

***Cylinder Accessories:***

- Tank Boot:
  - Allows rounded bottom cylinders to stand up

- Protects the bottom of the cylinder
- Plastic Net:
  - Protects the exterior and paint of the cylinder
- Dual Manifold:
  - Hooks two cylinders together sharing a common valve

***Cylinder Valves:***

- Every cylinder must have a valve to hold the air in. They act much like a water faucet. There are three types of valves:
- The United States "K" valve is one valve you will see often when diving. It is designed like a post with an on/off knob. The first stage regulator yoke fits over the post and the regulator is tightened against the post with a screw. These valves are not usually used at pressures higher than 200 BAR (3000 psi). An O-ring or gasket found on the cylinder valve makes a seal between the regulator and valve. If the O-ring is damaged or missing, the regulator will not seal to the cylinder and air will escape.
- A "J" valve looks like the "K" valve with a lever opposite the on/off knob. This lever is known as a reserve mechanism. The mechanism was designed to begin to restrict airflow at about 20 BAR (300 psi) to 33 BAR (500 psi) of pressure in the cylinder. When the mechanism was manually opened, the airflow was no longer restricted. The mechanism is rarely used because divers now use submersible pressure gauges to monitor their air supply
- The DIN valve system originated in Europe. The DIN valve has a large, threaded opening and the regulator screws into the valve . This system is also known as the captured O-ring system. While common in the rest of the world, DIN valves are not commonly seen in the United States. The DIN valve is stronger and capable of operating at pressures higher than 200 BAR (3000 psi).

***Cylinder Valves: other considerations:***

- Every cylinder is equipped with a pressure relief disk or burst disk, which allows excess pressure to vent safely.
- Proper care of your cylinder includes rinsing the outside with fresh water after using the cylinder, having the cylinder visually inspected each year, and having the cylinder hydrostatically tested as required by government standards (every 4 years in South Africa).
- Scuba cylinders must be inspected internally and externally at least once per year at a professional dive shop or a dive-equipment repair facility by a certified cylinder inspector.
- Hydrostatic testing tests the cylinder for metal fatigue.

***Scuba Cylinder Storage:***

- In steel tanks, keeping some air in your cylinder ensures that water cannot enter your cylinder and cause corrosion.
- With aluminum tanks, this is not as much of a concern. Aluminum tanks can be stored empty and with the valves open so that they will not be a hazard in a fire. You should store cylinders upright in a cool, dry, and protected location where they cannot be knocked over.
- You should lay your cylinder down to prevent damage to it, the valve, or injury to someone. When transporting a cylinder in a moving vehicle, place

the cylinder on its side and secure it to prevent damage to the cylinder, the valve, or the vehicle.

***Regulators:***

- The scuba regulator is a mechanical device that delivers air to you on demand.
- One function of the regulator is to reduce the high pressure of the air in the cylinder to the ambient pressure, or the pressure surrounding your body, so you can breathe it.
- Regulators are composed of two main parts: the first stage and the second stage.
- Regulators also commonly have other pieces of equipment attached to them, including additional regulator second stages and gauges.
- The First Stage
    - The high pressure air from the cylinder is reduced to approximately 9.6BAR (140psi) above ambient.
    - The first stage of most United States type regulators fits over the post of the cylinder valve using a device combining the *yoke* and *yoke screw*. Some use a DIN threaded fitting
    - **The first stage** must have at least one *high-pressure port.* This port bypasses the mechanisms that reduce the pressure from the cylinder. Your submersible pressure gauge is attached to this port so you can monitor your air supply.
    - **The following hoses might be connected to *low-pressure ports*** in addition to your primary second stage hose:
        - A power-inflator hose for your buoyancy compensator.
        - An alternate second stage or octopus regulator.
        - A dry suit power-inflator hose, if used.
- The Second Stage
    - The second stage further reduces the air pressure from approximately 9.6 bar (140 psi) above ambient.
    - The second stage of your regulator has a mouthpiece attached to it.
    - **The second stage further reduces** the air pressure from approximately 9.6 BAR (140 psi) above the surrounding pressure to whatever the ambient pressure is. Therefore, the air you breathe is always at the pressure needed by your body, no matter how deep you are under the water.
    - **Some regulators offer** higher performance than others and deliver a greater volume of air at deeper depths regardless of flow restrictions. This is important, because the deeper you go, the denser the air. If you plan to learn to do deep, wreck, cave, or ice diving or do underwater hunting, you will want a high-performance regulator.
- Alternate Air Sources
    - It is standard practice that you and your buddy be equipped with alternate air sources in case of emergency. An alternate second stage can be attached to your primary regulator, or you can carry a source of air totally separate from your scuba cylinder.
    - The most common alternate air source is an octopus regulator. The octopus regulator is an additional second stage that allows you to share air from your cylinder with another diver

- Another type of alternate air source is a combination regulator and power-inflator for your buoyancy compensator that fits on its power-inflator hose. These units eliminate the extra hose for an octopus regulator and are easy to locate in case of an emergency. The air donor typically uses this alternate air source and gives their primary air source to the other diver.
- Contingency scuba or true alternate air sources provide a totally independent regulator and air supply. The two main types of contingency scuba are:
    - A pony bottle, which is a small scuba cylinder with a separate regulator. Pony bottles are commonly used by wreck divers and divers who dive deep.
    - A smaller cylinder with an integrated first and second stage mounted directly on the cylinder
- An alternate air source will not do you or your buddy any good if it cannot be located immediately during an emergency.

***Gauges:***

- Divers must rely on gauges and instruments to tell them depth, bottom time, direction and air supply
- The submersible pressure gauge (SPG) is a required piece of equipment for scuba diving. The SPG displays the amount of air pressure remaining in your scuba cylinder in the same way a fuel gauge shows how much gas you have left in your car's gas tank
- A depth gauge gives you a way to measure your depth when you are under water.

***Compass:***

- A compass consists of a magnetized needle that aligns itself with the earth's magnetic field. The needle will point towards magnetic north as long as there are no magnetic influences nearby that can cause the needle to deviate or turn away from its specified direction. This constant reference to magnetic north enables you to know your position or direction of travel under or above the water relative to the north-seeking needle.
- A diving compass must:
    - Be filled with liquid to withstand pressure and dampen needle movement under water.
    - Have a reference line, called a lubber line, used as the direction of travel.
    - Have a means, such as a rotating bezel, to show a selected bearing or direction

***Maintenance:***

- Your life-support system should be carefully maintained.
- Steps you can take:
    - At the end of each diving day, you should rinse your regulator with fresh water to remove salt crystals or other impurities. Always be sure to let water run through the mouthpiece and exhaust tees on the second stage. However, you should never press the purge button when

running water through the mouthpiece. This could cause water to enter the hose to the first stage and get into the first stage of the regulator from there.
    - You should soak your regulator (if it does not have a DIN connector), alternate air source, and gauges overnight in fresh water at the end of a dive trip, and then rinse them thoroughly. Let the regulator dry completely and then store it in a cool, dry place. Do not coil the hoses tightly or allow them to hang at an angle with weight on them, which causes kinks at the hose ends. Hoses that have been stressed can spring leaks and must be replaced.
- The repair technician will take the first and second stages apart, clean all the metal parts, and replace the O-rings and other nylon or silicone parts of the regulator.
- The repair technician will also test and adjust the intermediate pressure of your first stage during the service.
- During an annual service, the repair technician will also inspect your submersible pressure gauge and high-pressure hose, depth gauge, and compass for proper operation.

***Additional Instruments:***

- Some additional diving instruments that you might want to consider using include:
    - Timing Devices: Watches used for diving must be designed to withstand pressure. They should be rated for depths of at least 100 meters (300 feet). Your watch should also have a way to measure elapsed time with one of the following: A rotating bezel around the dial of the watch. A stopwatch feature. The dive timer automatically records the elapsed time of your dive without action on your part.
    - At a minimum, a typical dive computer records or displays the following information: Maximum depth, Current depth, Actual dive time, Remaining allowable dive time. Between dives, the computer can display information from your previous dives as well as the amount of time that you have been out of the water. The computer can also help you plan your next dive by telling you how long you can stay at different depths.
    - If you use a dive computer, you should back it up with a second computer or a watch and a depth gauge. If you use an air-integrated computer, you should back it up with a submersible pressure gauge, depth gauge, and watch.
    - Rinse your instruments in clean, fresh water at the end of each diving day and have your instruments inspected and serviced once per year by a qualified repair technician.

***Buoyancy Control Devices:***

- Buoyancy control is one of the most important skills you will learn as a diver.
- A buoyancy control device (BCD), or buoyancy compensator (BC), enables you to control whether you float on the surface of the water, hover in the water, or sink to the bottom. You control this by adding air to or venting air from your BC

- Features: BCs must be equipped with an overpressure relief valve to prevent damage to the BC from too much internal air pressure. The BC must also have an inflator/deflator hose that is at least 2 centimeters (3/4 inch) in diameter. At the end of the inflator/deflator hose is a power-inflator mechanism and a deflator/oral inflator valve. All BCs are also equipped with a mouthpiece at the end of the inflator/deflator hose that enables you to inflate the BC by blowing air into it
- Types: Back-flotation systems are designed so that the entire bladder of the BC is behind you. This leaves your chest and waist uncluttered. Back-flotation systems are popular for underwater photography for this reason.
- Jacket-style BCs are the most popular buoyancy control devices. These BCs are designed so that the bladder wraps from your back around to your waist. These BCs are comfortable to wear, provide good trim under water, and float you upright on the surface when your BC is inflated.
- The older horse collar design encircles your neck. You can use a horse collar for both skin and scuba diving.
- Integrated Weight Systems: Some BCs enable you to integrate or add your weights directly to the BC.
- The advantages of weight integrated:
    - No weight belt.
    - Weights cannot slide around.
    - Weight is not supported solely by your back.
- Disadvantage to the weight integrated system:
    - Once assembled, it can be heavy and awkward to handle.
    - Hard to tell how much weight is on the BC just by looking at it.

***Selection and Maintenance:***

- The best way to select a BC is to try different models.
- Selection:
    - See which is the most comfortable.
    - Match the type of diving you will be doing.
    - Try on the BC with a cylinder attached.
    - The controls must easy to locate and operate.
- Maintenance:
    - You should rinse your BC internally and externally.
    - Rinse the inside with the following:
        - Fill with fresh water
        - Slosh
        - Drain
    - Store in a cool and dry place, with air in the bladder.

***Weights and Weight belts:***

- You wear lead weights when you are diving to offset the buoyancy of your body, wetsuit and other equipment.
- Weights are available in many configurations and as you gain diving experience, you will find the configuration that fits you best.
- Types: Most commonly, you will find lead molded into cylinders or blocks with slits to enable a weight belt to be threaded through the weight. The block of lead can be uncoated or coated with a plastic covering. Some of the larger blocks of lead are curved to fit the hip and are known as hip weights.

- The simplest and most common weight belt is a 5.0 centimeter (2-inch) wide nylon web belt with a metal or plastic buckle. Weight keepers are used on this type of weight belt to keep the weights from shifting on the belt. A weight harness, usually used with dry suits, uses a belt and shoulder harness system to support the weights on your shoulders rather than around your waist.
- Some weight belts are composed of a series of pockets attached to a nylon web belt. These pockets will hold either solid weights or soft weights.
- No matter what type of weight system you choose, you must have a means of ditching the weights with one hand. This type of system is known as a quick release

***Diving Suits:***

- Divers must wear a thermal-protection diving suit in all but the warmest waters
- The amount of insulation depends on:
    - Water temperature.
    - Activity level during the dive.
    - Your build, body fat, etc.
- Three types:
    - Dive Skins.
    - Wetsuits.
    - Dry Suits.
- Dive skins:
    - Tropical waters.
    - Protective covering to avoid injuries and sunburn.
    - Most common types, Lyrca and Polartec.
- Wetsuits, made from neoprene rubber:
    - Must fit precisely and snugly.
    - Water that is trapped in the suit keeps you warm.
    - Available from 2 to 7mm in thickness and styles:
        - Shorty.
        - Farmer john.
        - Step-in.
        - One piece.
- Drysuits:
    - Designed to keep you dry.
    - Used in colder water.
    - More expensive than wetsuits.
- Wetsuit options:
    - If your measurements are different from standard sizes you might consider a custom made wetsuit. Options for wetsuits can include:
        - Zippers at the wrist and ankles.
        - Knee pads.
        - Spine pad.
        - Pockets inside the wetsuit.
        - Sheaths to hold a knife.
        - Attached hood.
        - Pockets on the outside.
- Choosing the right suit:

- The correct suit for the conditions is one of the keys to enjoying a dive.
- Use the following guidelines when deciding what type of diving suit to wear:
    - 27° C (80° F) and warmer water
        - Dive skin
    - 23° C to 30° C (75° F to 85° F) waters
        - 2 to 3mm full wetsuit or shorty
    - 13° C to 27° C (55° F to 80° F) waters
        - 5 to 7mm full wetsuit
    - 2° C to 16° C (35° F to 60° F) waters
        - Full dry suit
    - 2° C (35° F) and colder waters
        - Special training and equipment are needed

***Diving Suits Maintenance:***

- You should rinse your diving suit with fresh water after every diving day.
- Maintenance includes:
    - Rinse dive skins and wetsuits inside and out.
    - Commercial products are available to help clean your suits completely before storage.
    - Store your suits on wide hangers designed especially for them.

***Accessory Equipment:***

- Accessories are available that can make diving more enjoyable.
    - Clips enable you to attach your instruments.
    - A dive knife is a working tool used for many purposes.
    - You need a gear bag to transport your gear.
    - Diver down flag lets others know you are underwater.
    - A logbook is your record of experience in the water and level of training.
    - It is a good idea to have a first aid kit on any dive trip.
- Some other useful accessories are:
    - Underwater slate.
    - Goodie bag.
    - Underwater light.
    - Marker buoy and line.
    - Spare parts kit.
    - Checklist.

**Quiz:**

1. What are two reasons for logging your dives in a logbook?

2. Name two additional accessories that are useful when diving?

3. List the basic equipment you need to go skin diving.

4. Describe scuba cylinders, including types and sizes, valves, maintenance, and inspections.

5. Describe regulators and the equipment usually attached to the regulator.

6. List the different types of diving instruments.

7. Describe the types of buoyancy control devices and how to select one that meets your needs.

8. Describe the use of weighting systems.

9. List the different types of diving suits used for warmth and protection and describe how to choose the right suit for your diving conditions.

10. List the accessory equipment that makes diving more enjoyable.

# *Unit 3: Diving Physics and Physiology*

**Objectives**:

- State some of the characteristics of air.
- Describe the concept of buoyancy and its effects
- Describe the concept of pressure and its effects on Volume and density
- Describe how pressure affects air spaces and how to prevent problems from pressure changes

**To learn more, think about another course, read lots, become a DAN member.**

***Direct Effects of Pressure***

- When we descend in water, the force from the combined weight of air and water will increase
- This in effect is called Pressure
- Air weighs 1.29 grams per liter.
- Freshwater weighs 1.0 kilogram per liter.
- Saltwater weighs 1.025 kilogram per liter.
- Water density is constant - the same at depth as at the surface.
- Water is about 800 times denser than air.

***The Air You Breathe***

- Air is a mixture of gases
    - 20.9% oxygen, 78% nitrogen and 1.1% miscellaneous
    - The most important component of air is oxygen
    - Nitrogen is metabolically inert
- Air can be easily compressed
    - The air surrounding the earth is compressed by the weight of the air above it
    - Air is less dense at altitude

***Vision and Colors***

- **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 look 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.

***Hearing, Heat Loss, Drag***

- Because of the greater density of water sound waves travel about 4 times faster in water
    - Omni-directional - Sound direction is difficult to tell.

- Heat is lost 25 times faster in water.
- Water resists movement – Drag.

***Buoyancy***

- One of the most critical skills to master
- As a diver you control your buoyancy primarily by the amount of weight you wear and the amount of air in your BC.
- States of buoyancy:
  - Positive
  - Neutral
  - Negative

***Factors Affecting Buoyancy***

- Your weight and your volume affect your buoyancy.
- Your weight includes the weight of the gear you wear.
- Your volume depends on:
  - Your body size
  - Thickness of your wetsuit - As the bubbles compress in a wetsuit, it displaces less water = loss of buoyancy
  - Your gear.
- To compensate for the loss of buoyancy, you must add air to your BC, which increases your displacement to regain the lost buoyancy.
- To compensate for additional buoyancy, you must vent air from your BC to control your ascent.
- Uncontrolled ascents are extremely dangerous.
- The density of the water in which you dive also affects your buoyancy.
  - Fresh water vs. Salt Water
  - Neutral in salt water - no change to weight - dive in fresh water - you will sink
  - Need to take off weight going to FW
  - Add weight going to SW
- Neutral buoyancy beneath the surface is your constant goal.
- Neutral buoyancy helps protect marine life
- Diving without buoyancy control is:
  - Tiring
  - Hazardous
  - Sign of an unskilled, unthinking, and uncaring diver.

***Pressure - SW and FW Pressure***

- **FW – Fresh Water**
  - A column of fresh water 10.3 meters tall would exert 1 bar = 1 atmosphere.
  - Each additional 10.3 m = 1 bar
  - At 20 m it would be….
  - At 25 m
- **SW – Salt Water**
  - A column of salt water 10 meters tall would exert 1 bar = 1 atmosphere
  - Each additional 10 m = 1 bar
  - At 20.6 m it would be….

- **At sea level, you are already under 1 atmosphere of pressure (air pressure)**
    - What happens if you dive to 10 meters SW? - You are under 2 atmospheres of pressure.

***Pressure at Depth***

- Gauge pressure only measures the pressure due to water
- To understand the direct effects of pressure, consider the effects of pressure on an open system
    - Invert a bucket full of air and take it to depth.
    - The pressure surrounding the bucket increases and compresses the air in the bucket.
    - Ascending decreases the pressure and the air expands to its original volume.
    - Inverse relationship between pressure and volume.
- Boyle's Law
- For a closed system – **NEVER HOLD YOUR BREATH**

***How Pressure Affects Density***

- Increasing pressure affects the density of the air.
- As the pressure increases, the air compresses to a smaller volume.
- As the air compresses, it becomes denser.
- Scuba diving involves breathing air that is compressed to the ambient pressure at your depth.
- The air is thus much denser than the air you breathe on the surface.
- You use your air faster when you dive deeper.

***Pressure and Air Consumption***

- Air consumption is directly proportional to the depth you dive.
- Air consumption factors:
    - Your activity level during your dive
    - Your mental state.
    - Your body size - Larger people = larger lungs and use more air. Smaller people = smaller lungs and use less air.
    - The warmth of your diving suit.
    - Your level of physical fitness.
    - Physical activity has the greatest effect
    - You can use up 4 times more through exertion
- Develop a slow and relaxed breathing pattern as well as a slow rate of breathing.
- **BREATHE NORMALLY**

***Monitoring Air Consumption***

- Monitor your SPG (Submersible Pressure Gage) to determine when to begin your ascent.
- Many factors can change your predicted air consumption.
- In certain specialty areas of diving, it is essential that you predict your air consumption to avoid running out of air.
- What Factors?
    - Depth

    - Cylinder Size
    - Time
    - Air Used
- Calculating your Surface Air Consumption Rate (SAC)
    - (Cylinder Volume X Gauge Pressure)/(Time X Absolute Pressure)
    - (CV X GP) / (T X AP)

***Physiology – Your Body and Diving***

- When you dive, the pressure of the water effects your air spaces as well as your breathing.
- What Air Spaces do you have?
- Squeezes
    - The pressure outside an air space is greater than the pressure inside an air space.
        - Can cause damage to your body.
        - This type of injury is called barotrauma (pressure injury).
- Blocks
    - A reverse 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.

***The Anatomy of the Ear***

- Your ears are divided into three sections:
    - Outer ear - the ear canal
    - The ear drum separates the outer and middle ear
    - Middle ear - Contains a series of three small bones.
- They transmit sound waves from the ear drum to the inner ear.
- Contain 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.
- **<u>You must be able to equalize the pressure inside your ears to dive.</u>**

***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:
    - Move air from your throat through the Eustachian tube into your middle ear.
    - If you cannot equalize end the dive and return to the surface.
    - Close your mouth tightly or block it with your tongue (on scuba), close your nostrils by pinching them shut, and exhale lightly.
    - Never forcibly equalize. You could cause serious damage to your ears.
    - The key to successful ear equalization:
        - Equalize before you feel the slightest pressure in your ears.
        - Keep the pressure differences between the water and the middle ear to a minimum.
        - Equalize early and often, starting on the surface.
    - If problems occur - Ascend a few feet to reduce the pressure and try again

- Descending feet first makes equalizing much easier for most people.
- Never try to equalize the pressure by performing forceful blowing.
- If you have a head cold, you must not attempt to equalize by any method. (Do Not Dive)

***Middle Ear Blocks***

- 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 breathe in.
- 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.

***Sinuses***

- Sinuses are air cavities lined with mucous membranes and surrounded by bones.
- Sinus squeeze and blockage - 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 and fill it.
- During ascent the air in the sinus will try to expand to it's original volume but it cannot because of the fluid.
- Blood can be forced into your nose, mouth, or mask.
- Never dive when you have a cold or sinus congestion.
- Avoid taking any medication that you know produces side effects when you use it.

**EQUALISE EARLY, OFTEN & GENTLY**

***The Anatomy of Your Lungs***

- LOPI (Lung Over Pressure Injury).
- Your lungs consist of millions of tiny air sacs, called alveoli. Over pressurize the alveoli will cause it to burst.
- This type of injury most commonly occurs when divers panic under water and make a rapid ascent holding their breath.
- The best technique is maintain normal lung volume during your ascent by breathing normally.
- As long as you breathe normally during ascent there is little danger of suffering a lung over-expansion injury.

**NEVER HOLD YOUR BREATH**

***Breathing and Circulation***

- Transporting oxygen through your body is a vital function of the circulatory system.
- Carbon dioxide controls your breathing.
    - Your breathing rate is controlled by the amount of carbon dioxide in your bloodstream.
- How to breathe under water.

    - Your breathing should be slightly slower than normal and deeper than you usually breathe.
- Shallow breathing:
    - If you breathe too shallow, you do not exchange enough carbon dioxide with each breath.
- Hyperventilation:
    - Deliberate hyperventilation can be hazardous when you follow it with a breath-hold dive.
- Skip breathing:
    - When a diver skip breathes, they hold 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.
- Air Starvation:
    - Stop what you are doing, rest, and breathe slowly and deeply until you recover, being sure to exhale fully with each breath.

***Indirect Effects of Pressure - In and Out Gassing***

- Indirect effects of pressure impact divers by means of the gases in the air we breathe while diving.
    - 78% of the air we breathe is nitrogen.
- Nitrogen is an inert gas, but is absorbed and dissolved in the bloodstream and tissues.
- With changes in the ambient pressure your body in-gasses or out-gasses until the nitrogen is balanced between the air and your body.

***Decompression Sickness***

- Occurs if you absorb a great deal of nitrogen (in-gas) and don't allow sufficient time to eliminate nitrogen (out gas)
    - It takes time for nitrogen to enter and to leave the body
    - If too much Nitrogen is present in your body bubbles form.
    - When bubbles form in your blood, they create microscopic clots that impair circulation.
    - The bends is usually caused by ascending to quickly.
    - Symptoms range from:
        - Skin rash
        - Extreme fatigue
        - Coughing
        - Painful joints
        - Paralysis
        - Unconsciousness
        - Prevention:
        - Stick to the dive tables
        - Never ascend faster than 9 m/min
        - Always do a safety stop
    - If you do suffer DCS give 100% Oxygen and seek medical attention. Call DAN.
    - You will need to be treated in a recompression chamber.
    - The chamber is pressurized to cause the nitrogen bubbles to go back into solution, then slowly released.

***Other Indirect Diseases***

- Nitrogen Narcosis
    - When nitrogen is under pressure it can produce an effect on your body also called “rapture of the deep”.
    - At depths exceeding 20 m but usually more than 24 meters
    - Ascend above 20 m.
- Oxygen toxicity.
    - Pure oxygen under more than 1.6 bar is toxic and lethal.
- Carbon Monoxide toxicity.
    - Cylinder contaminated with Carbon Monoxide can be lethal.

***Thermal Effects of Diving***

- You lose heat under water in several ways.
    - Water conducts heat away from your body rapidly.
    - Heat loss of your core body temperature can cause hypothermia.
- Humidity and temperature:
    - Causes masks to fog up
    - Causes dehydration.
    - Dehydration decreases your ability to exercise at full capacity and makes you more susceptible to DCS.
- You must drink plenty of fluids before, between, and after dives.

***Quiz***

1. Name what drinking plenty of fluids helps to prevent.

2. Describe what happens to the pressure in a scuba cylinder if the temperature is increased.

3. Describe how to avoid DCS.

4. Describe how to avoid nitrogen narcosis.

5. Describe what must be done if your buddy has symptoms of nitrogen narcosis.

6. Name the device you check to monitor your air supply under water.

7. Describe what an ocean diver must do to their weight in order to dive in fresh water.

8. State how many times greater the pressure is at 40 meters of sea water, than at the surface.

9. State the absolute pressure at 20 meters in fresh water.

10. List the two main components of air.

11. Describe the difference in the density of air in the mountains and at sea level.

# *Unit 4: Diving Environment*

***Objectives:***

- Learn about **S.E.A.B.A.G**
- Name the physical Characteristics of a dive site
- Name the different types of water movement and how it affects diving
- Explain the different categories of marine life
- State the positive impacts you can have on the underwater environment

***S.E.A.B.A.G:***

- **S**ignals: _____
- **E**mergency: _____
- **A**ctivity: _____
- **B**uoyancy: _____
- **A**ir: _____
- **G**o: _____

***Physical characteristics of a Dive Site - Types of Dive Sites:***

- Divers will dive anywhere there is water, but they are frequently attracted to interesting underwater formations.
- Formations can be man made:
  - Artificial reef
  - Oil rig
  - Breakwater
  - Jetty
  - Shipwreck
- Natural dive sites include:
  - Canyons with sheer drop-offs
  - Lakes
  - Rivers
  - Coral and Rock Reefs
  - Caves
  - Beneath the ice of frozen lakes
- In the case of Caves, Ice diving and wrecks :
  - Any diving environment that does not allow direct vertical access to the surface is called an overhead environment.

***Entries and Exits:***

- The easiest diving is usually from boats, and in many situations, boat diving offers some of the best diving available.
- Whenever you dive in a new area you need:
  - An orientation to the dive site
  - Know what to look for and what to avoid
  - It is advisable to dive a new site with an Instructor or Divemaster, or other experienced local divers
  - Seek information about the new dive site from various sources such as:
    - Local Experienced divers
    - Internet

- Town information Centre
- Your Dive Club

***Bottom Conditions:***

- The bottom conditions can greatly affect your diving.
- The underwater terrain can be expected to be an extension of the shoreline.
- You may find different bottom compositions such as mud, silt, clay, sand, pebbles, rocks and coral

***Visibility***

- Diving in limited visibility requires special equipment, training and procedures.
- Factors affecting visibility:
  - Seasons
  - Weather
  - Water movement
  - Composition of the bottom
- Limited viz can cause disorientation or dizziness from lack of visual references.
- Divers can hold hands to stay together, or use a buddy line. ( Rope of 2 meters with a loop on each end)
- If you are unable to find your buddy after one minute under these conditions, surface using the lost buddy procedure discussed in the dive briefing.

***Temperature:***

- Thermo cline:
  - Normally in summertime
  - In fresh water
    - A Thin Zone of radical change in water temperature between the surface and the bottom layers. Clearly visible horizontal white cloud in the water.
- Halocline:
  - Where one body of salt water and one body of fresh water come together. The water do not mix, the lower density body (Fresh Water) will float on the Higher density body (Salt water) Creating a definite zone between the two bodies.

***Waves and Surf:***

- As wind blows across the water, it transfers it's energy to the water. Water push into peaks and valleys and become waves
- The surf Zone is the area where waves are breaking as the water gets shallower closer to the shore.
- Surge is the underwater movement of water you will experience when diving in areas close to a shore with wave action.

***Tides:***

- Tides cause water movement in many areas.
- Gravitational attraction between the sun, Moon and Earth
- The change in water level at a dive site due to the tide can cause problems while you are on your dive if you don't plan for it.

- When you enter in high tide and stay too long it can cause bigger waves and surges as it becomes low tide, this can cause DCS
- Entry into the water can be easier in high tide as the water covers the difficult rocky terrain of low tide
- Water movement because of tides can also affect the underwater visibility, best vis time is high tide.

***Currents:***

- When diving in the sea, always make sure of the water conditions. Plan your dive to start the dive into the current.
- Diving from an anchored boat a trial line of 30 meters long with a buoy at the end should be extended behind the boat
- Types of Currents:
    - Standing currents
        - Regular, steady currents that do not change very much
        - Normally Long shore currents, In the direction of the coast
    - Tidal Currents
        - Caused by tides
        - Can be very strong (3.7 km/h)
        - In areas where tidal currents are common, consult tide and current tables, and only dive in slack water
        - Slack water is the transition periods between tides, plus minus 30 minute window from end of one tide to turn to other tide.
    - Transitory currents
        - Suddenly appear and disappear
        - Rip currents, in natural bays and harbors, trench or hole in shore
        - Rip currents are in 90 degrees relation to the shore line
        - Escape a rip current by swimming across the rip current parallel to shore

***Marine Life:***

- Aggressive animal behavior is rare underwater.
- Injuries only occur from aquatic animals reacting defensive
- Avoid potential problems with hazardous marine life by learning to identify such creatures that exist in your area or the dive sites you frequently visit.

***Marine Animal Injuries:***

- These injuries make out less than 2 % of all injuries or illnesses in Scuba Diving in South Africa.
- Together with the rules in place preventing Divers from touching anything, injuries are minimal. Those that do happen are caused by human error or could be unforeseen circumstances.
- Should you be on the beach stumbling on a blue bottle or walk over the rocks in low tide and get scratched by fire coral, there are ways to treat for each of the situations

***Treatment:***

- The best general way to remember the principles of treatment of marine animal injury is to apply three basic rules:

- Remove the cause
- Treat the effects
- Prevent further complications

***Hazardous Marine Animals:***

- 5 Categories of Hazards
  - Stingers
  - Stickers
  - Snappers
  - Scrapers
  - Shockers

***Stingers:***

- Jelly fish, Blue bottles, Portuguese Man of War
- Stingers have specialized venom cells known as nematocysts. These cells, when stimulated by contact, discharge a dart into the victim. The projectile introduces a protein based venom.
- This venom is fortunately destroyed rapidly by heat or contact with acidic or alkaline substances. Never use fresh water to rinse wounds caused by a stinger, it can worsen the injury. Even urine is better than fresh water. It is sterile - and is usually readily available!
- Treatment
  - Rinse or apply a gauze swab to the wound that has been soaked in vinegar or alcohol (even 43% (brandy, whiskey) if nothing else is available) as soon as possible. Best results come from early applications.
  - Vinegar and alcohol kill the nematocysts without discharging them and also neutralize the venom.
  - After the stinging cells have been destroyed, any remaining tentacles can be scraped off with a blunt knife.

***Stickers:***

- Cone shells; Sea urchins; Devil-, Scorpion- & Stone fish; Sea barbell; Stingrays
- Stickers have venomous barbs or spines that can inject venom into a victim. As with stingers, the venoms are also proteins and are destroyed rapidly by heat.
- Hot water is the treatment of choice. The water should be as hot as can be bear (40 - 50 °C) and immersion or continuous rinsing should continue. Even heated sand in a plastic bag may be acceptable. Pain is a very prominent feature with stone fish and sea barbell causing more than 24 hours of agony if left untreated.

***Scrapers:***

- Coral; Fire Coral
- All marine animals' surfaces are colonized by bacteria and any contact with marine animals resulting in disruption of the skin may therefore be complicated by an infection. Abrasions and lacerations sustained underwater should always be treated with suspicion and cleaned meticulously.
- Treatment

- Apply vinegar, meat tenderizer (made up as a paste with sea water) or sodium bicarbonate to neutralize any venom.
- Clean the area with a mild antiseptic (Savlon or Dettol).
- Antiseptic and local anesthetic ointments are useful. Avoid further contact with sea water or sunlight until wounds are healed.

***Shockers:***

- Electric ray & eel
- These animals generate electrochemical energy and can deliver electric shocks to stun prey or predators. The electric ray has two kidney shaped organs on both sides of the spine than can generate the electric discharge of up to 220 volts.
- Treatment – Treat for shock.

***Snappers:***

- Sharks; Game fish; Morays; etc
- At present there are approximately two shark attacks per year.
- Only one SCUBA diver has ever been attacked and killed in South African waters. This occurred at Hartenbosch in the Southern Cape during 1992.
- If the initial attack is not fatal, the usual cause of death is acute shock.
- Shark attack instills a primeval fear and emotion in bystanders and even emergency personnel.
- Treatment
    - Get the patient out of the water as soon as possible. It is important to get the victim out of the water quickly to provide life support.
    - Stop the bleeding by direct pressure or indirect pressure (pressure points).
    - If a tourniquet is used.
        - Mark the patient's forehead with a "T“
        - Note the time accurately.
        - Never use a towel as a tourniquet as one cannot apply sufficient pressure to the artery and the towel disguises the continuing bleeding.
    - It is important to try and keep the area clean and avoid complicating the wound.
    - Start treatment for shock:
    - Shock position;
    - Nil per mouth;
    - Arrange transport to the nearest level one trauma facility if possible.
    - First stabilize the person and stop the bleeding before transport.
    - There is little to be gained by blindly rushing the patient off to a hospital (i.e. to scoop and scoot).

***Negative Impacts:***

- It can be difficult to imagine that the hard coral structures are actually thousands of delicate animals called Polyps. These grow an average of one centimeter per year. Most of the big corals you’ll see are hundreds of years old already. Should it be damaged, it will take hundreds more to restore it to their original size and health.
- For the preservation of our marine life,

- Buoyancy is of absolute importance when diving in places like Sodwana
- Corals have protective coatings and even an accidental rub, will rub off the coating exposing the coral to dangerous bacteria that affect it's health and later cause it to die.

***Collecting:***

- In South Africa, all the dive sites we visit are protected by the National Parks Boards of South Africa.
- No Collecting is allowed.
- Gloves are not allowed when diving in South African waters, as it is an invitation to touch.
- As Scuba Divers, the only thing we take out of the water is Photographs and Memories.
- Leave only bubbles.

# *Unit 5: Diving Safety*

***Objectives:***

- State some of the methods of resolving problems under water
- Identify situations that can occur under water and how to prevent or resolve them.
- Assist another diver with problems.
- Plan a Dive and successfully execute your plan.
- Explain SEABAG

***Methods of Resolving a Problem:***

- Stop the activity
- Remain in control and analyze the situation
- Take action based on your analysis

**STOP, THINK, TAKE CONTROL**

***Diving Situations:***

- Heat loss – Hypothermia (Hypo = Low)
    - Loss of muscle strength
    - Muscle cramps
    - Inability to use your fingers or hands
    - Increased breathing rate with no increase in your activity
    - Shivering
    - Fatigue
    - Loss of ability to think clearly – Confusion
    - Ignoring these symptoms can result in a serious medical emergency.
        - Heart irregularities
        - Unconsciousness
        - Death
    - Take shivering as an indication to end your diving activities
    - Your best defense is to wear proper insulation
- Overheating – Hyperthermia (Hyper = High)
    - Pale clammy skin
    - Feeling of weakness and fatigue
    - Headache
    - Nausea and possibly vomiting
    - To Prevent –Pace yourself when donning your wetsuit
- Cramps
    - Stretch the cramped muscle
    - For cramps in your calf or foot, pull on the tip of your fin gently as you straighten your leg
    - Stretch your muscle gently to prevent injury to your muscle or tendons
- Entanglement
    - Typically occurs with underwater plants, fishing line or fish nets
    - Rely on your buddy to free you or cut yourself loose
    - DO NOT PANIC.
- Disorientation and Vertigo

- Can occur in limited visibility environments, night diving, cave/wreck diving
- To overcome dizziness, hold on to a solid object or hug yourself until the dizziness passes
- Do not close your eyes
- BUBBLES WILL ALWAYS GO UP

- Sea Sickness
  - Avoid eating greasy food
  - Avoid alcohol
  - Stay out of enclosed spaces on a boat
  - Position yourself in the centre of the boat
  - Look at the horizon
- Choking and coughing
  - If you must cough or vomit, keep the regulator in your mouth
  - Stay calm
- Air Starvation
  - Check for fluctuation on your SPG
  - Ask buddy to assist
  - Stay calm
- Out of Air options
  - Redundant air supply Source (Octopus Breathing)
  - Emergency Swimming Ascent
  - Buddy Breathing

***Dive Planning:***

- Long Range Planning
  - Plan the objective of your dive
  - Select the location
  - Research unfamiliar dive sites
    - Internet
    - Books
    - Dive centers
    - Instructors, Divemasters, Dive clubs
  - Set up a "To Do" List for arranging your excursion
- Short Range Planning
  - Starts a week before your dive
  - Create an inventory
  - Spare Parts list
  - Equipment Inspection
  - Check the weather conditions, tides and long range weather forecast.
  - Site Survey
- Evaluate the conditions at the site and determine if they are acceptable for your planned activity
- Determine the leader of your buddy pair or dive group
- Confirm roles and responsibilities

***Pre Dive Planning:***

- The acronym SEABAG:
  - S - SITE SURVEY AND SIGNALS
  - E - EMERGENCY

- A - ACTIVITY
- B - BUOYANCY
- A - AIR
- G - GEAR UP AND GO!!!

***Buddy System:***

- Buddies are two divers who remain within touching distance of one another while underwater
- Always check your buddy's equipment
- Be ready to assist your buddy in an emergency situation
- Always have a leader in a buddy pair
- Share tasks between buddies
- Buddies agree on pre dive plan procedures before diving
- SORT PROBLEMS OUT IN BUDDY PAIRS

***Communication:***

- Pre determined signals
  - Visual signals
  - Audible signals
  - Tactile signals

***Navigation:***

- To avoid long swims and to know where you are,
  - Compass
  - Natural navigation
  - Fin strokes
  - Time keeping device

***Assists and Rescue:***

- Causes of Diving accidents
  - Negligence
  - Recklessness
  - Human Error
  - Equipment Failure
  - Hazardous marine animals
  - Insufficient Training
- PREPAREDNESS PROBABLY EQUALS NO ACCIDENT

***Assists and Rescue:***

- Prevention of diving accidents
  - Plan your dive and Dive your plan
  - Know your equipment
  - Complete buddy checks
  - Remain calm at all times
  - Know your personal limitations
  - DON'T DRINK AND DIVE

***Assists and Rescue:***

- Recommended Training:
  - CPR

- First Aid
- Diving Rescue Techniques
- Oxygen Provision
- Master Diver

***Diving First Aid:***

- Bleeding
  - Pressure on wound
  - Tourniquet
  - Bandage
- No Pulse/ No Breathing
  - CPR (Cardio Pulmonary Resuscitation)

***Diving First Aid:***

- Shock
  - Keep body warm
  - Null per mouth
  - Elevate feet
  - Comfort
- Barotrauma
- Squeezes and blocks
- LOPI's
- Seek Urgent Medical Attention
  - Call DAN – 08000 20111
  - Administer 100 % Oxygen
  - Emergency Procedures
  - Predetermined Procedures (In Briefing)
  - Treatment
  - Transport
  - Medical Assistance
  - Contact information
  - Equipment and Log Books
  - Nearest Hospital (Directions)

***Health and Fitness Considerations:***

- Medical Status
- Heart Disease
- Lung Disease
- Blood Pressure
- Diabetics
- Cholesterol
- Epilepsy
- Fitness
- An increased level of fitness decrease your risk of DCS
- Woman and Diving:
  - Pregnant woman may not dive
  - It is safe to dive whilst menstruating
  - It is safe to dive with an Intra Uterine Device (The Loop)
- Personal habits and Diving
  - Alcohol

- Smoking
- Drug abuse
- Medication (Not approved)
- Mental state

- NO STRENUOUS EXERCISE AFTER DIVING

*Quiz:*

1. **Name some considerations when planning a diving excursion**

2. **What does SEABAG stand for?**

3. **Why is a buddy important?**

4. **Describe one way to navigate without a compass**

5. **What is most important to remember when in an emergency situation?**

6. **How do you treat a person for shock?**

7. **How can a diving accident be prevented?**

# *Unit 6: NAUI Dive tables*

***Objectives**:*

- Explain why our dive times and depths are limited according to the NAUI Dive Tables
- Understand the concept of residual nitrogen
- Log dives according to NAUI Dive Tables and Rules
- Name some of the NAUI Dive Rules relating to Dive Tables and Nitrogen
- Calculate your own SAC Rate
- Predict dive time according to your own SAC Rate

***Ingassing and Outgassing Nitrogen:***

- Nitrogen is absorbed into the bloodstream, soft tissues and bones of your body
- Your body ingasses nitrogen until the pressure of nitrogen in your body equals the pressure of nitrogen in the air you breathe (Equilibrium)
- The reason we ascent @ a rate of 9 meters per minute and do a safety stop @ 5 meters for 3 minutes:
- To allow or body to outgass the nitrogen we ingassed at a slow enough rate, preventing the nitrogen in your tissues to come out of solution so rapidly that bubbles form in your body.
- We as Divers must control the two factors that affect in-and Outgassing:
    - Time
    - Pressure

***Residual Nitrogen:***

- It takes hours for your body to outgass the nitrogen that is absorbed in one dive
- When you do another dive within 24 hours, you will still have nitrogen left from your first dive
- This is Residual Nitrogen Time
- This remaining nitrogen in your body must be taken into account when planning your next dive

***Dive Table Terminology***

- No-Decompression Limit:
    - The Time allowed diving at an indicated depth
- Dive Schedule:
    - Dive time and Depth
- MDT – Maximum Dive Time:
    - Maximum allowable dive time/No-Decompression time limit
- Decompression Stop:
    - Time stopped at a specific depth for a specific time to outgass nitrogen
    - Precautionary Decompression stop – Safety stop
    - Stop @ 5 meters for 3 minutes as a safety precaution
    - This is a required stop for every dive
- ADT – Actual Dive Time
    - The actual time spent under water
- RNT – Residual Nitrogen Time
    - The time it will take for the nitrogen left in your body to be outgassed

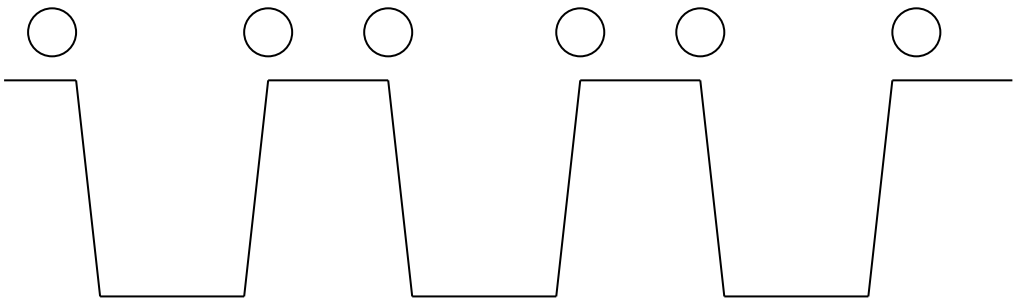
- SIT – Surface Interval Time
    - Time spent on the surface between consecutive dives
- Repetitive Dive:
    - This is a dive you make before you have completely outgassed from any previous dive or dives
- AMDT – Adjusted Maximum Dive Time
    - This is the Maximum dive time minus the Residual Nitrogen time for a repetitive dive at a given depth
- TNT – Total Nitrogen Time
    - The sum of your Residual Nitrogen Time and your actual dive time following a repetitive dive

***Dive Table Rules:***

- Ascend no faster than 9 meters per minute
- Use the exact or next greater number listed in the table for your depth and time
- Use the deepest depth you reached during your dive to determine the dive schedule for your dive
- Always make your deepest dive first when making a series of dives. Plan each of your repetitive dives to a shallower depth than your previous dives
- Consider any dive shallower than 12 meters to be a 12-meter dive
- SIT must be at least 10 minutes between dives. When your SIT is less than 10 minutes, you must consider your second dive as a continuation of the fist dive
- NAUI recommends a SIT of at least on hour between dives
- Use the next greater dive time if your dive is particularly cold or strenuous (Next Letter Group)
- Avoid dives that take you right to the no-decompression limit for any given depth and time combination.
- Always allow yourself to make a slow, comfortable ascent with plenty of air. Surface with 50 BAR left in your cylinder

***Dive Table Exercise 1:***

- Your first dive of the day was to 20 meters
- You descend at 9:40, Surfaced at 10:19, and completed a tree-minute safety stop.
- Your second dive was to 14 meters
- You descend at 12:32, surfaced at 1:13, and completed a three minute safety stop
- Your third dive was to 12 meters
- You descend at 2:43, surfaced at 3:26, and completed a three minute safety stop
- Draw a complete schedule with RNT, TNT, AMDT and ADT, also stating your end of dive letter groups.



**RNT:**
**ADT:**
**TNT:**

**RNT:**
**ADT:**
**TNT:**

**RNT:**
**ADT:**
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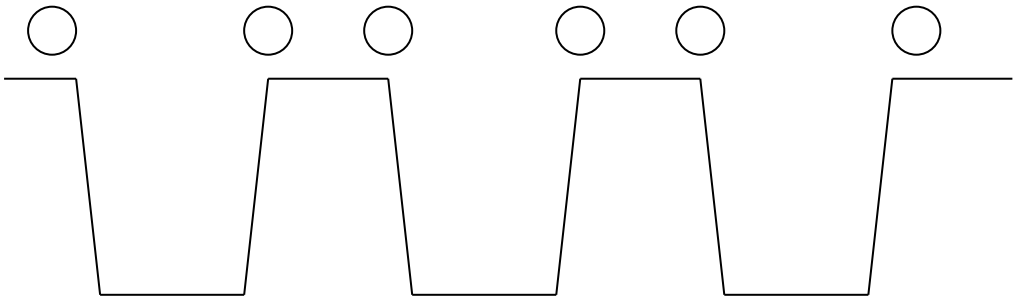
***Dive Table Exercise 2:***

- First dive – 24 meters
- Descend @ 8:35, surfaced @ 8:58
- SIT – 2:46
- Second Dive – 16 meters for 36
- Surfaced @ 12:20
- Third dive – 10 Meters
- Descend @ 3:10, Surfaced @ 4:10
- Draw a complete schedule with RNT, TNT, AMDT and ADT, also stating your end of dive letter groups .



**RNT:** **RNT:** **RNT:**
**ADT:** **ADT:** **ADT:**
**TNT:** **TNT:** **TNT:**

***Flying after Diving:***

- NAUI Recommends:
  - Wait 24 hours after the completion of your last dive.
- Altitude Diving
  - To account for the difference in pressure at altitude comparing to the pressure at the coast NAUI Follows special Procedures
  - Miracle Waters, Bass Lake, wondergat are all inland diving sites in SA. All rounded to a 20 % higher altitude as at the coast
  - To be more conservative on our dive planning we add 20% to our actual diving depth.
  - Formula = Depth X 1.2 Or Depth + 20 %

***Surface Air Consumption:***

- SACR – Surface Air Consumption Rate is the rate at which you consumed air from your cylinder under water
- Factors used:
  - Air Used
  - Cylinder Volume
  - Time
  - Absolute Pressure
- This formula also allows you to predict how long you can dive with a predetermined SAC Rate

***Quiz:***

1. What is RNT?

2. What ADT?

3. What is AMDT?

4. What rules apply when diving at altitude?

5. When your dive was cold or strenuous, how does it affect dive planning?

6. How do you predict the dive time of a planned dive?

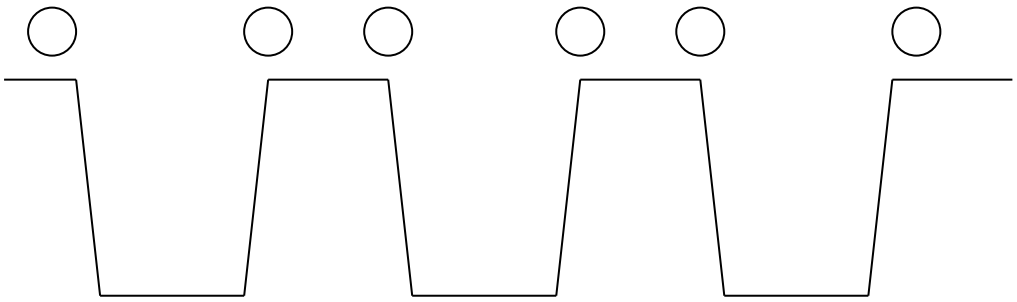
7. Why do we calculate our SAC Rates?

8. What is the minimum SIT time?

9. When can you fly, after your last dive?

10. What is NAUI's Golden rule regarding dive plans?

11. Dive table exercises:
    a. New diver dives to 27 meters for 20 minutes, sits for 1h57, dives to 18 meters for 45 minutes sits for 2h09, dives to 12 meters for 43 minutes. Work out end of dive letter group.



**RNT:** **RNT:** **RNT:**
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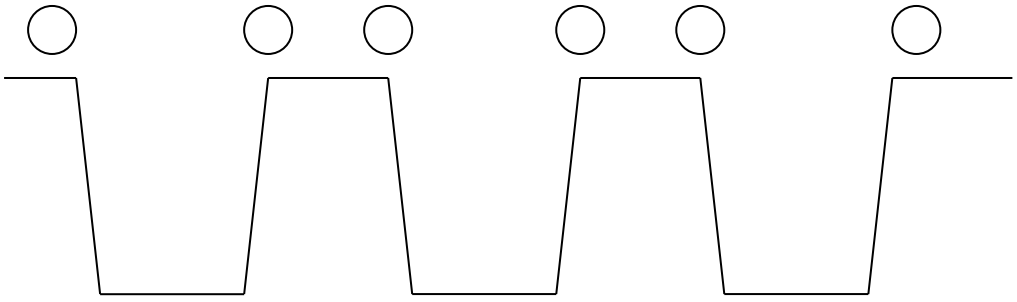
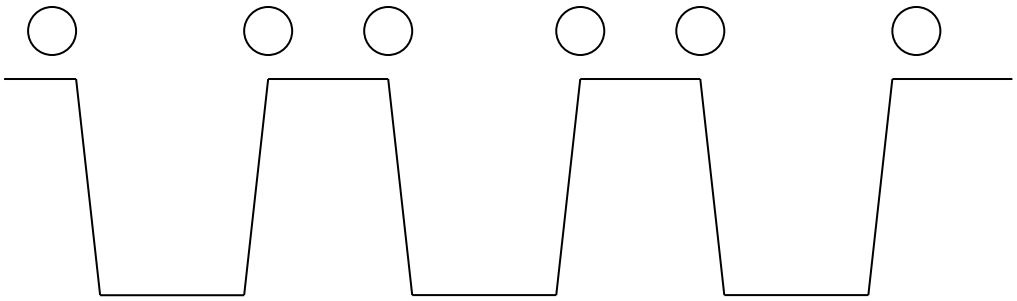
**TNT:** **TNT:** **TNT:**

    b. L Diver sits for 9h45 then dives to 18 meters for 45 minutes, sits for 2h54 dives 12 meters for maximum time



**RNT:** **RNT:** **RNT:**
**ADT:** **ADT:** **ADT:**
**TNT:** **TNT:** **TNT:**

c. New diver dives to 39 meters for 3 minutes, sits for 5h00, dives 27 meters for 10 minutes, sits for 3 hours, dives to 15 meters for maximum time. How long after this can he fly?



**RNT:**
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**RNT:**
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**TNT:**

**RNT:**
**ADT:**
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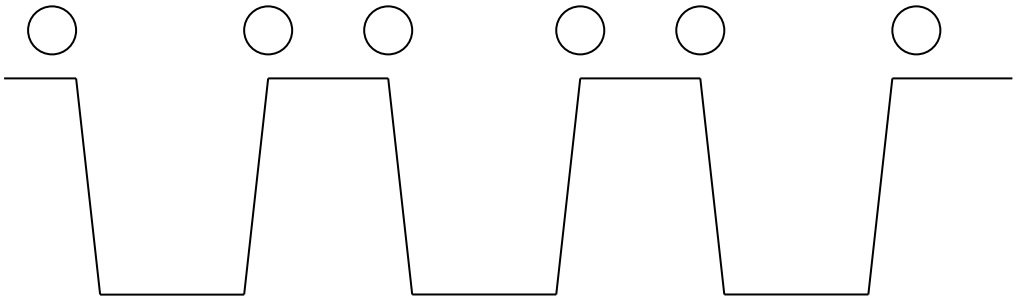
d. Diver dives to 22 meters for 40 minutes, and then 18 meters for 50 minutes, and then 12 meters for 60 minutes, work out min sit times required.



**RNT:**
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**RNT:**
**ADT:**
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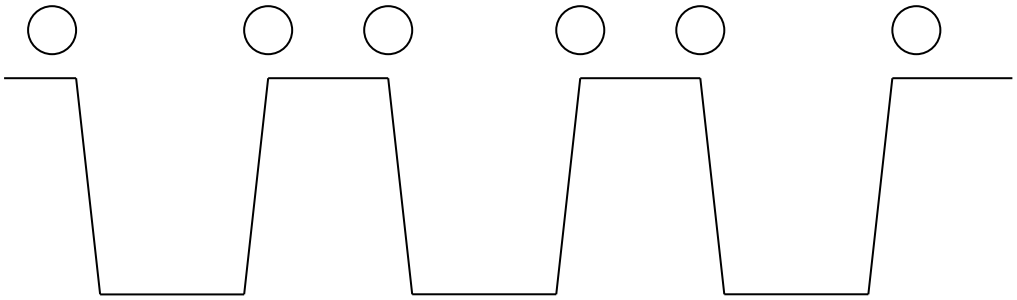
e. New diver dives to 21 meters for 10 minutes, then sits for 8 minutes then dives to 15 meters for 20 minutes. What is the end of dive letter group?



**RNT:**
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**RNT:**
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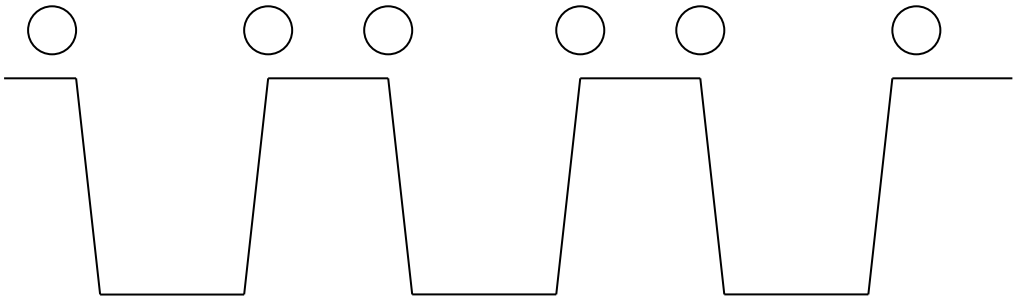
**TNT:**

**RNT:**
**ADT:**
**TNT:**

f. New diver dives to 21 meters for 135 minutes. What is the diver's end of dive letter group?



**RNT:**
**ADT:**
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**RNT:**
**ADT:**
**TNT:**

**RNT:**
**ADT:**
**TNT:**

g. New diver dives to 12 meters for 135 minutes what must he perform and for how long?

12. By how much, and what do you adjust if you dive in fresh water at miracle waters regarding dive tables?