STAGE
FREEDIVER

ENJOY THE SILENCE

Apnea International
DISCLAIMER

Please read this before you proceed.

Freediving is a fun activity!

When practiced conservatively and when all safety rules are followed the risks are minimal.

Nevertheless, Freediving is a potentially dangerous activity and can lead to serious injury and death even if all currently known limitations and safety guidelines are followed correctly. Accidents may be due to, but not limited to, drowning, shallow water blackout, defective gear, improper operation of boats, ear and sinus injuries, shark attack and others.

This manual is intended to serve as a guideline but should be combined with an actual course taught by a certified instructor. This manual is not a replacement for your own judgment, experience and honest assessment of your own freediving abilities and limitations.

APNEA INTERNATIONAL accepts no liability for any wrong doing, resulting in any damage, personal injury or death from intentional or non-intentional acts of negligence by any person associated with the interpretation, application, or instruction of any information presented in this manual.

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SAFETY AT A GLANCE

- ALWAYS DIVE WITH A BUDDY
- DIVE WELL WITHIN YOUR LIMITS
- CORRECT BREATHING BEFORE DIVING - NEVER HYPERVENTILATE
- ALLOW AT LEAST 12 HOURS WHEN FREEDIVING AFTER SCUBA
- NEVER EXHALE DURING A DIVE
- CORRECT BREATHING UPON SURFACING
- SUFFICIENT RECOVERY BETWEEN DIVES
- EQUALISE ON DESCENT, NEVER ON ASCENT
- ALWAYS USE A FLOAT AND FLAG
- MOVE SLOWLY - FAST MOVEMENTS USE MORE O₂
- CHOOSE YOUR GEAR WISELY
About Apnea International

Apnea International was established by Erez Beatus - Former world record holder (CNF 2001) and multiple national record holder. Erez has been the VP of A.I.D.A and has taught well over 2000 students in Australia and around the world and has been involved in freediving on a professional level since 1997.

Apnea International Promotes safe freediving through cutting edge education systems and top level instructors. All of our instructors have many years of experience as Freedivers in various capacities - from Competitive Freedivers to leading pro surfers and underwater photographers / Spearfishermen. The Manual you are reading is the fruit of many years of research and experience.

More information about Apnea International can be found on www.apnea-international.org
Preparing For a Session

- Consider tides, currents, visibility, water temperature, weather conditions, marine life, bottom composition, depth, emergency procedures, equipment, boat traffic, other divers

- Work in pairs or triples.

- Only one Freediver underwater.

- Make sure your buddy knows what you are planning to perform.

- Allow enough recovery time between divers.

- Passive safety for dives shallower than 10m.

- Active safety for deeper ones.

- Periodic emergency training

- First aid Kit available

- Evacuation procedures

- Emergency phone numbers

ALWAYS PREPARE AN EVACUATION PLAN WHEN TRAINING.
On the stage A course you were introduced to the concept of Gliding. This concept enables freedivers to minimise their $O_2$ expenditure by minimising movement once the freediver becomes negatively buoyant on the way down or positively buoyant on the way back up to the surface.

From a safety perspective, we aim to be Neutrally buoyant at a depth of at least 10m (33ft). Deeper divers tend to increase this depth even further. This means that once the freediver passes that depth he will not float up to the surface without kicking.

On the first course we explore the depths between 10-20m and direct the divers to stop kicking and go into the glide at around 12-13m. This allows the divers to experience the glide while having enough time to focus on Equalisation and streamlining. The closer we are to our Neutral Depth, the greater is the influence of our streamline on our speed of descent and our rate of acceleration. The point where we continue to accelerate instead of slowing down is defined as the point of no deceleration. This depth is roughly at 1.5-2 times the depth of neutral buoyancy.

Once at that depth, a Freediver will not slow down and will continue to drop at an increasing speed until he reaches “terminal velocity”. Unlike in air, Terminal velocity is much slower in water as it is greatly affected by streamlining.

Once EQ and technique improve to a point where the dive is automatic and there are no timing issues with equalisation the diver can begin to postpone the glide phase until a point where deceleration is minimal or non-existent. Analysis of dive profiles from a dive computer is extremely helpful to identify any possible improvements in the transition into the Glide.

In order to discover the best depth for gliding we can conduct the following experiment:
Perform a dive to a depth of 10m and count how many kicks it took (can either count single or double kicks). Repeat this a couple of times to arrive at an average.

Depending on the gear used (monofin vs. bi-fins, Soft vs. stiff blades) there will be a difference in the amount of kicks required. Once we arrive at that number we can estimate how many extra kicks it would take to arrive at the no deceleration depth.
X + Y INTO THE GLIDE

X - The number of kicks required to arrive at neutral buoyancy depth minus one or two kicks. Those kicks are strong (not fast or forceful, but generate a lot of thrust)

Y - the number of soft kicks which are required to arrive at the planned Glide depth. This number is usually around the same as X.

Example:
A freediver requires 10 kicks to get to 10m.
Our X will then be 8 or 9 kicks.
Our Y will be 8 kicks.

The freediver will perform 8 strong kicks and drop the intensity for the next 8 kicks. By the time they completes the 8 soft kicks they should be at around 16-18m where they can glide without noticing any slowing down.
The logic behind this technique is to allow more advanced divers to avoid the extra dive time.
Disadvantages:
As this technique results in a faster dive, freedivers with equalisation issues might experience difficulties.
As we kick for a longer duration the dive response (mainly the bradycardia) will react slower.

On ascent, the freediver can use a similar strategy but instead of 8 soft kicks the freediver will need to continue kicking until he passes the neutral buoyancy depth on the way up.

THIS CONCEPT CAN BE UTILISED WHEN USING A MONOFIN, WHEN DIVING WITH NO FINS AND EVEN IN FIM
ASCEND INTO THE LIGHT
Relaxation

Psychology plays a big part in freediving (especially when going deep) and will determine whether a diver consumes more $O_2$ or be efficient.

There are many ways of preparing the body and mind for freediving, some of them explained on the Stage A Course.

Let's look at some Examples:

**Exercises meant to prepare us for the dive**

Simulation / Rehearsal
- Used for increasing confidence
- Improves self image
- Easy to practice at home

Breathing exercises
- Easy to practice at home
- Works on the mind as well as the body

**Exercises to prolong breath-hold time / Dive time**

Story / Visualisation.
- Sight
- Sound
- Pulse
- Weight
- Touch
- Song

**Exercises for relaxation.**

Sphere of light - visualise a sphere of pure light traveling through the body, relaxing the muscles.
- Directed tension
- The line

**TRY TO FIND THE BEST RELAXATION SEQUENCE FOR YOURSELF.**
**CHANGE CONCENTRATION POINTS DURING THE BREATHHOLD.**
Breathing

As discussed on the first level, breathing is perhaps the most important physiological function we perform. From a physiological standpoint, breathing is done by utilizing muscles that increase and decrease the internal volume of the chest cavity.

There are 2 main ways in which we breathe:

Upper breathing – Using the inter-costal muscles to increase the volume of the rib-cage.
Lower (Abdominal / Diaphragm) breathing - using the Diaphragm to “pull” the lungs down.

Each of those systems use a slightly different part of the lungs:

Upper breathing – Using the top portion of the lungs
Lower breathing – Using the bottom portion of the lungs.
As the lungs look like a pyramid, the upper part is smaller than the lower part. Lower breathing also makes the air travel a longer way inside the lungs – resulting in better ventilation.

Each of us has a dominant system. On a shallow / relaxed breath each of us breathe slightly differently.

Full breathing / aware breathing is a way to combine those 2 systems into a more efficient way. It is important to understand that we should breathe in accordance to the level of activity we undertake: Resting breathing will provide all the O₂ the body needs for resting while during a jog the muscles might require more O₂ and so the breathing will change.

CO₂ levels and O₂ levels will affect our basic functions such as eyesight, concentration and hearing. A diver / person can “over-breathe” and change the ratios of those gasses resulting in changes to the most basic functions.

THERE IS NO “BEST BREATHING” – THERE IS ONLY “THE OPTIMAL BREATHING FOR THE PERSON AND EFFORT”

**Ratios**

As a rule, the exhale should be at least as long as the inhale. A ration of 1:2 is usually reached with some training.
Some divers prefer different ways of preparing for a dive before different disciplines, a point that is discussed in the Stage C course.
Stages of Breathing:

**Inhale:**
Begin by finding a comfortable place to sit. Keep your back straight and head looking straight. Place one hand on your belly and the other on your chest. Begin inhaling through the nose by filling the lowest part of your lungs. This is done by visualising the abdomen being filled with air. This stage may result in the belly sticking out. Once we fill the whole belly, begin filling the chest. This will result in your chest moving up. This part should take around 5 seconds. Some people require longer or shorter times. Make sure you do not use force during this stage.

Once you reach a point where effort is required stop inhaling.

**Exhale:**
Begin releasing the air passively by relaxing the muscles. The air will leave the abdomen first and then, lastly the ribs will drop. This stage should take at least 5 seconds.

As part of your training you should also practice full breaths where you fill 100% of your lungs and exhale to the maximum. This helps increase the flexibility of the ribcage and increase comfort levels with full inhales.

Stretching is another important part of breath training and will be covered in the relevant section.

Daily breathing changes around 1/2 litre of air on each breath (Tidal volume). Deep breathing will use 50-70% of the lung volume. Full breath potentially uses almost 100%. Packing can add another 15-30% of lung volume (training dependent)
Practicing Proper Breathing

1st stage:
- Inhale slowly into the abdomen.
- Follow up to the chest once the lower half is full.
- Fill the upper part of the chest.
- Exhale passively for 5 seconds.

2nd stage:
- Inhale same as in 1st stage. (5 seconds)
- Exhale passively to around 20%.
- Hold breath.
- Pull in the diaphragm.
- Exhale the remaining air.

3rd stage:
- Inhale same as 1st stage.
- Exhale slowly, trying to first empty the abdomen and then the chest.
- Use the abdominal muscles to push air out while maintaining slow and steady pace.

PRACTICE THOSE 3 STAGES GRADUALLY!! DON'T JUMP TO STAGE 2 IF YOU STILL CANT CONTROL YOUR INHALE!! TAKE YOUR TIME AND YOU WILL SEE RESULTS QUICKLY!!
Unsafe Breathing Practises

Before freediving education was broadly available, many freedivers had only a rudimentary – and often misleading – understanding of their own breathing and some of the risks involved in improper breathing were not yet understood or commonly known.

This is why even today, some freedivers use unsafe breathing practises that introduce unnecessary risks and are in part even counter productive to freediving.

**Hyperventilation**

A direct translation of the word hyperventilation is “too much (hyper) breathing (ventilation)”. Too much for what? This depends on our level of activity.

The basic function of our breathing is not so much to supply us with O₂ – on a tidal breath we exhale most of the O₂ we have just breathed in – but to regulate our CO₂ level. A useful definition of Hyperventilation is thus:

Hyperventilation is breathing that reduces our CO₂ below its normal level

It is important to understand that hyperventilation can not increase the amount of O₂ we have available to us, but instead increases our heartrate and decreases and delays the onset of our dive response. So if a freediver hyperventilates before freediving, they will use more O₂ than with proper preparation and thus increase the risk of blacking out.

Hyperventilation increases overall O₂ consumption and the risk of blackout.

**Packing**

Packing describes the the practise of pumping additional air into the lungs after a full breath in. While this does increase the volume of air available both for equalisation and for O₂ supply, it also introduces health risks that range from packing blackout to permanent, life-long lung damage.

PACKING IS ALSO – AND THIS IS GOOD TO KNOW – COMPLETELY UNNECESSARY FOR THE VAST MAJORITY OF DIVES. FREEDIVERS HAVE PERFORMED WORLD-CLASS STATICS AND CONSTANT WEIGHT DIVES TO MORE THAN 90 METRES WITHOUT ANY FORM OF PACKING, SO WE FIND THAT WE CAN DEFINITELY IMPROVE OUR DIVING WITHOUT RISKING THE HEALTH OF OUR LUNGS.

WE CAN ALWAYS IMPROVE OUR DIVING WITHOUT RISKING THE HEALTH OF OUR LUNGS.
REMEMBER TO BREATHE. IT IS AFTER ALL, THE SECRET OF LIFE

GREGORY MAGUIRE
Pranayama

Pranayama exercises are used for increasing breath control, increase breath-holds and more. Here, we will focus on the physiological benefits of pranayama practise and forego the complex underlying philosophy of the yogic practise of pranayama, which aims at far more than just breath control.

It is recommended to practice yoga and learn Pranayama from a qualified teacher, certified by a reputable certifying agency. Ask your Apnea International Instructor, they may just know someone.

Basic Pranayama
This exercise is – while not complex – advanced. Although there is no actual breath-hold through the session, the long breaths introduce a high level of CO₂.

Instructions
• Lie on the floor or a hard surface with a small, comfortable support under your head.
• Knees slightly bent.
• Breathe in as slowly as you can. Breathe out as slowly as you can. We want to maintain the quality of breath: We are looking for a relaxed, consistent and comfortable breath.
• Perform 10-15 breaths like this on the first day. At first, the length of the individual breaths may be shorter; it will slowly extend with practise.
• Start a stopwatch at the beginning of the exercise and stop at the end. Record the total time in your training log and note any additional comments.
• In each practice add one more breath working up to 30 breaths per session.

Pranayama (Sanskrit: प्राणायाम prānāyāma) is a Sanskrit word meaning “restraint of the prana or breath”. The word is composed of two Sanskrit words, prana, life force, or vital energy, particularly, the breath, and “ayama”, to suspend or restrain. It is often translated as control of the life force (prana).
Alternate Nostril breathing - Nadi Shodana

**Practice considerations:**

- This exercise is potentially the most powerful breathing exercise in your arsenal. It greatly enhances breath awareness, focus, control and timing.
- It is important to progress slowly and recommended to practice with a Yoga teacher.
- Breath should not be forced and needs to flow freely.
- Practice on an empty stomach and with a straight back
- Do not over-train and do not practice while driving.

<table>
<thead>
<tr>
<th>LEFT NOSTRIL</th>
<th>BOTH / HOLD</th>
<th>RIGHT NOSTRIL</th>
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<tbody>
<tr>
<td></td>
<td>INHALE 6 SEC'</td>
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<td>EXHALE 6 SEC</td>
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<tr>
<td>INHALE 6 SEC</td>
<td>HOLD 6 SEC</td>
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<td>INHALE 6 SEC</td>
<td>HOLD 6 SEC</td>
<td>EXHALE 6 SEC</td>
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</table>

- Each set – 2 minutes.
- 1 Min rest between sets
- Perform 5-10 sets.
- If you can’t maintain proper breathing – shorten the breath length
- (Check pulse before and after the exercise)
- It is possible to replace the sets with one long continuous “set”.

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**Stage B**

Freediver

Going Deeper

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The Dive Response

The dive response was previously referred to as the “mammalian dive reflex”. It was believed that only mammals exhibit the physiological changes required to adapt to depths. Interestingly enough, birds and reptiles also show the same adaptations. A reflex is a very simple mechanism with one input value and one output value (e.g. increased brightness → contraction of the pupil) – the dive response is much more complex than this, so a more appropriate term is “dive response” (DR).

The DR is a series of physiological adaptations that occur mostly in a state of immersion, but can with training also be triggered out of the water.

The intensity and speed in which this happens is determined by the situation (temperature, level of relaxation, level of activity, pressure, ...) and the type of diving.

**Bradycardic reflex**

Our heart is an amazing pump. It can change both its stroke volume and speed. In a state of immersion the heart slows down rapidly. This comes with an increase in stroke volume.

In some divers the heart rate drops to less than 20bpm.

**Factors that trigger Bradycardia:**

- Temperature difference
- Depth (Pressure)
- Empty / Full lung
- Psychology
- Training

**Peripheral vasoconstriction**

When under high pressure induced by deep diving, blood vessels in the extremities start closing off, stopping blood circulation to those areas. Vasoconstriction usually applies to arterioles, but in this case is completely an effect of the capillaries. Toes and fingers close off first, then hands and feet, and ultimately arms and legs stop allowing blood circulation, leaving more blood for use by the heart and brain.

**Consequences of Peripheral Vasoconstriction**

- Increased O₂ available to brain prolongs dive times
- Reduced O₂ available to muscles causing a build up of lactic acid
- Legs can weaken, feel heavy and tired
As lung volume reduces with depth, blood flows in to fill the blood vessels in the lungs to equalize pressure.

**Blood shift**

As we enter the water the hydrostatic pressure increases and as a result blood is directed to the thoracic cavity the capillaries surrounding the alveoli. The deeper we go - the more blood that goes into the lungs. This phenomenon causes the lungs to “stiffen” (hence the name- pulmonary erection), preventing them from collapsing.

As we ascend blood is then redistributed to the body through the heart.

Blood shift takes time to happen.

If a freediver goes too deep, too fast blood won’t have enough time to enter the lungs, resulting in a squeeze.

**Blood Shift and Immersion Diuresis**

As you immerse yourself in water, vertically, the pressure of the water causes about half a litre of blood to shift upwards from the legs to the chest, this distends the atrial wall and increases your cardiac output. This in turn alters the level of two hormones that influence water uptake by the kidney and stimulates urine production – so blood shift also causes the need to pee (and a good reason never to borrow someone else’s wetsuit!)

**Splenic Contraction**

The human spleen sequesters 200–250 ml densely packed red blood cells. Up to 50% of this viscous blood is actively expelled into the systemic circulation during strenuous exercise or simulated apnea (breath-hold) diving.

The spleen takes time to contract and when it does, Hemoglobin rich blood is available to transport O₂ into the cells.

The effect lapses within 10-20 minutes of terminating the exercise.
SPECIAL MEMORIES FOREVER
WHALE ENCOUNTERS IN TONGA...
DCS and freediving

Unless we dive to extreme depth or freedive after scuba diving, the risk of decompression sickness is virtually zero during a single breath-hold dive in humans, repeated dives may however result in a cumulative increase in the tissue and blood nitrogen ($N_2$) tension. Many species of marine mammals spend a lot of time at great depths, foraging or hunting, with only short surface intervals and some human divers regularly perform repeated dives to 30-40m or a single dive to more than 100m, all of which may result in Nitrogen concentrations that bring on symptoms of decompression sickness.

Neurological problems have been reported in humans after single or repeated dives and recent reports from research in stranded marine mammals were suggestive of DCS-like symptoms.

**Contributing factors to DCS in freediving are:**

**Bottom time**
The longer the bottom time, the more $N_2$ is dissolved into the tissues.

**Depth**
The deeper the dive, the faster the $N_2$ is absorbed and the faster the tissues get saturated.

**Ascent rate**
In Scuba - an ascent rate of 18m/Min is maintained and a safety stop is performed to reduce risks of bubble formation. Freedivers travel at an average of 1m/sec which is much faster. Having No safety stops as part of freediving practice also increases the risks.

**Repetitive diving**
More dives result in more $N_2$ absorption.

**Combining Scuba and freediving**
Freediving after Scuba greatly increase the risk of DCS as $N_2$ is already present inside tissues.

**Surface time**
Short surface time in freediving will not allow the tissues to “off-gas” and will greatly increase the risk of DCS.

**Dehydration / Exertion / Menstruation / Alcohol**
Packing
Packing increases the amount of gas carried which increases the amount of N₂.
Packing causes micro-tears in the lung tissues which makes the Freediver more prone to DCS.

Types of DCS

<table>
<thead>
<tr>
<th>DCS type</th>
<th>Bubble location</th>
<th>Signs &amp; symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musculoskeletal</td>
<td>Mostly large joints- (elbows, shoulders, hip, wrists, knees, ankles)</td>
<td>Localized deep pain, ranging from mild to excruciating. Sometimes a dull ache, but rarely a sharp pain. Active and passive motion of the joint aggravates the pain. The pain may be reduced by bending the joint to find a more comfortable position. If caused by altitude, pain can occur immediately or up to many hours later.</td>
</tr>
<tr>
<td>Cutaneous</td>
<td>Skin</td>
<td>Itching, usually around the ears, face, neck, arms, and upper torso Sensation of tiny insects crawling over the skin (formication) Mottled or marbled skin usually around the shoulders, upper chest and abdomen, with itching Swelling of the skin, accompanied by tiny scar-like skin depressions (pitting oedema)</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Brain</td>
<td>Altered sensation, tingling or numbness paresthesia, increased sensitivity hyperesthesia Confusion or memory loss (amnesia) Visual abnormalities Unexplained mood or behaviour changes seizures, unconsciousness</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Spinal cord</td>
<td>Increasing weakness or paralysis in the legs Girdling abdominal or chest pain Urinary incontinence and fecal incontinence</td>
</tr>
<tr>
<td>Constitutional</td>
<td>Whole body</td>
<td>Headache Unexplained fatigue Generalised malaise, poorly localised aches</td>
</tr>
<tr>
<td>Audiovestibular</td>
<td>Inner ear</td>
<td>Loss of balance Dizziness, vertigo, nausea, vomiting Hearing loss</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Lungs</td>
<td>Dry persistent cough Burning chest pain under the sternum, aggravated by breathing Shortness of breath</td>
</tr>
</tbody>
</table>
Treatment

All cases of decompression sickness should be treated initially with 100% oxygen until hyperbolic oxygen therapy (100% oxygen delivered in a high-pressure chamber) can be provided. Mild cases of the “bends” and some skin symptoms may disappear during descent from high altitude; however, it is recommended that these cases still be evaluated. Neurological symptoms, pulmonary symptom and mottled or marbled skin lesions should be treated with hyperbaric oxygen therapy if seen within 10 to 14 days of development.

Prevention

A strict separation of freediving from SCUBA diving, following the established safety rules and understanding the causes of DCS will minimise the risk of DCS.

The Surface Interval

During our surface interval, the time in between two dives, we breathe off some of the N₂ we accumulated during the session. If we leave enough time between dives, we can reduce the risk of DCS.

The DCS risk is greatly influenced by three main properties of the dive:
1. t: The total dive time.
2. p: The maximum pressure experienced during the dive in bar.
3. V: The maximum speed during the ascent in metres per second (m/s).

An easy to remember formula allows us now to adjust our surface interval according to the value of these factors during each dive:

\[
Surface \ Interval = t \times p \times v
\]

The speed of ascent varies somewhat with the means of propulsion. Monofinners have recently started a trend of fast dives with speeds over 2m/s, which we may even see during a dive to depth, whereas the other disciplines leave us in the comfortable situation that the speed of ascent with bi-fins, no fins and in free immersion for most divers is just under 1 m/s, so for freedivers swimming with bi-fins or without fins, we can work with a simplified rule of

\[
Surface \ Interval = t \times p
\]

e.g.: After a 2 minute dive to 20m (3 bar), this formula gives us a 2 * 3 = 6 minute surface interval

Another way of calculating the surface recovery can be by following the 1:2 dive to recovery ratio for dives up to 20m and 1:3 for deeper dives. This assumes that the dive was aerobic.

Minimise Your Risk of DCS

- When diving repeatedly, give yourself adequate surface Intervals.
- Drink enough water. More than what you are thirsty for.
- Account for the DCS risk in your dive plan.
Thoracic Squeeze

A Lung barotrauma, sometimes also called thoracic squeeze, or lung squeeze is an injury caused by a pressure difference between the airspaces in the lungs and the ambient pressure. During the descent, an increase in pressure causes air spaces and gas pockets within the body to compress. If compression can not occur, for example because the muscles around the chest are not relaxed, the walls of the alveoli or blood vessels may rupture, resulting in bleeding into the lungs.

Liquid in the lungs is never a good thing. The dive response causes the lung tissues to swell up, it does not cause blood to enter the alveoli.

Two Main Locations for Lung Barotraumas

1. Trachea squeeze
2. Lung Squeeze

Cause

- Increase in pressure
- Looking up, arching the back
- Trying to bring air from the lungs for equalisation
- Coughing underwater
- Stress

Signs

- Difficulty breathing
- Fatigue
- Unexpected hypoxia
- Urge to cough
- Red stains of Blood in saliva (trachea)
- Pink frothy blood (lungs)
Treatment
- Medical supervision
- Stop Diving for the day.
- If severe - Administer O₂
- Don’t dive until a doctor has cleared you

Prevention
- Keep your head in streamline and your back relaxed
- Trigger your dive response before deeper dives: Warm up
- Increase depth progressively. Only progress to greater depths when you can reach your current maximum in a very relaxed state.
- Increase relaxation at depth
Energy Cycles

Our body is an amazing machine. It can change the way it generates energy according to the intensity and available resources.

In general, we are looking at 3 types of energy cycles:

**Aerobic**

In moderate exercise our body uses $O_2$ to assist in converting food (mainly glucose and fatty acids) into an energy rich molecule called ATP. When this molecule breaks apart it releases energy. This type of activity is long lasting, low intensity and results in very small amounts of waste products (CO$_2$ and Water). As a result, the recovery from this kind of activity is very short.

Example — Moderate jogging

**Anaerobic Alactic**

When the intensity of exercise to a point where energy requirements can not be met by the body through aerobic metabolism, the body switches to anaerobic metabolism. In this case the muscles will use stored ATP to perform the effort.

This sort of effort is very high in intensity and for a short duration.

No waste products are generated but Aerobic activity is required for recovery.

Example — 100m sprint

**Anaerobic Lactic**

When a high intensity effort goes beyond the limits of pure anaerobic activity, the body produces ATP by converting Glycogen into lactic acid. This Lactic acid then increases in amount and eventually causes the muscle to cramp.

This kind of activity is usually a high intensity, longer-term effort.

As the lactic acid needs to be purged from the body, recovery is long.

Example — 400-800m sprint.

FREEDIVING CAN BE PERFORMED ON ANY OF THOSE ENERGY CYCLES DEPENDING ON THE DISCIPLINE
The Dominant Cycle

The main thing to consider when training is to know which energy cycle is dominant so that we can determine what the minimum recovery time between the dives should be.

Aerobic dives are usually comfortable and involve no contractions.

Anaerobic dives are dives where we experience contractions and possibly a build-up of lactic acid (mainly in the legs).

An example for an aerobic dive is an easy warm-up dive. An example of an anaerobic dive is a performance dive.

Freediving can be performed on any of those energy cycles depending on the discipline.

Breathing Before A Breath-Hold

Different disciplines use different energy cycles and so require different breathing as preparation. In Static apnea the CO₂ trigger comes earlier than in Deep diving. In both techniques, beginning the dive balanced will allow us to maximise the hold.

The main thing to remember is that our metabolism and mental state will greatly influence our breath-hold.

Try to stay motionless for a few minutes before a dive - do not swim around or move around the pool.
LIFE ISN’T AS SERIOUS AS THE MIND MAKES IT OUT TO BE.

ECKHART TOLLE
Diet is a very individual thing. As each of us is different, experimentation may be the best strategy – other than seeking the advice of a qualified nutritionist – in deciding which foods are best to avoid and which are best to eat before / after Freediving.

The main aspects which need to be considered are:

**Food which may increase congestion and mucus production**

As Equalisation is a major factor in Freediving, minimising the amount of mucus is key to easy diving. A Food allergy can greatly affect equalisation. Food allergies do not have to be severe to cause blockage – it is enough that they slightly narrow the tube or cause the mucus to become sticky enough to make equalisation very challenging.

The main foods which increase mucus are foods high in simple sugars and dairy products.

Lactose intolerance is the inability of adults to digest lactose, a sugar found in milk and to a lesser extent in other dairy products. Approximately 65 percent of the human population has a reduced ability to digest lactose after infancy which may manifest as bloating, digestion issues and other health issues. For Freedivers, having this intolerance also means swelling of the Eustachian tubes and over production of mucus which may inhibit equalisation.

**Coffee**

Caffeine is a stimulant which increases blood pressure and heart rate. It is also a vasoconstrictor. It is not advisable to drink coffee before diving but some heavy coffee drinkers exhibit strong headaches and other side effects if they do not get their caffeine hit. It is all about moderation and experimentation.

**Alcohol**

Alcoholic drinks greatly influence mental capacity and cause dehydration (a hangover is exactly that). Some alcoholic drinks cause congestion as they contain histamines. The most common drink which affects equalisation is red wine. The grape skin contains a strong histamine which causes congestion.

**Preservatives**

Many foods (almost all foods we buy) contain preservatives. Some of these substances are strong irritants which may increase mucus production and affect other physiologic functions. As with other foods, experimentation is the simplest strategy. In general, avoid foods which can be kept fresh for months.
**Hydration**

This may be one of the most important factors in freediving and any other physical activity. As we dehydrate our ability to perform physical activity drops significantly. Dehydration also makes the blood and mucus more viscous.

**Foods that are difficult to digest**

In general, eating a heavy meal before a dive is never recommended. Some divers avoid food many hours before diving while others eat a light meal or fruit in order not to feel heavy.

**Meat**

Although meat can be a great source of iron and protein, it does take a very long time to digest and as such will affect performance. Practicing freediving on a full stomach will result in slowing down of digestion in turn resulting in gas formation and acidity. Meat can be consumed after a dive.

**Spicy Food**

Spicy foods should be avoided prior to diving as they increase metabolism and increase mucus production.

**Gluten**

This can be found in pastry and in many other wheat products. Some people are sensitive to Gluten and develop an allergic reaction. If you have not been diagnosed with this sensitivity, you are very unlikely affected by it.

**Foods that are beneficial for freediving**

Complex carbs such as oats, sweet potato, peas, banana.

Alkaline foods such as Kale, Asparagus, Quinoa, beans.

Antioxidants such as those found in berries help eliminate free radicals which contribute to genome deterioration and cell aging.
BE ONE WITH THE OCEAN
Equalisation

Equalisation is one of the biggest limiting factors in freediving. The ability to equalise at great depths is dependent on many factors:

**Mind Set**
A positive attitude and the knowledge that a dive is achievable will greatly increase relaxation and ease equalisation.

**Flexibility**
Increased upper body flexibility will result in easier equalisation at greater depth. A lack of upper body flexibility on dives to advanced depths can result in barotrauma of the trachea or the lungs.

**Technique**
Valsalva fails at residual volume (RV). Alternative ways of equalisation exist. While some are harder to learn, some, like the Frenzel method are relatively easy to master and make equalisation beyond RV possible.

**Packing**
While packing increases the amount of air in the lungs, it – in itself – increases the risk of lung injuries. Equalisation problems are not solved by packing, only postponed.

**Diving with less than a full Lung**
Stretches the diaphragm, mimics the physical effects of very deep freedives.

**Equalisation Techniques**
- Toynbee
- Valsalva
- BTV / VTO (refer to Appendix 2)
- Frenzel
- Frenzel-Fattah/ mouthfill
Equalising Techniques for Deeper Freediving:

Below you will find an example of one of the most common misconceptions in freediving: packing and depth.

<table>
<thead>
<tr>
<th>TOTAL LUNG VOLUME</th>
<th>RESIDUAL VOLUME</th>
<th>FAILURE DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>6L- FULL INHALE</td>
<td>1.5L (25% OF TLC)</td>
<td>30M (4ATM)</td>
</tr>
<tr>
<td>8L- FULL INHALE</td>
<td>1.5L (25% OF TLC)</td>
<td>43M (5.3ATM)</td>
</tr>
<tr>
<td>6L- FULL INHALE</td>
<td>1L (REDUCED RV AFTER TRAINING)</td>
<td>50M (6ATM)</td>
</tr>
</tbody>
</table>

As you can see- for equalisation, increasing TLC is not as beneficial as decreasing RV.
The Frenzel Technique

The Frenzel Maneuver is named after Herman Frenzel (German ear, nose and throat physician and Luftwaffe commander). The manoeuvre was developed in 1938 and originally was taught to dive bomber pilots during World War II. The manoeuvre is used to equalise pressure in the middle ear.

Today, the maneuver is widely used by scuba divers, Freedivers, crew and passengers on aircraft as they descend and wherever else equalisation is necessary. As Valsalva equalisation stops working at around residual volume depth (around 30m for most freedivers), there is a need for a technique which will be effective deeper. In order to perform the Frenzel there has to be a bit of air in the mouth. As we push the tongue up the air is used and at some point we drop the tongue to allow more air to move into the space between the tongue and the palate.

The Frenzel maneuver is performed as follows:

- The nose is blocked. A nose clip is very handy when practising equalisations.
- The tongue is placed on the roof of the mouth to close the airway and create an airspace behind it.
- The back of the tongue is moved upward (as when starting to swallow) – often a click will be heard
- This is repeated with slight variations until equalisation occurs reliably every time.

In the process, the back of the tongue and adams apple will move causing the opening of the sinuses and Eustachian tubes, thus allowing air into the middle ear and equalising it to ambient air pressure.

The Valsalva maneuver uses air from our lungs and uses big muscles to push it up into the Middle ear. The Frenzel technique uses smaller muscles in comparison making it quick and efficient. At the end of this book you will find an article which describes a way to learn this technique.

This technique works past RV and can be combined with more advanced techniques such as the mouthfill (which is part of the Apnea International Stage C course) to equalise at great depths.

A FEW IMPORTANT THINGS TO REMEMBER:

- The Frenzel is not Hands Free.
- Timing is critical as in any other technique.
- Equalisation technique makes no difference in the amount of air used when equalising.
- Equalising more and staying ahead of the pressure will result in easier equalisation and lower risk of injury.
- Head position is critical – Looking up makes closing the throat (Epiglottis) more difficult.
COME FLY WITH ME
Pool Training

As discussed on the first course, pool training supports our ocean training and allows us to isolate specific factors of the dive.

Static Training

Breath-hold training contributes to many aspects of the dive including mental, Physical (CO₂ / O₂ tolerance), relaxation, breathing and more.

**ALSO IN THE POOL - ALWAYS TRAIN WITH A COMPETENT BUDDY!**

An example of a static training session:

Prepare your gear - Wetsuit, mask, snorkel, stopwatch, slate, sunscreen...
Begin with 10 minutes of Stretching to remove stress and to help your focus.
Decide who dives and who plays safety.

**The warm-up:**
- Begin with 3-5 minutes of facial immersion
- Perform 1 breath-hold on a passive exhale to the first urge to breathe.
- Recover.
- Perform a full lung breath-hold to the first urge. Do not go beyond the first contraction.

**Begin your exercise.**
To determine your Max, add another 2 breath-holds:
Full lung hold to 70% (Mark when you get the first contraction)
Max’ attempt.
**O₂ Training**

This table works on our ability to withstand low levels of O₂.

<table>
<thead>
<tr>
<th>DIVE</th>
<th>BREATHE UP</th>
<th>BREATH HOLD</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>1</td>
<td>02:00</td>
<td>50% OF MAX</td>
<td>JUST BEFORE FIRST CONTRACTION</td>
</tr>
<tr>
<td>2</td>
<td>02:00</td>
<td>55% OF MAX</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>02:00</td>
<td>60% OF MAX</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>02:00</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>02:00</td>
<td>70% OF MAX</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>02:00</td>
<td>75% OF MAX</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>02:00</td>
<td>80% OF MAX</td>
<td></td>
</tr>
</tbody>
</table>

**CO₂ Tables**

Most freedivers are limited in their freediving not by the lack of O₂, but by their reaction to increased levels of carbon dioxide (CO₂). An increased tolerance to CO₂ will result in greater relaxation, more efficient movements, easier equalisations, reduced risk of lung barotrauma and – all in all – more enjoyable and successful dives.

CO₂ tables are well defined sets of dives or breath-holds that aim to increase the CO₂ level in the body without ever getting close to low O₂ levels. This way, we can increase our awareness of our CO₂ levels, get to know our contractions in the safe knowledge that we are nowhere near hypoxia and all we do is to train our dive response – a very handy side effect of CO₂ tables.

The following is an example of a flexible high-intensity CO₂ table that can also be practiced dry.

This table increases the internal CO₂ level very quickly.

To warm up and get comfortable, you may want to perform a couple of easy breath-holds.

- Hold you breath until you have experienced a defined number of contractions. The first time you try this, start with 4 or 5 contractions per hold.
- One full breath: Exhale. Inhale and hold again for 4 or 5 contractions.
- Repeat this 5 times to get to know this type of CO₂ table and then adapt your table to your training level.

There is no need to measure the breath-hold as this exercise is not aimed at resulting in a long hold. With increasing CO₂ your contractions will come on sooner in the dive, this means that the individual holds will become shorter – and thus safer – as the table progresses.

This is one of the most effective CO₂ exercises, as it avoids low O₂ levels while creating potentially very high CO₂ levels.
Precautions:

- For extended tables, you may experience a mild headache towards the end of the table. This is a sign that your table is effective enough and there is no need to extend it further. Now work on your relaxation during the holds and on your control during the individual breaths.
- You will find the single breath between dives easier if you work on a very controlled and relatively slow first exhale. It makes a big difference in your comfort level.
- Make sure you properly hydrate after completing this exercise.
- Always have a buddy when practicing in the water.

Dynamic Training

Some suggestions and safety considerations for Dynamic training

- Aim to schedule your pool training when there are less children around – Children tend to copycat.
- Plan your session based on a well-founded training plan. Only doing maximum dynamics every time is not effective and a waste of your time. Instead, identify individual limiting skills and focus your training on them.
- Choose the time for your training taking into consideration food, sleep / rest and level of activity.
- Make stretching a part of every session.
- Plan your warm-ups.
- Define verifiable training goals, e.g.:
  - Volume sessions
  - Technique and form – Kicking / turns / glide / streamlining …
  - Preparation / Recovery
  - Relaxation
  - Weighting
  - Gear specific skills – wetsuit / (no) fins / mono …
An example of a volume session:

After stretching and a warm-up breath-hold or 2 begin with 1 or 2 * 25m with full recovery (2 minutes at least)
• 25m * 8 when we leave every 1 minute (if the swim takes 25 sec’ then we have 35 sec’ recovery / preparation)
• 25m * 6 When we leave every 50 seconds.
• 25m * 4 When we leave every 45 seconds.

You can add 50m swims if they feel comfortable. When swimming 50m allow around double the time for recovery. More than 50m dives are rarely productive.

Even when working on CO₂, make all your dives look good – a graceful dive is efficient

Delay Drill

Delay drills were first introduced on the Stage A course. The concept is to include a static segment before / during or at the end of a swim. Delays can be practiced on an inhale or FRC and – like all training in water – must be practiced with active safety.

Example:
If 50m DYN is challenging for you:
• On a 50m DYN, swim the first 25, then simply pause under water for 10 seconds – this is the static segment – before going the remaining 25m.
• Gradually increase the static segment. Repeat a few times.
• Once the static segment is 20 sec’ long, You can perform a longer DYN – for example 60m – and start adding static segments into that.
• Focus on efficient form when swimming and on relaxation during the static segment.
WATER IS THE DRIVING FORCE OF ALL NATURE.

LEONARDO DA VINCI
Appendix- Learning and practicing VTO

In the 1950’s the French navy developed a technique for middle ear equalization called ‘Voluntary Tubular Opening’. This technique is difficult to teach and only approximately 30% of taught can perform it reliably. This technique is similar to the events that happen in the back of your throat at the end of a yawn. It is also similar to wiggling your ears and some people seem to be born with the talent.

Before you is an instruction manual of how to perform the VTO. The exercise is 1 month in length and divided into 4 one-week periods. The exercises in this manual should be performed in the morning, on an empty stomach. 5 second rest periods are to be taken between the execution of the different exercises.

Loosen all muscles and any tight objects (necklaces, shirt collar etc.) in the area of your neck. Keep your head upright, hold your hyoid bone (the bone that holds up the ‘Adam’s apple’) in one hand, don’t squeeze too hard, look into a mirror to see the Adam’s apple.

Week one: Perform the following exercises every morning during the first week, repeat each exercise three times, slowly; Remember to take 5 second breaks between the execution of the exercises.

A) Tongue Exercises

1. With your moth wide open, try to touch your nose with your tongue then bring your tongue back into your mouth as far back as possible while pressing the tip of your tongue down and back. While doing this control the lowering of the Adam’s apple (which will go from its highest point to its lowest).

2. With your mouth wide open, place the tip of your tongue behind your two front (top) teeth and slowly draw it back, dragging it on the roof of your mouth, trying to touch the uvula (the thing that hangs in the back of your throat).

3. With your mouth wide open, place the tip of your tongue on your two front (bottom) teeth and try sticking as much of your tongue out of your mouth as possible (while keeping the tip on the two front (bottom) teeth).
B) Exercises for the rear of the roof of the mouth (‘Voile du Palais’)

1. With your mouth wide open and your tongue at rest, practice partial swallowing (to the point that the rear part of the roof of your mouth contracts) while trying to control the lowering movement of your Adam’s apple. This exercise, the most important of them all, is successfully completed when you start getting an upset stomach.

C) Exercises combining the tongue and Voile du Palais

1. With your mouth wide open, press the tip of the tongue on the two front (bottom) teeth and keep the back of the tongue pressed down and back in the back of the mouth, perform the partial swallow (up to the point of the contracting at the rear of the roof of your mouth). The Adam’s apple should move even further down than before with the partial swallowing manoeuvre pushing it lower.

Week two: Perform the following exercises every morning during the second week, repeat each exercise three times, slowly; Remember to take 5 second breaks between the execution of the exercises.

D) Exercises mandibulo – linguo – véliques

1. With your mouth half closed, stick your lower jaw out as much as possible, place the tip of your tongue behind your two front (bottom) teeth and try sticking your tongue out of your mouth as much as possible. Now perform the partial swallowing manoeuvre.

E) Exercises with closed mouth

1. With your mouth closed, perform exercises B, C and D with an emphasis on exercise B.

Week three: Perform all exercises every morning during the third week, repeat each exercise three times, at faster rate than before with the emphasis placed on exercise B with closed mouth.

Week four: Perform all exercise with the mouth closed and with increased intensity as follows:

5x Exercises C, D, E
10x Exercise B

Perform a Valsalva manoeuvre twice a week, then perform exercise B and keep track of the number of contractions necessary to clear your ears.
THE PRIMARY CAUSE OF UNHAPPINESS IS NEVER THE SITUATION BUT YOUR THOUGHTS ABOUT IT.

ECKHART TOLLE
1. List three examples of the dive response
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

2. What is a squeeze and how can it be avoided?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

3. What makes Hyperventilation dangerous?
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

4. What are the main factors which increase the risk of DCS in Freediving?
1.________________ 2._______________ 3.______________ 4._______________
5.________________ 6._______________ 7.______________ 8._______________

5. Which foods would you avoid before Freediving? Which foods would be good to consume before and after training?
_________________________________________________________________
_________________________________________________________________

6. Briefly explain the logic behind the concept of X+Y into the glide
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
## Progress report

<table>
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<th>Comments</th>
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### Stage B Completion

The following student has completed all required skills and is now certified as a **STAGE B Freediver**

Student Name: __________________________________________________________

Date:_____/_____/_____       Instructor:_____________________   Signed: ____________
What Next?

Well done! You have completed the second stage out of 3. This stage aimed to expand on the concepts learned on the stage A and to introduce concepts such as the dive response and deeper equalisation. The next steps in the ladder are:

**Stage C - Mental Preparation for Advanced freediving**

The third course will take you to a whole new level of understanding and performance.

This course will focus on the mental aspects of performance freediving and will provide insights in its various aspects.

To enrol in this course you will need to have experience and understanding of your technique and breathing.

The instructor will assess your performance, pinpoint your weak points and help you overcome them.

This course will teach you techniques that will allow you to dive deeper than 40m.

**The subject that will be covered:**

- Mental management systems for freedivers
- Nutrition
- Competitive freediving
- Goal setting
- Psychology
- Deep Equalisation techniques
- Personal training program
Spearfishing Courses

Apnea International offers specialised Spear-Fishing classes. The courses teach safe spearfishing techniques, codes of conduct, gear rigging and other subjects.

Breath Training for Survival- B4s

Especially developed for surfers and big waves surfers, this program covers safety, techniques and breath-hold exercises for increasing comfort and bottom time.

Instructor Course

The last step in the ladder is the instructor course. This course will allow you to teach “Apnea International” courses. Turn your passion into a rewarding career.

Training facilities

Apnea International has bases around the world. When you are planning your next holiday, make sure to check the Map Of Freediving (http://www.apnea-international.org/find-a-freediving-instructor/) to find an Apnea International centre near your location. They will be happy to help you plan your freediving holiday and be able to get you in contact with the local freediving community.

Important links and further reading

www.Apnea-International.org
www.facebook.com/Apnea.int

Sources and Contributors

Erez Beatus – Apnea Australia: http://apneaaustralia.com.au
Richard Wonka – We Freedive: https://wefreedive.com
Trips and Training

Training groups

A freediving course is only the beginning...

When you complete a course you have the tools required to improve your skill set and your ability.

By joining one of our training groups you will be able to train in a supervised environment, with set goals and cycles. We run training squads in each major city in Australia and will be happy to assist you in finding the nearest group.

Freediving Holidays

Freediving & Whale Encounters in Tonga

10-15 training days that include Yoga, Snorkelling, Freediving, Breath workshops, and spectacular whale swims - All in an Eco resort.

Get in Close and personal with the Humpbacks and improve your skill in the most “picture perfect” conditions

Training camps around the world

Join us on one of our Camps in Hawaii or Tonga and experience a different kind of Freediving.

Crystal clear water, Dolphins, Manta Rays, Volcanos, nature, great food and great company.
# Freedive Logbook

When training - it is important to log some basic details about the session. The achieved depth / time / distance are only some of the details that should be logged.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time Start</th>
<th>Time End</th>
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<th>Warm-up Sequence:</th>
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FREEDIVING

ENJOY THE SILENCE...