FREEDIVING EDUCATION

Wave 1 | Introduction to Freediving

v2.0 07-19

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TRIBUTE TO NATALIA

Natalia's aspiration was always to strive for safe and efficient freediving, and to achieve this through the provision of education and training, and the world's best freediving equipment. Everything we create now is based on this philosophy and strategy, but with the latest developments in education, technology and scientific research.

We are inspired and honored to have had Natalia as our founder. Without her, the Molchanovs freediving movement would not exist today.

ABOUT NATALIA MOLCHANOVA

Natalia was a freediving world champion and the holder of 42 world records. She remains the world's most titled freediver ever, achieving world records in all freediving disciplines. She won a total of 22 individual gold medals and two team gold medals at Freediving World Championships during her career. On 25th September 2009, she became the first woman ever to pass 100 meters depth on a breath-hold in Constant Weight, with a freedive to 101 meters.

Natalia was the president of the Freediving Federation. She designed and established its educational program from beginner to instructor level. Natalia shared her passion and knowledge of freediving both through her courses and with her university students in Moscow. Today thousands of freedivers have been trained by the Freediving Federation and several hundred instructors share Natalia's knowledge with a new generation of freedivers. In 2015, the presidency was passed to her son Alexey Molchanov, also a freediving world champion and record holder.

Natalia led research in freediver physiology and was interested in relaxation techniques and improving freediving performance and safety. She was the author of many articles, books and educational materials on freediving. Much of her work has been translated into English. Her love and passion for the sea are also reflected in poems she wrote and a short artistic movie she created, for which she received a number of festival awards. Natalia's life was about freediving.

MOLCHANOVS COMMUNITY

Natalia originally created the freediving education system for the Freediving Federation, with the aim of taking a student from beginner to an elite freediver. She and her son Alexey Molchanov founded the Molchanovs brand in 2010 and focused on developing equipment and this education system further.

The Molchanovs business as it is today was formally launched in 2018. It has taken the education and training system from Natalia, added its own expertise together with a group of the world's best freedivers (including Alexey Molchanov) and freediving trainers, and launched **Club Molchanovs** in August 2018. Club Molchanovs covers education, training and experiences. Our principle aim is to help a freediver to learn and train like one of the world's best, under instruction from Molchanovs instructors and with support from a global freediving Molchanovs community.

We also recognize that world champions require ergonomic, highly efficient equipment to support their freediving and to allow them to discover and to push past their limits. We aim to continue to develop and provide the highest quality equipment to the freediving community.

TABLE OF CONTENTS

FOREWORD

It was two years ago that Alexey Molchanov, Adam Stern and I were sitting in a coffee shop in Bali worrying about the state of the freediving world.

It seemed inevitable that freediving was going to end up as a de facto subspecialty of scuba diving. The big scuba education organisations were moving into freediving with their fat marketing budgets, slick ads and huge dive center networks, and their advance seemed unstoppable. The purer freediving systems seemed outgunned by the big fishes that had unceremoniously entered our small corner of the ocean.

We talked about what the freediving world was missing and how a system that tied a first-rate education, community training and shared experiences was the future of freediving. As the conversation went on into the night, we became increasingly excited and convinced that now was the time to create a new system and a new community, by freedivers for freedivers. That conversation became the seed of Club Molchanovs.

We are a freediving community dedicated to education, training and experiences that not only makes better, stronger freedivers, but most importantly instills a love for this life-changing sport, and brings more and more people into the freediving lifestyle. Based on the freediving principles taught by one of the greatest freedivers in history, Natalia Molchanova, and re-envisioned by the Molchanovs team, Club Molchanovs' mission is to build global and local freediving communities that stoke the passion for freediving.

Thank you for joining our freediving movement and we hope that Club Molchanovs will be a part of your freediving journey. Welcome to the Club!

Chris Kim
CEO Molchanovs, July 2019

MOLCHANOVS FREEDIVING EDUCATION

Molchanovs Freediving Education can take you from learning the basics of freediving through to an elite competition freediver. There are four open water course levels, each of which is known as a Wave. All levels are also available as Lap courses. Lap courses cover the same theory and pool requirements as the corresponding Wave course, but do not include open water sessions. Therefore, a Lap certification only certifies you to freedive in a pool. It does not certify you to freedive to depth in open water. You can easily convert a Lap certification to the corresponding Wave certification at a later date by adding the open water sessions. Please ask your Molchanovs instructor if you would like to do this.

Your learning for each Wave / Lap starts with our online course which features content from some of the best freedivers in the world, including world champion Alexey Molchanov. Qualified Molchanovs instructors then take you through this learning and help you develop your understanding and practical skills.

Once you have completed a Wave / Lap course, you can continue your training and track your progress by joining Base Training. This is a global freediving community founded on the philosophy and strategies of Natalia Molchanova and is a place to share knowledge, skills and experiences with other freedivers. Training programs for freedivers of all levels are published on a weekly basis, to help you progress through your learning and develop your freediving skills.

WAVE 1 / LAP 1- INTRODUCTION TO FREEDIVING

In this introductory course, you learn the basics of freediving and discover your natural freediving ability. You are taught to learn techniques to hold your breath beyond a minute and a half. Topics include physics and physiology of freediving, an introduction to freediving equalization, relaxation and breathing techniques, and rescue and safety procedures. If you are taking the Wave 1 course, you are also taught to freedive to a depth of 12-20 meters (40-66 feet) in open water.

WAVE 2 / LAP 2 - INTERMEDIATE FREEDIVING

In this intermediate course, you learn how to train your body for freediving and how to hold your breath for more than two and a half minutes. Topics include pre-dive optimization, improvement of Frenzel equalization and introduction to the dolphin kick. If you are taking the Wave 2 course, you master the skills and knowledge needed to freedive comfortably to a depth of 24-30 meters (79-99 feet) in open water.

WAVE 3 / LAP 3 - ADVANCED FREEDIVING

In this advanced course, you learn to equalize below your residual volume to achieve greater depth performances and to hold your breath for over three and a half minutes. Topics include advanced relaxation techniques such as attention deconcentration, and an introduction to mouthfill equalization. If you are taking the Wave 3 course, you are taught how to train in preparation to freedive comfortably to a depth of 34-40m (112-131 feet) in open water.

Following completion of Wave 3, you are permitted to act as an assistant in Molchanovs Wave and Lap courses (conditions apply) and you may also participate in a **Molchanovs Instructor Course**. Please speak to your Molchanovs instructor for further information.

WAVE 4 / LAP 4 - COMPETITIVE FREEDIVING

In this unique course, you learn the skills and finesse required for competitive freediving. Topics include mastering mouthfill, dealing with pre-competition jitters and competitive training methodologies. If you are taking the Wave 4 course, you learn how to master your body to freedive to a depth of 50 meters (164 feet) and above in open water.

PURPOSE OF DOCUMENT

This manual is aimed at the beginner freediver. It is divided into a number of chapters, each of which introduces key topics about freediving. Each chapter is self-standing, although we do recommend that you work your way through the manual. Take notes as you go and ask your Molchanovs instructor to answer any queries you may have. A glossary of general terms used in freediving is provided at the end of the document. Glossary terms are highlighted in gold for reference.

CHAPTER 1
INTRODUCTION

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Freediving is about feelings, whether it is the euphoria that comes from weightlessness, or our amazement at the beauty of the underwater world. We dive for the moments of joy which come from a deeper understanding of our thoughts and experiences. We freedive for the pleasure of solitude, where inner peace and awareness calm our racing mind. Freediving offers us happiness from nothing more than a single breath of air.

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Natalia Molchanova

This chapter introduces freediving and explains how it is developing. It also provides an overview of the aims of the Wave 1 / Lap 1 course, how you learn and what you have to complete to pass.

1.1 What is Freediving?

Freediving is the practice of holding your breath when diving underwater without the use of breathing equipment. It is undertaken for a variety of reasons: to become more physically and emotionally aware of your body, to be free from heavy scuba equipment, as a way to take underwater photos, to catch food, or to compete professionally. Freediving is a safe and increasingly popular activity. To some it always remains recreational, to others it becomes a way of life. Freediving is developing in four main areas:

GENERAL HEALTH AND FITNESS

Freediving is accessible to anyone with good health and fitness. Regular and focused freediving improves your physical fitness and mental well-being through anaerobic exercise. Anaerobic exercise generally promotes strength, power and fitness while building lean muscle mass and physical endurance.

Light hypoxic training, whereby oxygen availability in your body is limited by using specific training techniques, is known to have positive effect on your physiological systems. Freediving can also improve your mental health by increasing your ability to consciously relax, to manage stress, to focus and concentrate, and to become more mindful and self-aware.

RECREATIONAL FREEDIVING

Recreational freediving remains a leisure activity aimed purely at seeking pleasure from a freedive and is non-competitive. You can learn and develop new techniques to freedive underwater, while also enhancing your physical, psychological and emotional state. Training can cover general diet and fitness, techniques such as the breath-hold as well as relaxation exercises. Recreational freediving either in a pool or in open water, can help to reset your mind, allow you to feel renewed, and help you to find harmony with nature and your inner calm.

APPLIED FREEDIVING

Applied freediving signifies the more advanced skills and techniques used by freedivers to support their daily underwater activities such as hunting for seafood, exploring the underwater world, providing assistance as part of rescue training or undertaking scientific research with Giant Manta Rays. Freediving as part of daily life has been undertaken all over

the world for thousands of years. The female 'Ama' divers in Japan hunt for seafood and pearls while the Bajau people, indigenous to Indonesia, Malaysia and the Philippines live at sea and spearfish. Freediving is their life and their existence.

COMPETITIVE FREEDIVING

Competitive freediving focuses on the specific skill development of a freediver for competition and record attempts. There are different disciplines for pool and open water freediving, including static apnea (breath-hold without moving), dynamic apnea (diving to distance with breath-hold) and various forms of depth diving. Freedivers perform these disciplines while competing against others to achieve personal bests and to break records. There are different rules and equipment for each discipline. Reaching the top of the competitive freediving community requires total commitment as a professional athlete, to physical fitness and skills development as well as mental training, diet and rest. Competition freedivers have a strong social community where experiences, skills and knowledge are shared regularly.

1.2 Wave 1 / Lap 1 Course Objectives

There are two main objectives:

To acquire basic knowledge and skills

- Understand how the laws of physics affect you underwater.
- Understand the adaptations which take place in your body during a breath-hold freedive.
- Make static (time), dynamic (distance) and breath-hold freedives to depth with fins.
- Understand the DNF technique and make dynamic swims to distance without fins.
- Demonstrate pressure equalization, ideally using the Frenzel maneuver.
- Understand how to consciously relax your mind and body, before and during a freedive.
- Demonstrate correct freedive preparation, pre- and post-dive breathing.
- Demonstrate safe freedive procedures and practices.
- Perform rescue techniques and act as a buddy, providing safety for another freediver and appropriate freedives.
- Be prepared to start Base 1 training.

To prepare to progress further as a freediver

- Attain a basic level of freediving skills.
- Acquire the confidence to dive with a qualified buddy. To note, this is someone who has taken a freediving course of equivalent level.
- Gain a clear understanding of how to further improve your freediving skills and the next steps required to achieve this.

1.3 Wave 1 / Lap 1 Course Structure

The Wave 1 / Lap 1 course is comprised of four elements:

Knowledge development

This covers the following:

- An **online course** presenting videos to guide you through the main topics and a summary of key points.
- A **course manual** providing further information and detail on all topics. This supports the online course.
- An **online exam**: A 30 question exam to review and test the knowledge you have acquired during the course.

Dry skill sessions

During dry skill sessions, your Molchanovs instructor introduces you to appropriate relaxation and breathing techniques, as well as additional exercises to help you improve these techniques further. You also learn a number of basic equalization techniques and the differences between each.

Pool sessions

Your Molchanovs instructor conducts a minimum of two pool sessions with you during which you learn the basic skills of freediving including static breath-holding and diving to distance, both with and without fins. For both disciplines, you also learn how to take care of a freediver (buddying) and how to perform an appropriate rescue for a buddy who is experiencing difficulties.

Open water sessions (for Wave 1 certification only)

You apply what you have learned in the dry and pool sessions during three or more open water sessions. Your Molchanovs instructor introduces you to, and helps you develop basic skills such as equalization, duck diving, correct head and body posture and appropriate finning technique. This allows you to perform comfortable dives to depth.

Your Molchanovs instructor also introduces you to a number of freediving disciplines, for example, diving to depth by pulling yourself along a line (Free Immersion), or diving to depth using only your fins (Constant Weight). Procedures for buddying, safety and rescue are an important part of this learning.

1.4 Wave 1 / Lap 1 Certification Requirements

To pass Wave 1 / Lap 1, you should successfully complete the following:

- **Online course**: Take the online course by viewing the videos and understanding the key points. Go through any queries or areas which require explanation with your Molchanovs instructor.
- **Online exam**: Take the online exam and answer 80% of the questions correctly.
- **Skills demonstration**: Demonstrate the following practical skills for Wave 1 / Lap 1.

To note:

- Lap 1 water-based skills are completed in the pool only.
- Additional Open Water performance skills and Open Water skills are completed for Wave 1 only.
- Skills which can be performed with a monofin should be completed in the first instance with bifins. Once performance requirements have been met, a monofin
- All skills are performed with a mask including FIM. The exceptions are No Fins skills where the use of a nose clip is permit.

Table 1. Wave 1 / Lap 1 Skills Demonstration Requirements

	TYPE	REQUIREMENT	EXPLANATION
LAP 1 CERTIFICATION REQUIREMENTS (also for Wave 1)	PRE-REQUISITES	200m swim non-stop	Complete a non-stop 200m swim.
	THEORY	Boyle's Law	Understand how pressure affects compressible air spaces in your body during a freedive.
		Buoyancy and Archimedes' Principle	Understand how pressure affects your buoyancy during a freedive.
		Mammalian Dive Reflex, short and long term adaptations	Understand short and long term physiological changes that happen to your body when you hold your breath and when you freedive.
		EQ: Theory and Basic Exercises	Understand theory and concept of equalization, Valsalva and Frenzel maneuvers and basic exercises.
		LMC & Blackout - Prevention	Understand loss of motor control and blackout and how to prevent it.
		Surface Intervals	Understand the guidelines for safe freediving and general rules to follow.
		Ear Barotrauma	Understand barotrauma and potential injury to your ears.
		Buddy System & Rescue Procedures	Understand how to be a responsible buddy and how to perform rescue procedures.
		Basic Equipment	Understand the basic equipment used in freediving.
		Introduction to Base Training	Understand the aims and methods of Base Training.

	TYPE	REQUIREMENT	EXPLANATION
LAP 1 CERTIFICATION REQUIREMENTS (also for Wave 1)	DRY	Relaxation Technique	Perform all steps of the Body Scan correctly.
		Optional: Three Chest Breaths	Understand how to make a controlled chest breath.
		One Full Breath (Last Breath)	Perform all steps of a full breath correctly.
		Recovery Breathing	Perform all steps of the recovery breathing technique correctly.
		Introduction to Frenzel	Understand the principles of Frenzel equalization.
		Visualization	Understand how to perform visualization in preparation for a freedive.
		Use of Safety Lanyard	Demonstrate how to correctly use a safety lanyard.
	POOL PERFORMANCE	STA minimum 1 minute 30 seconds	Complete a breath-hold for a minimum of 1 minute 30 seconds, whilst lying face down and stationary in the water at the surface.
		DYNB 30m	Perform a 30m horizontal swim with bifins.
	POOL SKILLS	STA Buddying	Perform correct buddying technique for a static breath-hold at the surface of the water.
		STA Rescue	Perform correctly, all steps to rescue a buddy completing a static breath-hold at the surface of the water.
		DYN Posture and Head position	Perform correct posture and head position during a horizontal swim.
		DYN Finning Technique	Perform correct finning technique during a horizontal swim.
		DYN Turn	Perform correctly, a turn during a horizontal swim.
		DYN Buddying	Perform correct buddying technique for a horizontal swim.
		DYN Rescue	Perform correctly, all steps to rescue a buddy completing a horizontal swim.
		Introduction to DNF	Understand the DNF technique.

	TYPE	REQUIREMENT	EXPLANATION
Additional OPEN WATER Certification Requirements for Wave 1	OPEN WATER PERFORMANCE	CWTB 12-20m	Comfortably complete freedives to 12-20m depth with same weight for descent and ascent. Complete freedives with bifins and optionally with monofin thereafter, once performance requirements have been met.
		FIM 12-20m	Comfortably complete freedives to 12-20m depth by pulling down and back up a dive line, with same weight for descent and ascent. With fins for safety reasons.
		CWTB Buddying 6-10m	Perform the correct buddying technique for a CWTB freedive to 6-10m. Complete freedives with bifins and optionally with monofin thereafter, once performance requirements have been met.
		Rescue 6-10m	Perform correctly, all steps to rescue a buddy from a depth of 6-10m.
	OPEN WATER SKILLS	Relaxation Position	Perform correctly a relaxation position.
		EQ: Valsalva or Frenzel	Perform correctly, either the Valsalva or Frenzel equalization technique.
		FIM Basics	Perform correctly, the techniques required during a FIM freedive.
		CWT Body Position	Perform the correct body position while completing a CWT freedive.
		CWT Line Orientation	Perform correct orientation to the dive line while completing a CWT freedive.
		CWT Finning Technique	Perform correct finning technique while completing a CWT freedive.
		CWT Forward Turn	Perform correctly, a forward turn while completing a CWT freedive.

STA	Static	Static breath-hold lying face down and stationary at the surface.
DYN	Dynamic with Fins	Horizontal swim underwater. Bifins or monofin.
DNF	Dynamic No Fins	Horizontal swim underwater. No fins.
CWT	Constant Weight	Freedive to depth. Same weight for descent/ascent. Bifins or monofin.
CWTB	Constant Weight Bifins	Freedive to depth. Same weight for descent/ascent. Bifins. No dolphin kick
CNF	CW No Fins	Freedive to depth. Same weight for descent/ascent. No fins.
FIM	Free Immersion	Freedive to depth pulling down/up line. Same weight for descent/ascent. Fins on for safety.

CHAPTER 2
PHYSICS

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Freediving is not only a sport, it is a way to understand who you are.
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Natalia Molchanova

This chapter explains the physics of water pressure and buoyancy, and how they affect you when freediving. Your physiological state is also explained. Understanding these key principles allows you to make safe choices while freediving and to be at ease underwater.

2.1 Pressure and Boyle's Law

It is important to understand how pressure affects you during a freedive. The atmosphere above you has a weight which is equivalent to approximately 10 meters (33 feet) of water. As you descend underwater, the pressure above you increases. This is both atmospheric pressure and the pressure of the water above you.

Therefore, the ambient (surrounding) pressure is the sum of atmospheric pressure and water pressure. This is measured in atmospheres or bar.

- Atmospheric pressure is the weight of atmospheric air and is 1 bar (1 ATM) at sea level. 1 bar is equal to 1 ATM.
- Water pressure also known as hydrostatic pressure is the weight of the water column above your body and increases by 1 bar every 10 meters (33 feet) of depth.

Therefore, at **10 meters (33 feet)** of depth, the total ambient pressure exerted on your body is:

1 bar (atmospheric pressure) + 1 bar (water pressure) = **2 bar**

With this, you experience a total ambient pressure of 3 bar at 20 meters (66 feet), 4 bar at 30 meters (99 feet) and so on.

BOYLE'S LAW

Most of your body tissues consist mainly of water so they are non-compressible. This means your body is largely unaffected by the change in ambient pressure as you freedive to depth. However, gas is compressible so freediving has an effect on enclosed air spaces in your body. During a freedive, the air in these cavities is affected by changing ambient pressure. This is why for example, as you descend, you feel pressure in your ears (specifically your middle ears) as ambient pressure is exerted on your body. Aside from your ears, there is also air enclosed in other non-compressible spaces such as your sinuses, and between your face and the front of your mask. Your lungs are also filled with air, however you do not need to equalize them as they are compressible.

Boyle's Law explains how the volume of a gas in these air spaces varies with the surrounding pressure. It states:

'At a fixed temperature, the volume of a gas is inversely proportional to the pressure exerted by the gas.'

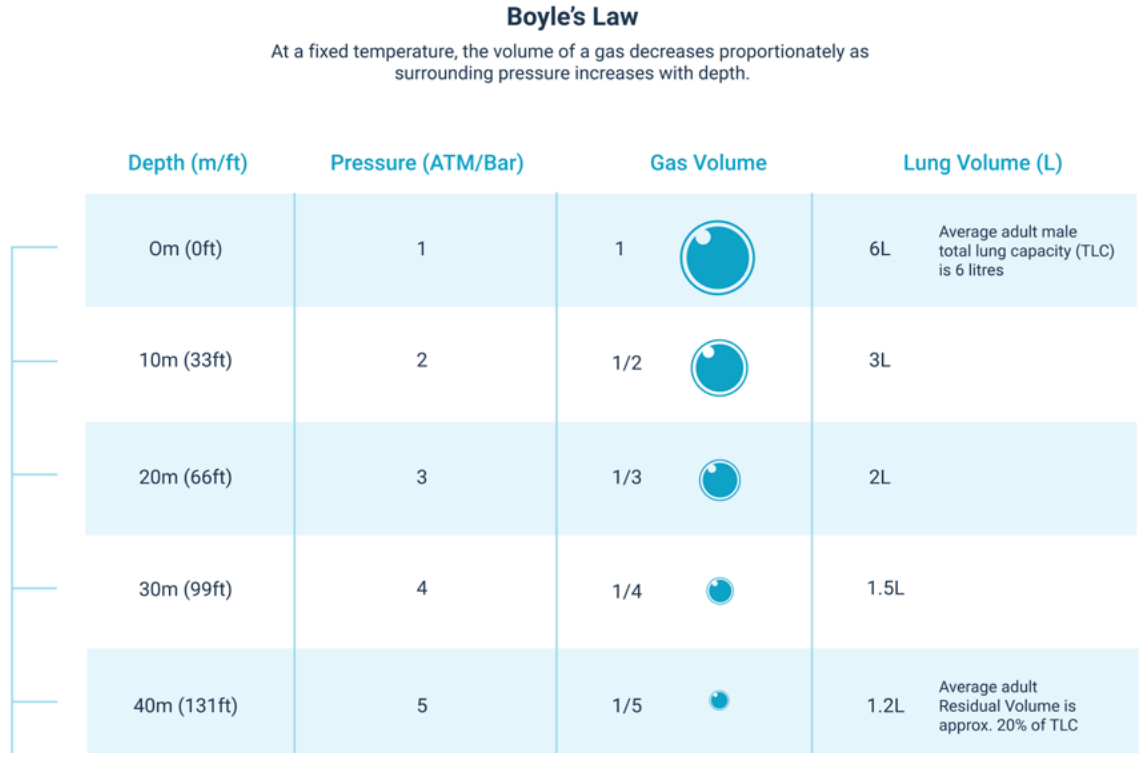


Figure 1. Boyle's Law

As pressure increases at depth, the volume of the gas decreases proportionately:

- If you take a balloon to **10 meters (33 feet)**, the total ambient pressure is 2 bar. Therefore, the balloon would be **one half** (1/2) its original size.
- If you take a balloon to **20 meters (66 feet)**, the total ambient pressure is 3 bar. Therefore, the balloon would be **one third** (1/3) of its original size.
- If you take a balloon to **30 meters (99 feet)**, the total ambient pressure is 4 bar. Therefore, the balloon would be **one quarter** (1/4) of its original size.

And so on...

IMPACT ON YOUR EARS, NASAL CAVITIES AND SINUSES

The cavity of your middle ear is an air-filled space. As you descend, increasing ambient pressure causes this air to compress and your eardrum to bend inward toward your middle ear. You use an equalization technique at depth to overcome this. Should you continue your descent without equalizing, the increasing pressure causes your eardrums to bend further inwards and cause pain or injury. Failing to equalize can result in ear barotrauma, i.e. a rupture of your eardrum. It is therefore important that you equalize carefully and regularly or ideally before you feel pressure in your ears. Pain indicates it is too late to equalize. Stop your descent immediately and return to the surface.

Your sinuses and nasal cavities are almost incompressible so the enclosed air volume does not change during a descent. When equalizing pressure in your ears, the pressure in these connected air spaces is equalized automatically. The pressure in these air spaces normally decreases automatically on ascent, so there is no need to equalize.

IMPACT ON YOUR MASK

The air space between your mask and your face also requires equalization. As ambient pressure increases with depth, your mask presses increasingly, creating a sucking effect on your face and eyes. To counter this and equalize the pressure, exhale a small amount of air through your nose and into your mask as you descend. Equalize the pressure in your diving mask regularly during your descent. Otherwise, this can lead to red eyes and damaged blood vessels. The pressure in your diving mask decreases automatically on ascent so there is no need to equalize.

A soft mask with a nose pocket and low internal volume is often used for freediving. The flexibility of a soft mask makes it a little more forgiving as to when you should equalize pressure. To note, swimming goggles and masks without a nose pocket should not be used for freedives deeper than 1.5 meters (5 feet) to prevent eye injury. This is because you are unable to exhale air into these air spaces to equalize the pressure.

IMPACT ON YOUR LUNGS AND GASTROINTESTINAL TRACT

The lungs are the largest air-filled spaces in the human body. You do not need to equalize your lungs as they are compressible. However, the volume of gas that you have in your body, specifically in your lungs has a huge effect on your buoyancy in the water and can determine whether you sink or float. This is detailed further in Section 2.2 Buoyancy and Archimedes' Principle.

The compressibility of your lungs is limited by the elasticity of your diaphragm and the mobility of your ribs. On descent, the volume of air in your lungs decreases to its residual volume. Residual Volume (RV) is the volume of air in your lungs after a maximum exhalation and is approximately 20% of the Total Lung Capacity (TLC) for the average person. The percentage of the RV to TLC tends to gradually increase with age, due to the decreasing elasticity of the diaphragm and reduced mobility of the ribcage.

Your gastrointestinal tract contains flatus as a by-product of digestion. Approximately 0.5 to 1.5 liters is created by your body each day. Pressure equalization is not required because the walls of your gastrointestinal tract are soft and easily compressed during a freedive. You may notice that the abdomen of a freediver curves inwards during a freedive. This is the diaphragm moving upwards when the volume of the lungs and gastrointestinal tract decreases.

Equalization for freediving is detailed further in Chapter 5 - Equalization. It is also important to always have a buddy supervising your freedives. The important concept of buddying is discussed in Section 9.2 The Buddy System.

2.2 Buoyancy and Archimedes' Principle

ARCHIMEDES' PRINCIPLE

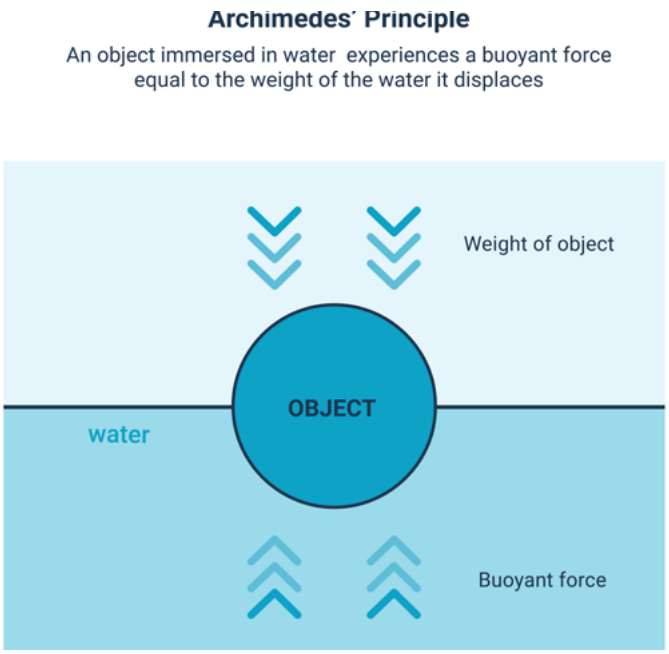


Figure 2. Archimedes Principle

Your buoyancy has a huge effect on your freediving and it is important to understand what influences this buoyancy. Achimedes' Principle states that:

'An object immersed in water experiences a buoyant force equal to the weight of the water it displaces.'

There are two forces acting on the object: its weight and the buoyant force equal to the weight of water it displaces.

This is the same for your body. The upward buoyant force exerted on a body immersed in water is equal to the weight of the water that the body displaces. Therefore, if your body displaces 60 kilograms (133 pounds) of water, there is an upward buoyant force equivalent to 60 kilograms pushing you up to the surface. If you are lighter than 60 kilograms, you float up or stay at the surface.

Understanding the principle of buoyancy is a key concept towards learning how to duck dive and descend underwater. Many people experience difficulty with diving head-first underwater. This is because the water pushes your body upwards at a force which is usually greater than your body weight. Therefore, you must overcome this surplus of buoyant force by using techniques such as the duck dive.

BUOYANCY

There are three types of buoyancy:

Positive buoyancy

You are positively buoyant and **float** when the buoyant force exceeds the weight of your body. With this, a reasonable amount of effort is needed to exert against this force at the surface in order to duck dive. Positive buoyancy can be used to aid your ascent and allows you to stop kicking and pulling during the last 5 metres (16 feet) before surfacing.

Negative buoyancy

You are negatively buoyant and **sink** when the weight of your body exceeds the buoyant force. With this, more effort is needed to swim upwards towards the surface.

Neutral buoyancy

You are neutrally buoyant. You **neither float nor sink**, when the buoyant force is equal to the weight of your body. With this, you can move along underwater horizontally with no effort and without floating to the surface or sinking to the bottom.

FACTORS INFLUENCING BUOYANCY

During a freedive, your buoyancy is dependent on a number of factors:

Depth

Buoyancy changes with depth. During a descent, as ambient pressure increases, the air in your body compresses in particular in your lungs, and you slowly become less buoyant. At the surface, you are positively buoyant i.e. the buoyant force exceeds your weight. As you descend, you slowly become neutrally buoyant. If you descend further, you become negatively buoyant i.e. your weight exceeds the buoyant force. As negative buoyancy increases with depth during a freedive, a point is reached where gravity overcomes the buoyancy of your body and you enter a state called free fall. When this happens, you can stop finning and allow yourself to fall effortlessly.

On ascent the opposite occurs. As ambient pressure decreases, the air in your body expands, in particular in your lungs and you soon become neutrally buoyant once more. Towards the surface, you become positively buoyant. As you approach, you can stop finning and allow the positive buoyancy to return you to the surface.

Water density

The density of seawater is greater than the density of freshwater due to its salt content. The greater the density of water, the greater the buoyancy. Therefore, with the same equipment, you require more lead weights when freediving in seawater than in freshwater.

Equipment

The equipment you wear affects your buoyancy, in particular your wetsuit. A thick wetsuit is very effective to keep warm. However, the thicker the wetsuit, the more positively buoyant it is. Lead weights are required to offset this buoyancy and a weight belt is often worn to hold them.

Volume of air in your lungs

You become less buoyant as the volume of air in your lungs decreases. The next time you are in the water, notice that exhaling causes you to sink a little. Once you have selected your weights to offset the buoyancy of your wetsuit, it is important to start your freedive with a consistent amount of air in your lungs. This is full lungs for a beginner freediver.

Body composition

Your buoyancy depends upon the composition of your body. Fatty tissues are positively buoyant in water, whereas muscles are negatively buoyant. The proportions of these different tissues in your body affect your buoyancy in the water and determine your personal weighting requirements. To note, your weighting can be very different from your buddy.

2.3 Weighting for Freediving

WHY OVERWEIGHTING IS UNSAFE

Although it is easier to start your descent by carrying more weight, the ascent is more difficult and you use more energy. It is also not safe practice to overweight yourself when planning to freedive horizontally, for example, along a coral reef. When swimming neutrally buoyant, it is easy to change your depth through small movements of your body such as stretching out your hand. This makes freediving easier and more efficient, but can cause you to descend quickly without warning. Overweighting in this situation is dangerous as you may constantly struggle against your weight to maintain your position in the water, and even more so in an emergency situation.

WHY UNDER-WEIGHTING IS NOT IDEAL

If you are under-weighted, positive buoyancy pushes you upwards. As a result, it may be difficult to freedive down and difficult to maintain a comfortable depth. You also expend significant energy fighting against positive buoyancy which is both tiring and prevents you from having an enjoyable freedive.

In the Wave 2 course, you will learn how to perform a Neutral Buoyancy Check. This is a skill which allows you to fine-tune the amount of weight worn and to set your neutral buoyancy depth as you freedive deeper.

SAFE WEIGHTING

Establish that you are not overweighted by conducting a Surface Exhale Test.

Surface Exhale Test

As a general rule, you should not sink below the surface after a comfortable deep exhale.

Follow these steps:

1. Hold onto a float and exhale deeply but without forcing all air out of your lungs.
2. Hold your breath on this exhale, relax your body and slowly let your hands slide off the float.
3. You should **not** sink. It is alright if your head bobs underwater but you should **not** begin to sink any further. Should you sink further, hold onto the float immediately or use your fins to return to the surface. Remove some weight and repeat this surface exhale test until you no longer sink.

Weighting for dynamic disciplines

Weight yourself to be neutrally buoyant at approximately one meter (3 feet) below the surface for dynamic dives in the pool. To note, you carry more weight for a pool dive than for a depth dive as you are neutrally buoyant at a much shallower depth. This assumes all other factors such as wetsuit and pre-dive breaths are the same as in open water.

To test your weighting:

1. Wear the amount of weight that you would like to test and the same equipment you use for your dynamic dives.
2. Take a consistent pre-dive breath, sink down into the water, and push straight off the pool wall at approximately one meter (3 feet) below the surface.
3. Assume the arrow position (arms extended and joined over your head) as you push off the wall and glide. Finalize your body posture by executing an arm-stroke and bringing both arms to your body with your hands slightly touching your thighs.
4. Glide in this position until you come to a stop.
5. If you have a tendency to rise or fall in the water column as your glide ends, adjust your weight accordingly for the next attempt.
6. Test your weighting several times until you are consistently neutrally buoyant at the end of your glide.

2.4 Summary

1. Boyle's Law explains how the volume of a gas in your air spaces varies with the surrounding pressure. It states: 'At a fixed temperature, the volume of a gas is inversely proportional to the pressure exerted by the gas'.
2. As pressure increases during a descent, the volume of air enclosed by the lungs, sinuses, middle ears, and mask decreases and must be equalized during a freedive.
3. The last 10 meters (33 feet) before the surface is where the largest change of pressure occurs. Always chose a conservative approach to progression your freediving, to prevent acute hypoxia or blackout. Always freedive with a buddy.
4. Archimedes' Principle states that 'an object immersed in a fluid experiences a buoyant force equal to the weight of the fluid it displaces.
5. There are three types of buoyancy: positive, negative and neutral. Your buoyancy is dependent on equipment, water pressure, water density, air volume in your lungs and your body composition.
6. You manage your buoyancy by using weights.
7. Be positively buoyant at the surface after a deep exhalation. This is a Surface Exhale Test.
8. Weight yourself to be neutrally buoyant at approximately one meter (3 feet) below the surface for dynamic freedives in the pool.

CHAPTER 3
PHYSIOLOGY

‘

There time will recognize
The deepness of the space
And, flowing to infinity of being,
We kindly wait for sense.
This time - it is
Just breath.
And then – the love that fills
The deepness of the heart
To all the living

’

Natalia Molchanova

This chapter explains the role of oxygen and carbon dioxide in your body and covers two important topics: hypercapnia and hypoxia. It explains what they are, how they can affect you when freediving and how to practice safe freediving with them in mind. This chapter also covers the short-term and long-term ability of your body to adapt to hypoxia over time.

3.1 Oxygen and Carbon Dioxide

The following gases are involved in cellular respiration:

OXYGEN (O_2)

Take a breath in and slowly exhale. You breathe air continuously and as you breathe, oxygen enters through your mouth or nose and makes its way into your lungs. Here, oxygen molecules pass into your bloodstream and your red blood cells carry them around your body for cellular respiration.

Cellular respiration is the process used by your cells to make energy available for activity and they require oxygen to make this happen. During this process, oxygen molecules break down glucose molecules in your cells, and energy in the form of ATP is released. ATP is used by your body to power all functions. A byproduct of this process is carbon dioxide.

CARBON DIOXIDE (CO_2)

Carbon dioxide is created as a byproduct of cellular respiration and is carried back in your blood to your lungs for exhalation. The main function of exhalation is to expel carbon dioxide from your body.

When you hold your breath in freediving, you do not exhale and so carbon dioxide builds up in your body. This increase in carbon dioxide causes the urge to breathe. To note, the urge to breathe is not caused by decreased oxygen in your body.

3.2 The Effects of Breath-hold

HYPERCAPNIA

Hypercapnia is caused by an elevated i.e. a more than normal level of carbon dioxide in your blood. When you hold your breath, you experience this as an urge to breathe. As a beginner freediver, you may feel some discomfort and anxiety when experiencing this for the first few times.

To explain this further: when the level of carbon dioxide in your blood reaches your

individual threshold, chemoreceptors which monitor and respond to changes in the partial pressure of carbon dioxide in your blood, signal the respiratory centre in your brain. This results in a rising urge to breathe which builds up until you may experience one or several involuntary spasms of your respiratory muscles. These spasms are known as contractions. On surfacing from a freedive, once you resume normal breathing, the balance of all gasses in your blood is restored quickly, the hypercapnic state is resolved and any contractions disappear.

HYPOXIA

Hypoxia or oxygen deprivation, is caused by an insufficient supply of oxygen to your body tissues. When you hold your breath, you begin to use up the limited amount of oxygen you have in your body. After an extended time of breath-holding, the resulting low level of oxygen is known as hypoxia. During the early stages of hypoxia, you may actually feel very comfortable underwater and experience a sense of euphoria. However, as your hypoxic state continues, the level of oxygen in your blood falls and the level of carbon dioxide increases. Always end your freedive at this point and do not allow this hypoxic state to develop any further.

If you continue to hold your breath and exceed your personal limits, you are in danger of losing consciousness. This is known as a blackout. Blacking out is an unacceptable part of freediving, even in competition. There are many world champions who have never had a blackout. There is no advantage to blacking out and so it is not recommended and must be avoided at all times.

To note, mild hypoxia in freediving is known as exercise-induced hypoxia and is not dangerous.

How to avoid a blackout and the warning signs and symptoms of hypoxia is explained in Section 8.1 Trauma relating to Hypoxia.

3.3 Freediving Safely

It is important to freedive safely and continually monitor your physical and mental state throughout your freedive. The following recommendations may help you achieve this.

RELAX YOUR BODY AND MIND

Relaxation is very important before, during and after your freedive. You can achieve a more comfortable and deeper freedive, and a longer breath-hold if you are more relaxed. Experienced freedivers are able to expertly relax their body and mind underwater. This results in a slower production of carbon dioxide which in turn delays the urge to breath and any related discomfort. Experienced freedivers also have a lower sensitivity to carbon dioxide due to prolonged exposure to it during training.

As a beginner, you may react relatively quickly to the urge to breathe because your body is not used to elevated levels of carbon dioxide. The urge to breathe is an important safety mechanism for you and allows you to gauge when to end your freedive. The urge to breathe increases towards the end of your freedive when there are very high levels of carbon dioxide. In theory, you can continue your freedive even when feeling the urge to breathe because your body still has oxygen available. However, this is not recommended for recreational freediving. Always begin your ascent as soon as you experience the urge to breathe.

To note, some freedivers have a very low sensitivity to carbon dioxide and combined with the ability to relax so deeply, they may experience weaker signals to end their freedive. Therefore, during a freedive, always be fully aware of your body and pay close attention to your sensations, in particular to your clarity of mind.

As a beginner freediver:

- Focus on relaxation before, during and after a breath-hold or freedive.
- Always freedive in a comfortable state and surface even before you feel the urge to breathe.
- End your freedive immediately should you experience the urge to breathe.
- Remember that progress in freediving involves making consistent and conservative freedives.
- Never push yourself to the limit.

BUILD CO_2 AWARENESS AND TOLERANCE

Should you fail to end your breath-hold in good time and you push yourself to the point of an uncomfortable urge to breathe, the partial pressure of oxygen may drop below a critical level. This is because your resources are limited. Should you persist and push your freedive and you do not pay attention to your discomfort, your bodily resources are eventually exhausted. This triggers a protective mechanism in your central nervous system which shuts down the conscious parts of your brain functions and results in a blackout.

AVOID BLACKOUT

It is very important not to exceed your individual limits during a breath-hold. Sensitivity of your respiratory chemoreceptors to carbon dioxide varies from individual to individual. Through training and experience, you learn to read the signals of rising carbon dioxide and this makes you a more competent and safer freediver.

In recreational freediving, statistics (breath-hold time in seconds, distance and depth in meters) are not important. Instead, as a beginner, focus on:

- mental relaxation and focus
- physical relaxation
- an efficient freediving technique

3.4 Short and Long-term Adaptations

There are significant physiological changes that happen in your body when your hold your breath and when you freedive. Your body can adapt to high levels of carbon dioxide and to a certain extent, a hypoxic state.

These physiological changes are divided into two categories:

- **Short-term adaptations** are bodily changes that happen during a freedive or freedive session, which allow your body to function more efficiently under new conditions. They generally disappear when you resume breathing.
- **Long-term adaptations** are changes to your body through regular training, making it more efficient when encountering hypoxic situations. These changes can last for months, years or a lifetime.

SHORT-TERM ADAPTATIONS: THE MAMMALIAN DIVE REFLEX

Short-term adaptations are often referred to as the Mammalian Dive Reflex (MDR).

There are a number of triggers which produce this reflex:

- immersion of your face in water, receptors in your skin register when you are immersed in water
- breath-hold (hypoxia and hypercapnia), for example you begin to have a lower heart rate and blood shift due to hypoxia
- rising environmental pressure as you freedive deeper
- a cold water temperature

These triggers cause a number of physiological changes:

Slowing of the heart rate and blood flow velocity

Your heart rate slows which reduces the energy consumed by your heart. This is known as bradycardia. Additionally, this limits the consumption of oxygen to your vital organs and tissues, and slows your metabolic processes. Metabolic processes take place in all living cells and provide energy to sustain your vital processes and the synthesis of cellular material.

Spleen effect

Your spleen contracts and releases stored red blood cells containing haemoglobin, into the bloodstream. This increases the oxygen-carrying capacity of your blood, due to increased concentrations of haemoglobin binding with oxygen.

Peripheral vasoconstriction

The blood vessels in your extremities - your hands, arms, feet and legs - constrict and push more blood towards your body core, to optimize the supply of oxygen to your vital organs and your brain.

Blood shift

Blood increasingly compensates the space created when air in your lungs compresses. Therefore, blood vessels in your lungs expand and are engorged with blood to compensate for the loss of air volume. This increases their ability to handle the rise in pressure.

Central vasodilation

While blood vessels in your extremities contract, known as peripheral vasoconstriction, other blood vessels around your vital organs e.g. heart, brain and lungs, dilate to allow more blood flow, known as central vasodilation.

Further effects of the Mammalian Dive Reflex

Due to peripheral vasoconstriction, blood moves away from your extremities towards your vital organs. Therefore, a reduced flow of blood to your muscles in your extremities increases the rate at which your muscles fatigue. This reduced flow accelerates the **build up of lactic acid** in your muscles, causing a feeling of **heaviness** or **muscle fatigue**. You can train your body to tolerate higher levels of lactic acid over time with repeated freediving.

Finally, **immersion diuresis** brings about an increase in urine production due to the hydrostatic pressure exerted on your body, vasoconstriction and a decrease in body temperature when you freedive. This is one of the reasons why it is important to keep hydrated throughout your freedive session.

Stories from Adam Stern

Having equalization challenges when you are freediving is incredibly common. In fact, I find that around 30% of my students have some form of an equalization problem. The good news is that I am yet to encounter a student who has not resolved an equalization issue. There are some easy steps you can take to solve any issues to become a happier, safer, and better freediver. The key with learning how to equalize is patience. Never be angry with your body. You can only allow it to do what is possible at that moment. Know that with repetition and practice, it gets better.

LONG-TERM ADAPTATIONS

Long-term adaptations to hypercapnia and hypoxia through training result in multiple changes in your organs and tissues. You can improve your freediving through consistent practice, allowing your body to adapt gradually to situations with elevated carbon dioxide and lowered oxygen levels. The more regularly you train, the greater the long term effect on your body.

For example, your body's tolerance to high levels of carbon dioxide can increase. When you first start freediving, you may not be able to hold your breath for very long without experiencing the urge to breathe. However with regular training, you are able to hold for longer without feeling discomfort, and also remain fully aware of the effects of rising

carbon dioxide. You may experience contractions, but they no longer cause you significant distress.

The better and more regularly you train, the better your body manages oxygen and the longer you are able to hold your breath before putting yourself in a potentially dangerous situation. It generally takes some time to improve the ability of your body to handle hypoxia, but the ability of your body to tolerate higher levels of carbon dioxide can change quite quickly. Regular training can result in dramatic improvements in a short period of time. Should you stop training, these improvements generally reduce very quickly. However, if you have raised your CO_2 tolerance to a certain level, you can generally return to this level more easily.

Effects of hypoxic training in humans include the following:

Polycythemia

An increase in concentration of red blood cells in your blood which improves oxygen-carrying capacity.

Lowered critical threshold for partial pressure of oxygen

A lower critical threshold for the partial pressure of oxygen increases the capacity for your brain and muscles to work in low oxygen conditions.

Changes in cell membranes

An increase in mitochondria and cell respiratory enzymes help your cells to consume oxygen more efficiently.

Increased capacity and efficiency of your respiratory system

Your inhalation capacity is maximized due to an increase in gas exchange surface in your lungs, greater capacity of your ribcage, and stronger respiratory muscles.

Increased elasticity of your arteries and arterioles

An increase in elasticity allows a greater capacity of blood to be stored in the blood vessels that supply your heart and lungs.

3.5 Summary

1. Hypoxia in breath-hold diving is called exercise-induced hypoxia. It is a temporary functional state. Practiced incrementally with conservative progression, breath-hold induced hypoxia is neither dangerous nor worsens your health.
2. Early stages of hypoxia may result in you feeling very comfortable underwater and experiencing a sense of euphoria.
3. Hypercapnia occurs when there is an elevated level of carbon dioxide in your blood and is characterized by a rising urge to breathe.
4. When the partial pressure of carbon dioxide in your blood reaches a threshold value, chemoreceptors gradually trigger the respiratory centre in your brain, causing the urge to breathe and subsequent contractions.
5. As a beginner freediver, make freedives in a comfortable state and surface as soon as you feel a slight urge to breathe.
6. Exceeding your personal limits triggers a protective mechanism in your central nervous system which can lead to a loss of consciousness, known as a blackout.
7. The degree of hypoxia experienced depends on the duration of your breath-hold, the power of your muscle work and level of mental activity. It can be improved by physical and mental relaxation and an efficient freediving technique.
8. Always maintain optimal movement throughout a breath-hold dive.
9. Typical short-term physiological reactions during a breath-hold dive include a slower heart rate and blood flow, greater contractility of your heart, ejection of extra blood cells from your spleen, centralization of blood flow (peripheral vasoconstriction), opening of capillaries (central vasodilation). Other effects include hormonal regulation, muscle fatigue and immersion diuresis.
10. Long-term adaptations to hypoxia and hypercapnia include polycythemia, lowered critical threshold for partial pressure of oxygen, changes in cell membranes, increased capacity and efficiency of your respiratory system, and increased elasticity of your arteries and arterioles.

CHAPTER 4
BREATHING AND RELAXATION

‘

When you find yourself alone in a silent underwater world, you’ll reconsider your previous thoughts and attitudes, and discover new things. Thoughts pass and disappear in a few seconds, and this silence has a calming and nurturing effect on our restless souls.

’

Natalia Molchanova

This chapter introduces basic breathing and relaxation techniques and explains how you can maximize your performance and freedive safety.

4.1 Basics of Breathing and Relaxation

Breathing techniques have evolved significantly over recent years and can be divided into three main areas:

- preparation
- filling your lungs before a freedive: one full breath
- post-dive breathing

Training regularly to develop your relaxation and breathing practice can enhance your performance and allows you to have a more enjoyable breath-hold.

PREPARATION

The aim of preparation is to achieve maximum relaxation of your mind and body before a freedive. This is best achieved by using a relaxation technique such as the body scan. This relaxation technique involves bringing your awareness to different parts of your body in turn, finding any tension and releasing this tension before moving to the next part.

Practice your preparation for a breath-hold by following these steps:

1. Find a comfortable position. Out of the water, lie facing upwards with your arms and legs relaxed on the floor. In the pool or open water, use a mask and snorkel, and float at the surface. If you are negatively buoyant which can happen when not wearing a wetsuit, use a pool noodle under your chest and arms to keep you afloat.
2. Release any tension in your body and quieten all internal dialogue.
3. Focus on an area of your body such as your head. As you breath in a relaxed way, imagine your head to become warm and completely relaxed.
4. Move to the next area of your body such as your neck. Do the same, notice any tension in your neck and simply let it go.
5. Scan your entire body. For example, head, face (eyebrows, eyelids, eyeballs, cheeks, lips, tongue, jaw), neck, shoulders, back, arms, hands, chest, abdomen, pelvis and so on). Bring about an inner calm and peace of mind as you pass from area to area. If you feel any tension, simply notice it and let go of it.
6. Continue your body scan for a minimum of two minutes.

There are different ways of scanning your body, from starting at the top of your head and scanning down to your toes. Alternatively, starting at your toes and scanning up through your body, or simply focusing on key areas of tension. You will learn which is right for you and you will develop your practice and ability to scan your body as you learn. To note, keep your mask on during preparation.

ONE FULL BREATH (LAST BREATH)

Once you have reached a state of complete relaxation, it is time to comfortably fill your lungs with air. Do this in a relaxed manner to avoid the build up of any unnecessary tension. You use two of your major breathing muscle groups one after the other to fill your lungs with air. These are your diaphragm and your intercostal muscles.

Follow these steps to fill your lungs:

1. **Inhale using your diaphragm**. The diaphragm is a large muscle that separates the upper and lower part of your torso. It sits right below your lungs and allows you to access a significant part of your lung volume. As you inhale using your diaphragm, your belly slowly bulges out, hence this is also called belly breathing. Inhale, as much as you comfortably can into your abdomen first.
2. **Inhale using your intercostal muscles**. Once you have finished inhaling using your diaphragm, activate the muscles between your ribs. This expands your torso and further fill your lungs with air. This is also known as chest breathing.
3. **And relax**. Once you have expanded your chest comfortably to its maximum, it is important to fully relax again and release any tension built up during this full inhalation. The best way to achieve this is by locking your throat. Then emulate, or say out loud, the sound 'hhha.' This is the same sound you would make when preparing to lift a heavy weight, as you inhale deeply and lock your throat just prior to lifting. This closes your vocal folds and keeps the air in your lungs from flowing out, so you can then completely relax your torso.

This practice is the most efficient way to fill your lungs with air and with minimal waste of energy. Once you are completely relaxed and have full lungs, you are ready to freedive. In the past, to prepare for a freedive, freedivers would hyperventilate. This would lower the level of carbon dioxide in their body and thus extend the time they could remain underwater without experiencing the urge to breathe. It is the carbon dioxide which is responsible for the urge to breathe during a freedive. To note however, hyperventilation is dangerous and detrimental to your performance as a freediver and is not recommended. Please refer to Section 4.2 Hyperventilation for further information.

POST-DIVE BREATHING / RECOVERY BREATHING

Post-dive breathing is about re-oxygenating your body as quickly as possible after reaching the surface. This is an integral part of your safety when freediving. To note, a breath-hold is not complete when you surface, it is complete after your recovery breathing. Even after shallow freedives, use correct recovery breathing as it is important to assume the habit of performing it automatically every time.

To practice recovery breathing, follow these steps after you surface:

1. Exhale passively and let the air from your lungs flow out.

2. Inhale actively with a wide open mouth to allow maximum intake of air into your lungs. This sounds like you are saying 'hope' on your inhale.
3. Exhale approximately half your air with light resistance. Do this by pursing your lips or by using your tongue to restrict the airflow. This increases air pressure in your lungs and facilitates oxygen transfer to your blood and the removal of carbon dioxide.
4. Inhale actively with a wide open mouth to allow maximum intake of air into your lungs.
5. Repeat step 3 and 4 a minimum of three times, or until you feel fully recovered and able to resume normal breathing.

OPTIONAL: ADD THREE CHEST BREATHS

During your first breath-holds, you have a very personal experience of rising carbon dioxide (CO_2) in your body. This is because the level of your tolerance to rising carbon dioxide is individual to you. Your Molchanovs instructor can add three controlled chest breaths which can make a comfortable breath-hold more accessible to those with low CO_2 tolerance. These controlled chest breaths deliberately and moderately lowers your level of CO_2 before your breath-hold. The chest breath technique allows you to gain confidence and self-awareness through an enjoyable breath-hold.

A chest breath is an inhalation from the intercostal muscles only. Technically, it is an activation of the inspiratory intercostal muscles, as you perform it during the full breath before your breath-hold. It is essential that the rest of your body stays fully relaxed while performing a chest breath, in particular your abdominals, shoulders, neck and face. The exhalation of a chest breath is passive. It is important to simply let the air flow out as if you are sighing.

Chest breathing technique

The technique is as follows when including three chest breaths before the full breath:

1. Relax: complete a body scan for two minutes
2. Complete three chest breaths with passive exhalation
3. Take one full breath i.e. your last breath
4. Start your breath-hold

Your Molchanovs instructor will help you to learn and apply this technique correctly. Should this technique work for you, it is important to practice it with a snorkel to prepare you to freedive in open water. If you find your freedives are more enjoyable using the chest breath technique, then use it for now. However, your long-term aim is to reduce the chest breaths from three to two to one, and finally to none as you progress through the Wave 1 / Lap 1 course or within subsequent Wave / Lap courses.

The key principle for a safe and longer breath-hold is to develop your ability to relax and your tolerance to carbon cioxide.

4.2 Hyperventilation

Hyperventilation is defined by breathing more air in and out than your body needs. Hyperventilation does not store more oxygen in the blood because your body does not have the means to accumulate additional oxygen prior to a freedive. Breathing more than needed does however increase the rate at which carbon dioxide is removed. This results in a lower partial pressure of carbon dioxide in your lungs and arterial blood and can give rise to a number of symptoms.

Symptoms of hyperventilation include:

- light-headedness / dizziness
- tingling in your fingers or other parts of your body
- an increased heart rate
- euphoria
- numbness around your mouth
- a metallic taste

WHY YOU SHOULD AVOID HYPERVENTILATION

There is a common misconception that hyperventilating before a freedive can help you stay longer underwater. During a breath-hold freedive, you experience an increasing urge to breathe as the partial pressure of carbon dioxide increases in your blood. This urge to breath acts as an important signal for you to gauge when you should surface.

Trying to 'get plenty of air before a freedive' by breathing rapidly and deeply does remove carbon dioxide from your blood and causes your respiratory system to signal the urge to breathe later than usual. However, this is extremely dangerous and is not recommended. A hyperventilated freediver may experience a false sense of well-being and no urge to breathe, even when the oxygen level in the blood drops below critical levels. In this instance, there is a significantly increased risk of a blackout, sometimes without prior warning.

Therefore relax before a breath-hold and breathe naturally. Should any symptoms of hyperventilation arise, resume your relaxation exercises and do not freedive until they disappear.

4.3 Summary

1. Preparation for a breath-hold is about achieving maximum relaxation of your mind and body. Release any tension in your body and find inner calm and peace of mind by focusing on a relaxation technique called a body scan for a minimum of two minutes. Add three chest breaths to finish your preparation if appropriate.

2. Filling your lungs is a slow and deliberate process of 'filling your belly' first followed by your chest.

3. Recovery breathing allows your body to re-oxygenate as quickly as possible after reaching the surface. It consists of a passive exhalation followed by active inhalations and increasingly longer exhalations against light resistance. Perform three cycles of this breathing or continue until you are fully recovered and you are breathing normally once more.

4. During a breath-hold freedive, you experience an increasing urge to breathe as the partial pressure of carbon dioxide increases in your blood. This is an important signal for you to safely gauge when it is time to return to the surface.

5. Hyperventilation is defined by breathing more air in and out than your body requires. This form of over-breathing reduces the partial pressure of carbon dioxide in your lungs and blood and can allow you to stay underwater without experiencing an urge to breathe. However, it is extremely dangerous to hyperventilate prior to a breath-hold freedive and it is not recommended.

6. Symptoms of hyperventilation include light-headedness and dizziness, tingling in your fingers or other parts of your body, euphoria and an increased heart rate.

7. A hyperventilated freediver may experience a false sense of well-being and no urge to breathe, even when the oxygen level in the blood drops below critical levels. In this instance, there is a significant risk of a blackout without prior warning.

8. CO_2 tolerance is individual. Deliberately and moderately lowering CO_2 by means of chest breaths can make a breath-hold more accessible to those with low CO_2 tolerance. However, your long-term aim is to reduce the chest breaths from three to two to one, and finally to none as you progress through the Wave 1 / Lap 1 course or within subsequent Wave / Lap courses. The key principle for a safe and longer breath-hold is to develop your CO_2 tolerance.

CHAPTER 5
EQUALIZATION

‘If you are in a hurry, you never experience the harmony and immensity of the ocean around you.’

Natalia Molchanova

This chapter explains the basic theory and concept of equalization, introduces equalization techniques such as the Valsalva and Frenzel maneuvers, and recommends which techniques are suitable for freediving. It also provides exercises to help aid equalization, and skills and tips on how to practice it safely and effectively.

5.1 Equalization Theory and Concept

Section 2.1 Pressure and Boyle's Law explains that pressure increases the deeper you freedive. This causes the air in your body cavities to compress and decrease proportionately. To prevent these air spaces from causing pain or suffering injury, this build up of pressure requires active or passive equalization. On ascent, as the pressure decreases, the air in your body cavities increases proportionately and usually disperses naturally. There is no need to actively equalize on ascent.

There are three main air spaces to equalize:

- your ears, more specifically your middle ear
- your sinuses
- your mask

Your lungs do not require equalization because they compress as pressure increases on descent and expand again as pressure decreases on ascent. Middle ear and sinus barotrauma are the most common injuries arising from increasing water pressure and failing of appropriate equalization. Please refer to This is explained further in Section 8.2 Barotrauma.

THE ANATOMY OF EQUALIZATION AND KEY TERMS

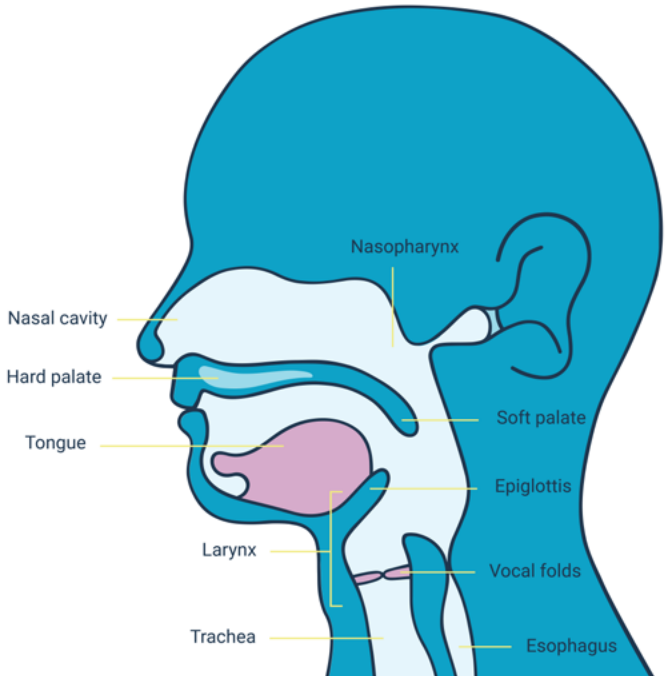


Figure 3. Anatomy of equalization

Eustachian tube

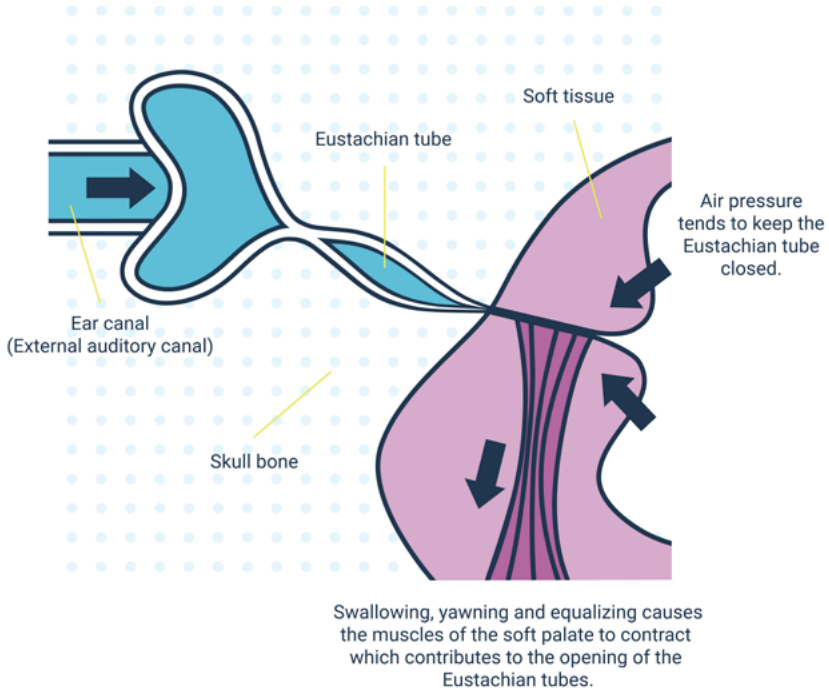


Figure 4. Eustachian tube

Your Eustachian tube is a canal which connects your middle ear cavity to the upper part of your throat and back of your nasal cavity. This is known as the nasopharynx. The pressure within your middle ear is managed by your Eustachian tube to ensure it is equal to the pressure outside your body. Your Eustachian tubes are normally closed, and open only with certain movements such as yawning, swallowing or chewing. Then they open allowing air to enter your middle ears which equalizes the pressure. When there are rapid changes in atmospheric pressure such as during a freedive, you equalize your ears purposely.

Middle ear

Your middle ear is the part of the ear between your eardrum and the oval window to your inner ear. The middle ear is also known as the tympanic cavity. During a dive descent, ambient pressure increases which in turn puts pressure on your eardrums, causing them to bend inwards. Your eardrums are very sensitive to pressure changes but you can equalize this pressure purposely by equalizing. Should your Eustachian tubes remain closed or are not opened sufficiently after equalization, you may experience pain and discomfort. If a descent is continued without equalization, your eardrums can rupture. During a dive ascent, ambient pressure decreases. The expanding air within your ears opens your Eustachian tubes automatically so you do not generally need to equalize.

Nasopharynx

The nasopharynx is the upper part of your throat which connects with your nasal cavity above the soft palate.

5.2 Equalization of Air Spaces

There are a number of techniques which can be used to equalize the pressure in your air spaces.

MASK EQUALIZATION

Equalize the pressure within your diving mask regularly throughout your descent. This prevents your mask from sucking onto your face, potentially resulting in red eyes at the end of your freedive.

Equalizing your mask is very simple:

1. Release your nose pinch.
2. Move a small amount of air through the nose and into the mask.
3. Repeat frequently on descent before you feel pressure build in your mask.

To note, on ascent, the pressure gradually decreases automatically. There is no need to equalize. You may also see or hear bubbles escaping from your mask as you ascend. This is the air that you exhaled into your mask, nose, and sinuses during your dive.

EAR EQUALIZATION

Normally you pinch your nose to equalize. When one of the following equalization techniques is used, this traps and builds air pressure in your nasal cavity and passes air through your Eustachian tube and into your middle ear for equalization.

There are two ways to build up pressure in your nasal cavity to equalize your middle ear:

1. Exhale against pinched nostrils and use the air in your lungs to create pressure. This is called Valsalva equalization.
2. Push with your cheeks or with your larynx and tongue against pinched nostrils to create air pressure. This is called Frenzel equalization.

We recommend using Frenzel equalization. This course teaches you why this is more effective for freediving and how to develop this technique.

SINUS EQUALIZATION

Your sinuses do not require separate equalization. When your equalize your ears, your sinuses generally automatically equalize too. Your sinuses are lined with a membrane which produces mucus. Over half a liter is produced each day by your body. This amount increases when, for example, you have a cold or you work in a dusty or air-conditioned environment. It can then become difficult to equalize your sinuses. A mucus blockage can prevent air from getting into one or several of your sinuses and can therefore prevent equalization altogether. Should you feel any pressure in your sinuses when freediving, either under your eyes or on your forehead, return to the surface to prevent any further difficulties and to avoid rupture of your blood vessels.

5.3 Equalization Techniques

THE VALSALVA MANEUVER

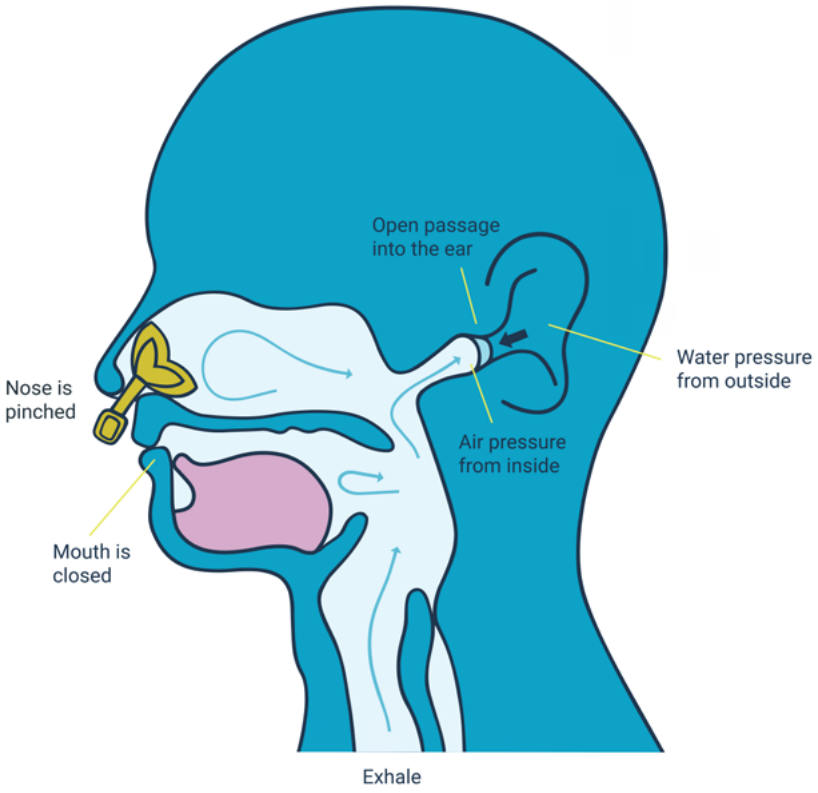


Figure 5. Valsalva maneuver

The Valsalva maneuver is generally considered to be the easiest equalization method and is commonly used by scuba divers and many beginner freedivers. It is named after Antonio Maria Valsalva, an 18th-century physician and anatomist from Bologna. He treated otopyosis (pus in the middle ear) by piercing the eardrum and asking the patient to exhale forcefully keeping both their mouth and nose closed.

To equalize pressure in your middle ear using the Valsalva maneuver:

- Exhale through your nose against a pinched nose and a closed mouth. By doing this, air cannot escape through your nose, so the air is pushed into your middle ear through your Eustachian tubes and returns your eardrums to their natural position.
- Your ears make a popping sound as the pressure is equalized

Why the Valsalva maneuver is not recommended

Although the Valsalva maneuver is often taught to beginners due to its simplicity, it is not the ideal way to equalize because you are using air from your lungs by pressing with your respiratory muscles. It is also less effective at greater depth. This technique becomes progressively harder and eventually fails the deeper you go and the more the air in your lungs is compressed. We therefore recommend the Frenzel technique as a more effective method to equalize. The Frenzel equalization technique ensures your respiratory muscles

are not actively engaged and you remain relaxed at depth. You may begin freediving using Valsalva equalization but as you progress, you learn to use the Frenzel technique detailed below.

Whichever technique you use during your learning as a freediver, perform it in a relaxed and controlled manner. The more often you perform equalization, the easier it becomes.

THE FRENZEL MANEUVER

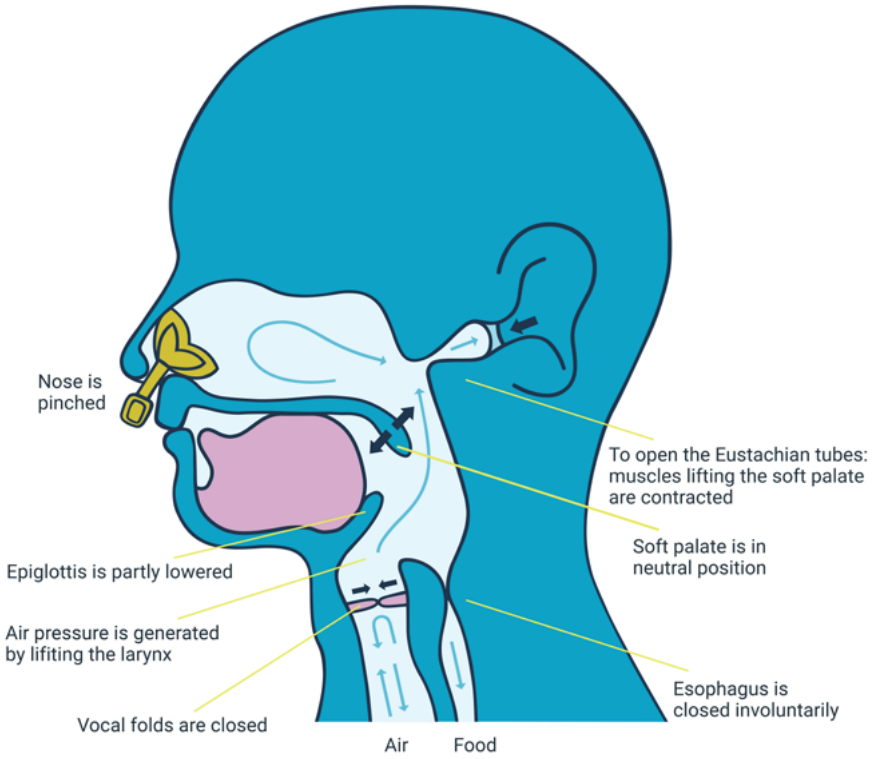


Figure 6. Frenzel maneuver

Frenzel equalization is the preferred method for freediving, because smaller muscle groups are used to perform the technique and there is no need to use your breathing muscles to push air up from your lungs into your nasal cavity.

It is a more relaxed and more controlled way to equalize. Your Molchanovs instructor will explain Frenzel equalization and demonstrate the technique to you.

KEY ANATOMY FOR FRENZEL EQUALIZATION

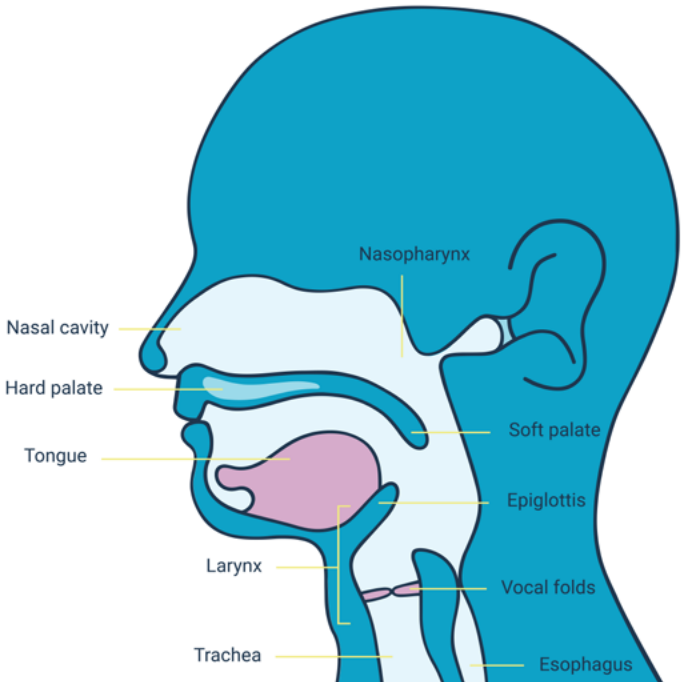


Figure 7. Anatomy of equalization

Vocal folds

Your vocal folds or glottis, are a group of muscles located around your vocal cords and the slit-like opening between them. They separate your oral cavity i.e. your mouth from the thoracic cavity i.e. your lungs. The opening of your vocal folds widens on inhalation and narrows on exhalation with a normal breath. Holding your breath causes your vocal folds to close.

Soft palate

Your soft palate separates your nose and mouth cavities and directs the flow of air in and out of your lungs.

- When you inhale and exhale through your nose, your soft palate touches your tongue to direct air out of your nasal cavity.
- When your inhale and exhale through your mouth, your soft palate moves up and back to direct air out of your oral cavity.
- When your soft palate is in neutral position, air passes through both your mouth and nose.

To perform the Frenzel maneuver, your soft palate is in the neutral position. To note, when you feel stressed underwater or try to equalize too hard, your soft palate can close up against your nasal cavity and stop air from entering. It is therefore important to relax when you equalize.

Larynx

Your larynx controls the flow of air and is also known as your voice box. It is a tube about 5 cm (2 inches) long in adults. It sits above the windpipe (trachea) in your neck and in front of your food pipe.

Epiglottis

Your epiglottis is a flap of cartilage located at the top of your larynx near the base of your tongue. It protects your vocal folds and prevents food from entering your larynx. To note, your epiglottis closes the opening of your larynx during swallowing and is not used during Frenzel.

PERFORMING THE FRENZEL MANEUVER

To perform the Frenzel maneuver, follow these steps:

1. Pinch your nostrils
2. Place the front of your tongue at the roof of your mouth as if you are making a T or K sound. These are called the T and K position or lock. Alternatively, squeeze your lips and cheeks as if you are saying P forcefully. This is the P lock where your cheeks are used to equalize, for example while using a mouth-fill.
3. Close your vocal folds and lift your larynx up to push air out of your mouth and into your nose.
4. You feel a popping or clicking sound as the air equalizes in your middle ear.
5. Repeat the above steps each time you need to equalize.

To note, keep your soft palate in a neutral position to let the air pass from your mouth through your Eustachian tubes.

If you are equalizing your ears without any thoracic or abdominal movement, you are doing it correctly. You also hear clicks in your ears and feel air entering your nose under your fingers. If you do not, your vocal folds are still open and air is leaking back to your lungs. Alternatively, if the air remains in your mouth but equalization has failed, your soft palate is still in the raised position and is preventing air from entering your nose. Learning to Frenzel equalize takes time and patience. Ask your Molchanovs instructor to demonstrate this technique so you can practice.

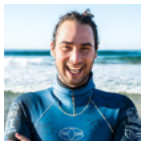
PRACTICING THE FRENZEL MANEUVER

To improve your Frenzel technique, you can complete a series of exercises designed to better control the flexibility and strength of your vocal folds, larynx, soft palate and tongue. You can practice a number of these exercises using the EQ Trainer. The EQ Trainer is a balloon attached to a nose-piece which allows you to use your nose to inflate the balloon. Please see Section 5.4 Equalization Exercises for further information about the EQ Trainer and exercises you can try.

Once you have mastered dry equalization using the Frenzel maneuver, try the following in the pool:

1. Enter the pool feet first using the ladder.
2. Stop at each step and equalize your ears remembering what you have learnt so far.
3. If you have no problems, practice by freediving to depths of 2, 4 and 6 meters (7, 13 and 20 feet). Freedive diagonally underwater first and equalize your ears with every movement cycle.
4. Gradually, move towards making a vertical descent and practice equalizing this way.

Stories from Adam Stern



Having equalization challenges when you are freediving is incredibly common. In fact, I find that around 30% of my students have some form of an equalization problem. The good news is that I am yet to encounter a student who has not resolved an equalization issue. There are some easy steps you can take to solve any issues to become a happier, safer, and better freediver. The key with learning how to equalize is patience. Never be angry with your body. You can only allow it to do what is possible at that moment. Know that with repetition and practice, it gets better.

OTHER EQUALIZATION TECHNIQUES

A number of people can equalize without pinching their nose. They open their Eustachian tubes by using the muscles of their soft palate and throat. This is known as 'hands-free' equalization or Béance Tubaire Voluntaire (BTV), French for Voluntary Tubal Opening (VTO). It is possible to learn this technique and it generally takes approximately four to six weeks of exercises and training.

5.4 Equalization Exercises

INTRODUCING THE EQ TRAINER

The Molchanovs Equalization Training Tool can help you work on your Frenzel skills without being in the water. Also known as an EQ Trainer, it helps you work with balloon exercises to strengthen and improve control of your tongue, your vocal folds and your soft palate. You can use this tool regardless of your level of expertise.

Figure 8. Molchanovs Equalization Training Tool or EQ Trainer

SOFT PALATE, LARYNX, VOCAL FOLD AND TONGUE CONTROL EXERCISES

Neck rotations with inhale vocal fold hold

1. Inhale and hold your breath while keeping your mouth open. Your vocal folds automatically snap shut.
2. Perform neck rotations slowly and gently while holding your breath.
3. Try to maximize your range of motion.
4. Complete ten rotations in each direction.

Neck rotations with exhale vocal fold hold

1. Exhale and hold your breath while keeping your mouth open.
2. Perform neck rotations slowly and gently while holding your breath.
3. Try to maximize your range of motion.
4. Complete ten rotations in each direction.

Vocal fold control 1

1. Hold your breath, inhale and use your vocal folds to stop the air flow gently and slowly.
2. Then, exhale and use your vocal fold stop the air flow gently and slowly.
3. Repeat this process for two minutes.

Vocal fold control 2

1. Exhale, hold your breath, and pull against your vocal fold gently.
2. Continue for two minutes.

SOFT PALATE CONTROL EXERCISES

Soft palate awareness

1. Inhale with an open mouth. Interchange between breathing in through your nose and mouth by regulating the air flow using your soft palate.
2. Change the air flow several times on one breath.
3. Repeat the exercise again, this time exhaling the air.
4. Repeat several times (minimum 3-5 repetitions).

Soft palate control 1

1. Inflate the balloon with the EQ Trainer in.
2. Close one nostril with your fingers and position the EQ Trainer against your other nostril so that the air from the balloon applies pressure on your soft palate.
3. Release your soft palate gently with your mouth open so that air escapes from your mouth.

4. Practice starting and stopping the flow of air.
5. Repeat several times (minimum 3-5 repetitions).

Soft palate control 2

1. Fully inhale.
2. Exhale slowly while keeping your vocal folds open and mouth closed, while keeping your cheeks fully inflated.
3. Keep exhaling and release the air through your nose by gently opening your soft palate in a controlled manner.

Soft palate control 3

1. Inflate the balloon with your mouth. Hold your breath by closing your vocal folds. Make sure that your cheeks and tongue are relaxed, your tongue is not touching your soft palate and the air from the balloon and your mouth share one space.
2. Allow air from the balloon to escape through your nose by relaxing and tensing your soft palate with small intervals. Repeat several times (minimum 3-5 repetitions).
3. Repeat with inhale, repeat with exhale. Alternate with pinching and releasing your nose and changing nostrils.
4. Repeat using the balloon without the EQ Trainer to have more pressure.

LARYNX AND TONGUE CONTROL EXERCISES

Larynx and tongue control

The goal of this exercise is to increase your awareness and mobility of your larynx and tongue i.e. the root, middle and tip of your tongue:

1. Use your larynx and tongue to create piston-like vertical movements with your Adam's apple.
2. Repeat with a full inhale, and repeat with a full exhale.

Tongue control 2

1. Without pinching your nose, practice the K, T, P locks, while keeping your soft palate closed and pressurizing the air by using your larynx and tongue.
2. This is similar to pronouncing the above consonants silently.

COMBINATION CONTROL EXERCISES

Combo control

1. Pinch your nose and apply pressure for each of the K, T, P locks.
2. Release your fingers so that air is immediately released from your nose. This means that your soft palate is open.
3. Keep pinching your nose to equalize.

5.5 Tips for Good Equalization Practice

EQUALIZE EARLY AND FREQUENTLY

Prior to a dive, equalize your ears and mask at the surface. This facilitates equalization at depth. During your descent, equalize early and frequently. Ideally, equalize before you feel a sensation of pressure in your ears. To note, your eardrum returns easily to its normal position once you have equalized but not if significant pressure has built up. Never wait until you feel discomfort or pain. Stop your descent by grabbing the rope and tilt your head to the opposite side if you are unable to equalize an ear. For example, to equalize a problematic left ear, tilt your head towards your right side which lengthens the left side. Try to equalize again in this position. Should you freedive deeper without equalizing your ears, you may not be able to equalize at all. This is because the difference in pressure between your middle ear and the external environment is too great.

SLOW DOWN YOUR DESCENT

The slower you descend, the easier it is to equalize pressure in your ears. Your eardrums and Eustachian tubes also adapt to pressure changes with regular training and you can then equalize with less effort. To note, as you descend deeper, the relative difference in pressure between each meter decreases and you find that you can equalize less frequently the deeper you go. Slowing down and relaxing helps you to establish your own pace to equalize and makes equalization easier.

RELAX

Mental stress can cause muscular tension. Tension in your abdominal and intercostal muscles can hinder lung compressibility. Tension in your head and neck, in particular in your soft palate and in the muscles attached to your Eustachian tubes can hinder ear equalization. This can result in blocked Eustachian tubes. Therefore, two freedivers with different elasticities of their diaphragm and different abilities to relax mentally attain different maximum depths. Relaxation is key. Therefore:

- Take your time preparing for a dive. Dive when you feel completely relaxed.
- During your dive, focus on your neck and facial muscles to release tension in your head and neck and focus on relaxing your mind.
- Release any worries and leave them behind.
- Make your first breath-hold dives in shallow water with good visibility to minimize and conquer any fear.

COMPLETE WARM-UP EXERCISES

Perform the following warm-up exercises prior to a freedive to prepare the muscles around your Eustachian tubes:

1. Massage the skin in front of, and behind your ears.
2. Pull on your ears. Start from the bottom at the ear lobe and work your way up to the top which is known as the helix.

3. Push the little lobe at the front of your ear - your tragus - in against your ear and massage it with circular motions.
4. Stretch your jaw down and relax into this position.
5. Move your jaw left and right.
6. Rotate your jaw.

To note, perform jaw movements carefully, otherwise it is possible to damage the delicate joints and muscles which move your jaw. Should you continue to experience problems with equalizing, practice equalization gently. Do not push yourself to go deeper as this can lead to more discomfort or injury.

5.6 Summary

1. Pressure increases the deeper you dive which causes the air in your body cavities to compress and decrease proportionately. To prevent these air spaces from causing discomfort, pain or injury, this build up of pressure requires active or passive equalization.
2. There are three main air spaces to equalize: the middle ear, the sinuses and the mask.
3. There are two ways you can build up pressure in your nasal cavity to equalize your middle ear:
   - Exhale against pinched nostrils and use the air in your lungs to create pressure. This is called Valsalva equalization.
   - Push with your cheeks or with your larynx and tongue against your pinched nostrils to create air pressure. This is called Frenzel equalization.
4. We recommend you use Frenzel equalization because smaller muscle groups are used to perform the technique and there is no need to use your abdominal muscles to push air up from your lungs into your nasal cavity. It is a more relaxed and more controlled way to equalize.
5. To perform the Frenzel maneuver, follow these steps: Pinch your nostrils. Place the front of your tongue at the roof of your mouth as if you are making a T or K sound. This is also called the T or K tongue position / lock. Or just squeeze your lips and cheeks as if you are saying say P. This is the P lock. Lift the back of your larynx up to push air out of the mouth and into the nose. You feel a popping or clicking sound as the air equalizes in your middle ear. Repeat the above steps each time you need to equalize. If performed correctly, you hear clicks in your ears and feel air entering your nose under your fingers.
6. Equalize frequently and before you feel pressure building up against your ear drums. Do not wait until you feel pain. Your eardrums and Eustachian tubes adapt to pressure changes with regular training and you can then equalize with less effort.
7. Use the EQ Trainer to help train your larynx, vocal folds, soft palate and tongue and develop your Frenzel technique.
8. To equalize pressure in your diving mask: Release your nose pinch. Move a small amount of air through the nose and into the mask. Repeat frequently on descent before you feel pressure build in your mask.
9. Facilitate ear equalization by equalizing early and frequently. Descend slowly and relax your neck and facial muscles.

CHAPTER 6
DIVING TECHNIQUES

‘

The pool is where you training. The sea is where a freediver is made.

’

Natalia Molchanova

This chapter introduces you to the No Fins technique and how to learn and develop your style.

6.1 Introducing the No Fins technique

There are a number of different freediving disciplines which are performed without fins including Dynamic No Fins (DNF) and Constant Weight No Fins (CNF). Constant Weight No Fins is considered to be one of the most physically demanding disciplines and this is introduced in the Wave 2 / Lap course.

Dynamic No Fins (DNF) is a horizontal underwater swim without fins. The stroke most commonly used is a variation of the breaststroke.

WHAT IS NO FINS?

The basis for the No Fins technique is breaststroke, the familiar, classic style of swimming you may have learnt as a child and use today. You usually swim breaststroke on the surface but you may have swum underwater breaststroke for one cycle when pushing off the wall at the start of your swim. You may also have seen competitive swimmers push off the wall and swim breaststroke underwater until they surface to continue their swim.

Learning a good breaststroke technique improves your streamlining, endurance and strength as it uses your whole body. It is one of the more tiring and physically demanding styles but by establishing a good technique, you add to the variety of swimming styles available to you which is very beneficial for freediving. This in turn increases your options for training. It is important to establish variety in your training and you improve significantly in freediving by using different training methods and practicing different styles, both with and without fins.

How well you feel the water and support yourself in it, is also an important and fundamental part of swimming. By developing your No Fins technique, you engage more of your muscle groups and you naturally develop a better feel and sense of the water. It is harder to develop this when swimming with fins. The No Fins technique not only develops and builds your confidence and comfort in the water, it also improves and fine-tunes your coordination.

Finally, learning this technique gives you complete freedom and flexibility to freedive anywhere in the world without the need for fins, simply with just goggles (in the pool only) or a mask.

THE BASIC TECHNIQUE

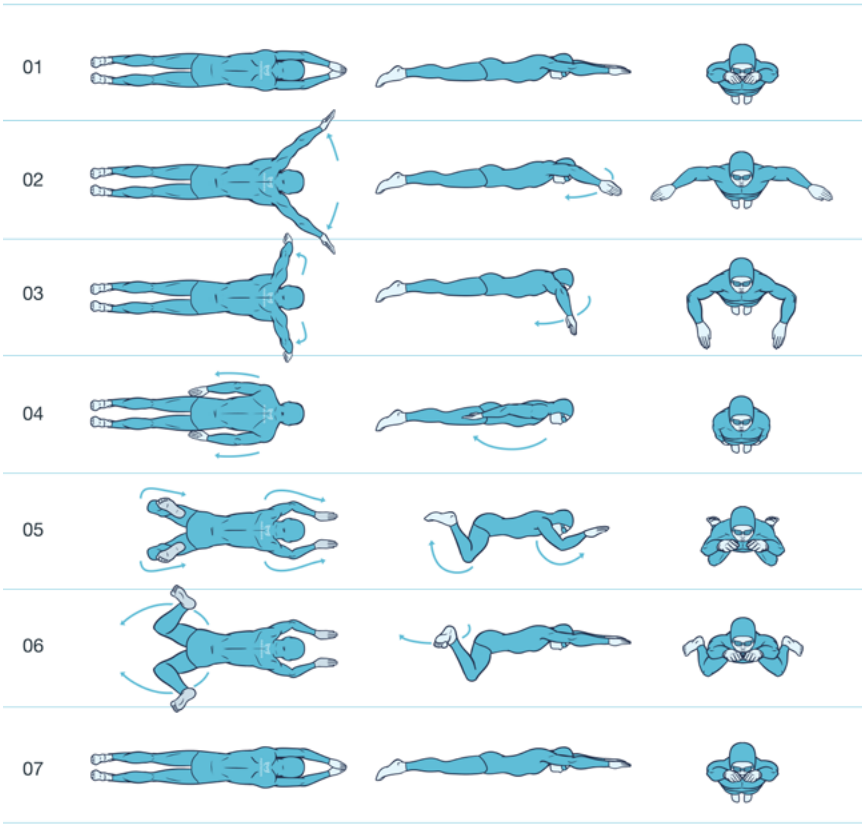


Figure 9. No Fins technique

Follow these steps to develop the correct technique:

1. **Start** with your hands and feet together in an arrow position. Arms are extended out in front.
2. **Arm Pull.** Pull your arms and hands from above your head all the way down to your hips, keeping your elbows high during your arm pull. Your arms are held in a similar position as if you are hugging a large fitness ball, i.e. your arms are curved forwards and your elbows are high. Pull down with your arms for as long as possible and **slowly** move your elbows into your sides as you move them down.
3. **Leg kick.** Bring your heels up and open your legs to prepare for your kick. Extend your arms forward at the same time. When your arms are extended, push your legs down in a frog-like motion. Push your legs **down** and not to the side by squeezing your knees together when you straighten your legs. Finish with straight legs and pointed toes.
4. **Glide.** Continue with your arms extended into a glide and resume your starting position once more in preparation for your next cycle.

Key to the No Fins technique is to keep your upper body still and horizontal in the water, while your arms and legs do the work. Your Molchanovs instructor will explain and demonstrate the breaststroke technique to you as this is a requirement for the Wave 1 / Lap 1 course. Ask any questions you may have and include this as a regular part of your on-going training.

6.2 Summary

1. There are a number of different freediving disciplines which are performed without fins including Dynamic No Fins (DNF) and Constant Weight No Fins (CNF).
2. Dynamic No Fins is a horizontal underwater swim without fins and uses a variation of the breaststroke.
3. Learning good breaststroke technique improves your streamlining, endurance and strength as it uses your whole body. The No Fins technique not only develops and builds your confidence and comfort in the water, it also improves and fine-tunes your coordination.
4. Key points of technique to remember for breast stroke: **Arm Pull.** Keep your elbows high during your arm pull. **Leg kick.** Push your legs down and not to the side.

CHAPTER 7
MENTAL TECHNIQUES

‘

A freediver should have a positive attitude and chase away all negative thoughts related to the forthcoming freedive.

’

Natalia Molchanova

This chapter introduces and explains a simple mental technique which you can begin to use prior to a freedive. Further techniques to enhance and improve your mental state is introduced in later Waves.

7.1 Technique: Visualization

Preparing yourself mentally is important and beneficial to your overall freedive experience and safety. Visualization can be used prior to a freedive and is a powerful tool used by many athletes in different sports. It is an effective way to increase performance and alleviate anxiety from an activity.

WHAT IS VISUALIZATION?

What you see, what you remember and what you imagine, fire in the visual cortex of your brain in a similar way and in fact the brain does not differentiate between them at all. This phenomenon allows you to imagine a freedive and convince your mind that you have performed the freedive before and that there is no need to worry. Diving to a certain depth is much easier the second, third or fourth time.

Performing a visualization is simple. You imagine the freedive you are about to perform. You imagine it in great detail and you imagine everything is going well. Detail is important. The more detailed the visualization, the more convincing the story becomes. You imagine the positive sensations of the freedive: the feeling of water on your face, the power of kicking your fins and the happiness of reaching the bottom of the line. Choose whatever you believe gives you the strongest emotional response and imagine it vividly as you go through the freedive in your mind.

VISUALIZATION EXAMPLE

Use the following visualization as a guideline for your practice.

While resting at the surface prior to your freedive, focus first on your body scan until you feel completely relaxed. Then visualize your freedive for 1 - 2 minutes, paying close attention to every detail and aspect of your planned freedive:

1. Imagine starting with a perfect duck dive, then facing the dive line and staying close to it as you descend.
2. Keep your head in line with your body.
3. Equalize the pressure in your ears and mask regularly.
4. Keeping your legs straight, make strong, powerful kicks at a moderate pace.
5. Then, imagine the turn. Grab the dive line with your hand and make a perfect forward turn.
6. Start your ascent by making strong, powerful kicks.

7. Then, reduce the effort as you get closer to the surface.
8. Close to the surface, allow the positive buoyancy to push you upwards with minimal effort.

Then to ready yourself to start your descent:

1. Check that you are fully relaxed.
2. Perform up to three relaxed chest-breaths if you need.
3. Fill your lungs in one full breath.
4. Start your descent.

7.2 Summary

1. Visualization is an effective method used by many athletes in different sports to increase performance and alleviate anxiety from an activity.
2. When you perform a visualization, you imagine the freedive you are about to perform in great detail and you imagine everything is going well.
3. Before each descent, spend one to two minutes visualising your freedive step by step.
4. Then ready yourself for your descent: check if you are fully relaxed, perform up to three relaxed chest breaths if appropriate, fill your lungs in one full breath and start your descent.

CHAPTER 8
POTENTIAL TRAUMA

‘Freediving should be associated with internal calm, but never with struggle. ‘In good time’ is a key principle in freediving.’

Natalia Molchanova

This chapter explains two main types of trauma that can occur in freediving:

- trauma relating to hypoxia or the lack of oxygen in your body during a breath-hold
- barotrauma, which is physical damage to your body tissues caused by changes in ambient pressure

It is important that you develop an awareness and understanding of how to prevent these trauma and how to freedive safely and responsibly.

8.1 Trauma relating to Hypoxia

You can risk suffering from a loss of motor control (lmc), also known as a samba, if you push a breath-hold too far. It is therefore critical to learn and understand key preventative measures to ensure your own safety and the safety of your buddy.

HYPOXIA AND SAFETY

Freediving is not dangerous providing you are aware of the risks and follow important safety rules. Section 3.2 The Effects of Breath-hold explains that hypoxia induced by freediving may cause you to experience a number of temporal effects, for example a sense of euphoria, but these do not cause any damage to your brain. If you are a healthy and fit freediver, generally you recover quickly after freedives with no lasting adverse effects. However, should the partial pressure of oxygen in your lungs and blood fall below critical level, you will suffer from acute oxygen deprivation and may blackout.

The partial pressure of oxygen can decrease for two reasons:

- oxygen consumed by your body
- ambient pressure decreasing on ascent from depth. Even though you may feel well at depth, you can become hypoxic on ascent simply due to the decrease in pressure.

It is important to recognize the warning signs of acute hypoxia which can vary considerably from person to person. Remember to ascend well before experiencing any symptoms of hypoxia. To note, currently there are no pressure-resistant or waterproof pulse oximeters available which can monitor the partial pressure of oxygen and therefore, the level of hypoxia in your body.

Signs and symptoms of acute hypoxia

The most common symptoms of acute hypoxia include:

- clouding of consciousness
- disorientation
- tunnel vision
- increasing weakness of your body
- feverish feeling in your body

- heaviness in your muscles
- strain in your neck muscles

Acute hypoxia may be also be characterized by the following signs:

- loss of coordination
- loss of balance

Surface immediately as soon as you notice any of the symptoms listed above.

The key to safe freediving is learning to read the symptoms of increasing carbon dioxide in your body during a breath-hold. As you progress in your training, you become more tolerant to increasing levels of carbon dioxide. However, you still experience these symptoms and you learn to judge when is the right time to end a breath-hold.

LOSS OF MOTOR CONTROL

A loss of motor control (lmc) is a late warning sign that can precede a blackout. Involuntary contractions generally develop in your neck, shoulders, arms, and occasionally in your leg muscles. These contractions are caused by lack of oxygen in the motor zone of your cerebral cortex. Although a loss of motor control may lead to a blackout, occasionally you can regain control over your muscles through good recovery breathing. Therefore:

- Carefully monitor all minor changes which take place in your body throughout a freedive. Watch for any symptoms of increasing carbon dioxide.
- End your breath-hold immediately if you experience any symptoms of acute hypoxia.
- Always end your breath-hold dive in a comfortable state with sufficient reserves.

BLACKOUT

After a hypoxic blackout in the dry, for example during a breath-hold exercise at home, you generally regain consciousness without assistance. However, if you are alone and a hypoxic blackout occurs while your airways are submerged in water, spontaneous recovery does not happen and so the danger of death is real. Should you blackout during a freedive, water does not enter your lungs for some time. This is due to the occurrence of a laryngospasm which is a sudden involuntary spasm of your vocal folds. Once your buddy brings you quickly to the surface and exposes your airways to air, this spasm usually stops and normal breathing resumes. Your buddy supports this by performing several cycles of Blow, Talk.

- **Blow** on onto the area below your eyes to dry your skin. This causes your skin receptors to signal to your brain that you can resume normal breathing. When practicing, just blow next to the face out of courtesy.
- **Talk** to you by calling your name and asking you to breathe. Your unconscious mind is able to recognise your name being called and this can help bring you back.

This is explained in further detail in Section 9.3 Rescue Procedures.

Artificial respiration known as rescue breaths must be provided should you not recover after initial attempts to revive you for approximately ten seconds using Blow, Talk. Occasionally for cases of severe hypoxia, rescue breaths should be given immediately at the surface. To note, you can still blackout at the surface while actively breathing.

After regaining consciousness, you are generally unable to recall what has happened and thus you should be supported by your buddy until you are fully in control of your mind and body. You may suffer from fatigue, headache, vertigo, nausea, and body aches following a blackout. Changes caused in your body by acute hypoxia are reversible. Full recovery generally takes one to two days so do not freedive until this time has passed and certainly until you are fully recovered.

Following a blackout:

- Breathe pure oxygen if available, for 5-10 minutes. This lowers the oxygen debt as quickly as possible.
- Have a good rest to accelerate recovery.
- Drink plenty of water.
- Eat nourishing and nutritious foods.
- Do not freedive for a minimum of 24 hours.
- Establish the reasons for your blackout and correct your technique prior to freediving again. Speak to your Molchanovs instructor if you require help to do this or if you have any questions.

Rescue procedures to be followed in the event of a loss of motor control or blackout are explained in detail in Section 9.3 Rescue Procedures.

PREVENTING LOSS OF MOTOR CONTROL AND BLACKOUT

The following is recommended to reduce the risk of a loss of motor control or blackout.

Relax mentally and physically

Relaxation of your mind and body is critical to ensuring both a safe and pleasurable experience before, during and after a freedive. Preparing yourself mentally is important and the more relaxed you are, the better the freedive experience, the deeper the freedive and the longer the breath-hold.

Practice and use correct relaxation and breathing techniques

Poor pre-dive preparation and post-dive breathing can lead to a loss of motor control or blackout. Hyperventilation before a freedive can reduce the amount of carbon dioxide in your blood to such a degree that you do not subsequently experience the urge to breathe during the freedive, even when you are already experiencing symptoms of acute hypoxia. Therefore, it is recommended that you **avoid hyperventilating** before a freedive. Instead focus on your body scan and breathing. Finally practicing a good

recovery breathing technique and using it each time you surface is also important. Without correct recovery breathing, you are often unable to recover lost oxygen promptly enough which may result in acute hypoxia.

Section 4.1 Basics of Breathing and Relaxation and Section 7.1 Technique: Visualization introduced you to a number of techniques which can help you relax before a freedive. Review these again now and practice them under guidance from your Molchanovs instructor.

Freedive within your limits

A blackout can occur if you overestimate your ability and exceed your individual limits. Therefore:

- be considerate of your personal limits
- freedive conservatively
- surface if you experience any symptoms of acute hypoxia

Key to safe freediving is to progress in good time. There is no rush. Repeat your current freedive performance several times before setting your next goal e.g. a deeper or longer freedive. Increase your goals in small and manageable increments.

Monitor your physical and mental condition

It is generally difficult to assess your personal limits before you start freediving, as they are dependent on many factors: your physical condition, emotional state and fatigue from recent training. For example, you use oxygen resources more quickly if you are stressed because activity and tension in your muscles increase. As a result, even if you have planned your freedive i.e. depth, distance and/or time remember to:

- constantly monitor your condition throughout your freedive
- listen to your body
- end your freedive in good time.

As a beginner freediver, focus on relaxation, monitor all changes in your body and ascend as soon as the first sign of discomfort in your breath-hold arises.

Focus on developing a good freediving technique

As a beginner freediver, it is important to spend time practicing, improving and mastering your freediving techniques, for example equalization, body posture and finning technique. At this stage you generally use more oxygen in comparison to a seasoned freediver because you are developing and enhancing your techniques. As your techniques improve and your experience increases you are able to monitor and recognize the warning signs and symptoms of hypoxia more easily. This significantly reduces the risk of acute hypoxia.

8.2 Barotrauma

Barotrauma refers to the physical damage of body tissues which results from a difference in pressure between internal body cavities and the external environment.

BOYLE'S LAW

The following principle explains why a barotrauma occurs. Boyle's Law states that:

'The pressure and volume of a gas have an inverse relationship. As the volume of a container decreases, the concentration of the gas inside it, and its pressure, both increase.'

Therefore, as you descend and water pressure rises, the air volume in your lungs becomes smaller. However, there are a few air spaces in your body which do not change, or only change slightly in volume as the surrounding pressure rises. The middle ear and the sinuses are two examples and you need to equalize these cavities as you descend.

MIDDLE EAR BAROTRAUMA

Your middle ear is surrounded by cranial bones and cannot change in volume. Your Eustachian tube is the auditory tube which connects your middle ear with the upper part of your throat behind your nose. If you do not equalize during a descent, your Eustachian tube remains closed. As a result, the amount of air in your middle ear remains the same as at the surface before your freedive, while ambient pressure increases with depth. This results in a pressure difference on both sides of your eardrum and the external and internal surfaces of the blood vessels in your middle ear. This causes your eardrum to curve inwards and the walls of your blood vessels to stretch. If the pressure difference is too high, your eardrum ruptures and/or the weakest blood vessels tear. This is called a middle ear barotrauma.

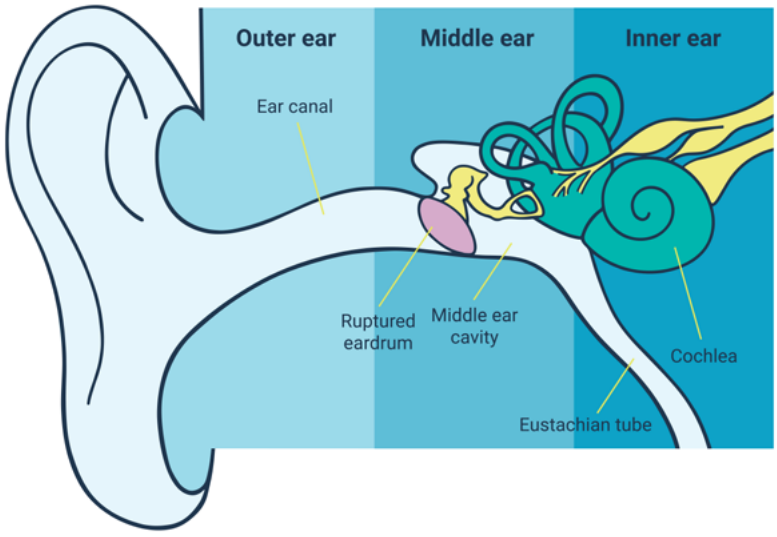


Figure 10. Middle ear barotrauma

There are three degrees of ear barotrauma. To note, either one or both ears can be affected.

Table 2. Degrees of Ear Barotrauma

MILD	MODERATE	SEVERE
Visible injury (otoscopic picture*)		
○ Moderate reddening and curving of eardrum	○ Pronounced redness of eardrum ○ Blood in middle ear from surrounding tissues	○ Rupture of eardrum
Signs and Symptoms		
○ Ear pain ○ Stuffiness in ears	○ Severe pain ○ Feeling of stuffiness ○ Fluid in ears ○ Hearing impairment	○ Sharp pain in ear ○ Nausea ○ Vertigo ○ Bleeding from the external auditory canal ○ Hearing impairment Ear infection
Length of recovery		
○ Heals within 2 weeks	○ Between 2 weeks and 2 months	○ May require up to 2 months for full recovery or surgery to repair damage

* An otoscopic picture is what your doctor sees during a check up of your ears.

Should you rupture your eardrum, you experience momentary pain and mild bleeding from your ear canal. This bleeding may not be apparent until you surface. In addition, water can enter your middle ear and irritate your inner ear. A ruptured eardrum is classed as a severe ear barotrauma,

This may cause:

- vertigo
- nausea
- vomiting
- hearing impairment
- pain

If you suspect you may have ruptured your eardrum during a freedive, ascend immediately, stop freediving and seek medical advice. Ear barotrauma can also result from a diving hood that is too tight or excessive earwax in your ear canal. Both can trap air in your ear canal during a freedive. The pressure of this trapped air becomes lower than the equalized air pressure in your middle ear, resulting in your eardrum curving outwards towards your ear canal.

To avoid middle ear barotrauma:

- Frequently equalize pressure in your middle ear, ideally before you feel pressure in your ears. Do not wait until there is pain and discomfort.
- Before starting your freedive, let some water into your hood if it is tight.
- Stop your descent if equalization fails.
- Do not freedive if you are suffering from a cold, congestion, or inflammation in your upper throat.

If you suspect either you or your buddy has ruptured an eardrum during a freedive, ascend immediately, stop freediving and seek medical advice.

If you suffer from an ear injury of any type:

- Keep the affected ear dry until fully healed.
- Avoid blowing through your nose.
- Avoid using alcoholic ear drops.

Occasionally, you may hear a squeaking noise in your ears during equalization which results when air passing through the Eustachian tubes is obstructed. An obstructed Eustachian tube can result from:

- a swelling of your mucous membranes, Eustachian tubes, and upper throat
- your anatomical structure such as a narrow or curved Eustachian tube

If this occurs, equalize with particular care and do not try to compensate for the reduced air flow by applying excessive pressure during equalization. If you cannot equalize comfortably and in a relaxed manner, it is safer to stop freediving for the day.

INNER EAR BAROTRAUMA

Blowing too hard into your nose to equalize may cause an inner ear barotrauma. Key signs and symptoms are:

- prolonged vertigo
- gait disorders
- impairment of orientation
- nausea
- vomiting
- ear noise or tinnitus

Inner ear barotrauma may lead to temporary or permanent hearing disturbances. To avoid permanent hearing impairment, always seek medical advice if you experience any of the above.

To avoid inner ear barotrauma:

- never force equalization
- avoid freediving with any ear-related illness

If you have chronic ear disease or a hearing impairment, consult a doctor and take special care of your ears during your freedives. It is common to find that equalizing one ear is more difficult than the other. It is the slower ear that defines the speed of your descent. Should you fail to equalize during a descent, stop immediately and return to the surface.

REVERSE BLOCK

Ear barotraumas are unlikely to occur on ascent. This is because your Eustachian tubes open automatically when pressure in your middle ear exceeds the surrounding pressure. However, a condition called a reverse block can develop during ascent. In this instance, air in your middle ear is blocked by a closed Eustachian tube, for example, if plugged by mucus. The trapped air expands on ascent causing pressure and pain in your ears. A reverse block can damage both your eardrum and your inner ear, and can even cause a blackout if the pain makes it difficult to reach the surface.

If you experience a reverse block:

1. Stop your ascent by holding on to the dive line.
2. Move your lower jaw left and right, and forward and backwards.
3. Make swallowing movements.
4. Continue ascending slowly should the blockage persist.

To avoid a barotrauma relating to a reverse block, avoid freediving when your respiratory tract is inflamed for example, with a cold or an ear infection. Also remember that the effects of any medication you take is temporary and can wear off during a freedive. This can result in a reverse block when you try to ascend.

VERTIGO

Vertigo is a condition whereby you have a false illusion that the world is spinning or swaying around you. Vertigo during a breath-hold dive is caused by exposure of your inner ear to cold, or by a barotrauma, whether this is a middle or inner ear barotrauma or a reverse block. The sensation of vertigo is caused by unequal signals received by your inner ears. This can arise from unequal states of equalization or a barotrauma in one of your middle ears. This is also known as an alterobaric barotrauma.

SINUS BAROTRAUMA

There is no need to specifically equalize your sinuses. When you equalize pressure in your middle ear on descent, pressure in your sinuses are normally also equalized. However, the openness of these channels may be impaired by inflammation, allergic reaction

and a rapid descent. The growing pressure differential may lead to an injury of your mucus membranes in the affected sinus cavities. This is called a sinus barotrauma or sinus squeeze. Typical symptoms include:

- pain in the maxillary and/or frontal sinuses and the bridge of your nose
- bloody nasal discharge
- radiation of pain to your forehead, eye sockets or upper teeth

To avoid sinus barotrauma:

- avoid freediving if you have a cold or are congested
- equalize your ears regularly
- stop your descent immediately if equalization fails

Blood in your diving mask is usually a sign of either a sinus barotrauma or a nosebleed. A nosebleed can result from forceful equalization of the ears or in fact is an individual predisposition unrelated to freediving. The following first aid can be provided when blood is seen in your diving mask:

- Keep your head upright. Don't tip it back as this causes blood to enter your throat.
- Avoid blowing your nose as this may further traumatize damaged blood vessels.
- Apply a cold wet cloth to your nose. The cold promotes vasoconstriction and slows the flow of blood.

Occasionally, you may find blood in your diving mask if you have a cyst (a small fluid-filled sac) in your sinus. Increasing pressure on descent may cause this cyst to rupture. When this happens, the contents of the cyst blocks the channels connecting your sinuses and the expanding air causes significant pain.

MASK SQUEEZE

Mask squeeze can occur when you fail to equalize your mask. Mask squeeze can result in damage of the capillaries in your eyes and skin. To avoid mask squeeze:

- exhale regularly into your mask
- never inhale from the mask space
- release your nose pinch from time to time during equalization
- use a well fitting, low volume mask
- adjust the length of your mask strap so that it is not too tight

DENTAL BAROTRAUMA

A dental barotrauma occurs when the pressure in air-filled cavities in your teeth changes. Air bubbles in a dental cavity can squeeze a nerve which can cause pain. Occasionally, a toothache caused by barotrauma will disappear after surfacing, but it can also continue for a period of time until it subsides. To avoid dental barotraumas, see a dentist and ensure any cavities are filled.

8.3 Summary

1. Loss of consciousness or blackout during a breath-hold dive is caused by the partial pressure of oxygen in your brain dropping below a critical level.
2. The partial pressure of oxygen can fall due to oxygen consumed by your body and surrounding pressure decreasing on your ascent from depth.
3. Symptoms of acute hypoxia include: clouding of consciousness, disorientation, tunnel vision, increasing weakness in your body, a feverish feeling in your body, heaviness in your muscles and strain in your neck muscles.
4. Acute hypoxia may be also be characterized by the following signs: Loss of coordination and loss of balance
5. A loss of motor control (lmc) or samba is a late warning sign that can precede a blackout. Involuntary contractions usually develop in your neck, shoulders, arms, and sometimes legs, which are caused by lack of oxygen in the motor zone of your cerebral cortex.
6. When you blackout during a freedive, water does not enter your lungs for some time because of laryngospasm, a brief involuntary contraction of your vocal folds. When brought to the surface, an intense hypercapnic stimulus stops laryngospasm which usually causes you to resume breathing naturally.
7. You can also blackout while already on the surface and breathing actively. During a freedive, vasoconstriction or narrowing of the blood vessels occurs which causes body tissues receiving less blood than normal. This results in an increase in the total oxygen debt.
8. After suffering from a blackout, breathe pure oxygen if available for 5-10 minutes. Rest, drink plenty of water, and eat well-balanced and nutritious food to help recovery. Do not freedive for a minimum of 24 hours. Establish the reasons for your blackout and correct your technique prior to freediving again.
9. Assess your abilities before freediving and only freedive in good physical and mental condition. Poor freediving techniques, and improper breathing before and after a freedive, can increase the risk of LMC or a blackout.
10. A barotrauma occurs in body tissues located around air spaces. This is because pressure in these air spaces may differ from the ambient pressure during both descent and ascent.
11. To prevent middle ear barotrauma: Equalize pressure in your middle ear before any discomfort is felt in your ears, let some water into your diving hood if too tight, stop your descent immediately if equalization fails, and never freedive with inflammation in your nasopharynx or ears.
12. Symptoms of an inner ear barotrauma include: Loss of orientation, vertigo, nausea, ear noise (tinnitus) and gait disturbances.

13. To prevent inner ear barotrauma, never force equalization.

14. Acute pain in your forehead during a freedive indicates that you have inflammation in your frontal sinus. Avoid freediving until you are fully recovered.

15. To prevent barotrauma in your sinuses, equalize pressure regularly, ascend immediately if equalization fails, and never freedive with a cold or any inflammation of your airways.

16. Excessively forceful equalization using the Valsalva maneuver is dangerous and at depth, it may cause a lung injury.

17. To prevent facial injuries from mask squeeze, exhale into your mask by regularly releasing the nose pinch during equalization, avoid inhaling from your mask, and adjust your mask strap properly to ensure it is not too tight.

CHAPTER 9
SAFETY AND RESCUE

‘You make new discoveries each day by entering the world of freediving and going deeper in both the literal and figurative sense. To enjoy these discoveries, you should be skillful enough to freedive safely. As a beginner, you should first learn three important things: to be yourself, to be at depth, and to be yourself at depth. The last is the most important of all.’

Natalia Molchanova

This chapter explains important safety procedures to follow when freediving and rescue techniques to be used in the event of a loss of motor control (LMC) or a blackout. The buddy system is also introduced.

9.1 Key Safety Measures

The following key safety measures are important to ensure comprehensive preparation for, and safe conduct during a freedive.

ALWAYS FREEDIVE SAFELY

The most important part of safety in freediving is how you freedive. Firstly, be well trained for your level, mentally and physically prepared and in good health before considering freediving. Secondly and even more important is your attitude and approach when freediving. Be relaxed, progress and improve in small increments and never push your limits. Be a responsible freediver.

Always consider the following prior to each freedive or training session:

- Always freedive with a trained buddy.
- Focus on good technique and relaxation. Avoid hyperventilation.
- Always take your snorkel out before a freedive.
- Always perform recovery breathing when surfacing from your breath-hold dive.
- If you feel unwell, restrict your freediving training to learning and fine-tuning swimming technique at the surface. Avoid breath-holding.
- Freedive correctly weighted.
- Check weather conditions and currents. When in doubt, seek advice from local freedivers.
- Stay well hydrated.
- Never push your freedive.
- Bring a float.

PROGRESS IN GOOD TIME

Progressing in good time is a sensible principle to remember and follow. It does not mean that you do not challenge yourself but it does mean that you do so in a controlled and planned manner. For example, if you reach a specific depth for the first time, repeat freedives to this depth until you are fully comfortable with your performance. As a guide, this means that you can comfortably:

- equalize at your target depth
- spend a few moments at this depth before starting your ascent.

Once, you have achieved this repeatedly, you are ready to add a few meters to your next freedive.

ALWAYS FREEDIVE WITH A BUDDY

Formally freedivers commonly freedived alone in rivers, seas, and oceans, sometimes at great risk. Nowadays, safety is paramount and is a fundamental part of freediving training. Some freedivers push beyond sensible personal limits, for example, if they remain underwater for too long while trying to break a personal record or if they become too absorbed in their surroundings or the marine life. Freediving alone in these situations is extremely dangerous. Remember to always freedive with a competent and qualified buddy (i.e. a person who has taken a freediving course of equivalent level or higher) who can supervise and provide assistance if required. This applies to both training situations and recreational freedives. The importance of the buddy system is discussed in Section 9.2 The Buddy System.

RESPECT SURFACE INTERVALS

To date, there are no conclusive studies regarding what minimum surface intervals are required to ensure safe freediving. However, there is consensus in the freediving world regarding general rules of thumb to follow and this also includes both buddying and recreational freediving. We have defined and use conservative surface interval rules to ensure that we keep our freedivers safe. Please use the following to calculate your required surface interval.

- **Rule 1: SI = p x t**, where p is rounded up to the next full number
- **Rule 2:** Freedives deeper than 60m (181 feet): **one freedive in a 24h period**

Key:
SI = Surface Interval
p = maximum pressure in bar (or atm)
t = Dive time in minutes or seconds

*Rule 1 is referenced from Richard Wonka

Examples

Example 1

A freedive to 7 meters (23 feet) with a 30 second duration.

Using Rule 1, the minimum surface interval is 60 seconds (**SI = 2 x 30, 1.7 bar rounded up to 2**)

Your surface interval is a minimum of **60 seconds**.

Example 2

A freedive to 15 meters (49 feet) with a 36 second duration.

Using Rule 1, the minimum surface interval is 108 seconds or 1 minute 48 seconds (**SI = 3 x 36, 2.5 bar rounded up to 3**)

Your surface interval is a minimum of **1 minute 48 seconds**.

Example 3

A freedive to 28 meters (92 feet) with a 60 second duration.

Using Rule 1, the minimum surface interval is 240 seconds or 4 minutes (**SI = 4 x 60, 3.8 bar rounded up to 4**)

Your surface interval is a minimum of **4 minutes**.

Example 4

A freedive to 35 meters (115 feet) with a 80 second duration.

Using Rule 1, the minimum surface interval is 400 seconds or 6 minutes 40 seconds (**SI = 5 x 80, 4.5 bar rounded up to 5**)

Your surface interval is a minimum of **6 minutes 40 seconds**.

Example 5

A freedive to 48 meters (197 feet) with a 100 second duration.

Using Rule 1, the minimum surface interval is 600 seconds or 10 minutes (**SI = 6 x 100, 5.8 bar rounded up to 6**)

Your surface interval is a minimum of **10 minutes**.

Example 6

A freedive to 62 metres (213 feet) with a 140 second duration.

Using Rule 2, Freedives deeper than 60m (181 feet): **one freedive in a 24h period**

Do not freedive for **24 hours.**

9.2 The Buddy System

Always freedive under the supervision of a competent buddy. A buddy acts as a safety freediver and plays a different role and uses different techniques depending on the discipline, and whether in the pool or in open water. You will learn how to become a skilled and dependable buddy. Remember freediving with a buddy not only keeps you safe, it is also more fun. The main responsibilities of a buddy are to provide safety and assess the physical condition of a freediver (i.e. their buddy) during their freedive and once they have resurfaced.

As a good buddy:

- Be attentive at all times.
- Know what your buddy is doing at all times and ensure your buddy knows in turn, where you are and what you are doing.
- Be able to assess the physical condition of your buddy accurately and promptly.
- Provide accurate and prompt feedback about the hypoxic or physical load which results from a freedive. To note, your buddy cannot always feel or judge their personal limits accurately.
- Advise your buddy to avoid attempting the same distance or depth immediately again, or if their personal limits have been exceeded, advise them against further freediving.
- Be trained and proficient in rescue procedures.

Recognize the key signs which indicate that your buddy has exceeded personal limits:

- If your buddy surfaces from a breath-hold dive with blue lips, note it and tell them. This change of lip color can be caused by a slightly lowered but not yet dangerous level of oxygen in their blood. This is also called cyanosis. Your buddy cannot feel this and relies on you, as their buddy to tell them. Blue lips can also be a sign of being cold i.e. hypothermic. If this is the case, advise your buddy to stop freediving because they are using too much oxygen too quickly.
- If you notice one or more of the following signs: Unfocused eyes or loss of motor control (LMC) after surfacing, a sudden exhalation or an abrupt change in movement such as speeding up or slowing down towards the end of a freedive

This is detailed further in Section 9.3 Rescue Procedures.

STATIC BREATH-HOLD BUDDYING

Static breath-hold training in the pool is performed stationary in shallow water under the supervision of a buddy. Prior to the breath-hold, the buddy team i.e. you and your buddy agree time intervals for a safety check and which verbal or non-verbal cues will be given during the breath-hold and when. This could include a tap on your buddy's arm or shoulder, asking for a signal or saying how much time has passed. Regular checking is vital.

For example, you may agree that you will notify your buddy that it is one minute prior to the planned breath-hold, then 30 seconds, and then start. Also then to notify your buddy every 15 seconds during their breath-hold. To note, notification of preparation and breath-hold times are very much a personal preference. Some freedivers like a verbal notification, others prefer just a tap. Some like to be checked regularly with time notifications while others like to be checked at random intervals with no indication of time.

During the breath-hold:

- Always stand next to your buddy.
- Conduct a regular and agreed safety check on your buddy. At each check, your buddy must respond and indicate they are in control. They can do this by showing a visible hand signal such as the OK sign or by lifting an index finger.
- Confirm to your buddy that you have seen their signal either verbally or with another tap.
- Carefully monitor their body position and physical condition to ensure they do not black out.
- Keep them close to the pool edge at all times.

Towards the end of the breath-hold, your buddy holds on to the wall and places their feet on the pool floor, while keeping their face immersed in the water. When they are ready to finish their breath-hold, they slowly bring their head out of the water and start recovery breathing. Continue to supervise this activity and prompt them to take their recovery breaths. Make an assessment of the physical and mental condition of your buddy at this point.

DYNAMIC BUDDYING

During dynamic disciplines in the pool, as a buddy, swim above the freediver i.e. your buddy, to assess progress, monitor their condition and ensure they are not in any danger. To note, always use fins and a snorkel to ensure you conserve energy and are ready to assist at any time. As a buddy, practice 'sideways fin swimming' so your fins stay submerged during the whole finning cycle. In this way, you are able to easily stay head-to-head with a fast freediver. Your buddy swims close to the pool wall or a lane rope, so they can grasp it immediately after finishing their freedive. Should your buddy experience difficulty keeping their head above water after they surface, help them stay up.

DEPTH BUDDYING

In depth disciplines, agree with your buddy the estimated dive time of their next freedive and at what depth you will meet to return together to the surface. The meeting point should be at a minimum one third of the target depth of your buddy. Then roughly calculate how long it will take you to get to the agreed meeting point and so when to start your freedive. For example, your buddy estimates it will take one minute to complete a 30 meter (99 feet) freedive. You estimate it will take ten seconds to descend ten meters

(33 feet and one third of the target depth) and ten seconds to ascend to the surface. Therefore, you will begin your freedive at 40 seconds, meet your buddy at ten meters (33 feet) at 50 seconds and ascend to the surface together, completing the freedive in one minute.

During the freedive, meet your buddy at the agreed meeting point and accompany them up to the surface. Do this by swimming face-to-face, about one arm-length away from the dive line, keeping the line positioned between you. To note, pay special attention to the eyes of your buddy as they ascend. If their focus changes this is a strong warning sign.

9.3 Rescue Procedures

The following procedures should be followed step by step in the event that your buddy shows visible signs of a loss of motor control (LMC) or experiences a blackout. Remember to respond to your buddy as quickly as possible but without compromising the quality of assistance you provide.

Loss of motor control (LMC)

Your buddy may experience a loss of motor control after a freedive if their oxygen levels are too low. This is known as a hypoxic fit and they are often unaware that it is happening. A loss of motor control is sometimes known as a samba due to the jerky movements of the head, body and limbs.

Blackout

A blackout is a loss of consciousness due to insufficient levels of oxygen in your body. A loss of motor control may result in a blackout.

KEY SIGNS

In dynamic or depth disciplines, it is easy to see if your buddy is in trouble because their movement is affected. They stop moving and generally exhale some air so you see bubbles. In static disciplines, although your buddy is not swimming, there are still visible signs:

Signs of a LMC or blackout during a static breath-hold

The following signs can be identified during a static breath-hold:

- no OK signal from your buddy after a second, repeated tap
- sudden and strong exhalation of air
- unfocused eyes after surfacing
- convulsive muscle contractions after surfacing

Should your buddy experience a loss of motor control, bring their head out of the water, help your buddy to keep their airways above the surface and protect their head from hitting against the pool wall.

Signs of a LMC or blackout during a dynamic breath-hold

The following signs can be identified during a dynamic breath-hold:

- slowing down to a stop
- sudden acceleration and / or quicker arm strokes
- decline or loss of technique e.g. cycling
- loss of coordination
- sudden and strong exhalation of air

RESCUE PROCEDURE FOR LMC

In the event that your buddy experiences a loss of motor control, follow these key steps:

1. Prompt your buddy to breathe.
2. Support your buddy, keep their airways clear and protect their head from hitting any hard objects, such as a pool wall.
3. Remove all facial equipment such as mask, goggles, nose clip, and neck-weight and hood if needed.
4. Check for injury.
5. Once fully back in control, remind your buddy to stop freediving for the remainder of the day.
6. Assess why the loss of motor control occured, and understand how to prevent it from happening again.

RESCUE PROCEDURE FOR BLACKOUT

In the event that your buddy has a blackout follow these key steps:

Returning your buddy to the surface

If your buddy is still underwater, your main priority is to return them immediately to the surface:

- If your buddy has a blackout in the zone of negative or neutral buoyancy, consider removing their weight belt and/or removing your own, particularly if they are heavy and/or you are quite small or inexperienced.
- If the blackout occurs in the zone of positive buoyancy, keep weight belts on. Lift your unconscious buddy to the surface as quickly as possible.

Follow these key steps:

1. Approach your buddy from behind.
2. Reach with one hand **under** their arm to the front of your buddy.
3. With the same hand, a) close your buddy's mouth with the palm of your hand and b) secure their mask by putting two fingers on the glass. This helps to ensure that

their airways are closed. To note, a laryngospasm is a protective reflex activated by a blackout and is an involuntary closure of the voice box which prevents water from entering the lungs. In this rescue scenario, it may help to keep the airways of your buddy from flooding, however do not rely on it.

4. Place your other hand flat on your buddy's back and keep their head straight and aligned with their body. Do **not** tilt their head backwards.
5. Twist your entire body away from your buddy so that the outside of your hip is touching them. This allows you to move your fins freely. If you are rescuing someone who isn't significantly taller, you may also extend your arms straight up over your head instead of twisting your hips away from your buddy.
6. Start finning and bring your buddy to the surface as fast as possible. Aim to surface next to the float during your ascent.

Blow, Talk technique

Once you have reached the surface, follow these key steps which include the Blow, Talk technique.

1. Keep their face and airways out of the water. Drop their weights and yours if you haven't done so already.
2. Remove all facial equipment such as mask, goggles and nose clip.
3. **Blow** onto the area below their eyes to dry their skin. This causes the skin receptors to signal to their brain that they can resume normal breathing.
4. **Talk** to them by calling their name and asking them to breathe. Their unconscious mind is able to recognise their name being called and this can help bring them back. In the majority of cases, their body is waiting to be shown a signal that it is in a safe place where it can revive itself and begin breathing. The clearest signal is fresh air entering their lungs.
5. If they have not regained consciousness within 10-15 seconds, tilt their head backwards and provide rescue breaths.

Providing rescue breaths

An unconscious freediver very often resumes breathing and regains consciousness without the need for any rescue breaths. However, should they not regain consciousness, follow these steps:

1. Lift them onto the pool side. If you are in open water and / or too far away from shore or a boat, continue the procedure with step 2 below, with them floating face-up at the surface. Remember to keep their airways out of the water.
2. Open their airway and lift their chin by moving their lower jaw forward and tilting their head backwards.
3. Support their head with one hand, pinch their nose with the other, and cover their mouth with your mouth to form a seal.
4. Breathe into their mouth. Give up to five rescue breaths. They generally regain consciousness after a couple of rescue breaths. If you are in open water, keep providing rescue breaths while towing them to shore or to the boat.

5. Should they still not resume breathing, call emergency services for help and evacuate them to the nearest medical facility. If no pulse is present, initiate CPR.
6. If available, pure oxygen should be provided to accelerate recovery. The freediver should rest and stop freediving for the day.
7. Assess and understand why the blackout occured, and how to prevent it from happening again

We strongly advise freedivers to take a reputable CPR and First Aid course. This is also a mandatory requirement for Wave 3 / Lap 3 - Advanced Freediving.

POST BLACKOUT CARE

After regaining consciousness following a blackout, you are generally unable to recall what has happened and should be supported by your buddy until you are fully in control of both mind and body. You may suffer from fatigue, headache, vertigo, nausea, and body aches following a blackout. Full recovery generally takes one to two days. Do not freedive until this time has passed and until you are fully recovered.

Following a blackout:

- Stop freediving immediately for a minimum of 24 hours.
- Breathe pure oxygen if available, for 5-10 minutes. This lowers the oxygen debt as quickly as possible.
- Have a good rest to accelerate recovery.
- Drink plenty of water.
- Eat nourishing and nutritious foods.
- Before you freedive again, assess and understand the reasons for why your blackout occurred and what you can do to prevent it from happening again.

The key to safe freediving is learning to read the symptoms of increasing carbon dioxide in your body. As you progress in your training, you become more tolerant to increasing levels of carbon dioxide. However, you will still experience these symptoms and you will learn to judge when is the right time to end a breath-hold. Finally, please freedive conservatively to avoid repeated blackouts and any damage to your body which this may cause.

9.4 Summary

1. Safe freediving depends mainly on your responsible behavior.
2. Always undertake freediving with a qualified buddy.
3. Be attentive and assess the physical condition of your buddy. Inform them about the hypoxic or physical load caused by the freedive and if necessary, advise them against further freediving.
4. During static breath-hold, stand next to your buddy and carefully monitor their condition while keeping them close to the pool edge. Conduct regular safety checks. If your buddy loses control, they may not show an OK signal when tapped or asked repeatedly. They may also make a sudden, strong exhalation into the water or experience convulsive contractions in the neck and shoulders.
5. When your buddy undertakes a distance dive, swim sideways with fins and snorkel (without weights) above them and monitor their movement. Signs of a loss of motor control or blackout during a distance dive include slowing down to a stop, suddenly speeding up, loss of coordination, exhalation of air and convulsive muscle contractions.
6. If your buddy has blacked out, bring them to the surface immediately. Keep their face and airways out of the water. Remove facial equipment. Use the Blow, Talk technique. **Blow** onto their face and **Talk** to them by calling their name and by asking them to breathe. If they do not regain consciousness within 10 - 15 seconds, provide rescue breathes. Should they still not resume breathing, call emergency services for help and evacuate them to the nearest medical facility. If no pulse is present, initiate CPR.
7. We strongly advise freedivers to take a reputable CPR and First Aid course. This is also a mandatory requirement for Wave 3 / Lap 3 - Advanced Freediving.
8. Following a loss of motor control or blackout, do not freedive for at least 24 hours. Assess and understand why it occured and how to prevent it from happening again.

CHAPTER 10
EQUIPMENT

‘

Those who have never made breath-hold dives are usually very surprised when freedivers tell passionate stories about the freedives they have made on their journey to penetrate deeper and deeper into the water and to overcome personal fears and doubts. People wonder what attracts freedivers to deep blue water which can be almost completely black at depth. What drives them to set out on these challenging and unusual adventures? There is no single answer to this question. Each freediver has their own personal reasons.

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Natalia Molchanova

This chapter provides an overview of basic equipment used by freedivers, together with our recommendations on how to choose and maintain your equipment.

10.1 Basic Equipment

The following equipment is recommended for beginner freediving:

WETSUIT

Figure 11. Wetsuit

The thermal conductivity of water is eight hundred times higher than that of air. This means that the human body loses heat around 25 times faster in water than in air of the same temperature. To keep warm underwater, freedivers often wear neoprene wetsuits of varying thicknesses and surface types depending on the temperature of the water.

A wetsuit made with a **smooth skin** neoprene exterior combined with an inner lining of elastic Lycra is the best choice for a beginner freediver. Although this is not the warmest wetsuit available, the inner Lycra makes it easy to put on and take off without the need for lubricant.

A wetsuit made with an **open cell** interior lining provides good protection against the cold and when combined with a Lycra exterior, it is more durable. The open cell lining clings to your skin and a lubricant like shampoo may be needed to put it on. Alternatively it is easy to put this type of wetsuit on in the water. A wetsuit with a smooth skin neoprene exterior and an open cell interior lining provides the highest thermal protection, but is also more

fragile and difficult to put on and take off. This high quality and usually more expensive neoprene wetsuit helps a freediver to feel more streamlined and unrestricted underwater.

A freediving wetsuit should be snug but not too tight as this restricts normal breathing. When trying on a new wetsuit, take into account that it feels looser in the water than on dry land. To note, as you go deeper, the water pressure squeezes your suit, gradually making it thinner and reducing its thermal protection and buoyancy. Finally, consider the water temperature you generally freedive in as well as your tolerance to the cold.

Care and maintenance

Rinse your freediving suit in fresh water after every saltwater freedive, otherwise the build up of salt crystals can damage the neoprene. If fresh water is not available immediately after a freedive, pack your suit into a plastic bag to prevent it from drying. Finally, always dry your suit in the shade as direct sunlight and radiator or fire heat can damage the neoprene.

NEOPRENE SOCKS AND GLOVES

Figure 12. Neoprene socks and gloves

Neoprene socks and gloves are used for cold water freediving. An inner layer made of open cell neoprene provides better thermal protection, while a nylon outer layer ensures high durability. Tuck your socks under your suit legs and pull your gloves over your sleeves for maximum streamlining.

WEIGHT BELT

Figure 13. Weight belt

A weight belt compensates for the positive buoyancy of a freediving suit and helps you to pass through the zone of positive buoyancy on descent. The belt should be made of elastic rubber so you can wear it on your hip bones and therefore not restrict relaxation and breathing. The Marseille buckle is generally considered to be the most reliable buckle as it has a quick-release, allowing you to remove your weight belt easily in an emergency. Spring-loaded buckles are also widely used for freediving. Metal buckles are recommended as plastic ones tend to be weaker, less durable and can open suddenly without warning.

WEIGHTS

Figure 14. Weights

Freedivers generally use lead weights either on a rubber belt or as a neck weight. During descent, if weights are located on your hip, it is easier for you to take in a full breath. Neck weights are typically more streamlined. However, we recommend that you use a neck weight only once you are an experienced freediver as it can take some time to become accustomed to the feeling of having weight around your neck.

As a beginner freediver, always use rubber weight belts when freediving to depth. The weight carried should be adjusted according to your suit thickness, your body composition and the depth at which you wish to be neutrally buoyant. The weights should also be evenly spaced out on your belt. Some general rules for choosing weights for an average person:

In a 3mm wetsuit

3 kilograms (6.6 pounds) for freedives up to 20 meters (66 feet)
2 kilograms (4.4 pounds) for freedives up to 30 meters (99 feet).

In a 5mm wetsuit

5 kilograms (11 pounds) for freedives up to 20 meters (66 feet).
4 kilograms (8.8 pounds) for freedives up to 30 meters (99 feet).

Use these general recommendations to start your first session in a new environment and/or with new equipment. It is very important that you adjust your weights using the following procedure:

- A Surface Exhale Test. See Section 2.3 Weighting for Freediving.

MASK

Figure 15. Mask

A mask used for freediving should have a low internal volume and a soft skirt, as this helps to save air for equalization during a freedive. When selecting a mask, remember that it should fit your face perfectly. To try a mask: Look upwards, place the mask on your face without moving it and while keeping the strap in your hand. Check for a good fit. Then breathe in through your nose. If the mask sticks to your face, it is the right fit.

Other factors to consider when choosing a mask are the curvature of the lens and flexibility of the frame. A slightly curved lens improves peripheral vision but tends to distort the image seen. A flat lens gives a truer, though more restricted field of vision. A flexible frame facilitates equalization, while a more rigid frame requires more effort to equalize. The choice is your personal preference.

Prior to first use, read the manufacturer label carefully. If the mask has an anti-fog layer already, use the mask as it is. If not, wash the lens with shampoo or toothpaste to remove the oily film which protects the lens during production. This prevents mask fogging during your freedive. It is recommended that you wash your mask with shampoo or dish washing liquid every two weeks. To prevent fogging, right before use, it can also help to spit on the lens, rub all over and rinse.

SNORKEL

Figure 16. Snorkel

Freedivers use a snorkel when resting at the surface, when freediving for exploration or when supervising a buddy. Freedivers use simple snorkels. There is no need for valves or other features. If you plan to freedive along a reef, attach your snorkel to your mask at the back of your mask strap. If you are freediving to depth, again either attach your snorkel

to your mask or alternatively attach your snorkel to a buoy with rope so that you do not lose it. Prior to your freedive, you can drop it from your mouth or pass it to your buddy, and start your descent.

To note, never freedive with a snorkel in your mouth. In the event of a blackout, water rushes into your mouth through the snorkel and this can make a rescue extremely difficult

BIFINS

Figure 17. Short rubber fins

Short rubber fins are appropriate for developing technique, strength and stamina during pool training sessions. These fins also help you master the flutter kick. It is important to keep your legs straight for maximum transfer of power. Using stiff, long fins in the pool can be challenging if you are just starting to freedive because significant energy is expended trying to keep your legs straight and learning the correct technique.

Figure 18. Bifins

In open water training, use freediving bifins with long blades and soft foot pockets. Start with blades of soft stiffness so they do not tire you out as you begin your freediving learning. For freedives to depth, long fins made specifically for freediving are more efficient. The blades are generally made of plastic, fibreglass or carbon fibre. The choice of blade stiffness depends on your technical skill and body weight. Plastic fins are strong and durable while fins made of fibreglass and carbon have more flexibility and efficiency. Bifins with carbon blades are the most flexible and energy-efficient.

SAFETY LANYARD

Figure 19. Safety lanyard

A safety lanyard prevents you from getting lost in open water. One end of the lanyard is attached to a dive line and the other to you.

A safety lanyard is mandatory:

- if you plan to freedive deeper than 20 meters (66 feet)
- if the current is considerable
- when freediving beyond surface visibility

A safety lanyard should have the following features:

- strong enough to hold your weight
- metal parts are made of resistant marine stainless steel to prevent rusting
- shaped to glide snag free even along very thick rope
- a wide cuff with a quick release tab that opens easily in an emergency, for example when the lanyard becomes entangled at depth.
- the flexible part of the lanyard should be approximately one meter long and made of a non-twisting material to prevent it from tangling with the dive line, for example, stainless steel wire wrapped in plastic

To note, when freediving with fins, attach the safety lanyard to your wrist. During FIM (Free Immersion) when pulling on a line, attach it to your ankle. During a constant weight freedive without fins (CNF), it should be attached to a harness or alternatively to a belt around your waist. **Warning: Do not attach the lanyard to a simple weight belt.**

When you are not using your safety lanyard, avoid carrying it or attaching it to the float in an open loop. This can result in either you or your buddy getting tangled up in it, and is particularly dangerous if you are in an emergency situation or rescue. Instead, twist and loop your lanyard twice or more as shown overleaf.

Figure 20. Looped lanyard

In a competition environment, or for very deep freedives in general, a counter-ballast system is used. This system enables an unconscious freediver to be lifted quickly to the surface in an emergency. In this extreme emergency situation, the lanyard becomes a vital piece of safety equipment, as it is the only connection of the freediver at depth with the dive line and in turn the counter-ballast system.

10.2 Summary

1. The thermal conductivity of water is higher than that of air, which causes you to lose heat faster in water. To keep warm underwater, freedivers wear neoprene wetsuits of varying thicknesses and materials depending on the water temperature and their tolerance to the cold.

2. A freediving wetsuit should be snug but not too tight as this restricts normal breathing. Take into account that a wetsuit loosens in the water and the increasing water pressure squeezes your suit at depth, making it thinner and reducing its thermal protection and buoyancy.

3. A weight belt and weights compensate for the positive buoyancy of a freediving suit and help you to pass through the zone of positive buoyancy on descent. The weight belt should be made of elastic rubber and have a quick-release buckle for emergency

4. Freedivers usually use lead weights either on a rubber belt or as a neck weight. The amount of weight depends on your suit thickness, body composition, and the depth at which you wish to be neutrally buoyant.

5. Neoprene socks and gloves are used for cold water freediving. An inner layer made of open cell neoprene provides better thermal protection, while a nylon outer layer ensures high durability

6. A freediving mask should have a low internal volume and a soft skirt which saves air for equalization during a freedive. When selecting a mask, check that it fits your face perfectly and consider your preference regarding curvature of the lens and frame flexibility.

7. You should use a snorkel when resting at the surface, when freediving for exploration or when supervising your buddy.

8. Long bifins made specifically for freediving are more efficient. The blades are made out of plastic, fibreglass or carbon fibre. The choice of blade stiffness depends on your technical skill and body weight.

9. A safety lanyard prevents you from getting lost in the open water. One end of the lanyard is attached to a dive line and the other to you.

CHAPTER 11
BASE 1 TRAINING

‘

You should always enjoy the initial stages of training. Otherwise, what is the point of doing it?

’

Natalia Molchanova

This chapter explains the importance of training, introduces Club Molchanovs and summarises key aspects of the training and the 12 week cycle.

11.1 The Importance of Training

During Wave 1 / Lap 1, you learned the basic theories and principles of freediving. You also received practical training from your Molchanovs instructor in the pool (and additionally in open water for Wave 1) to begin freediving and to use basic freediving techniques. You may wonder what you can do next to continue freediving and further develop your skills.

True understanding and mastery of freediving requires focus, practice and training. Continue to practice what you have learned in Wave 1 / Lap 1 and you will begin to realize the benefits of freediving. Your physical condition will improve and with regular training, your technique will also improve and your body will become more accustomed to higher levels of carbon dioxide and lower levels of oxygen. Freediving is also fundamentally a discipline of the mind, so you will begin to develop a greater internal awareness, a deeper state of relaxation and a stronger focus.

11.2 Base 1 Training and Club Molchanovs

Molchanovs has created a global freediving training program with the aim of supporting and empowering local communities to train like the world's best freedivers. To help you master the skills and techniques you learned in Wave 1 / Lap 1, you can begin Base 1 Training. You will find Base 1 Training and Club Molchanovs at:

community.molchanovs.com

The core aims of Base 1 Training are to:

- Begin with the basics
- Build a strong foundation
- Solidify your technique and improve your ability

Follow Base 1 Training under guidance from your Molchanovs instructor or join one of our training groups in many locations all over the world. Ensure you prepare for each session with a full warm-up. To note, if you have a Lap certification, this only certifies you to freedive in a pool. It does **not** certify you to freedive to depth in open water. You can easily convert a Lap certification to the corresponding Wave certification at a later date by adding the open water sessions. Please ask your Molchanovs instructor if you would like to do this.

BASE 1 TRAINING OVERVIEW

Base 1 Training is organized into a 12 week cycle. A new cycle starts the first full week of

each calendar quarter i.e. the first full week of January, April, July and October. Base 1 Training has three components:

- Workout of the Week
- Benchmark Workouts
- Badges

Workout of the Week (WOW)

A WOW is a general freediving workout plan to improve physical conditioning, technique and skills, and adaptation. Every week, a WOW is available for Base 1 Training. You can adjust this training to a level which is appropriate for you. Freedivers around the world undertake the same training together and then stay connected with Club Molchanovs during their training to track progress, discuss training and share ideas and experiences.

To note:

- A WOW is not a replacement for guided training such as individual Wave or Lap training with a qualified Molchanovs instructor or as preparation for competition.
- A WOW should be undertaken with safety measures in place. Always train with other qualified freedivers who have received safety training.
- Safety must always be in place for all water-based training.
- If you have completed Lap 1, only undertake pool-based activities. Do not undertake open water activities.

Benchmark workouts

Benchmark workouts are universal. They are an important indicator of readiness for the next level and another way to compete and challenge yourself alongside the main disciplines. Workouts include activities such as Sweet 16s, 500 meter over/under and 50 meter Tortuga Races. For more information on Benchmark workouts, please ask your Molchanovs instructor.

Badges

Badges recognize key milestones in your freediving journey. A number of the badges are performance based, for example, the Benchmark Badges and the Complete Freediver Badges. Others are meaningful or fun challenges and accomplishments. Badges are awarded to community members by your Molchanovs instructor. Please view the list of badges here.

11.3 What next?

Practice and training will give you the time you need to master the skills you have learned in Wave 1 / Lap 1. Once they become second nature, you will be ready for Wave 2 / Lap 2 - Intermediate Freediving.

Your freediving journey is just beginning. Become part of Club Molchanovs and begin Base 1 Training!

CHAPTER 12
ROUND UP

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Freediving will give you many of the emotions you have been craving your entire life.

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Natalia Molchanova

This chapter concludes the Wave 1 / Lap 1 - Introduction to Freediving manual, summarises the main topics covered and provides information about questions and further learning.

12.1 Wave 1 / Lap 1 Completed Topics

This manual has covered the basic theories, principles and techniques of freediving, specifically:

- the laws of physics and how they affect you underwater
- the physiological changes which take place in your body during a breath-hold dive
- pre dive preparation, full breath and post dive breathing technique
- equalization techniques which you can use during a breath-hold dive
- mental techniques to relax and condition your mind before and during a freedive
- potential traumas common to a freediver
- safety measures and the buddy system
- rescue techniques
- basic equipment used for freediving

12.2 Questions and further learning

Should you have any questions about the information contained in this manual, please contact your Molchanovs instructor for further explanation. They can answer your queries and guide you through key learning points.

To note, it is very common at this stage to feel overloaded with new information and overwhelmed by a new experience. It is important to discuss any concerns you may have with your Molchanovs instructor. Through measured and regular practice at a pace suited to you, you will begin to develop your freediving skills and also understand the changes happening in your body.

Thank you for learning with Molchanovs!

GLOSSARY

Ambient pressure	Ambient or surrounding pressure is the sum of atmospheric pressure and water pressure. This is measured in atmospheres or bar.
Apnea	The cessation of respiratory airflow. In freediving this is a voluntary breath-hold during a freedive or with the face below the surface of the water.
Archimedes' Principle	Achimedes' Principle states that: 'An object immersed in a fluid experiences a buoyant force equal to the weight of the fluid it displaces.' Therefore, there are two forces acting on the object, its weight and the buoyant force equal to the weight of water it displaces.
Arrow position	A freediving position: arms extended and joined over your head.
Atmospheric pressure	The weight of atmospheric air measured in ATM or Bar. The atmosphere above you has a weight which is equivalent to approximately ten meters (33 feet) of water. Therefore 1 bar of atmospheric pressure at sea level.
ATM	A unit of pressure equivalent to the weight of the earth's atmosphere at sea level.
Bar	A unit of pressure equivalent to the weight of the earth's atmosphere at sea level. 1 Bar equals 1 ATM.
Barotrauma	The physical damage of body tissues which results from a difference in pressure between internal body cavities and the external environment
Belly breathing	Also known as abdominal breathing. A breathing technique used for relaxation. Belly breathing involves inhaling by moving the upper part of the abdomen forward which lowers the diaphragm. This brings air into the abdomen and expands the belly.
Bifins	Fins specifically designed for freediving with long blades and soft pockets
Blackout	A blackout is a loss of consciousness due to insufficient levels of oxygen in the body. A loss of motor control may result in a blackout.
Blood shift	Blood flow to your extremities is redistributed to your head and chest during a freedive.

Blow, Talk	To be used in the event of a blackout. Blow onto the area below the eyes of the victim to dry their skin. Talk to the victim by calling their name and asking them to breathe.
Body scan	A relaxation technique you can use to prepare for a freedive to bring about an inner calm and peace of mind. It involves bringing awareness to different parts of the body in turn, finding any tension and releasing this tension before moving to the next part.
Boyle's Law	Boyle's Law explains how the volume of a gas within an enclosed air space varies with the surrounding pressure. It states: 'At a fixed temperature, the volume of a gas is inversely proportional to the pressure exerted by the gas.' Therefore, as the pressure increases, the volume of the gas decreases proportionately.
Buddy	Your training partner or safety diver, who looks after and supervises you before, during and after your freedive.
Buoyancy	The tendency of an object to float in water due to the upward force of the water pushing up.
Buoyant force	The buoyant force on an object immersed in a fluid is equal to the weight of the fluid it displaces. If the weight is equal to or less than the buoyant force, the object will float. If the weight is greater, it will sink.
Carbon Dioxide (CO_2)	A colourless, odourless gas produced by burning carbon and organic compounds and by respiration. Carbon dioxide consists of a carbon atom bonded to two oxygen atoms. Also written as CO_2.
Cellular respiration	The process used by our cells to make energy available for activity. Oxygen molecules break down glucose molecules in our cells to produce energy in the form of ATP which is used by our body to power all functions. A by product of this process is Carbon Dioxide.
Chest breath / breathing	An inhalation from the intercostal muscles only.
Constant No Fins (CNF)	A freedive to depth, with the same weight for descent and ascent. No fins.
Constant Weight (CWT)	A freedive to depth, with the same weight for descent and ascent and using bi-fins or a monofin. Any technique.
Constant Weight Bifins (CWTB)	A freedive to depth, with the same weight for descent and ascent using bi-fins. No dolphin kick.
Contraction	A involuntary spasm in your respiratory muscles caused by an elevated level of carbon dioxide in your body and the rising urge to breathe.
Cyanosis	A bluish discolouration of the skin or mucous membranes due to a low level of oxygen in the tissues near the skin surface.

Diaphragmatic breathing	Breathing from your abdomen. Also known as 'belly breathing' or 'abdominal breathing'.
Decompression Illness	Caused by inadequate decompression following exposure to increased pressure. Rapid changes of pressure result in nitrogen bubbles building up in your body tissues and causing localised damage.
Duck dive	A technique used to dive nose-first under the water at the start of a freedive.
Dynamic with Fins (DYN)	A horizontal swim underwater, with bi-fins or a monofin.
Dynamic No Fins (DNF)	A horizontal swim underwater, no fins.
Epiglottis	A flap of cartilage located at the top of your larynx near the base of your tongue which protects your glottis and prevents food from entering your larynx.
EQ Trainer	Also known as the Molchanovs Equalization Training Tool. The EQ Trainer is a balloon attached to a nose-piece which can be used for equalization exercises to improve Frenzel technique.
Equalization	The equalization of pressure between your body cavities and the surrounding environment as you freedive to depth. There are three main air spaces to equalize: your ears, more specifically your middle ear, your sinuses and your mask. There are a number of techniques which can be used to equalize the pressure in your air spaces, including Frenzel and Valsalva maneuvers.
Eustachian tube	A canal which connects your middle ear cavity to the upper part of your throat and back of your nasal cavity. The pressure within your middle ear is managed by your Eustachian tube to ensure it is equal to the air pressure outside your body.
Free fall	As negative buoyancy increases with depth during a freedive, a point is reached where gravity overcomes the buoyancy of your body and you enter a state called free fall. When this happens, you can stop finning and allow yourself to fall effortlessly.
Free Immersion (FIM)	A freedive to depth by pulling down and then back up a dive line, with same weight for descent and ascent. No fins.
Frenzel equalization	Pushing with your tongue or cheek muscles against your pinched nostrils to create air pressure. Also known as the Frenzel maneuver.
Glottis	A group of muscles located around your vocal folds and the slit-like opening between them.
Gluteal muscles	Also known as the gluts. The gluteal muscles are a group of three muscles located in your buttocks: gluteus maximus, gluteus medius and gluteus minimus.

Hip flexors	A number of muscles in your hip which allow you to move your legs and body together and apart, for example to move your leg or knee up and towards your body, or to bend your body forwards.
Hypercapnia	Hypercapnia is caused by an elevated (more than normal) level of carbon dioxide in your blood.
Hyperoxia	Hyperoxia is caused by an excess supply of oxygen to your body tissues or higher than normal partial pressure of oxygen.
Hyperventilation	Hyperventilation is defined by breathing more air in and out than your body needs. Symptoms of hyperventilation include light-headedness and dizziness, tingling in the fingers or other parts of the body, euphoria and an increased heart rate.
Hypoxia	An insufficient supply of oxygen to the body tissues.
Hypoxic Fit	A loss of motor control of the body characterised by jerky movements of the head, body and limb. Also referred to as a 'samba.' A hypoxic fit happens at the surface after a freedive or breath hold. It can be followed by full recovery or a blackout.
Larynx	The larynx controls the flow of air and is also known as your voice box.
Loss of motor control (LMC)	A late warning sign that can precede a blackout. Involuntary contractions generally develop in the neck, shoulders, arms, and occasionally in the leg muscles. A loss of motor control can happen following a freedive if your oxygen levels are too low. Also known as a hypoxic fit, you are often unaware that it is happening. A loss of motor control is sometime known as a 'samba' due to the jerky movements of the head, body and limbs.
Lung squeeze	Damage or injury to your lungs due to increased ambient pressure on the enclosed air spaces of your lungs during a freedive. Also known as lung or Pulmonary barotrauma (PBT).
Mammalian Dive Reflex (MDR)	The bodily changes that happen during a freedive or freedive session, which allow your body to function more efficiently under new conditions. They generally disappear when you resume breathing.
Mask	A freediving mask has a low internal volume and a soft skirt to save air for equalization.
Middle ear	The part of the ear between your eardrum and the oval window to your inner ear. The middle ear is also known as the tympanic cavity.
Mindful breathing	This technique involves bringing your awareness and focus to your breath, using the inhale and exhale to achieve deep relaxation.

Mindfulness	Mindfulness is a meditation discipline with its roots in Buddhist tradition. It is a moment-by moment awareness of your body, your mind and the surrounding environment. It is acceptance of your thoughts without judging whether they are right or wrong. It is active focus on the here and now.
Molchanovs Equalization Training Tool	Also known as the EQ Trainer, the tool is a balloon attached to a nose-piece which can be used for equalization exercises to improve Frenzel technique.
Monofin	A single fin for both feet used primarily for freediving.
Nasopharynx	The upper part of your throat which connects with your nasal cavity above the soft palate.
Neoprene socks / gloves	Used for cold water freediving and made of open cell neoprene to provide better thermal protection.
No Limits (NLT)	A freedive to depth using weight. Ascending to the surface using a lift-bag or other buoyancy device.
Oxygen (O_2)	A colourless and odourless gas. Oxygen consists of two atoms of oxygen in every molecule. Written as O_2.
Oxygen debt	A cumulative deficit of oxygen resulting from intense exercise. This deficit should be balanced once the body is resting.
Paranasal barotrauma	Also known as sinus squeeze. An injury of the mucus membranes in your sinuses.
Partial pressure	The partial pressure of a gas is defined as: The total pressure multiplied by the fraction of the gas in the mix. For example, the partial pressure of oxygen at the surface is 1 bar x 0.21 = 0.21 bar.
Post-dive breathing	Also known as recovery breaths. Post-dive breathing consists of active inhalations and long exhalations against light resistance. The main goal of post-dive breathing or recovery breathing is the elimination of oxygen debt and fast recovery after a breath-hold.
Pre-dive breathing	Also known as breathe-up or relaxation phase. The focus on the rhythm of your breathing and the movement of your abdomen to prepare for a breath-hold. The aim of pre-dive breathing is to maximize psychological relaxation.
Quadriceps muscles	Also known as your quads. A group of four muscles located at the front of your thighs.
Recovery breaths / breathing	Also known as post-dive breathing. Recovery breathing consists of active inhalations and long exhalations against light resistance. The main goal of post-dive breathing or recovery breathing is the elimination of oxygen debt and fast recovery after a breath-hold.
Residual volume (RV)	The volume of air in the lungs after a maximum exhalation, approximately 20% of the Total Lung Capacity (TLC) for the average person.

Rescue breaths	Artificial respiration.
Reverse block	A reverse block can develop during ascent. In this instance, air in the middle ear is blocked by a closed Eustachian tube, for example, if plugged by mucus. The trapped air expands on ascent causing pressure and pain in the ears.
Ruptured eardrum	Classed as a severe ear barotrauma, a ruptured eardrum can give rise to the following symptoms: vertigo, nausea, vomiting, hearing impairment and pain.
Safety lanyard	A safety lanyard prevents you from getting lost in the open water. One end of the lanyard is attached to a dive line and the other to you.
Samba	Also know as a loss of motor control, a samba can happen following a freedive if your oxygen levels are too low. It is characterised by jerky movements of the head, body and limbs.
Shallow Water Blackout (SWB)	A blackout which can occur due to a lack of oxygen in the brain caused by rapid pressure changes on ascent from a freedive.
Sinuses	Four paired air-filled spaces that surround your nasal cavity. Your frontal sinuses are above your eyes, your maxillary sinuses are located under your eyes, your sphenoidal sinuses are behind your eyes and your ethmoidal sinuses are between your eyes.
Sinus squeeze	Also known as paranasal barotrauma. An injury of the mucus membranes in your sinuses.
Snorkel	Used by freedivers when resting at the surface. Freedivers use simple snorkels without valves.
Soft palate	The soft palate separates your nose and mouth cavities and directs the flow of air in and out of your lungs.
Static (STA)	A breath-hold whilst lying face down and stationary on the surface of the water.
Surface Exhale Test	A safety check at the surface prior to a freedive to ensure you are not overweighted. You should remain at the surface after a comfortable deep exhale.
Surface interval	The required minimum time spent at the surface between two freedives to minimize the risk of Decompression Illness.
Tongue position or lock	There are four different Frenzel tongue positions to enable equalization: the P, T, K and H positions. These are also known as locks.
Total Lung Capacity (TLC)	The total amount of air in our lungs after a maximum inhale.
Valsalva equalization	Exhaling against pinched nostrils and using the air in your lungs to create pressure. Also known as the Valsalva Maneuver.

Variable Weight (VWT)	A freedive to depth using weight. Leaving the weight at the bottom and ascending either by finning and/or by pulling back up a dive line.
Vertigo	Vertigo is a sensation of feeling disorientated or off balance. You may have a false illusion that the world is spinning or swaying around you.
Visualization	A simple mental technique which you can begin to use prior to a freedive. This involves imagining each step of freedive you are about to perform in great detail.
Vocal folds	Also known as vocal cords. Comprised of two folds of mucous membrane lying horizontally across your larynx.
Water pressure	The weight of the water column above the body. Increases by 1 bar every 10 meters (33 feet) of depth. Also known as Hydrostatic Pressure.
Weight belt	A rubber belt worn around the waist, to which lead weights are attached. Used to compensate the positive buyoancy of a wetsuit and to aid descent.
Weights	Lead weights worn either on a rubber belt around the waist or as a neck weight.
Wetsuit	Used by freedivers to keep warm underwater. Freediving wetsuits are available in various materials and thicknesses, and are chosen according to the temperature of the water.

TABLES AND ILLUSTRATIONS

TABLES

ILLUSTRATIONS

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