APNEA **SURVIVAL**

SURF APNEA – FACE TO FACE COURSE

STUDENT NOTES

Safety considerations when breath holding

1. The buddy system

When training in water always train with a competent buddy and always use a pre rehearsed buddy system that both you and your buddy are familiar with. The buddy system is a safety system that requires a person to remain above the water and / or have the breath holder under direct observation throughout the entire breath hold. The job of the buddy is to monitor the breath holder's behaviour and respond to any circumstances that may place the breath holder in danger.

Safety points to consider when training in water:

1. Never train in water alone.
2. Always training with a competent buddy and use a buddy system
3. Training buddies must both know each other's limits and abilities, practice rescue procedures such as black out, LMC and recovering a breath holder to the surface from the bottom of the pool and what to do at the surface and how to manage an emergency response.
4. Keep all training intensity to a maximum of 70% of your maximum perceived rate of exertion.
5. Use only clear and untinted, non-fogging goggles or masks that always provides
6. unobstructed observation of the breath holder's eyes.
7. Due to the very fast onset of hypoxia associated with exhale breath holds do not perform any exhale breath holds in water-based environments (these are best performed using land-based drills).
8. Plan every breath hold / training session (plan the breath hold and stick to the plan when breath holding).
9. Breath holder and buddy must discuss the particulars of the training / session plan prior to any breath holds being conducted. For example. Types of and times for safety checks and how various signals ('OK' / Not OK) will be communicated.
10. The buddy should remain at the surface or in a position that allows them to have direct observation of the breath holder during the breath hold and be prepared to render immediate assistance if required.
11. The buddy must maintain observation of the breath holder during the entire breath hold and during the recovery periods.
12. During long dynamic swims consider following your breath holder using a snorkel and swimming above them or use an outside lane and walk up and down the pool with the swimmer. This enables direct observation and an immediate response.
13. Watch for signs of loss of consciousness and loss of motor control (LCM). E.g. bubbles - sudden air loss, change in stroke rate, sinking etc. Increases in stroke speed or changes in swimming technique during dynamic efforts may be an indicator of increases in stress due and hypoxia. *Note - If any of following are observed: tremors, loss of motor control, loss of consciousness, sudden air loss (including trickling bubbles or air), and /or failure to react or respond to signals make immediate physical contact with the breath holder, terminate the breath hold and assist them to the surface.* Failure of the breath holder to react or respond to signals during static holds may indicate the breath holder has become hypoxic, disorientated, or switched off their consciousness. If two consecutive OK requests have failed to solicit a response from the breath holder terminate the breath hold immediately.
14. If black out or loss of motor control occur withdraw the person from training immediately and have them seek medical attention from a medical practitioner who is trained to conduct diving assessments before returning to training.

A few notes on the buddy system. The following article was written by Julien Borde – a professional AIDA freediving instructor and the owner of Pranayama Freediving and Yoga in Playa del Carmen, Mexico. Although it references freediving it is very pertinent to any form of water-based breath hold training.

"As in scuba diving the buddy system is very important in freediving. It is a diver's main method of ensuring safety on dives. The buddy system not only reduces the risks of freediving but increases a diver's comfort and enables one diver to control the buoy while the other is underwater. Here are three reasons why using the buddy system is important. One of the most important pieces of advice for freedivers is to never freedive alone!

The buddy system only increases diver safety if the buddy knows what to do in the case of an emergency. Here are several safety considerations for a freediving buddy. A freediving buddy should be a certified freediver with enough basic safety knowledge to assist the diver efficiently in an emergency. The freediving buddy should supervise every dive that their companion makes.

A freediving buddy should be familiar with and adept at all the rescue techniques. This requires that the buddy not only be certified but that the buddy team practices the rescue skills periodically. Practicing rescue skills during a freediving session only takes a few minutes but makes a rescue exponentially more efficient in the unlikely event of an emergency. Monitoring a diver for problems does not stop when the team reaches the surface. In fact, most losses of motor control (LMC) and black outs will happen at the surface. The buddy needs to keep constant eye contact on the diver until he is sure that the freediver has caught his breath properly and is able to communicate that he feels well.

Communication between buddies is also an important aspect of safety. A diver should communicate his dive plan and dive time. Communicating the dive plan allows the buddy to know what to expect of the diver. It is also a good idea to decide on an emergency signal with your buddy so that he knows when you want him to help you swim back to the surface. Communication is equally important on static and dynamic apnea dives, even if the buddy stays at the surface. A buddy will be much more efficient if they know what to expect.

Comfort - A training buddy makes the preparation and execution of a breath hold as smooth as possible. A buddy can oversee timing during the preparation of a breath hold and can also track times etc. A good freediving buddy can also make sure that everything stays quiet and calm around the dive site so that the freediver can concentrate. He can ensure that there are no scuba divers hanging on the freediving line and no people jumping around or yelling close to the diver.

During static dives the buddy can assume a coaching role. At the end of a static dive, everything becomes complicated for the diver, so the buddy can talk to the diver to help him to relax and handle more contractions to extend the length of his dive. The take-home message about the buddy system and freediving. Never dive alone!"

Blackout

2. Shallow Water Black Out (SWBO)

Although SWBO has become a generic term for people blacking out anywhere in the water column during a variety of circumstances, its more correctly defined as, a loss of consciousness caused by cerebral hypoxia towards the end of a breath hold in water typically shallower than five meters deep. SWBO only occurs where all phases of the breath hold have taken place in shallow water (5 meters depth or less). Nor is depressurisation a factor with SWBO and the event typically involves static or dynamic apnea distance breath holders (usually in a swimming pool).

A primary mechanism for SWBO is hypocapnia followed by cerebral hypoxia (reduced CO2 in the blood and reduced O2 in the brain). Hypocapnia can cause significant delays with experiencing any feelings of air hunger (needing to breathe) and is often brought about by hyperventilation prior to the breath hold. During any black out event, the breath holder may not necessarily experience a need to breathe and may have no other obvious condition as a trigger preceding the actual black out.

Many blackouts underwater have been associated with the practice of hyperventilation. Survivors of shallow water blackout often report using hyperventilation techniques to increase their bottom time. Hyperventilation is sometimes used in the mistaken belief it will increase oxygen (O2) saturation and make the breath hold more relaxing. Under normal circumstances the breathing rate dictated by the body alone already leads to 98-99% O2 saturation of the arterial blood and the effect of over-breathing on the oxygen intake is very minor.

Blacking out in water results in drowning unless the breath holder is rescue immediately. Blacking or greying out near the end of a limit pushing breath hold is not uncommon during competition. However. Should be avoided completely during training or at a recreational level. The most current thinking on the topic has identified blacking out especially underwater is not as benign as once thought. It results in a lingering Central Nervous System trauma which can predispose the breath holder to greater risk of future black out events, create performance barriers and training setbacks. This is due to a phenomenon known as *fear perceptive memory*, whereby the body attempts to prevent the traumatised person from revisiting the place (mentally or physically) where the original injury occurred.

3. Surface blackout

Surface blackout occurs when a breath holder with low levels of circulating O2 has surfaced from a challenging breath hold and has started breathing. The breath holder can black out before any inhaled O2 has time to circulate and reach the brain (up to 30 seconds). This process can be exacerbated by the reduction in internal lung pressure (Eg. exhaling forcefully upon surfacing) resulting in a reduction in partial pressure of O2 in the lungs and loss of diffusion which can cause a drop in cerebral O2 saturation and thus blackout.

4. Avoiding a black out

Black Out can be avoided by ensuring that carbon dioxide levels in the body are maintained prior to a breath hold and that appropriate safety measures are in place. This can be achieved by the following:

1. Taking time prior to the breath hold to relax and allow blood O2 and CO2 levels to reach their natural equilibrium.
2. Prior to the breath hold use your normal relaxed breathing rate and depth and allow your body to dictate the rate of breathing to ensure CO2 levels are properly calibrated.
3. If excited or anxious about a breath hold spend additional time calming and relaxing.
4. Use relaxation techniques to extend your relaxation time which will extend your

breath hold time.
5. Develop your breath hold abilities gradually and progressively.
6. Get yourself and your b=training buddy formerly trained (certified) in the techniques you are using.
7. Never train alone. Always train with a competent buddy.
8. Always have one person observing from the surface whilst the other is diving.
9. Never push limits beyond 7/10.

5. Response to shallow or deep-water blackout.

1. Recovery the breath holder to the surface.
2. Roll the diver face up using the push pull method (Closest hand pushes down on closest shoulder. Other hand reaches across diver and pulls furthest away shoulder toward rescuer. The breath holder will roll toward the rescuer and be rotated onto their back.
3. Keep the diver afloat face up by supporting them with a knee into their glutes or swimming with them to keep them afloat.
4. Remove the breath holder's mask / goggles (exposing fascial sensors and airways).
5. Repeatedly call the breath holders name and instruct them to breathe. Eg, "Breathe - *Name of breath holder* - breathe!"
6. Simultaneously blow air across their cheeks (this helps stimulate breathing).
7. If the diver does respond and regains consciousness help the diver exit the water. Give O2 therapy if available, maintain continuous observation and seek medical assistance.
8. If the diver does not respond within 45 seconds begin rescue breaths and rescue procedures as per whatever CPR training you have received.
9. Call out for / seek assistance.
10. Remove breath holder from the water ASAP.
11. If breath holder is not breathing once removed from water commence CPR immediately, send for help and call emergency medical services (as per whatever CPR training you have received).
12. NOTE: Be aware of the "Laryngospasm" – This is when the epiglottis locks shut and seals off the throat to prevent water inflow to lower airways and lungs. The release of this spasm is triggered by rising levels of CO2 and may take 45-60 seconds at the surface to occur. The breath holder cannot breathe until the spasm has relaxed.
13. The breath holder should not train again until cleared by a medical practitioner qualified in diving examinations (a four-week period before returning to breath holding is the general rule following any loss of consciousness).
14. Practice and be prepared to respond to medical emergencies and undertake training in First Aid, CPR / Advanced resuscitation / O2 provider
15. Ensure you or your training venue has functioning emergency life support equipment such as Oxygen, AED (defibrillator), etc. Know where it is located prior to training at the facility.

NOTE: <u>ALWAYS</u> seek medical advice following any black out event. Drowning can occur hours after the event if water has entered the lungs.

6. Laryngospasm

Laryngospasm refers to a sudden spasm of the vocal chords. The spasm can be a symptom of underlying conditions including anxiety, stress or the *entry of water into the larynx or trachea* (windpipe). In an aquatic environment laryngospasm can occur when a person is negotiating waves or turbulent waters like rapids. It typically happens when a person breaks the surface and attempts to take a breath at the same time water unexpectedly enters the upper airway (trachea or larynx). At this moment an involuntary reaction occurs during which the vocal cords close rapidly in an effort seal off the windpipe and prevent any ingress of water to the lungs.

When experiencing a laryngospasm people report feelings of choking and an inability to breath. The spasm can occur in both conscious and unconscious people and is not uncommon in submerged blackout victims. Although quite a stressful (when experienced conscious) the spasms generally last only 5-10 seconds. Laryngospasm can be treated by holding your breath for around 10 seconds allowing CO_2 levels to rise. The subsequent rise in CO_2 is one of the things that can trigger the release of the spasm. To recover from the spasm, breathe in and out slowly through your nose keeping the mouth closed or if too challenging inhale through the nose and gently exhale through pursed lips.

7. Loss of motor control (LMC) / Samba

Loss of motor control (LMC) AKA Samba is a series of muscle twitches caused by low O_2 levels in the body. LMC can be a minor tremble and brief event or violent convulsions progressing to unconsciousness.

Indicators of LMC include:

1. Trembling
2. Convulsions
3. Confusion
4. Difficulty breathing
5. Lack of responsiveness,
6. Loss of bladder control and
7. Cyanosis (blue lips).
8. Saucepan eyes

Avoid LMC in training by extending breath hold times gradually and never beyond 70% of your maximum ability. Do not push limits prematurely. It takes time for your body to adjust and adapt.

9. Response to loss of motor control (LMC)

1. Hold the head / face / airways of a breath holder clear of the water.
2. Remove mask / goggles.
3. Keep the Breath holder's airway clear.
4. Talk to the breath holder in a clear assertive voice, 'Breathe……. Breathe ….. Breathe…, etc' as you would during a black out.
5. Provide a visual cue by clearly demonstrating how you wish them to breath.
6. Look into their eyes acknowledge them and direct them to follow your breathing. Like me… Breathe like me….do this inhale… exhale….
7. Encourage big inhales with short, relaxed exhales (aids diffusion).
8. Provide verbal and visual reassurance.
9. After recovery the diver should discontinue diving and seek medical attention as per blackout aftercare.

Breathing.

Why do we breathe.

- Humans are aerobic beings. They rely on aerobic respiration to survive.
- Oxygen (O2) is required for aerobic respiration (production of energy).
- Metabolic by-products such as Carbon (C) in the form of carbon dioxide – CO2 need to be removed from the body.

Respiration is the movement of gas across a membrane.

Our Breathing impacts everything about us

Breathing is the ventilation of air in and out of the body. Breathing has other functions apart from solely supporting aerobic respiration.

The manner in which we breathe impacts every function in our body. EG.

- Gas levels eg O2 and CO2 levels in the body.
- Nitric Oxide (NO) production in nasal cavity.
- Motor control and postural stability
- Emotions
- Heart Rate
- Heart Rate Variability (HRV)
- Vagal toning (vagus nerve function)
- Autonomic nervous system (Parasympathetic and Sympathetic regulation)
- Circulatory system
- Digestive system / Enteric nervous system

The way we breathe affects the function of all other systems in our body. Including how well we prepare for and recover from a breath hold. If your breathing is crappy your performance is going to be the same.

Recurring Feedback Loop

(The mind / body / breath connection)

The *recurring feedback loop (RFL)* is a circular repeating cycle of communication between the Mind, Body and Breath. Each can affect the other and each can be manipulated involuntarily or voluntarily. Being aware of the involuntary reactions of the RFL can enable us to regain control through voluntary manipulation of any of the three components. IE if you notice your breathing has changed (E.G. short fast chest breathing) you can adjust your movement by slowing it or thinking using self-talk for example to bring it back under control.

Psychophysiology

This is the first drill we did on the course to demonstrate how powerful breathing is and how easy it is to impact our psychophysiology simply by changing the way we breathe.

The drill consists of 1 minute voluntary hyperventilation (superventilation) followed immediately by 1 minute nasal only breathing and is performed as follows.

The psychophysiology drill.

1. Lay flat on your back on the floor or sit relaxed and comfortable.
2. Breathe only through the nose using your natural breath cadence to relax.
3. Continue for 2 minutes
4. After 2 minutes.
5. Purse your lips and inhale with as much force and as hard as you can. Followed by an exhale in the same manner. Breath rate should be as fast as possible around 1 breath cycle (inhale + exhale) per second.
6. Continue for 1 minute focussing on what sensations you are feeling and what emotions you are experiencing.
7. After 1 minutes. Return to a naturally paced nasal only breathing. Breath in and out softly and quietly and in a calm, controlled manner through the nose only. Close your eyes if you feel like closing them. Pay attention to what sensations you are feeling and what emotions you are experiencing and how this differed from the previous superventilation.
8. Continue for 1 minute.
9. After 1 minute take a couple of natural breaths have a stretch and get up and move around.

WARNING: If you feel any dizziness, pain or severe tingling or disorientation during any of the exercises or drills in this course. Cease immediately. Sit or lay on your side in a comfortable position and allowing yourself return to your natural relaxed breathing rate and pace.

What happens during superventilation.

Superventilation is controlled hyperventilation refers to breathing (ventilation) which exceeds our metabolic demand. The superventilation you will perform may have result in you experiencing any or a combination of the following classic symptoms associated with hyperventilation:

- Dizziness
- Light headedness
- Physical weakness
- Shortness of breath
- Unsteadiness / loss of balance
- Muscle spasms / cramps (extremities)
- Tingling sensations (mouth and fingertips)
- Increased heart rate
- Feeling confused
- Feeling anxious
- Feeling stressed
- Feelings of depersonalisation (non-reality / dream-like)
- Loss of focus and concentration
- Impaired memory
- Hallucinations
- Blurred vision
- Tunnel vision
- Flashing lights
- Seeing multiple
- Saw ribs and breathing anatomy
- Changes in blood pressure
- Wheezing (Bronchi constrict to restrict loss of CO_2 – sports asthma)

Hyperventilation creates a rapid lowering of CO_2 levels in our blood which causes a narrowing of the blood vessels (vasoconstriction) that supply blood to the brain and tightens the bond between haemoglobin and O_2. Reducing its availability at a cellular level.

What happens during nasal breathing.

When nasal breathing we may have experienced any or all the following:

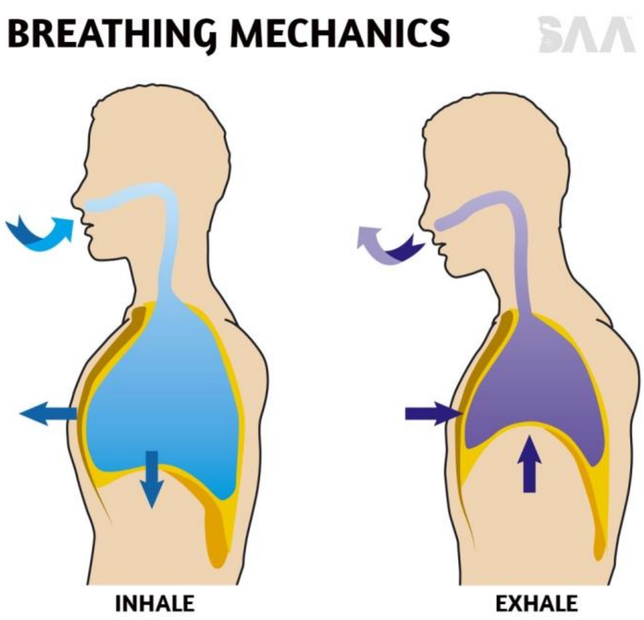
- Effortless breathing

- Reduced breathing cadence (your breathing slowed down)
- Longer inhale
- Longer exhale
- Feeling of calm
- Feeling of relaxation
- Closing of your eyes
- Light abdominal centric breathing
- Increased self - awareness
- Increased self-control
- Improved mental clarity
- Improved vision
- Improved hearing
- Improved focus
- Slowed heart rate

Slow controlled nasal breathing sends a signal to our body's systems that we are in control and that everything is OK. This messaging activates greater parasympathetic (rest and recovery) toning and down regulates the sympathetic nervous (fight or flight) system rebalancing autonomic homeostasis. Practising slow nasal breathing regularly produces significant improvements in our physical, cognitive, mental health and overall well-being.

NOTE: In aquatic environments and when recovering from and preparing for long or intense breath holds it is more appropriate to used controlled mouth breathing (as per the Full Lung breathing exercise we will perform in later lessons).

Breathing Mechanics.

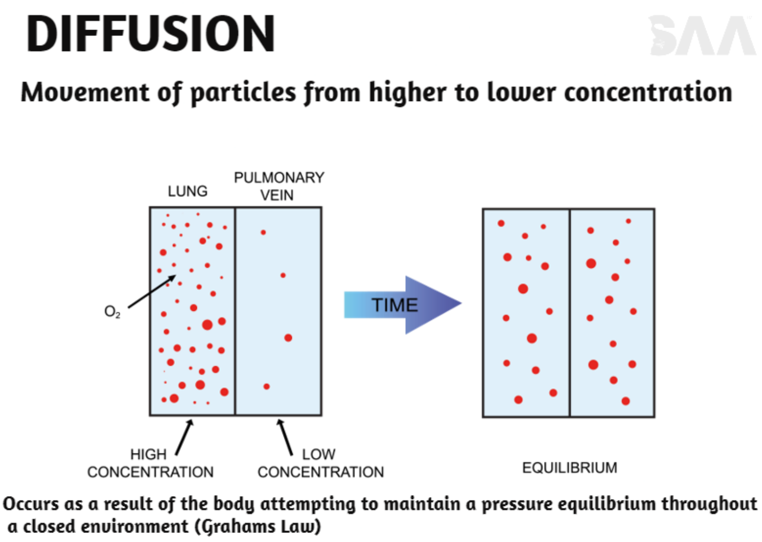


The diaphragm is a thin muscle that sits at the base of the chest and separates it from the abdomen. When you inhale your diaphragm contracts and pulls downward increasing the space (volume) in and around your lungs allowing them to expand. The muscles between your ribs (intercostals) also play a significant role to enlarge the chest cavity. They work to pull your rib cage upward and outward when you inhale again increasing the space in which the lungs can expand. As the diaphragm contracts and the thoracic cavity space increases the pressure inside the lungs is reduced to the point where it is less than atmospheric pressure outside of your body. This creates vacuum effect which draws air into the lungs (area of lower pressure) via the airways from outside the body (area of higher pressure).

When you exhale your diaphragm relaxes upward reducing the space in and around the lungs decreasing the lung volume. The intercostals also assist by contracting the rib cage. This process increases the internal pressure of the lungs to a point where it is greater than the air pressure outside the body and causes air to move out of the lungs via the mouth or nose to the surrounding atmosphere of less pressure.

Gas exchange in the human body.

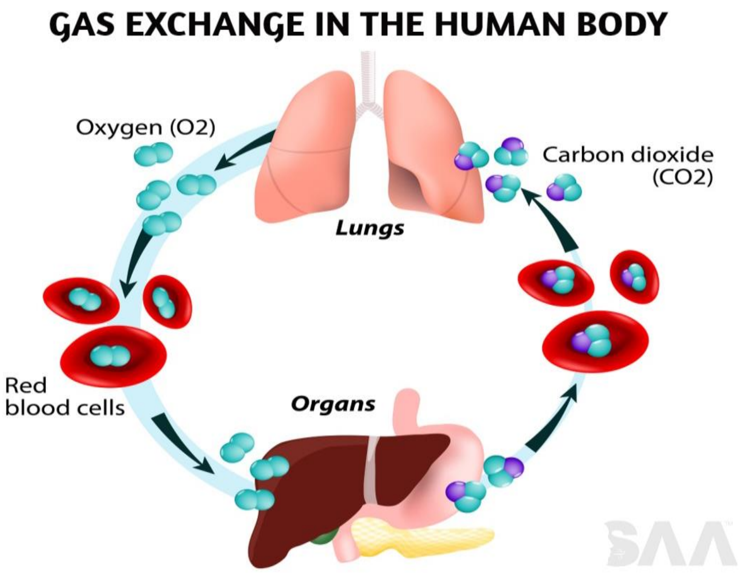
Diffusion



Diffusion is the process by which gases are transferred from the air we inhale via the lungs into the circulatory system for transportation to tissues and organs. Diffusion occurs as a result of a gas attempting to maintain a pressure equilibrium throughout a closed environment (Grahams Law).

The higher the pressure exerted upon a gas the greater ability of that gas to diffuse. In a closed system pressure and temperature are directly related in that the higher the temperature of the closed space the greater the pressure and the more easily a gas will diffuse and vice versa. This is caused by the gas contained in that space "wanting" to maintain an equal pressure across all permeable portions of the system in which it exists.

Diffusion is the process that allows gases like O2 and CO2 to move in and out of the body.

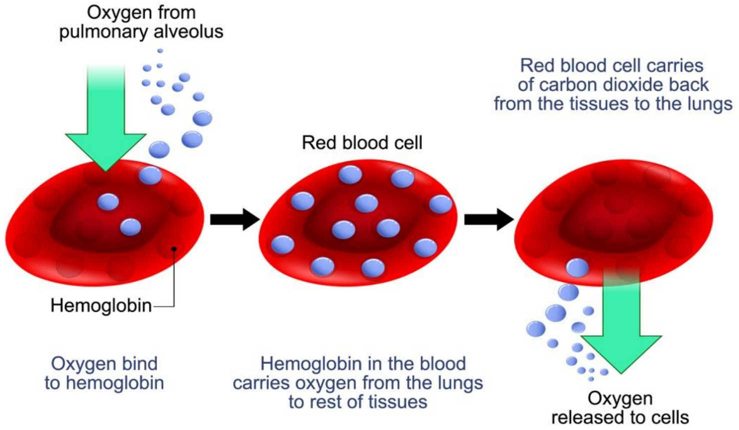


In the context of breathing and breath holding gas exchange refers to the movement of O2 into the blood and CO2 out of the blood. O2 and CO2 move across the respiratory membrane. O2 moves out of the alveolus into the capillaries while CO2 moves in the opposite direction from the capillaries into the alveolus.

- Diffusion results from a body or substance attempting to maintain a pressure equilibrium throughout a closed environment.
- The efficiency of diffusion in your body impacts the availability of O2 for use at a cellular and cerebral.
- Diffusion will cease once a pressure equilibrium is reached.
- Increased pressure = enhanced diffusion

The Bohr Effect

The *Bohr effect* refers to the observation that increases in the CO2 partial pressure of blood (decreases in blood pH /higher acidity) result in a lower affinity of haemoglobin for O2. This is due to the difference in pH between the cells of the body and haemoglobin. Hence the presence of CO2 is required to maintain the movement of O2 from haemoglobin in the blood to the cells and tissue.



Focusing for a hold down

"Is preparing for a freedive the same as preparing for a surfing hold down?"

Most breath holding deaths occur as a result of untrained people pushing limits beyond what can safely be performed given that person's condition and capability.

Characteristics of a freediving breath hold

- Performed when the diver chooses
- Performed when the diver is fully recovered
- Time available for optimal preparation
- All breath holds and or training is planned
- Supported and supervised by buddies and or safety teams
- Performed in a controlled or suitable environment with optimal diving conditions
- Breath holder is calm and relaxed
- Repetitive. Breath holds are repeated many times so divers become very familiar with the experience
- Parasympathetically dominant. Due to the relaxed and controlled conditions most freediving occurs and the super relaxed state they are able to maintain control of their nervous system and prevent it from entering a fight or flight response
- Intensity is controlled by the diver who may choose when to dive or return to the surface
- Usually occur following low levels of physical activity and mental stimulation.

Freedivers are:

- Specialists at conserving O2 / energy.
- Possess excellent body and mind awareness and control.
- Perform a great deal of progressive and repetitive practise (They do the same dives over and over).

Surfing Hold Down

Surfers are specialist at naturally developing their abilities through years of progressive exposure and play. They naturally observe and react to what is going in around them and have a good sense of their personal limitations

The surfing hold down occurs in an uncontrolled environment, it is involuntary, sudden, intense, aggressive and violent when compared to a freedive. Surfing hold downs vary in their magnitude based on many ever-changing variables, like weather conditions, water clarity, wave size, wave intensity, water depth etc. There is also a general absence of safety teams and training buddies who can come to immediate assistance.

Surfing hold downs by nature are:

- Sudden
- Unexpected
- Violent
- Anticipation (stress)
- Fear / Anxiety / Panic
- Hyper Alert
- Elevated heart / breath rate
- Physical
- Sympathetic response
- Vary in intensity at the whim of the elements
- Usually occur after high levels of physical activity.

Points to remember:

- Preparation is different for a freedive and surfing hold down
- The way we recover and prepare for each is also different
- Despite the differences there are also common factors inherent to both.

The Challenge

Regardless of the difference between freediving and surfing hold downs, when under water on a single breath we face the same challenge. That is. At some stage we must return to the surface in order to our next breath.

To optimise our survivability during a hold down we can focus on the few things we do have control over in what may appear to be a relatively out of control situation.

1. When under water on a single breath we have limited stored energy and O_2 and we need to be mindful of conserving both.

2. The way our body and mind react to a situation can affect our energy and O_2 consumption rate. If we can remain calm and relaxed both in body and mind, we use much less O_2 and energy than when we are stressed and physically active.

3. The brain uses around 25-30% of the body's total energy and O_2 consumption. Keeping a calm and relaxed mind can significantly reduce of use of O_2 and energy and therefore extend our survivability time under water.

4. Regardless of the situation we have a choice of how we will behave. Our behaviours and responses can be engrained by developing physical and mental adaptions through progressive training and exposure. Even when it may feel like you have absolutely no control over a situation you always have a choice about how you will respond.

The urge to breathe

What drives the urge to breathe?

Being aware of and recognising the physiological and psychological changes that occur within us as we navigate a breath hold help us to understand what the urge to breathe (feeling that you need to take a breath) is and what the driving force is behind it. From a young age most people associate the urge to breathe with low O_2 levels. For this reason many people associate it with suffocation and the perception that we must take a breath or we will die.

The urge to breathe is not driven by low O_2 levels.

When we hold our breath we prevent the exhalation of CO_2 from our body. Once the levels of CO_2 in our body reach the point where we would normally take a breath our brain and body goes into action sending reminders throughout our various systems to encourage us to breathe. These reminders arrive in the form of swallowing impulses, diaphragmatic contractions, other muscle contractions eg chest and throat and can get gradually more aggressive and violent. This is the urge to breathe.

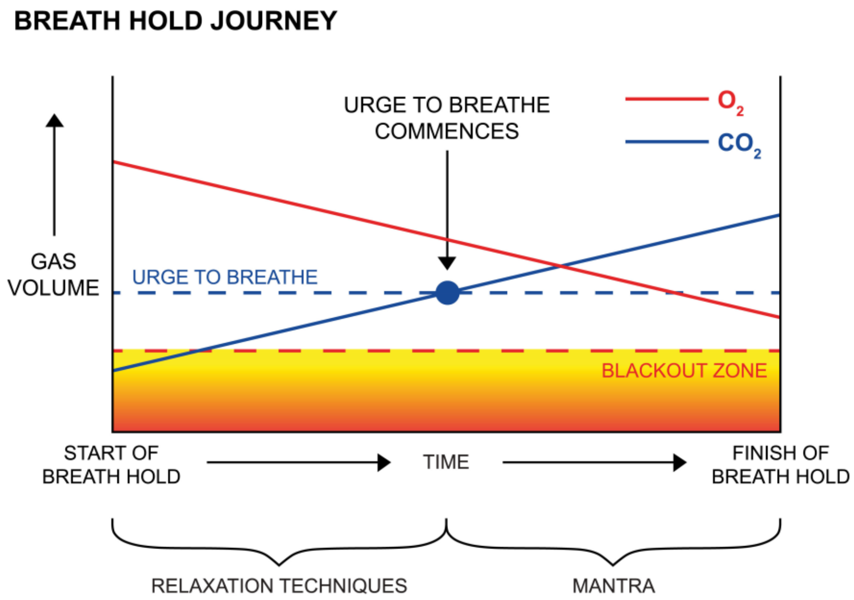
Note: The body will react to critically low levels of O_2 but not until it is critically low (20-30%) in which case it will generally immobilise you (black out). A major take away from this course is that you understand what is driving the urge to breathe. Knowing it is not driven by low O_2 enables you to remain calmer and more relaxed and push through the initial discomfort of the urge to breathe, significantly lengthen your breath hold.

Breath holding is largely about managing the stress created by CO_2 and the urge to breathe.

A simple drill to demonstrate this is to use an oxypulsemeter during your breath holds and observing your O2 levels whilst experiencing strong urges to breathe. Even after a couple of minutes of holding your breath in a static position your O2 saturation levels will remain around the mid to low 90%.

Add to this the knowledge that the average person can safely push your O2 saturation to below 70% (depending on your training and personal nuances). Relaxing during breath holds should become a lot easier.

As depicted in the Breath Hold Journey diagram below when a breath hold is performed following normal Breathing. The urge to breathe kicks in on the average person around 50% of the way through their total capacity (general only) and is well clear of any cerebral black out risk (black out resulting from the brain being deprived of O2).



Practical Exercise - “Breath Hold Journey” drill.

Equipment required for this drill:

1 x Oxypulsemeter

1 x nose clip (optional)

The drill consists of two breath holds. Dont worry about how to breathe up and prepare for or recover from breath holds just yet. It does not matter how long your breath hold goes for with this drill. What you need to focus on are the sensations you experience during the breath hold and what the thing was that prompted you to breath. IE how you felt physically and mentally and what was it that made you take a breath.

The average person at sea level when breathing normally will have an O2 saturation of around 97-99% as measured by the Oxypulsemeter. Check this before you start this drill. If your resting O2 saturation is 95% or below and remains there. You should consult a medical professional.

- Be mindful when using an oxypulsemeter that there may be a delay in the reading of up to 20 seconds with most oxypulsemeters. So, you may find once you start breathing after the breath holds the oxypulsemeter will indicate your O2 saturation is still dropping. Disregard this as within 30-45 seconds with normal breathing your O2 saturation will return to its full or near full capacity.

Breath hold 1.

1. Relax and when you are ready take a last breath in and hold it for as long as you can.
2. During the breath hold be sure to block your nose by pinching it with your fingers or wearing a nose clip. Do this by pinching your nostrils closed with your thumb and forefinger. This ensures there is no sneaky breathing (unintentional breathing that can occur via your nose as pressure builds up in your airways). This helps to intensify
3. Continue the breath hold until you need to breathe.
4. Rest with natural nasal breathing two minutes
5. Think about what triggered your ceasing of the breath hold and taking of a breath.

Breath hold 2.

Following your 2 minutes rest from breath hold one attach the oxypulsemeter to your finger and activate its functions so you can observe your O2 saturation.

Repeat as per breath hold one but this time use the oxypulsemeter to keep track of your O2 saturation. When you feel like you need to breathe observe where your O2 saturation is at. Remember it does not get critical until you are at 20-30% and it is perfectly safe for most healthy people to drop it into the 70 or 60%s. Now push yourself a little further beyond what you felt in the first breath hold.

1. Relax and when you are ready take a last breath in and hold it for as long as you can.
2. During the breath hold be sure to block your nose by pinching it with your fingers or wearing a nose clip. Do this by pinching your nostrils closed with your thumb and forefinger. This ensures there is no sneaky breathing (unintentional breathing that can occur via your nose as pressure builds up in your airways). This helps to intensify the experience and also enables you to push a bit harder.
3. When you feel the urges to breathe come on push a bit harder and beyond the point at which you chose to breathe in breath hold one.
4. Continue the breath hold until you need to breathe whilst observing your O2 levels.

What was your O2 saturation when you needed to breathe?

After you commence breathing following the breath holds have a couple of minutes to rest and relax. During this time think about

what drove your decision to resume breathing and what sensations and changes in your mind and body you experienced as the breath hold progressed?

This is a powerful exercise and most first-time breath holders are surprised by how little O2 they actually use when holding their breath. Reality is. During normal breathing in a relaxed state the body uses only around 4% of inhaled O2 the rest is expelled during exhalation.

Your response to elevated CO2

CO2 is an irritant gas accumulating as a by-product of metabolism (aerobic respiration) but also a regulator of many important bodily functions including your breathing dynamics. For this reason, the brain keeps a close eye on CO2 levels in the body.

CO2:

- Stimulates Breathing
- Adjusts blood chemistry (lowers pH and increases acidity)
- Dilates capillaries
- Drives the Bohr Effect

Remember. The brain also measures O2 levels in your body but does not act unless it is critically low (20-30% saturation).

Suffocation Alarm Response

The suffocation alarm response promotes a feeling and thinking you experience when holding your breath (or when you are out of breath) that you will suffocate if you do not take a breath. The purpose of the alarm is to stimulate you to breathe.

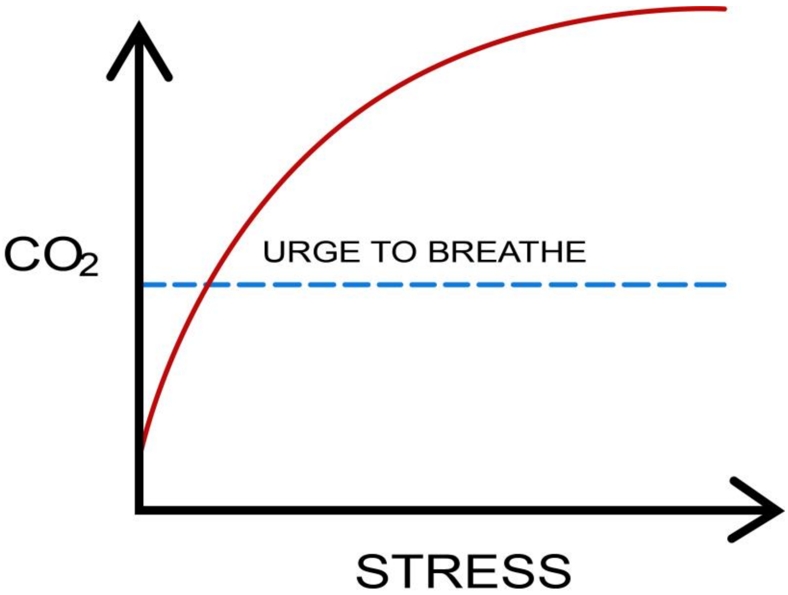
The "suffocation alarm response" is associated with the urge to breathe and is driven by high levels of CO2 not low O2.

- You have a CO2 tolerance set point based for your everyday breathing patterns
- The way you breathe impacts your body's tolerance to CO2
- Increased CO2 triggers innate sympathetic (fight or flight) response and stimulates the fear of suffocation.
- Increased CO2 triggers an anxiety / panic response
- Suffocation alarm response is supported by learned behaviours

CO2 and stress

CO2 is often referred to as the stress molecule as it is frequently associated with our ability to manage stress. This is due to CO2 being an irritant gas that stimulates our urge to breathe by creating a psychophysiological stressor.

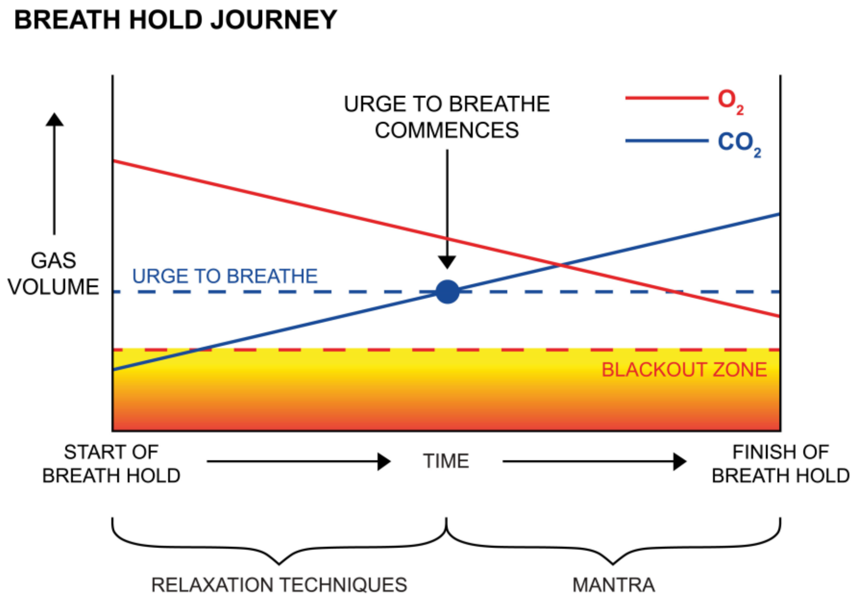
The greater tolerance to CO2 we have the greater our tolerance to stress. Our tolerance to both CO2 and stress can be improved with progressive exposure (familiarity created by training and practise).



The Breath Hold Journey

The Breath Hold Journey is the combination of psychological and physiological sensations we experience whilst navigating our way through a breath hold. Breath holding is as much a mental exercise as it is physical so it helps to understand the processes going on in our body and mind so we can use that knowledge to find our way through the challenge.

The *Breath Hold Journey* diagram below shows how O2 and CO2 volume change during a breath hold commenced post normal relaxed breathing and how the urge to breathe can provide a safety mechanism by prompting us to take a breath well before we near any risk of unconsciousness.



Remember:

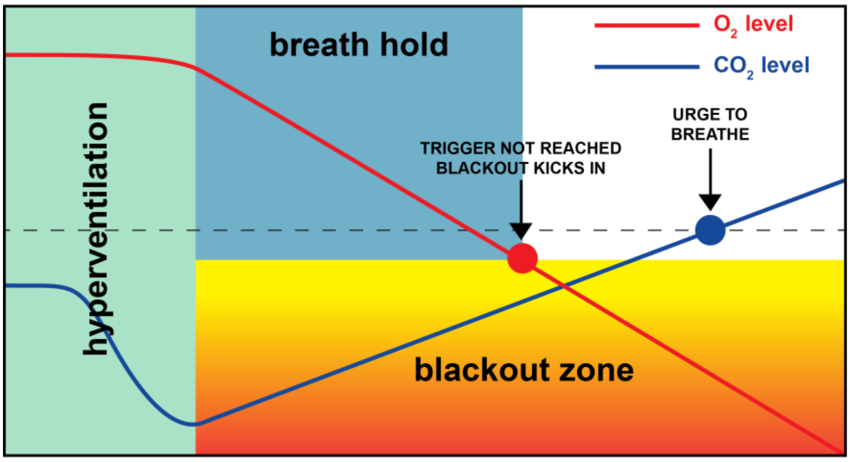
- High CO2 drives our urge to breathe and is the driving force behand the stress we experience during challenging breath holds.
- During a breath hold that follows normal breathing the urge to breathe kicks in way before any risk of blacking out (at around 50% of the average healthy persons total breath hold duration).
- The urge to breath can be our best friend as it provides an indicator of our breath holding limits
- The urge to breathe helps prevent black outs.

Hyperventilation

Hyperventilation is "Breathing in excess of our metabolic demands" That is. An excessive rate and depth of breathing that results in an abnormal loss of CO2 from the blood. The below diagram shows the O2 and CO2 gas relationship during a breath hold following hyperventilation. This practise can result in a dumping of CO2 reducing levels of the gas to a point where it would significantly delay the urge to breathe.

Delaying the urge to breathe during longer breath holds can result in an unintended black out. This is due to O2 levels reaching critical limits before CO2 levels rise enough to trigger the urge to breathe and stimulate the breath holder to take a breath.

HYPERVENTILATION



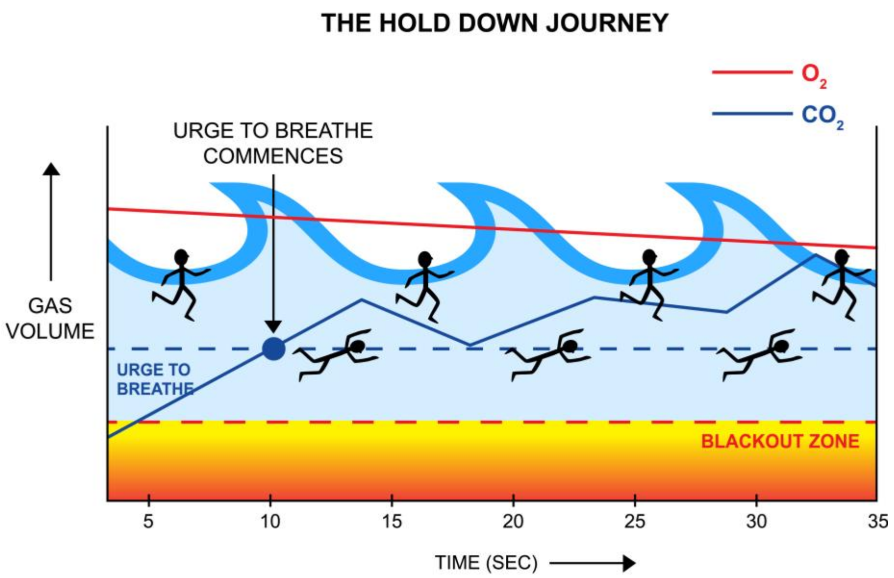
Remember:

- Hyperventilation flushes CO2 out of the body and excessive hyperventilation disturbs the delicate gas balance within the body by lowering normal CO2 levels and delaying air hunger (urge to breathe).
- When the urge to breathe is delayed we are at greater risk of black out!
- Black out can result from O2 levels reaching critical limits before CO2 levels rise enough to trigger an urge to breathe that is strong enough to stimulate the recommencement of breathing.

The Surfers Hold Down Journey

Due to the high physical activity associated with surfing (paddling, etc) a surfer's body is loaded with higher-than-normal levels of CO2. This results in the urge to breath commencing very early on in the breath hold. Meaning surfing hold downs can feel pretty ugly quite early on (within a few seconds of being submerged). This is compounded by the repeated nature of surfing hold downs (like a paddle out scenario).

When paddling out through a surf break or when "caught inside" the surfer is working hard physically and generating excessive amounts of CO2 whilst having to perform repeated short duration breath holds with limited to no recovery opportunity. Although they are short in duration the repetition and lack of recovery maintains high levels of CO2 in the body which generates higher levels of stress.



Superventilation

For scenarios where we generate excessive CO2 it is possible to use a form of controlled hyperventilation to quickly recalibrate the CO2 in our system returning it closer to normal and more manageable levels. This reduces CO2 induced stress, enables us to take a better last breath and relax more for the next hold down.

Taking 3 -5 superventilation breaths following and prior to a short intense breath hold can safely bring 'excess' CO2 levels back to 'normal' resting levels without inducing any risk of black out. This enables the surfer to maintain a more relaxed and less stressed state. Subsequently improving the taking of their next last breath in.

Focussing during breath holds.

Relaxation techniques

The relaxation phase of the breath hold precedes any strong urge to breathe and is ideally maintained for as long as possible.

Relaxation techniques include:

- Closing the eyes (reduces sensory input and promotes relaxation)
- Body scanning (isolating, visualising and relaxing each body part).
- Visualisation (creating a picture or movie in your mind using your imagination. EG. A work project, physical activity, or passion)
- Listen to the sounds around you and visualise what is making the noise you are hearing
- Listen to or feel your heart / pulse beating.
- Deconcentration of attention. Opposite to concentration.

Try out a few different methods of relaxation to find the one that best works for you then stick with that one.

Mantras

Once the carbon dioxide begins to accumulate in your system to higher-than-normal levels it will begin irritating you in attempt to force breathing. Things will start to get quite uncomfortable. Once this begins try to relax into it as much as possible and not fight it. The key is to remain as relaxed and least stressed as possible. Eventually the pressure and contractions will become increasingly severe and it will be virtually impossible to remain relaxed.

This is when you switch from relaxation techniques to something more powerful like a *mantra*. Traditionally a *mantra* is a sacred word, sound or phrase repeatedly recited in an attempt to harness and focus the power of the mind

During the challenging end of a breath hold switch to a short sharp phrase and repeat that phrase over and over to negotiate the ensuing discomfort. Remember to keep your phrases short.

Examples of breath hold mantras:

- Simple but firm counting “1234,1234,123…”
- Short third person phrases EG “You’re the boss, you’re the boss, you’re the boss…”.
- “You’ve got this” and “Hang in there” or “Stay with it, its only CO2” are others.

Try out a few different mantras to find the one that best works for you then stick with that one.

Conserving O2 and Energy

O2 consumption = increased CO2 production = increase in stress.

The brain is only 2% of the body's mass but it is responsible for up to 30% of all O2 / glucose consumption in our body. Per gram of body mass, the brain uses energy ten times faster than any other tissue or organ in the body.

Oral conversation increases brain activity by 30%. This is because oral conversation is a very complex process and requires a high rate of brain activity.

Our brain is responsible for around 25 - 30% of the body's total energy and O2 consumption so minimising brain activity during breath holds reduces CO2 production and O2 consumption.

Less stress = less CO2 production and less O2 consumption. And. Less CO2 production = less stress and less O2 consumption.

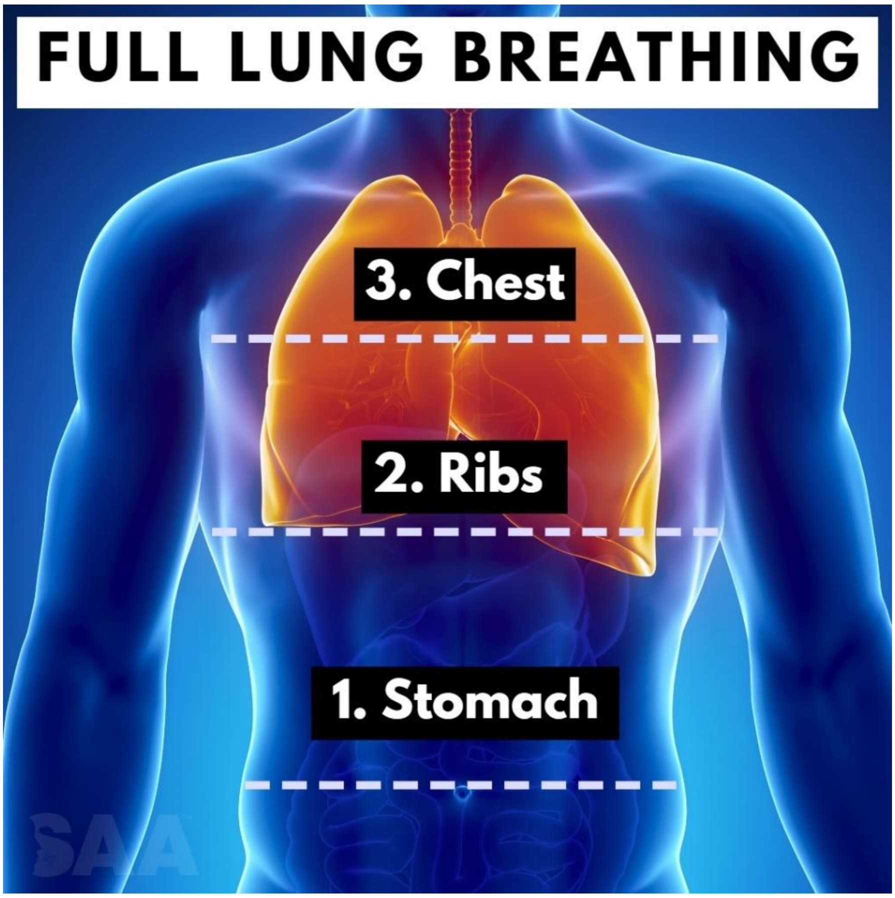
Taking a last breath

To enable the taking of the best last breath possible we need to practise using the full extent of our lungs and breathing musculature. To do this we use a full lung breathing exercise during which we break down the inhale into three phases and cueing points. The three cueing points we use for taking a full lung of air are Stomach, Ribs and Chest.

The *Full Lung Breathing* drill is a fundamental drill that develops efficient and effective breathing habits by creating greater awareness and control of our breathing. Used with nasal breathing this drill can provide a very simple and effective relaxation tool. The same drill can be adapted for use in taking a quick but solid last breath prior to a sudden breath hold.

When drawing in a full lung of air we ideally start low (around the stomach region) pulling air into the lower lobes of the lungs and filling upward toward the chest area (upper lobes).

When used for relaxation the aim of *full lung breathing* is to soften and quieten the breath to a point where air flow and body movement is undetectable. If practising the relaxation version of this drill it is possible you may become so relaxed you will fall asleep on the floor! The secret for relaxation is to reduce your breath cycles (inhale + exhale) to 3-5 cycles per minute. This creates a resonance effect that resets the frequency of all systems in the body.



Relaxation

1. Lay flat on your back on the floor and get comfortable (place a pillow or cushion under your back if required to relax your back).
2. Breathe only through the nose using your natural breath cadence.
3. Place your hands lightly on your stomach and breath only into your stomach (lower lung lobes). As you inhale feel your stomach and circumference of your lower torso expand. Think of your torso as a 360° cylinder. All sides need to expand when you inhale and contract during the exhale.
4. Inhale for a count of 4-5 and exhale for a count of 10-15 (Note: when exhaling you are releasing the same amount of air as you inhaled but slower and with more control. If you're not able to perform 5/15 try 2/6 or 3/9. Wherever you fall maintain the ratio of 1:3 for Inhale:Exhale.
5. Continue for 2 minutes.
6. After 2 minutes slide your hands up either side of your body to your lower ribs and breath only into your rib region. As you inhale allow your ribs to open and expand and again ensure the 360° circumference of your torso EG the middle back is also expanding. Your middle back should press gently into the floor as you inhale and fill with air.

7. Exhale. Let everything relax and your ribs collapse. If you're having trouble moving your ribs use your hands to lightly press them in when you exhale and release the pressure allowing them to expand when you inhale. This will provide sensory feedback that will help getting any sticky ribs moving again.
10. After 2 minutes slide your hands up to your chest and breath only into your chest. As you inhale allow your chest to expand and ensure the circumference of your torso EG upper back and lats are also expanding. Your upper back should press gently into the floor and your upper ribs should fan out as you inhale.
11. Still breathing through the nose only. Combine all 3 stomach, ribs and chest into one single movement while inhaling and exhaling. Once you've got the hang of this focus on the timing of your breath. Inhaling for 4-5 counts, slight pause then exhaling gently and controlled for 10-15 counts followed by another pause at the bottom of the exhale then inhale again. Continue for 4 minutes.

Total time 10 minutes.

Last breath in

1. Lay flat on your back on the floor and get comfortable. (LEVEL ONE)
   - Sit in a chair (LEVEL TWO)
   - Lay face down on the floor (LEVEL THREE)
2. Breathe through your mouth using pursed lips (like you are sucking air in through a straw). During the exhales use your tongue to create resistance (making an SSSSSSSSS sound) and controlling the exhale.
3. Place your hands on your stomach and breath only into your stomach. As you inhale draw as much air in as quickly as you can and feel your stomach and circumference of your lower torso expand. Think of your torso as a 360° cylinder. All sides need to expand when you inhale and contract during the exhale.
4. Inhale firmly for a count of 4-5 and exhale for a count of 10-15 releasing the same amount of air as you inhaled slowly and with control. If you're not able to perform 5/15 try 2/6 or 3/9. Wherever you fall maintain the ratio of 1:3 for Inhale : Exhale.
5. Continue for 2 minutes.
6. After 2 minutes slide your hands up either side of your body to your lower ribs and breathe only into your ribs. As you inhale allow your ribs to open and expand and again ensure the 360° circumference of your torso eg middle back is also expanding. Your middle back should press gently into the floor as you inhale and fill with air.
7. Exhale slowly and with control. Let everything relax and your ribs collapse. If you're having trouble moving your ribs use your hands to lightly press them in when you exhale and release the pressure allowing them to expand when you inhale. This will provide sensory feedback that will help getting any sticky ribs moving again.
8. Continue for 2 minutes.
9. After 2 minutes slide your hands up to your chest and breath only into your chest. As you inhale allow your chest to expand and ensure the circumference of your torso

EG upper back and lats, etc are also expanding. Your upper back should press gently into the floor as your upper ribs fan out as you inhale.

10. Continue for 2 minutes.
11. After 2 minutes. Combine all 3 stomach, ribs and chest into one single movement while inhaling and exhaling. Once you've got the hang of this focus on the timing of your breath. Inhaling filling up as fast as possible.
12. Hold your breath for ten to fifteen seconds then exhale slowly and with control for 10-15 counts followed by another short breath hold at the bottom then inhale again. Continue for 4 minutes.

Add in the breath hold

1. Lay flat on your back on the floor and get comfortable. (LEVEL ONE)
    - Sit in a chair (LEVEL TWO)
    - Lay face down on the floor (LEVEL THREE)

2. Initial relaxation. Breathing through the nose only. Combine all 3 stomach, ribs and chest into one single movement while inhaling and exhaling. Once you've got the hang of this focus on the timing of your breath. Inhaling for 4-5 counts, slight pause then exhaling gently and controlled for 10-15 counts followed by another pause at the bottom then inhale again.
3. Continue for 2 minutes.
4. After 2 minutes. Commence with breathing as per the combined stomach, ribs and chest (Version 2 - Last breath -section 11/12).
5. Continue for 2 minutes.
6. After 2 minutes switch to breathing through your mouth using pursed lips (like you are sucking air in through a straw). During the exhales use your tongue to create resistance (making an SSSSSSSSS sound) and controlling the exhale (as per Version two). Continue the full lung (Stomach, Ribs and Chest) sequence for 2 minutes.
7. After 2 minutes. Take an inhale as fast as possible and hold your breath for 60 seconds.
8. After 60 seconds resume breathing with whatever comes naturally an inhale or exhale and continue to breath during the recover as per 2. Initial relaxation phase.
9. Continue relaxation breathing for 45 seconds.
10. After 45 seconds switch back to pursed lip mouth breathing and within 15 seconds take another strong fast inhale and hold your breath for 60 secs.
11. Repeat this cycle 5 – 10 times always maintaining control of your breathing as per the relaxation phase during the recovery period.
12. Finish with 2 minutes super relaxed nasal only breathing using your natural breath cadence.

8.3 Throat Locks

Tongue can provide a way of sealing off our airways (throat) during more intense phases of a breath hold.

During the relaxation phase of a breath hold, gentle / relaxed pressure is all that is required to create a seal. As the breath hold intensifies gradually increase the pressure applied via the tongue to the hard palate (hard bone on the roof of mouth) to match the increase in intensity from the breath hold.

The T lock

The T-lock is when the front of your tongue contacts the front of the roof of the mouth on the hard palate and is in the same position as when you make the "T" sound. Mouth remains closed.

The K lock

The K-lock is when the middle of your tongue contacts the centre of the roof of your mouth on the hard palate.   Like you're going to make a "K" sound. Mouth remains closed.

Both the T and K lock are performed with the tongue contacting the hard palate.

The Human Diving Response

The *Human Diving Response* (AKA dive reflex or mammalian dive reflex) is a set of physiological reflexes to breath holding and immersion water. The response overrides basic homeostatic reflexes and is found in various air-breathing vertebrates other than humans.

The most noticeable effects of the response on the cardiovascular system are:

- Bradycardia (Slowing of the heart rate) – triggered by immersion in cool water and rising CO_2.
- Peripheral vasoconstriction (redirection of blood from extremities to the vital organs) – triggered by rising CO_2
- Spleen contraction (release of red blood cells stored in the spleen)
- Blood shift - Occurs because of pressure exerted on the body beyond 40 -50 Meters

Hypercapnia Vs Hypoxia

Definition Hypercapnia

- Hyper – Higher than normal levels
- Capnia - CO_2 in blood
- Hypercapnia – Higher than normal levels of CO_2 in the blood.

Hypercapnia training (CO2 Tolerance)

Hypercapnia or CO2 retention training consists of drills performed with a higher-than-normal carbon dioxide (CO2) levels in the blood. CO2 is elevated during exercise and normally expelled through the lungs by increased breathing. When we hold our breath CO2 is not expelled and accumulates in our blood and lungs and drives a much stronger urge to breathe. This can result in a very intense exercise experience.

Hypercapnia training results in the body becoming more tolerant of high levels of CO2 and to stress generally. Hypercapnia training is characterised by maintaining high levels of O2 saturation coupled with short duration intervals consisting of moderate to high activity, limited rest periods and short breath holds (high intensity interval training). This training significantly elevates the body's CO2 levels increasing the intensity of the breath hold and reducing our ability to completely off load accumulating CO2. It can become very intense and uncomfortable very quickly but at the same time it is a very safe training method. Due to a strong urge to breath becoming intolerable long before O2 is depleted. Meaning the breath holder will be forced to breathe long before there is any significant risk of O2 deprivation, loss of motor control (LMC / Samba) or black out.

Hypercapnia training tables are commonly used by professional freedivers (around 70% of their training) and are the most appropriate form of training for surfers. There are many flow-on adaptions from hypercapnia training for all athletes and anyone who is wishing to develop any form of stress management.

Hypercapnia training can be performed on land or in the water. Hypercapnia training is high in intensity but low in risk. Hypercapnia training is the principle breath hold technique taught by Apnea Survival due to its specific applicability to unexpected and intense aquatic immersion scenarios and its low risk profile.

Hypercapnia training benefits include:

- Increased tolerance to high levels of CO2
- Increased tolerance to stress
- Increased performance during high stress situations
- Enhanced exercise and breath hold recovery times
- Enhanced dive response activation
- Makes breath holds more comfortable
- Lengthens breath holds

Hypercapnia training table

The CO2 static table is designed to adapt the body to higher levels of CO2 by reducing the rest duration between fixed breath holds. The duration of the timed breath hold should not exceed 50% of your personal best (PB) and the table should consist of no more than 8 cycles. The following 8 cycles are based on a personal best static breath hold of 3 minutes. Total duration 25:15 min.

Rest	Hold
1.00	1.30
1.00	1.30
1.00	1.30
1.00	1.30
1.00	1.30
0.45	1.30
0.30	1.30
0.15	1.30

As you progress adjust the table to suit new PBs by changing the breath hold duration to 50% of your improved breath hold time.

Definition Hypoxia

- Hypo – lower than normal levels
- Oxia – Oxygen
- Hypoxia – Lower than normal levels of oxygen

Hypoxia training (O2 deprivation)

Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply at a tissue level. Hypoxia may be classified as either generalised - affecting the whole body or localised - affecting a region of the body. Eg brain – cerebral hypoxia. Hypoxia training is characterised by a deficiency in the amount of O2 reaching the body's tissues.

Due to its nature of depleting the body's O2 reserves which significantly elevates the risk of cerebral hypoxia (black out) Hypoxia training should only be used by experienced breath holders and when under supervision of a competent training buddy.

Hypoxia training builds tolerance to low O2 environments by creating an environment low in O2 using progressively increased breath hold durations.

Example of a Low O2 Tolerance Static Table

The below static table adapts the body to lower levels of oxygen by increasing breath hold length and maintaining set resting periods. The length of the last breath hold in the table should not exceed 80% of your current max breath hold with no more than eight cycles. The following table is based on a max breath hold of 3 minutes. Total duration 30:45 min.

Hold	**Rest**
1.00	2.00
1.15	2.00
1.30	2.00
1.45	2.00
2.00	2.00
2.15	2.00
2.30	2.00
2.30	2.00

As the breath holder progresses adjust the table to suit new PBs by changing the breath hold duration to 80% of your improved breath hold time.

Note: Always be cautious when performing Hypoxia breath holds, know your limits and always restrict your exertion to 7/10. This ensures there is limited to no risk of blacking out!

Recovery breathing techniques

Surfing hold downs and hypercapnia training

During Hypercapnia training levels of CO2 in the body can increase in pressure to an intolerable point forcing us to breathe. Blood pressure also increases and it is not uncommon for the breath holder to experiences sensations of wanting to urinate. This is the body's way of dumping fluid as it attempts to relieve itself from the increased blood pressure.

Due to the high intensity and short recovery opportunity provided by surfing hold downs and hypercapnia training it can be difficult to use freediving style hook breaths. Nor are these techniques necessary or appropriate for Intense high CO2 / high O2 rich, short duration breath holds with limited recovery opportunities. The priority here is to quickly unload excess CO2 and set up the best possible last breath prior to the next hold down or breath hold.

For the surfing hold downs it is preferred to use superventilation (controlled hyperventilation for 3-5 breaths starting with an exhale immediately upon surfacing for 3 – 5 breaths (if possible) before returning to natural relaxed breathing (if there is an opportunity to do so) or taking the next last breath if required for a subsequent hold down. Each scenario will dictate how many breaths you get to take. Sometimes it may be only one solid exhale followed by the last inhale.

The superventilation helps quickly eliminate excess CO_2 built up following the previous breath hold and brings CO_2 levels back closer to normal levels. Due to the relatively short duration of surfing hold downs we should never be depleted of O_2 if we get a good last breath in and hold on to all our air so this technique is perfectly safe when used in the appropriate setting.

Longer breath holds and hypoxia training

During Hypoxia training O_2 saturation can be depleted to near critical levels. For this reason, we use a freediving hook breathing technique of inhaling first immediately upon surfacing followed by a short pause then a passive exhale for 3 - 5 breaths before trying to lower CO_2 levels. This technique helps to keep the pressure of O_2 in the lungs high enough to optimise diffusion.

As we are often depleted of O_2 when training hypoxia any forced exhalation may result in loss of internal O_2 partial pressure which negatively impacts the process of diffusion, reducing the ability of O_2 to move from the lungs to blood vessels and tissues. A consequence of this can reduced O_2 delivery to the brain and extremities resulting in loss of motor control (samba) or black out.

Hook breathing.

The inhale first AKA hook breathing recovery technique maintains pressure in the lungs and increases diffusion of O_2 rich throughout the body.

How to do hook breathing for freediving:

1. As soon as you resurface inhale.
2. Hold your breath for 1 – 2 seconds.
3. Create pressure around your lungs. While holding your breath exert a mild force onto your lungs by flexing your abs, ribs, diaphragm and chest
4. Passive Exhale. After 1 – 2 seconds passively exhale (don’t force it).
5. Repeat 3 breath cycles (steps 2 – 5).
6. Commence normal natural breathing. Do not hyperventilate just breathe at a normal, natural pace.
7. Rest.

- The noise made during the inhale ideally sounds like “HOO” (as in ‘whoo’)
- The noise made when exerting pressure through the lung space ideally sounds like the start of a word beginning with K IE a short ‘Ka’ sound.
- Together both the ‘HOO’ and the ‘K’ “HOOK”. Hence the name ‘HOOK’ breathing.

Stress

Stress is either a physiological or psychological response to a stressor. A stressor is a stress causing stimulus. IE is a chemical or biological agent, environmental condition or an event that challenges or threatens an individual's safety or survival. Stress is how our bodies react to that challenge or threat.

Stress can be defined by three key descriptors.
1. Physiological or psychological tension
2. Internal or external forces
3. Exceeding a person's resources for their ability to cope

The stress we experience can be both psychological or physiological and is triggered by the release of *stress* hormones such as adrenaline and cortisol via processes initiated by the hypothalamic–pituitary–adrenal (HPA) axis. During periods of stress the production of these specific hormones triggers physical changes in the body.

Changes that occur in response to stress

Psychological:

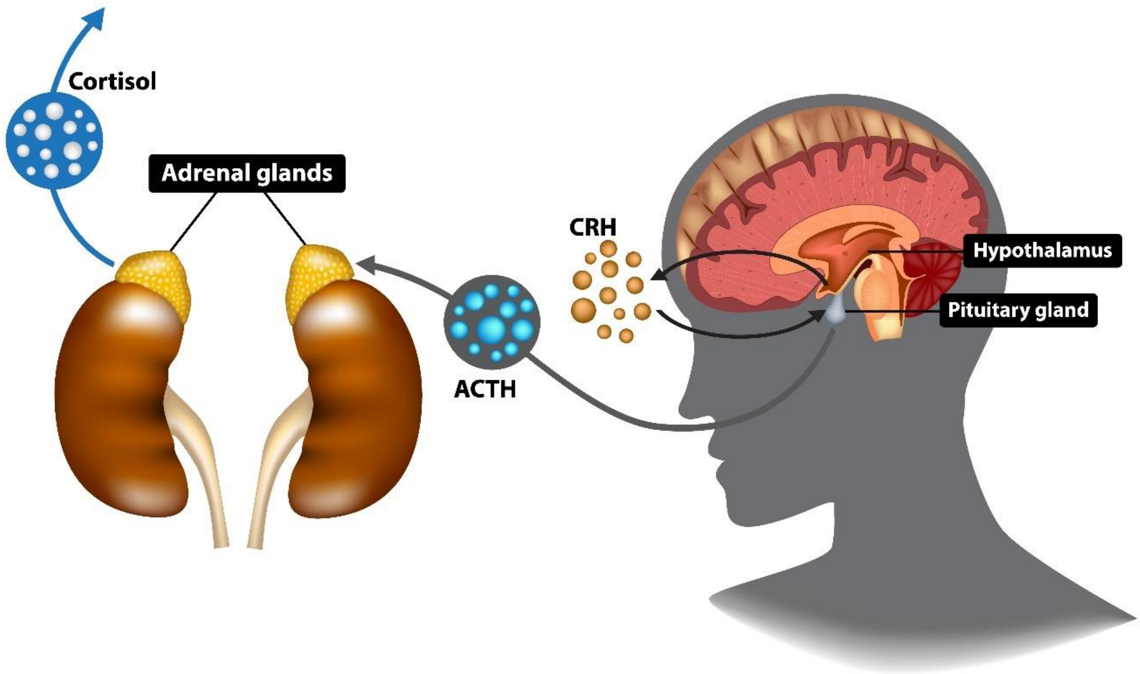
- Increased focus and attention
- Increased alertness
- Difficulty concentrating on anything away from threat
- Reprioritising of activity / function
- Reduced cognition (prefrontal cortex shuts down as midbrain takes over for more rapid decision making)

Physiological:

- Dilated pupils
- Pale or flushed skin
- Blood clotting
- Heartbeat increases
- Respiratory rate increases
- Trembling
- Blood pressure
- Increased cortisol production
- Increased adrenaline production
- Bowels – Relax and evacuate
- Immune system – Suppressed

The hypothalamic–pituitary–adrenal (HPA) axis

The body's system used to cope with stress is the hypothalamic-pituitary-adrenal axis (HPA axis). The sensations of stress we experience are triggered by the release of specific hormones such as adrenaline and cortisol via processes initiated by the HPA axis.



Emotional hijacking (AKA Amygdala hijacking)

Emotional hijacking is a state in which our *emotions interfere with the functioning of our brain*, resulting in reactions such as aggression or irrational fear-based behaviour.

An amygdala hijack causes the prefrontal cortex to shut down making it difficult to think clearly, inhibiting our ability to make rational decisions. This action results in the triggering of the HPA Axis and our stress response system.

The amygdala can serve to "hijack" our brain when we are faced with a stressful / threatening situation. The amygdala prepares our body to react as if the situation we are anticipating presents a real danger to our ongoing survival. Although in most cases, there may be no real danger.

An emotional hijack will generally result in aggressive reactions or a panic attack. Which can pose significant consequences for both our decision-making ability and eventually our well-being.

It is crucial to recognise the psychophysiological cues that precede a hijacking. Increased self-awareness = increased self-control and better decision making. Particularly during critical situations.

The level at which we can recognise and control our emotions is referred to as emotional intelligence. A benefit of being emotionally intelligent is that it provides the ability to de-escalate our emotional responses and prevent hijacking.

We can train emotional intelligence through practices using exercises that increase awareness of the present moment, tune us into our surrounds and intercept any circular, negative and internal narrative.

Things that relieve stress.

1. Rest / Sleep.

2. Relaxation. Daily rituals that release tension in your body and your mind. EG relaxed breathing exercises for ten minutes before going to bed.

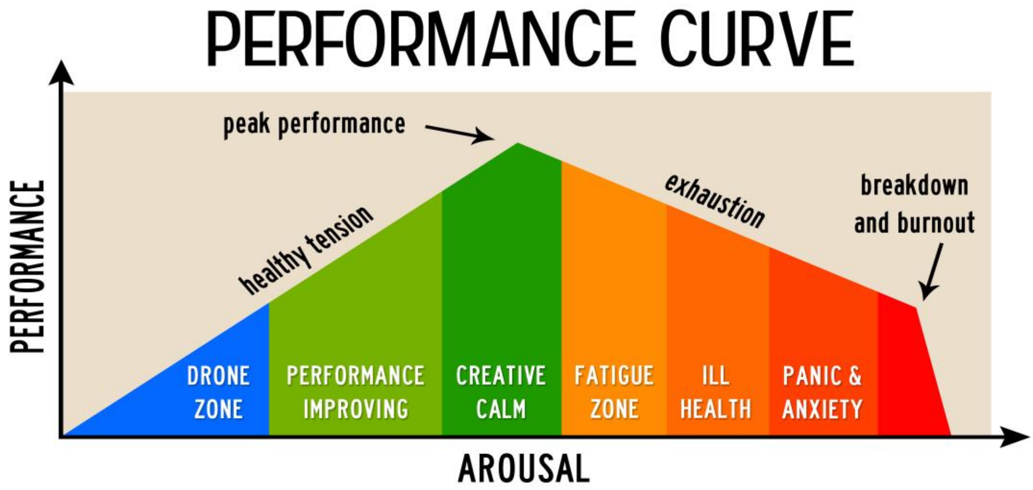
3. Exercise. Known to reduce stress due to imitating the completion of the stress response cycle (physical feat - fight or flight) which activates the down regulation of the stress response. A simple thirty-minute walk or social sports game can down blow off the residual effects of stress.

4. Greater awareness. Knowing what triggers your stress allows you to better understand and control it.

5. Learning how to control the stress cycle (recurring feedback loop).

Distress V Eustress

The diagram below is based on the *Yerkes Dodson Stress Performance Curve* and explains how some stress can be beneficial to our performance.



Fear

Used as a noun fear is given the following meaning by the Merriam Webster dictionary.

An unpleasant often strong emotion caused by anticipation or awareness of danger and to experience anxious concern or reason for alarm (sense danger).

As a verb fear is given the following meaning by the Merriam Webster dictionary.

To be afraid or feel fear.

Fear is experienced as an unpleasant emotion which arrives in response to how we perceive a situation as being a danger or threat to our survival (although the danger may not be real). Fear provokes our stress response which subsequently triggers physiological changes that may produce behavioural reactions such as fighting or fleeing. These sensations can feed a self- perpetuating cycle of fear and stress, increasing the perception of impending doom and distorting further the genuineness of the any real threat or lack thereof.

We can condition our fear by reinforcing it through our behaviour. EG if we are afraid of suffocating whilst holding our breath our defence mechanisms are being conditioned to that perceived danger. Such behaviour further supports our belief (perception) that the danger is real.

We cannot entirely extinguish our fears but we can unlearn them. Through incremental and progressive exposure to small and tolerable doses of the relevant stressor. This is the basis for *hormesis*, a characteristic of organisms used to adapt through small doses of exposure to increasing amounts of a stressor. IE small doses of a stressor are generally favourable even though a large dose may be detrimental. So going back to our breath hold and suffocation example, by regularly experiencing slightly more challenging breath holds than we are normally comfortable with, we can learn to tolerate higher stress loads which results in us becoming more comfortable with more challenging breath holds.

Managing fear

Fear can never be extinguished entirely but it can be unlearned and our responses to the stressors that trigger it can be better managed. Part of this process is recognising the stressor responsible for generating the fear we experience and developing a greater tolerance to the stressor. For example. Our initial fear of thinking we will die from hypoxia when we first experience the urge to breathe while holding our breath is an example of how fear is conditioned. Once we develop a tolerance to the provoking stressor (CO_2) through understanding our physiology (education) and incremental exposure to that stressor (training) the stressor causes much less concern and any fear of being suffocated whilst holding our breath is reduced.

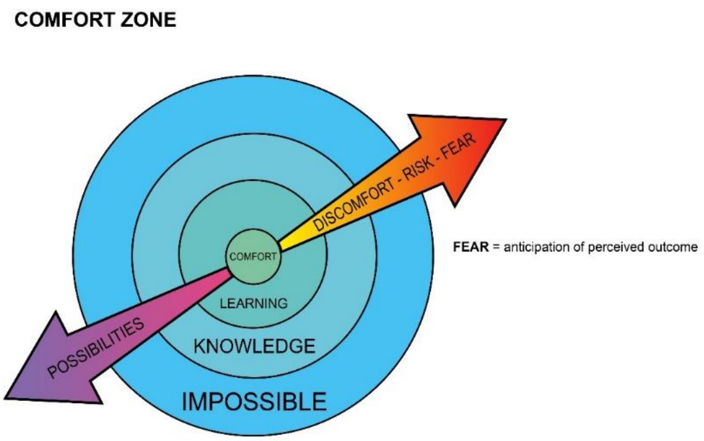
Steps to controlling fear.

1. Accept fear is a necessary survival tool and is always going to be a part of life.
2. Rationalise all components of situations that provoke fear and understand the real nature of the danger (if any).
3. Mentally work through worst case scenarios and outcomes without any attached emotion. Use visualisation techniques to put yourself in these scenarios with favourable outcomes.
4. Identify the triggers (stressors) of your fear and challenge them through progressive and controlled exposure (practise and training - create adaptations).
5. Gradually progress your training from controlled environments to real life situations taking small steps that reinforce successful outcomes.

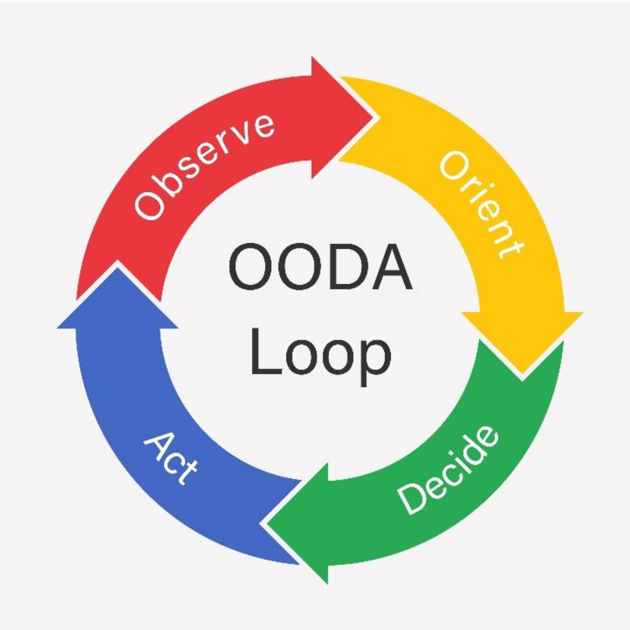
Comfort Zone

Within the comfort zone we experience feelings of familairity, feel at ease, in control and have low stress levels. Here we feel safe, secure and comforatble with both our physiological and psychological state. However comfort zones can lead to a mental stagnation brought on by the fear of risk taking required to take on challenges that remove us from the zone. Fear and lack of motivation can result if we do not challenge the boundaries of the zone by avoiding exposure to stress.

For any individual to grow they need to challenge fears, be exposed to stress and learn to navigate the discomfort that comes with experiences outside the comfort zone.



12. The OODA Loop



We can train ourselves to make better decisions when under stress by repeatedly rehearsing responses to expected situations. This repetition and rehearsal develop mental blueprints and repeatable responses that our unconscious mind can deploy during future high stress exposures (when pre-frontal cortex is shut down to allow faster decision making).

The OODA loop (Observe, Orient, Decide, Act) is a four-step decision-making process that allows us to filter available information (data), put it in context and quickly make the most appropriate decision and act. Reassessing occurs as more data becomes available and the loop continues.

The OODA loop is a naturally occurring process and that could be enhanced through training.

Explaining the loop.

Observe.

Step one is to observe the situation with the aim of building the most accurate and comprehensive picture of it as possible.

Orient

The second stage of the Loop is Orient. To orient yourself is to recognise any barriers that might interfere with other components of the OODA Loop, connecting yourself with reality and seeing the situation as it really is.

Decide

Observe and orientate form the groundwork needed to make informed decisions and select appropriate courses of action. If there are multiple options, we need to use our observation and orientation skills to select the best one for the situation we face.

Act

Once we make up our mind, act. By acting we test our decision. The subsequent outcome indicates whether it was a good decision or not and provides information for when we cycle back and reassess at to the observation part of the Loop starting the looping process once more in preparation for the next action.

Land based drills.

Aim:

- Experience the sensations of rising levels of CO_2 levels in the body during exercise.
- Familiarise yourself with the physiological changes and mental stress associated with a strong urge to breathe.
- Deploy specific recovery techniques to assist in rapidly adjusting your biochemistry to prepare for subsequent Breath holds.

Walking CO_2 table

The walking CO_2 table is a set of continuous 30 second full lung, walking breath hold intervals, each separated by 15 seconds of walking recovery.

How its performed:

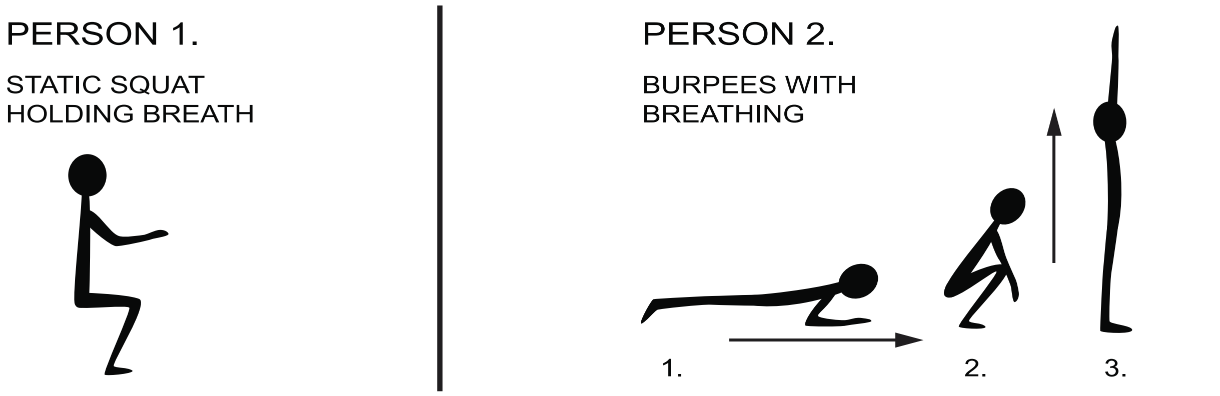
1. Walk continuously in a circle at an easy pace.
2. Relaxed breathing 2 minutes whilst walking.

3. Hold Breath 30 seconds whilst maintaining walk at a relaxed pace with nose pinched.
4. Recovery Breathing 15 seconds and set up next last breath in whilst maintaining walk at a relaxed pace.
5. Repeat for 2 minutes.
6. After 2 minutes increase walking pace to a moderate speed.
7. Hold Breath 30 seconds whilst maintaining walk at a moderate pace with nose pinched.
8. Recovery Breathing 15 seconds and set up next last breath in whilst maintaining walk at a moderate pace.
9. Repeat for 2 minutes.
10. After 2 minutes increase pace to a quick walk.
11. Hold Breath 30 seconds whilst maintaining walk at a quick pace with nose pinched.
12. Recovery Breathing 15 seconds and set up next last breath in whilst maintaining walk at a quick pace.
13. Repeat for 2 minutes.
14. After 2 minutes increase pace to a jog.
15. Hold Breath 30 seconds whilst maintaining jogging pace with nose pinched.
16. Recovery Breathing 15 seconds and set up next last breath in whilst maintaining jogging pace.
17. Full Recovery. At the conclusion of the 2 minutes jogging return to a relaxed walk with relaxed breathing
18. Finished

The total time for this drill is 10 minutes. Increase the pace of the walk every two minutes starting with an easy walk (approx 4kph) ending with a light jog (8kph).

Burpee squat pyramid

- Improves CO_2 tolerance plus.
- Teaches dynamic recovery breathing.
- Improves taking of a last breath in.



- Person 2 starts by performing one burpee whilst person 1 is in the static (stationary)
  squat position holding their breath.
- Once person 2 completes the first burpee they immediately hold their breath and move into
  the static squat position whilst person 1 performs one burpee whilst recover breathing.
- After both person 1 and 2 have completed their first burpee the sequence is repeated with two burpees. And so on repeating the sequence up to five burpees. This forms the top of the pyramid.
- Once both person 1 and 2 have completed 5 burpees and process is continued in a descending manner finishing once both person 1 and 2 have completed the last single burpee.
- Burpee pyramid (1 , 2 , 3 , 4 , 5 , 4 , 3 , 2 , 1) = Total 25 burpees.

Walking - pause breathing CO2 tolerance pyramid.

Walk at a pace you can comfortably hold your natural tidal breath rate and nasal breathing.

1. On the inhale hold your breath for 5 steps (L and R = 1)
2. Slow controlled exhale
3. Natural Inhale
4. Hold breath again but for 10 steps….
5. Repeat the above sequence increasing each breath hold by five steps until you reach a length that is uncomfortable and you feel like you need to gasp for breath on the inhale.
6. Then descend the pyramid back down to 5 breaths and start again. EG Hold breath for 5 steps, Hold breath for 10 steps, Hold breath for 15 steps, Hold breath for 10 steps, Hold Breath for 5 steps and so on.

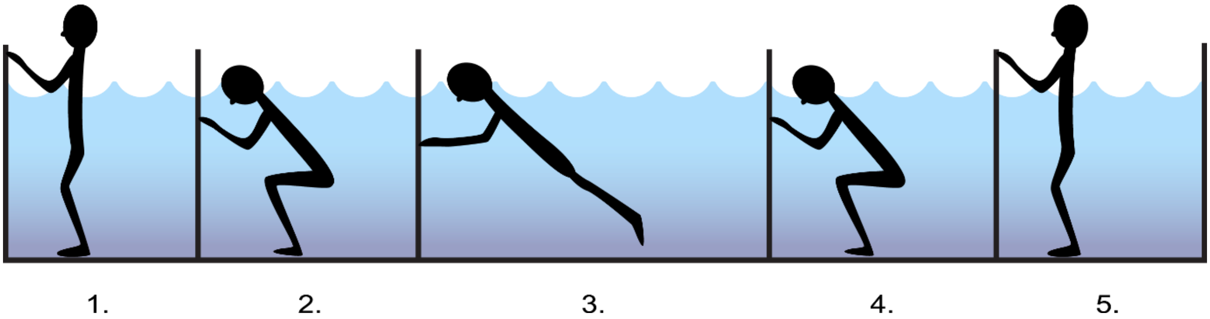
The drill should not be intense and should be performed at a pace you can maintain a relaxed and controlled exhale and inhale.

Mild discomfort / air hunger is all that is required to develop CO2 Tolerance.

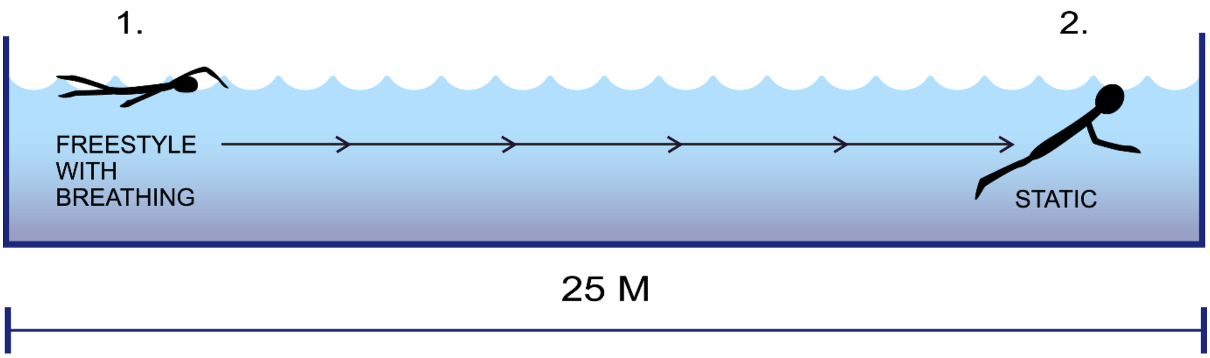
Perform this drill continuously for 10-20 minutes.

40. Pool drills

STATIC BREATH HOLD POSITIONS



FREESTYLE STATICS



Aim

A water based version of the Squat burpee drill. Highly effective at developing CO2 tolerance in a dynamic environment whist maintaining self-awareness and self-control.

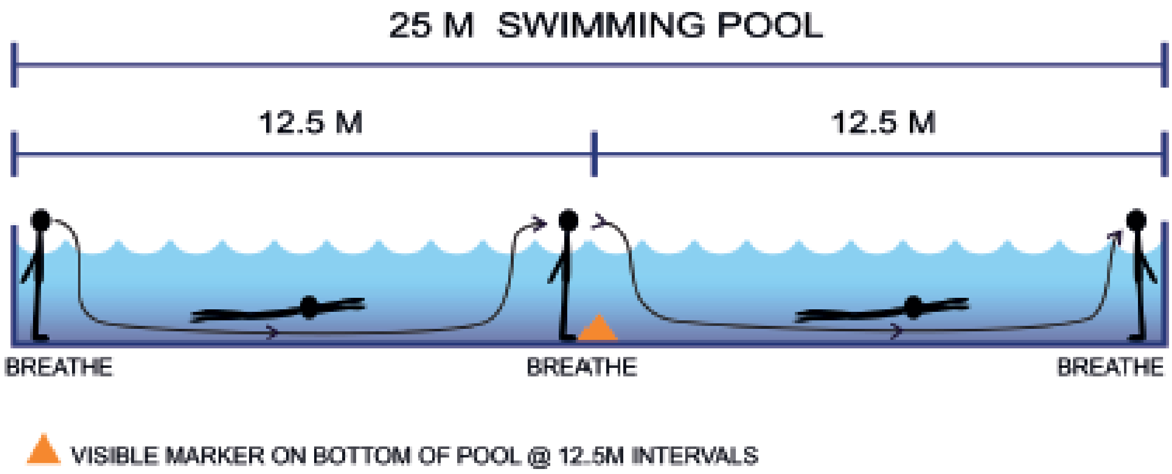
Drill

The Freestyle static drill is performed by swimming 25M freestyle at a firm (approx. 70% max exertion rate) followed immediately by a static breath hold. The breath is held until a strong urge to breathe is felt (70% max). Upon which the swimmer undertakes the next 25M freestyle (breathing and recovering during the 25M of freestyle only).

The goal is to complete multiple sets of 4 x 25M lengths (with 4 statics). Rest between sets 1-2minutes.

This is a good baseline drill for developing dynamic recovery and also keeps the breath holds safe by ensuring the swimmer is loaded with CO2 (and O2) before commencing the holds.

<u>One Breath Drill</u>



Aim

Build CO2 tolerance in a dynamic environment whist maintaining self-awareness and self-control.

Drill

The one breath drill is performed by swimming 16 consecutive 12.5M lengths underwater using a frog style stroke on a single breath for a total of 200M. Breathing only at each 12.5M interval. Breathing is restricted to 1-5 controlled breaths per exit. The drill will increase in intensity as it progresses. The idea is to maintain a calm mind and consistent breath and stroke rate regardless of the intensity increasing.

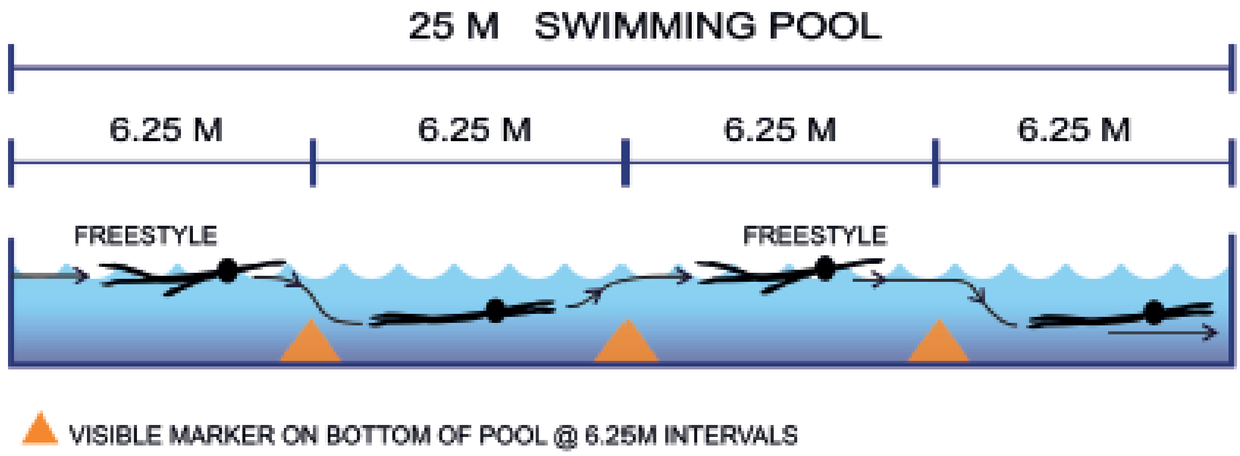
The ultimate goal is to be able to complete the entire drill with only one breath per exit.

This drill shouldn't get too intense until the last 75-50 meters. If it does get intense earlier add an additional breath or at each exit to allow more recovery. During future sessions work on progressively reducing your breaths as you become better conditioned.

Start with 5 breaths per exit and scale it according to your ability. EG. If it is too easy drop to 3 or 4 breaths and so on.

This is a good baseline / progress drill to keep track of your progress and can be added to the end of any session as a finisher.

Under Over Drill



Aim

Develop CO_2 tolerance, maintain self-awareness and self-control and develop good last breath habits when under stress in a dynamic environment.

Drill

This drill is a progression from the One Breath drill. To which we are simply adding freestyle swimming during the rest period. All the same principles apply. The intermittent freestyle increases the breath holding challenge by breaking up the rhythm and requires CO_2 generating activity to be performed during the rests.

It is performed by swimming a total of 100M continuously using consecutive 6.25M lengths alternating freestyle swimming with underwater swimming. Breathing only during the freestyle. The drill will increase in intensity as it progresses and CO_2 accumulates. The idea is to maintain a calm mind and consistent breath and stroke rate regardless of the intensity increasing. The ultimate goal is to be able to complete 200M continuous swimming.

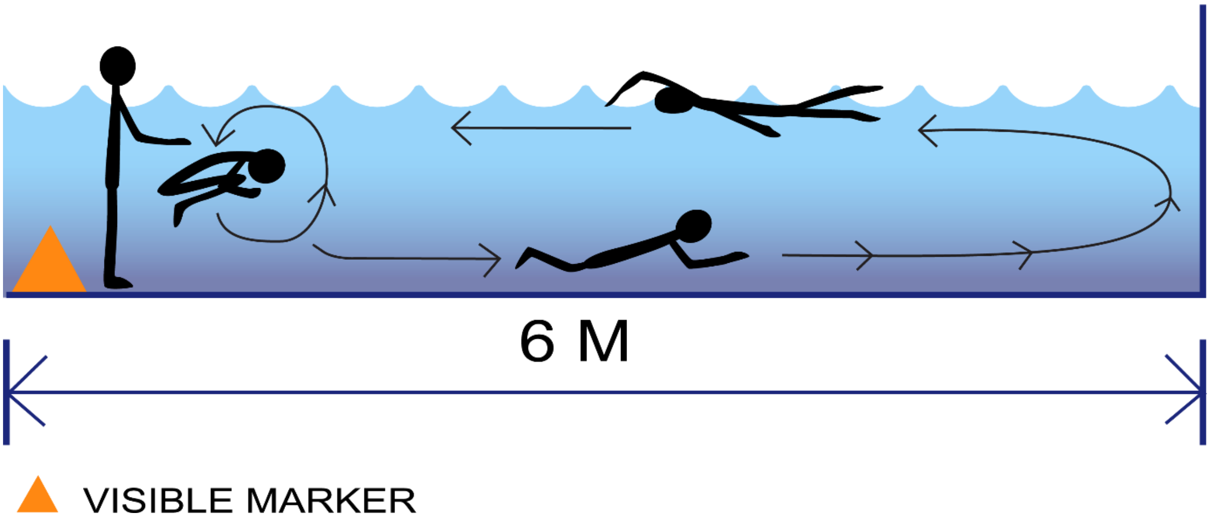
The drill should not get intense until the last 50 % of the drill. The swimmer will need to focus on unloading CO_2 during the freestyle as well as setting up the last breath.

As CO_2 accumulates longer exhales will better manage the urge to breathe prior to each underwater length. The key here is not so much a matter of how many breaths you can squeeze in during the freestyle but more so optimising the few breaths you do take.

This is a great drill that simulates a paddle out scenario where you must keep paddling (working), ducking under waves and holding your breath to negotiate the break. It teaches you to remain calm, use recovery breathing techniques to unload CO_2 and developing a good last breath before diving under again.

Note: The drill can be broken down into 50M / 100M reps or 150M repeats performed at relevant intensities EG shorter reps are performed at a higher all out intensity with less rest than the longer reps which have longer rest periods) with equal interval to rest and repeated in sets of 4 or 5 reps.

O.O.D.A. DRILL V.2 (TUMBLE & GO)



Aim

Develop CO2 tolerance, maintain self-awareness and self-control and develop good last breath and dynamic recovery breathing habits. Whilst creating a solid decision making processes under stress in an increasingly dynamic environment.

Drill

This drill imitates repeated 10 second turbulent hold downs followed directly by the need to re orientate the self, whilst under water on a single breath and swim to the surface. Where the next breath can be taken.

The drill is a progression from the Under Over Drill. To which we are simply adding a 10 second tumble following each freestyle swim. The breathing and rest period remains during the freestyle swimming component of the drill.

The tumbling creates disorientation and requires the swimmer to reorientate themselves to establish the correct direction they need to swim under water. The intermittent freestyle increases the breath holding challenge by breaking up the rhythm and generating CO2 but also provides a window for recovery.

It is performed by swimming a total of 4 complete reps before swapping out with your training partner.

The drill will increase in intensity as it progresses and CO_2 accumulates. The idea is to maintain a calm mind and consistent breath and stroke rate regardless of the intensity increasing. The ultimate goal is to complete multiple rounds of 4 reps alternating with a training buddy,

The drill should not get intense until the last 50 % of each 4 rep set. The swimmer will need to focus on unloading CO_2 during the freestyle as well as setting up the last breath heading back into subsequent tumbles.

As CO_2 accumulates longer exhales will better manage the urge to breathe prior to each tumble. The key here is not so much a matter of how many breaths you can take but optimising the few breaths you do take.

This is a great drill that simulates a caught inside scenario where the swimmer must keep paddling (working), ducking under waves and holding their breath to negotiate the break. It teaches swimmers to remain calm, use recovery breathing techniques to unload CO_2 and developing a solid last breath when under the pump.

Example training sessions

Apnea pool session 1.

Warm up

4 x static every 4 minutes on the 4 minutes (70% max - Rate of perceived exertion).

Main set

4 x 100M Under over (equal rest to effort) 75% (RPE)

2 minute rest

4 x 50M Under over (equal rest to effort) 85% RPE

2 minute rest

4 x 50M Under over (equal rest to effort) 85% RPE

Apnea pool session 2.

Warm up

4 x 25 meter underwater swim - on a single breath) Equal rest to effort

Main set

2 x 200M one breath drill (2 minute rest between each set – focus on recentring the mind and slow relaxed nasal recovery breathing during the 2 minute rest period)

2 minute rest

Finisher

10 x 25M freestyle no breathing (holding the breath and sprinting for the entire 25M) every 45 sec on the 45 95% RPE. Recovery is the time you have left until the next 45 sec comes around. If you are not a fast swimmer do the same drill but on the 60 and so on. Scale to your ability.

Remember

- **Keep training limits to 70% of your maximum.**
- **Never breath hold train in water alone and always train with a competent buddy.**

Suggested reading

O2 Advantage -By Patrick McKweon

Breatheology - By Stig Severinsen

Breathe to Heal – By Konstantin Buteyko

Deep – By James Nestor

Breath – By James Nestor

The Rise of Superman – By Steve Kottler

Teachings of the Ocean – Jernej Rakuscek (a zero to hero story of Rakuscek's learn to surf quest that ended in him surfing big Waimea Bay).

The Fear Project – Jaimal Yogis (very applicable as is written by a big wave surfer. The journey and science of how he learned to control is reactions to fear when surfing challenging waves).

The Apneist" by Antonio Del Duca

STAY LOADED – BE HARDER TO KILL!