

Ocean Diver

# What happens if?

## Module objectives

Diver training is “preventive” training; not only when teaching diving skills but also when anticipating how to recognise and resolve problems should they arise. As Ocean Diver students are at an early level of training, some of the areas considered will give them an awareness rather than in-depth knowledge and these will be built on in later diver training grades.

## Achievement targets

At the end of this module students should:

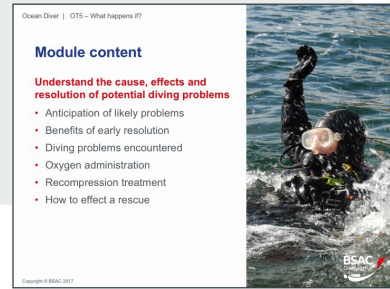
- Understand that anticipating problems is part of dive training and planning
- Understand the importance of the early resolution of underwater problems
- Be aware of the types of problem that divers may encounter
- Know that oxygen administration is a first-aid tool for divers
- Know that recompression treatment should be sought following any abnormalities present after a dive
- Know how to effect a rescue

## Additional visual aids needed

- Oxygen administration kit
- SMB/DSMB

## Module content

This session considers what happens if a problem arises when diving.



### The cause, effects and resolution of potential diving problems

Students may already know how to resolve at least one of the problems in this module from their practical training, that is the out of gas/alternate supply situation. However, there are also some new areas, which although not directly applicable to this level of diving – for example narcosis and oxygen toxicity – that students are likely to hear about when they begin diving with other more experienced divers.

The module covers the following topics:

- **Anticipation of likely problems**  
Many potential diving problems can be avoided if we take some time to think through the 'what-if' scenarios.
- **Benefits of early resolution**  
When problems occur divers need to understand the importance of reacting to and resolving the issue early and not carrying on.
- **Diving problems encountered**  
All divers need to be aware of the types of problems that may occur when diving and that many can be prevented through a combination of training and good management practices. Ocean Divers may encounter decompression illness, nitrogen narcosis, contaminated breathing gas, gas supply failure, and they should be aware of oxygen toxicity.
- **Oxygen administration**  
The use of oxygen administration equipment is outside of the scope of this module, but all divers need to be aware of the importance of this as a first-aid treatment for many diving-related ailments.
- **Recompression treatment**  
Recompression is the only treatment for decompression illness (DCI), and all divers need to understand its significance.
- **How to effect a rescue**  
In the rare occurrence of a serious incident, divers should understand how to conduct an appropriate rescue: either an alternative supply ascent; a controlled buoyant lift or a free ascent.

## Prevention is best

Most diving-related incidents are preventable and usually occur as a result of human error. By carefully adhering to the precautions detailed in training and following safe diving practices most problems can be prevented.



## Diving has a very good safety record

The sport has a very good safety record. This has been achieved through a combination of training and good management practices.

## Safety is achieved through actions

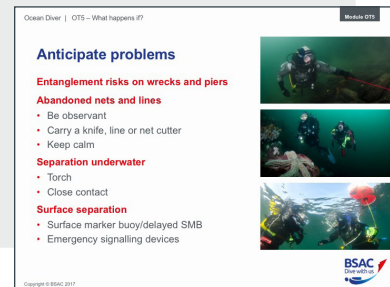
- **Dive management/triangle of responsibility**  
Everyone in the dive group needs to take responsibility for safety. The dive manager has overall responsibility for the diving operations. The dive leader has responsibility for the execution of dive plan underwater. Individual divers are responsible for diving safely within the limits of the plan and taking corrective action in event of problems.
- **Training, practice and experience**  
All divers should keep their personal skills up-to-date through training, and practice. Experience should be carefully built up and divers should always be careful of overextending themselves and attempting dives beyond their capabilities.
- **Appropriate equipment**  
Ensure equipment is serviced, working and checked.
- **Buddy checks**  
Before each dive a brief but thorough buddy check should be carried out to ensure that all equipment is properly assembled and working correctly. In the event of an emergency knowing how your buddy's equipment works will be very important in successfully resolving any problems.
- **Buddy monitoring**  
Throughout the dive regularly check-in with your buddy. Are you following the plan? Do you both have enough gas? Have you adhered to your dive time and maximum depth?
- **Common sense**  
Taking a common-sense approach to your fitness to dive and not diving beyond your capabilities is important. Divers should also be aware of the risks associated with overconfidence, when divers take excessive risks and develop a loose attitude towards adhering to safety precautions.

- **Support from other divers**

Diving with the support of an experienced dive group through a BSAC branch or centre increases safety. In the event of an incident, experienced divers will be on hand to oversee and provide rescue management and oxygen first aid. Such divers will also be familiar with how to seek expert advice from the emergency services.

## Anticipate problems

Before each dive think through what problems you might encounter. Here are some commonly encountered hazards.



## Entanglement risks on wrecks and piers

Entanglement is a hazard that is usually associated with wreck dives or other sites where fishing is commonly carried out.

- **Abandoned nets and lines**

Discarded monofilament fishing line or nets can be a snagging hazard for an unwary diver. Abandoned trawl nets can also be a problem on deeper wrecks.

- **Be observant**

The best precaution is to be aware and be observant. Divers should be on their guard at all times but especially on sites where such hazards have been reported.

- **Carry a knife, line or net cutter**

Divers should carry a net or a line cutter to cut away lines if entangled. Note that many large dive knives are not efficient at cutting line underwater, and dedicated net cutters or shears can be more effective. Put some tension on any line before cutting.

- **Keep calm**

If snagged, divers should keep calm and avoid thrashing around and making matters worse. Most important, do not attempt to twist or turn around. This will only cause further tangling. As soon as you feel a snag, freeze and then slowly back up a little and see if that frees you. Nine times out of 10 it will. If not, seek assistance from your buddy.

## Separation underwater

Buddy separation is possible on all dives.

- **Torch**  
In low-light conditions the use of a torch can greatly reduce this possibility, making it much easier to see your buddy.
- **Close contact**  
Hold hands or use a buddy line, if required.

## Surface separation

In choppy water divers can lose sight of each other or the dive boat.

- **Surface marker buoy/delayed SMB**  
An inflatable surface marker buoy (SMB) can be used on the surface to keep a buddy pair together and can also be used as a signaling device to the boat cover. (Instructors should show some examples of these so that students know what they look like, but do not get diverted into detailed demonstrations of features and use at this stage. Training on the use of SMBs/DSMBs belongs in Sports Diver training.)
- **Emergency signalling devices**  
There are a variety of devices available. Flags, torches, strobes and even old CDs can be used as signaling devices to attract the attention of surface cover.

## Early resolution

In following sections, we will review some of the more serious diving problems. However, there are some common principles that apply to all diving problems.

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### Early resolution

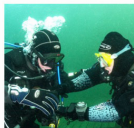
- Prevention is always better than cure
- Act early
- Regain control

**Resolve problems**

- Don't press on
- Seek buddy assistance

**Buddy monitoring**

**Practice, practice, practice**



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## Prevention is always better than cure

With any problem, prevention is better than cure.

- **Act early**  
Acting early gets a problem under control before it gets out of hand. For example, if a diver finds that they are getting out of breath on a long surface swim, the diver should take a few minutes to regain control of their breathing before moving on. Pushing on and getting dangerously out of breath could result in panic.

- **Regain control**  
In the event of real problem, a diver may either resolve it, resolve the problem with assistance of their buddy, or the buddy may need to carry out a rescue.

## Resolve problems

Prevention and resolution of problems both rely on rescue skills being continually practiced. Training shouldn't stop at the end of the course. If divers have had a long layoff from diving, then a skills refresher session should be undertaken before returning to the sport to ensure that basic skills are of an acceptable standard.

- **Don't press on**  
All divers have the right to cancel or abort a dive at any time for any reason without fear of judgment. Don't allow yourself to be pressurised into conducting a dive you feel unprepared for. Underwater if you are feeling uncomfortable about dive safety, then abort the dive: there is always another day.
- **Seek buddy assistance**  
Following the practices of buddy diving, where each diver looks out for their partner, most issues can be resolved before they become a problem. This ensures that rescues are a very rare occurrence. In fact, the vast majority of divers will never encounter a rescue situation.

## Buddy monitoring

Buddy diving and monitoring is of great importance. Keep close and be ready to assist if required. Do regular check-ins with your buddy. Make sure you both have enough gas and that the dive is running to plan. Pre-agree signals for bringing the dive to an end.

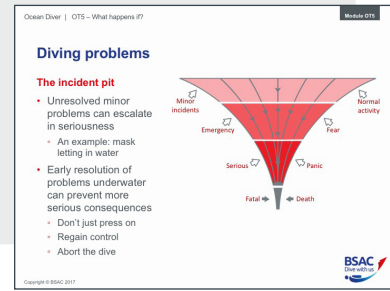
## Practise, practise, practise

Dive skills need to become second nature so that you can focus your energy on enjoying the dive itself.



# Diving problems

Before looking at some of the more significant diving problems students should be introduced to the concept of the incident pit.



## The incident pit

Incidents rarely happen as the result of just one factor but, more commonly, are the result of a combination of factors. Each factor in isolation may be quite innocuous but, as the combination builds, the stress on the diver increases ever more rapidly until it is beyond their capabilities. This effect has been likened to a pit whose sides become steeper and steeper the further one descends – do not fall in.

- Unresolved minor problems can escalate in seriousness**

While the slope is gentle it is easy to retain one's footing and to climb back out: minor incidents can be resolved. As the descent continues, one's footing becomes less sure and it becomes more and more difficult to climb out: minor incidents escalate into emergencies, which become more difficult to resolve. Ultimately, all grip is lost and the severity of the emergency exceeds the ability for resolution with fatal consequences.

**An example: mask letting in water**

An annoying leaky mask, which seems OK at the surface could result in panic if the underwater visibility is unexpectedly poor.

- Early resolution of underwater problems can prevent more serious consequences**

Resolving problems, particularly early on if underwater, does prevent more serious consequences that could occur. In many instances, divers train for "worst case scenarios" so they can assist on less serious cases with a high degree of proficiency.

- Don't just press on
- Regain control
- Abort the dive

Specific diving-related issues to be considered include: DCI, nitrogen narcosis, oxygen toxicity and loss or contamination of breathing gas.

## Decompression illness (DCI)

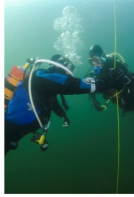
Students should understand there is a risk of DCI on all dives, but thorough training and adhering to guidelines will reduce this risk to acceptable levels. However, it should be realised that the risk cannot be completely eliminated.


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### Decompression illness (DCI)

**Nitrogen release**

- Ascents need to be controlled
- Ascents do not release all nitrogen
- Surface release for many hours
- Further diving in this period adds to nitrogen levels
- Minimise risk of DCI by managing nitrogen
  - Tables and computers
  - Dive practice
  - Using nitrox (gas mix with oxygen >22%)



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### Nitrogen release

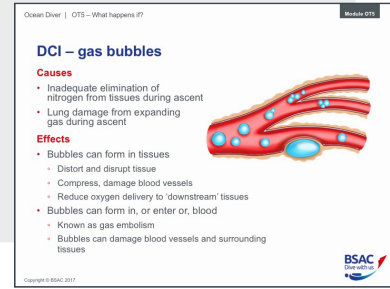
Reviewing what was learned in OT4, Dive Planning, the students should be reminded about nitrogen release.

- **Ascents need to be controlled**  
Any ascent has to be controlled with good buoyancy.
- **Ascents do not release all nitrogen**  
An ascent will not release all the nitrogen absorbed on a dive.
- **Surface release for many hours**  
Nitrogen continues to be released for many hours following a dive.
- **Further diving in this period adds to nitrogen levels**  
Subsequent dives in a sequence will elevate nitrogen levels.
- **Minimise risk of DCI by managing nitrogen**  
Planning and managing nitrogen on dives will minimise the risk of DCI. Divers use tables or computers to plan dives, follow good dive practice and use suitable nitrox mixes.
  - **Tables and computers**  
All dives must be planned and decompression schedules calculated. BSAC tables or a suitable diving computer should be used to plan and monitor dive depth and duration.
  - **Dive practice**  
Good diving practice includes careful control of buoyancy especially on ascents. Avoid of saw-tooth profiles, etc.
  - **Using nitrox (gas mix with oxygen >22%)**  
Using a nitrox mix and air tables for decompression planning can reduce the DCI exposure risk. However, any advantage is lost if diving is conducted on the nitrox tables or using a dive computer set to the nitrox mix.



## DCI – gas bubbles

Decompression illness is a term that covers a number of conditions that may affect divers including the formation of gas bubbles within the body.



### Causes

There are two main causes of bubble formation.

- **Inadequate elimination of nitrogen during ascent**  
Nitrogen bubbles can be caused by inadequate elimination of nitrogen from the body tissues during an ascent.
- **Lung damage from expanding gas during ascent**  
Gas bubbles, called gas emboli, can arise following lung damage during ascent.

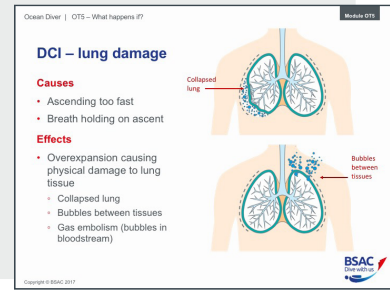
### Effects

Both types of bubbles can have similar effects. The effects may depend on the part of the body involved.

- **Bubbles in tissues**  
Bubbles can form in tissues as a result of gas coming out of solution when the surrounding pressure is reduced, in much the same way as gas is released when opening a fizzy drink can or bottle.
  - **Distort, disrupt tissue**  
Body tissues may be damaged and forced out of shape by the bubbles compressing nerves and causing pain and weakness in the affected tissues.
  - **Compress, damage blood vessels**  
The bubbles within the tissues can apply pressure on blood vessels causing damage and reducing blood flow.
  - **Reduce oxygen delivery to 'downstream' tissues**  
This will reduce oxygen delivery to cells downstream of the blockage.
- **Bubbles can form in, or enter, the blood.**
  - **Known as gas embolism**  
Bubbles forming in the blood, or entering the blood, are known as gas emboli.
  - **Bubbles can damage blood vessels and surrounding tissues**  
As the bubbles pass through the blood vessels they can cause damage to the lining of the vessels, hinder the uptake of oxygen by the surrounding tissues and disrupt the body's functions.

## DCI – lung damage

Damage to the lungs (called barotrauma) can result not only in gas bubbles passing into the bloodstream, but also in gas pockets between the tissues and organs in the chest.



### Causes

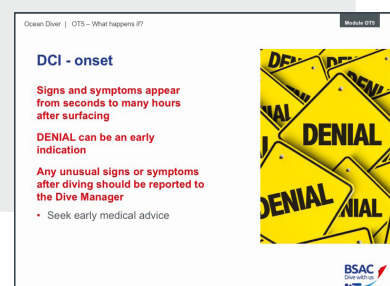
- **Ascending to fast**  
Divers should carefully control their ascent speed and adhere to the recommendations provided by the BSAC tables or a dive computer. Rapid ascents due to poor buoyancy control are a significant contributory factor in many DCI cases.
- **Breath holding on ascent**  
Untrained or panicking divers may forget to breathe normally and hold their breath during an ascent.

### Effects

- **Overexpansion causing physical damage to lung tissue**  
Overexpansion of breathing gas in the lungs causes physical damage to lung tissue and tiny blood vessels
  - **Collapsed lung**  
Gas escaping from damaged air sacs, or alveoli, can pass through the thin membrane sac surrounding the lungs into the chest cavity. Expansion of this gas on ascent can cause the lung to collapse resulting in breathing difficulties.
  - **Bubbles between tissues**  
Gas escaping from damaged alveoli can travel between the tissues around the lungs and heart in the chest cavity up to the neck.
  - **Gas embolism (bubbles in bloodstream)**  
Gas bubbles can also pass through the damaged lung tissue and enter the blood supply resulting in gas embolism.

## DCI – onset

Decompression illness can present with a wide variety of signs or symptoms.



## Signs and symptoms appear from seconds to many hours after surfacing

Symptoms can appear from within seconds to many hours after surfacing from a dive. Any unusual signs or symptoms that occur up to 24 hours after a dive should be considered as possible DCI.

## Denial can be an early indication

One of the first indications of DCI is denial. Divers will often deny anything is wrong. Getting DCI is not something to be embarrassed about, but it does need resolving as quickly as possible. And the longer the denial period, the worse a diver could become and the more complex the treatment needed.

## Any unusual signs or symptoms after diving should be reported to the Dive Manager

Decompression illness is a very serious but treatable condition. It is best if it is recognised early. Any usual signs or symptoms after diving should be reported to the Dive Manager.

- **Seek medical advice**

If you have any concerns, then you should seek urgent medical advice. Tell any doctor you consult that you have been diving and what the signs and symptoms are.

## DCI – signs and symptoms

Do not worry about differentiating the causes of DCI, the treatment will be the same. Some or all of the following may be present and the lists are not in any significant order. Some symptoms may not happen at all.

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### DCI – signs and symptoms

**Signs**

- Itches and rashes
- Nausea, headaches, confusion
- Weakness, paralysis
- Voice change/crepitation
- Shortness of breath
- Unconsciousness

**Symptoms**

- Chest discomfort
- Aches in joints
- Numbness, tingling
- Visual disturbances, dizziness
- Any abnormality after diving

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## Signs

Signs are objective evidence of a disease or illness, and are things that can be recognised by an observer. Signs of DCI include:

- **Itches and rashes**

Rashes or mottling of the skin are commonly overlooked signs that should be taken seriously. Remember denial.

- **Nausea, headaches, confusion**

It's easy to confuse such signs with other conditions such as seasickness, but if in any doubt treat as DCI.

- **Weakness, paralysis**  
A more obvious DCI sign that clearly should not be ignored.
- **Voice change/crepitation**  
Crepitation is bubble formation in the tissue under the skin, giving a bubble-wrap-like effect. It can cause voice change as a secondary effect when the tissues expanded by bubbles put pressure on your voice box. It's a relatively rare sign but may be a sign of very serious DCI.
- **Shortness of breath**  
Breathing difficulties can accompany severe DCI.
- **Unconsciousness**  
Unconsciousness may also be a consequence of DCI. It's a more obvious sign and is very serious.

## Symptoms

Symptoms are subjective. They are things that can only be experienced or described by the person experiencing them.

- **Chest discomfort**  
Pains following a dive should be taken seriously.
- **Aches in joints**  
It's not uncommon after exercise or carrying heavy weights to suffer from aches and pains, but joint pain is a symptom of DCI and one of reasons that the DCI is often called the Bends.
- **Numbness, tingling**  
Vague symptoms such as areas of numbness or tingling may occur.
- **Visual disturbances, dizziness**  
Tunnel vision, loss of peripheral vision, flashing lights, and other visual disturbances, may be experienced by a diver affected by DCI. Hearing and balance problems may also occur.
- **Any abnormality after diving**  
Any abnormality after a dive should be thought of as a symptom of DCI.

## DCI – treatment

There is only one way to resolve DCI

### Only one - recompression

Urgent treatment is required in a recompression chamber.

The longer DCI is left untreated, the more likely that any damage to tissues may not be resolved, which can have serious consequences

- **Recompression chamber**

The treatment recompresses the diver in a pressurised chamber. Treatments can take many hours to complete and in extreme cases may have to be repeated.

- **Reduces bubble size**

Recompression reduces the size of the bubbles within the body.

- **May restore compromised circulation**

This helps promote the restoration of circulation to affected areas.

- **Needs specialist medical supervision**

Recompression facilities have diving medics who provide specialist supervision of any treatment.

### Diver first aid

Because DCI is a serious condition, divers provide first aid on site, by giving oxygen first aid. (Point out/show to students your branch or centre's oxygen administration kit or, if diving is carried out from hard boats, emphasise that the Dive Manager ensures there is oxygen on board. Training is given by the BSAC in oxygen administration and is open to divers of a minimum qualification of Ocean Diver).

- **100% oxygen**

The equipment can provide the casualty with up to 100% oxygen, remember air only contains 21% oxygen.

- **Improves oxygen delivery to tissues**

The benefit of oxygen administration is that it increases the oxygen levels in the blood and helps to improve oxygen delivery to damaged tissues.

- **Improves nitrogen release as no nitrogen being breathed in**

It also speeds up elimination of nitrogen from the body, by removing nitrogen from the gas breathed in.



- **Fluids**

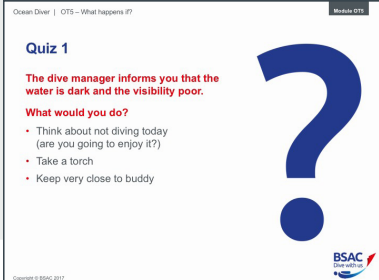
Blood circulation can be optimised by ensuring that the body is properly hydrated. Low fluid levels may hinder the flow of blood and reduce the effectiveness of other treatments.

- **One litre per hour if possible**

Administer fluids (water or isotonic drinks) at a rate of one litre per hour. Avoid fizzy drinks. Do not apply fluids if there is a risk of unconsciousness or if surgery is likely to be required.

## Quiz 1

Instructors should routinely check for transfer of knowledge to the students. This can be done by asking an open question such as:



Ocean Diver | OT5 – What happens if? Inside OT5

**Quiz 1**

The dive manager informs you that the water is dark and the visibility poor.

**What would you do?**

- Think about not diving today (are you going to enjoy it?)
- Take a torch
- Keep very close to buddy

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## The dive manager informs you that the water is dark and the visibility poor. What would you do?

Question assesses the students' ability to start thinking about anticipating problems and taking actions to resolve or mitigate the problem.

- **Think about not diving today (are you going to enjoy it?)**

Never push yourself to undertake a dive you do not feel that you are comfortable in doing. There is always another day to go diving.

- **Take a torch**

A torch will help you see your surroundings and avoid underwater hazards. It will also reduce the risk of separation, as you will find it easier to keep track of your buddy.

- **Keep very close to buddy**

Buddy pairs should always keep close even in clear water, but in low visibility conditions keeping close will reduce separation risk.



## Nitrogen narcosis

Students may hear other divers refer to nitrogen narcosis or “the Narks” and, although unlikely to affect them at their level of diving, the following explains what narcosis is.

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### Nitrogen narcosis

**Cause**

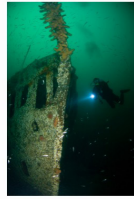
- Nitrogen breathed under pressure affects nerve transmission
- Usually noticed below 30m

**Signs and symptoms**

- Affects people in different ways
- Euphoria or anxiety
- Unlikely to be experienced by Ocean Divers

**Treatment**

- Ascending to a shallower depth immediately resolves the narcosis



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### Cause

- **Nitrogen affects nerve transmission**  
It is thought that nitrogen breathed under pressure affects the transmission of impulses in the nerve cells.
- **Usually noticed below 30m**  
Generally, this is only noticed when divers go deeper than 30m, but it can start much shallower.

### Signs and symptoms

Nitrogen narcosis is often described as being similar to the effects of alcohol and has been described as the raptures of the deep.

- **Affects people in different ways**  
Nitrogen narcosis affects individuals in different ways. The effects can also vary from day to day. Some divers deny they ever get it.
- **Euphoria, or anxiety**  
Most divers experience narcosis as anxiety or worry rather than the euphoria described in books or experienced in recompression chamber dives.
- **Unlikely to be experienced by Ocean Divers**  
Ocean Divers are limited to a maximum depth of 20m so are generally unlikely to encounter this condition.

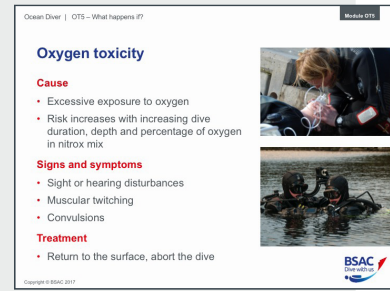
### Treatment

The condition can be easily resolved.

- **Ascending to a shallower depth immediately resolves the narcosis**  
Even ascending a few metres can reduce the symptoms almost immediately.

## Oxygen toxicity

Students may recall earlier references to oxygen toxicity (OT2 and OT4). Although very unlikely to affect Ocean Divers, the following explains what oxygen toxicity is. While there are actually two types of oxygen toxicity, this section concerns only acute oxygen toxicity, which is the type most likely to be encountered in diving.



### Cause

- Excessive exposure to oxygen**

Oxygen can be toxic when breathed at the high pressures encountered when diving. Oxygen toxicity determines the maximum operating depth (MOD) for a particular nitrox mix. A gas mix with a higher percentage of oxygen will have lower maximum operating depth, so for example Nitrox 32 has an MOD of 33m whereas Nitrox 36 is limited to 27m.
- Risk increases with increasing dive duration, depth and percentage of oxygen in the nitrox mix**

Divers must ensure that they always observe the MOD for a nitrox mix, but this does not guarantee freedom from oxygen toxicity. The length of time that oxygen is breathed at depth is also a major consideration.

### Signs and symptoms

Some or all of the following may be present and the list is not in any significant order. Some signs and symptoms may not happen at all.

- Sight or hearing disturbances**

Visual or auditory disturbances, including dizziness or nausea, can occur.
- Muscular twitching**

Muscular twitching of the face, lips, or fingers may be seen.
- Convulsions**

In serious cases convulsions or fits may occur, which lead to a significant risk of drowning when underwater.

### Treatment

Remind students that prevention is better than cure. Ocean Divers are restricted to 20m depth and to a maximum nitrox mix of 36%, which should largely eliminate the risk of oxygen providing you follow the rules.

In the event of an oxygen toxicity incident

- **Return to the surface, abort the dive**

This may require the buddy to execute a rescue if convulsions or unconsciousness has occurred.

## Contaminated breathing gas

Diving compressors are specialist equipment providing high-performance filtration and drying of the compressed diving gas, but occasionally things can go wrong resulting a so-called “bad fill”.



### Caused by poor maintenance or operation of diving compressor

Contaminated breathing gas arises as a consequence of poor maintenance or operation of a compressor. Whether at a branch or dive centre, compressors work to stringent breathing gas purity standards and, fortunately, bad fills are few and far between. However, problems do sometimes arise. There two main problems that can occur: atmospheric contaminants can be drawn into the air intake or the compressor’s filters can become exhausted or are faulty. Compressor stations need to ensure that the intake for the compressor is away from any possible sources of atmospheric contamination, car and other engine exhausts.

### Results in contamination with

- **Oil**  
Oil is used to lubricate the mechanical components of the compressor. Small traces of oil will pass into the compressed gas, but these are normally removed by the compressor filtration system.
- **Carbon monoxide**  
This is formed by the partial breakdown of the hydrocarbon oils used to lubricate the compressor. In well-maintained compressors normally only very low amounts are created. Compressor filters contain absorbent agents to remove any carbon monoxide produced.

Carbon monoxide reduces the efficiency of the blood delivery of oxygen to the cells. Students may be aware of people who have suffered from carbon-monoxide poisoning from faulty heaters or boilers in the home. Although this poisoning is generally over a longer period of time than a diver will be exposed to, it is the increased pressure that magnifies the effect when diving. This is why there are stringent breathing gas purity standards for breathing-gas filling stations.

- **Carbon dioxide**  
Is another by product of the breakdown of compressor oil. Trace levels should be controlled by the compressor's filtration system.
- **Water vapour**  
Water vapour is naturally occurring in the atmosphere and is normally removed by the compressor filters. Its presence can cause corrosion of diving cylinders.

## What you might notice pre-dive

Problems with contaminated diving gas can often be detected during your pre-dive checks.

- **Oily taste or smell**  
An oily taste or smell may be detected when checking equipment. If there is contamination, remember there is also a possibility that carbon monoxide may be present which cannot be detected on its own by taste or smell.

## What you might notice on the dive

Depending on the level of contamination, problems may not become apparent until a diver is breathing the gas on a dive.

- **Feeling sick**  
Apart from the taste, the diver may also begin to feel nauseous.
- **Dizziness or disorientation**  
The diver may become dizzy or disoriented.
- **Headache, during or following a dive**  
There may be no apparent sign of contamination before or during the dive, but divers may experience headache during or after a dive.

## Contaminated breathing gas (2)

### Resolution

- **As always, prevention is better than cure. Make sure you always get your gas fills from a reputable dive centre. Change cylinder if pre-dive**

If there is any doubt over the quality of gas, then change the cylinder before diving. Keep in mind your new cylinder was most likely filled from the same compressor.

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### Contaminated breathing gas (2)

**Resolution**

- Change cylinder if pre-dive
- Abort the dive
- Buddy assistance: AS ascent/rescue
- Avoid diving again same day
- Consider medical attention

**Report occurrence to**

- Dive Manager
- Filling station



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- **Abort the dive**  
If bad breathing gas is detected during a dive, the dive should be aborted. The 'something wrong' sign should be given.
- **Buddy assistance: AS ascent/rescue**  
The buddy should remain very close throughout the ascent to assist if necessary. Upon surfacing, breathing normal air should resolve any giddiness or nausea but a headache may persist.
- **Avoid diving again that day**  
It is advisable not to dive again on that day, and a wise diver allows a sufficient recovery period.
- **Consider medical attention**  
Seek medical advice/assistance, especially if symptoms don't resolve quickly.

## Report occurrence to

- **Dive Manager**  
The bad breathing-gas fill and any effects a diver has had or is still experiencing must be reported to the Dive Manager. The diver will be monitored for a period following the dive as is normal when any abnormality occurs during or after a dive. The Dive Manager will also alert other divers who may have had a fill from the same source.
- **Filling station**  
The bad breathing-gas fill must also be reported to the filling station. They may be unaware of the problem and need to rectify it as soon as possible.

## Gas supply failure

Gas supply failure is fortunately rare but is a very serious hazard when diving.

### Causes

Causes of gas supply failure are:

- **Poor monitoring**  
Failure to plan and monitor gas consumption during a dive is by far the most likely scenario and is completely avoidable.
- **Free flow – cold water**  
When diving in cold water (below 10°C) it is possible for ice to form inside the demand valve resulting in a 'free flow' of gas rapidly depleting a divers gas supply.

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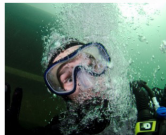
### Gas supply failure


**Causes**

- Poor monitoring
- Free flow - cold water
- Equipment failure - rare

**Prevention**

- Regular gas checks
- Protect equipment from cold before diving
- Service equipment



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- **Equipment failure – rare**  
Fortunately, equipment failure is rare.

## Prevention

- **Regular gas checks**  
Regularly check your gas supply and adhere to the rule of thirds.
- **Protect equipment from cold water before diving**  
Keep your demand valve dry and warm before the dive. Avoid breathing through the demand valve or pressing the purge button on the surface. As much as possible avoid heavy exertion on the dive and keep your regulator in your mouth to avoid cold water entering the mouthpiece.
- **Service equipment**  
Ensuring that all equipment is routinely serviced and used in line with manufacturer's instructions is the best defence.

## Rescues – alternative supply (AS) ascent


Loss of a diver's main breathing gas supply will require them to use an alternative supply to reach the surface. This is likely to be an octopus rig or pony cylinder.

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### Rescues – alternative supply (AS) ascent

**Running out of gas**

- AS is a back up system
- Dive should be aborted
- Buddy pair ascend together, using AS
- Once on surface
  - Rescuer to fully inflate own BC
  - Inflate casualty's BC by mouth
  - Release weights in emergency



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## Running out of gas

If an out of gas situation occurs, this must be treated as an emergency and a controlled AS ascent should be made. (This practical skill is covered in the practical modules OT2, OT3 and OO2).

- **AS is a back-up system**  
The AS is something that needs to be checked during every buddy check. It is also advisable to check it again underwater early in the dive.
- **Dive should be aborted**  
In an event that requires the use of an AS, then divers should stop briefly and regain control of the situation. The dive should then be aborted.
- **Buddy pair ascend together, using AS**  
The ascent considerations depend on type of dive being undertaken. If diving at the base of a wall or slope or shot line, then an AS ascent using these reference points is preferable, but if out of sight of a reference point, a direct AS ascent to the surface should be made.



- **Once on the surface**

The AS rescue doesn't end once the surface is reached. The following actions need to be completed:

- **Rescuer to fully inflate own BC**  
The rescuer should fully inflate their own BC on the surface first.
- **Inflate casualty's BC by mouth**  
The casualty's BC should be inflated; with total air loss, this will need to be by the BC mouthpiece or emergency cylinder (if fitted).
- **Signal for help**
- **Release weights in emergency**

Ditching the weight belt or other weight system should be considered.

## Rescues – controlled buoyant lift (CBL)


A diver may become incapacitated underwater by injury, stress or illness and need assistance from their buddy to reach the surface by means of a controlled buoyant lift.


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### Rescues – controlled buoyant lift (CBL)

**Incapacitated/unconscious buddy (rare)**

- Dive should be aborted
- Priority to lift casualty to surface
- May involve a faster than normal ascent
- Ensure casualty buoyant on surface
- Signal for help
- Consider alternative means of positive buoyancy
- If convulsing (oxygen toxicity) wait until convulsions stop before lifting



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## An incapacitated/unconscious diver (rare)

This must be treated as an emergency and a controlled buoyant lift should be carried out. (This technique is covered in practical modules OT5 and OO3).

- **Dive should be aborted**
- **Priority to lift casualty to surface**  
The priority is to get the casualty to the surface, particularly when they are unconscious.
- **May involve a faster than normal ascent**  
When learning to do a CBL, it is done in a very controlled manner but in reality, a CBL may mean a slightly faster than normal ascent. This may incur a decompression penalty but that can be resolved on the surface, but not getting to the surface means no resolution.
- **Ensure casualty buoyant on surface**  
Following the CBL and on reaching the surface, the rescuer must firstly ensure the casualty is buoyant by fully inflating the casualty's BC and if not already done, dump their weights to prevent them sinking before surface assistance reaches the divers. The rescuer should then ensure they also buoyant.

- **Signal for help**  
Once on the surface give a clear and loud emergency signal and shout for help. Throughout the rescue, rescuers should ensure that they maintain a firm grip of the casualty at all times.
- **Consider alternative means of positive buoyancy**  
When the casualty's breathing gas supply is exhausted, and therefore the BC direct feed no longer works, an alternative means of achieving positive buoyancy, such as dumping the casualty's weights/weight belt, or using the BC emergency inflation cylinder (if fitted), will need to be used. This may result in a less controlled rate of ascent, but this is preferable to an unsuccessful lift.
- **If convulsing (oxygen toxicity) wait until convulsions stop before lifting**  
Where the casualty is suffering from convulsions due to oxygen toxicity, it is likely that their breathing stops and their airway becomes obstructed. At this point, any ascent to the surface could result in a burst lung. Under such circumstances, wait until the convulsions have stopped before lifting the casualty. It is also safer for the rescuer.

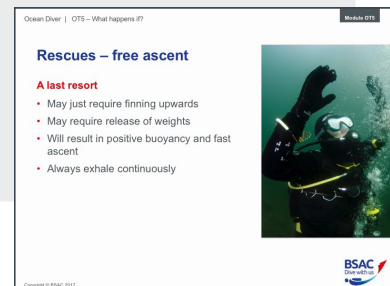
## Rescues – free ascent

As a last resort in an emergency, a diver can carry out a self-rescue. This skill is not practiced.

### A last resort

There is no second chance and a free ascent must result in the diver reaching the surface.

- **May just require finning upwards**  
Depending on the diver's buoyancy finning upwards for a short distance will start an ascent and then the expansion of gas in the diver's suit or BC, or the suit material, will provide sufficient buoyancy to continue the ascent.
- **May require release of weights**  
If the diver is over-weighted at depth, then finning will require too much effort. The diver will need to jettison their weight system. This needs to be done carefully and the weight belt/weights held clear of the diver before release to ensure that they do not snag on any other equipment and prevent the diver's ascent.
- **Will result in positive buoyancy and a fast ascent**  
Once the weight system has been released there is little the diver can do to control the rate of ascent. Creating drag by spreading arms and legs and angling fins will help.



- **Always exhale continuously**  
The diver should exhale as deeply as possible during a free ascent to counteract the rapidly decreasing ambient pressure.

## Rescues – surface support

For Ocean Divers, the resolution of a rescue requires that they get the casualty/their buddy to the surface and ensure that they are positively buoyant.



### Dive manager/surface cover takes over on the surface

From that point on, the more experienced divers in the group can organise and handle the surface recovery and any additional assistance that may be required. A rescuing diver signaling distress, or a lone diver appearing on the surface, will activate the surface cover to provide assistance. The assistance provided will include:

- **Monitoring both casualty and rescuer**  
Following any abnormal ascent, even if it is a controlled rescue ascent such as using an AS, the divers involved will automatically be monitored by the Dive Manager and other divers following the dive.
- **Administering oxygen first aid**  
If any abnormalities occur following an ascent, then oxygen first aid will be administered.
- **Seeking specialist medical advice via coastguard**  
Where necessary, the Dive Manager will contact a diving medical specialist for further advice and/or arrange evacuation by the emergency services.
- **Arranging urgent recompression via coastguard**  
With DCI cases, urgent recompression treatment is needed and this will immediately be set in train by the Dive Manager. Note: the coastguard is the coordinating emergency surface at sea or by the coast. If at an inland site, the ambulance service will take over.

## Quiz 2

Instructors should routinely check for transfer of knowledge to the students. This can be done by asking an open question such as:

### What are the signs and symptoms of DCI?

Signs:

- Denial
- Voice change/crepitation
- Shortness of breath
- Itches and/or rashes
- Nausea, headaches, confusion
- Weakness, paralysis
- Unconsciousness

Symptoms:



- Chest discomfort
- Aches in joints
- Numbness, tingling
- Visual disturbances, dizziness
- Any other abnormality after a dive

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### Quiz 2

**What are the signs and symptoms of decompression illness?**

- **Signs**
  - Denial
  - Voice change/crepitation
  - Shortness of breath
  - Itches and/or rashes
  - Nausea, headaches, confusion
  - Weakness, paralysis
  - Unconsciousness
- **Symptoms**
  - Chest discomfort
  - Aches in joints
  - Numbness, tingling
  - Visual disturbances, dizziness
  - Any other abnormality after a dive

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## Summary

Recap the module objectives and provide students with opportunity to ask questions.

### The causes and effects of potential diving problems

- Decompression illness
- Nitrogen narcosis
- Contaminated breathing gas
- Gas supply failure
- Oxygen toxicity

### How to resolve problems

- Oxygen administration
- Recompression treatment
- Rescues

