

Safe Snorkelling Workbook

First Edition

SAMPLE PAGES



Student's
Name _____

Bob Moffatt

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INTRODUCTION

A. Why study this workbook

To enjoy snorkelling as an adult

This is a workbook for high school students wishing to attain the physical fitness and ocean situation awareness skills necessary to snorkel with their family and friends after they leave school.

It is not a manual for snorkelling instructors, nor a guide for commercial operators who run snorkelling tours as part of their business.



My first class to North West Island, Queensland in 1979

To get a job where snorkelling is part of a business

None the less, if you want to get a job as a snorkelling worker, this workbook addresses many of the issues commercial snorkelling operators face and may serve as a useful introduction of what you can expect from your prospective employer.

There are plenty of publications that describe these requirements and can usually be found on Government websites that assist with workplace health and safety issues. For example www.worksafe.qld.gov.au

To compete a unit of study as part of the school curriculum

Snorkelling is studied in schools in most Australian states and your teacher will have organised a course that matches the curriculum. This edition has been organised with the basics first, so if you are completing a marine science course, with a few pool sessions before your trip and snorkelling in a supervised tour, sections 1-3 may only apply. However, if you want to work in the industry, the complete workbook gives you an insight into the course material you need to study.

B. Why no E book?

Firstly with E books, you can just cut and paste answers, and we all have been guilty of that, however this workbook requires you to write out the answers in the hope you will remember the every day facts you need to know while snorkelling.

Secondly, internet reception is poor underwater, and mobile phone signals on many offshore islands are next to zero, so to get an answer from "Siri" just won't happen.

For example:

Your buddy suffers severe chest pains, falls over and becomes unconscious - how many compressions a minute was that? Should I give EAR? No time to unlock your phone - this needs to be done immediately.

You are in the water and you step on something causing great pain; - was that vinegar or hot water? Sure you need to get back to your phone and then seek urgent medical help, but you need to know what to do until help arrives.

You get a really bad cramp - again, its a bit hard to unlock your phone in the water. So the idea of writing out the answer to say question 10, on page 32, is designed to help you remember what to do. You won't remember a thing if you just cut and paste the answer from an Ebook, while watching YouTube videos.

Finally

And finally, the workbook is not a trick question book. Each section has objectives, and if you are studying at school, your teacher may put a different verb in. In addition, all the answers are referenced, so it's just a matter of getting organised, looking them up from the page referenced and writing them out.

Bob Moffatt
Wet Paper Publications
April 2022



Companion guides

Teacher's guide and power points.

These resources are available at:

www.wetpaper.com.au

Missing worksheets from my old 6th edition workbook

These are now free at:

<https://www.wetpaper.com.au/products/Safe=snorkelling-workbook-HARD-COPY-143.htm>

SECTION 1: EQUIPMENT SELECTION

Objectives

- A. List advice you could get when buying equipment.
- B. List types of snorkelling equipment you can buy including masks, snorkels, fins, PPE, underwater cameras, spear fishing gear and for each:

1. Describe how each piece helps you snorkel.
2. Distinguish between types and materials used in each.
3. List advantages and disadvantages of each item purchased.
4. Describe equipment care and maintenance of each item.

- C. Evaluate shark deterrent devices
- D. Experiment with snorkelling PPE materials to determine equipment care.

A. Advice

Five pieces of basic equipment for snorkelling include a mask, snorkel, fins, body covering and protective footwear so you can walk to a snorkelling site. It's best to buy these from a dive shop where you can get detailed advice on comfort, cost, suitability, storage, health and hygiene. Sports stores usually have beginner sets as shown in Figure 4.1 with limited advice.

a. Comfort

Any piece of equipment selected should be a good, firm but comfortable fit which can be worn for long periods without causing any discomfort. For example comfortable fins.

b. Cost

Look for quality when purchasing equipment even though it may cost more. For example: A silicone mask will last longer than a silitex mask.

c. Suitability

Different localities or activities may require specialised types of equipment. For example, in colder water, thicker wet suits are required to prevent hypothermia, whereas long sleeved 50+ rashies suit tropical waters to prevent skin cancer. Lycra stinger suits are great for snorkelling in tropical waters in the summer months when snorkelling north of Bundaberg and Geraldton for protection from marine stingers.

d. Storage

It's a good idea when you buy your equipment to think about storage as well. A crate with a lid that seals and that will fit under your bed or on the top shelf of your room cupboard will help:

- Keep your fins and wet suit flat so they will keep their shape.
- Stop cockroaches, spiders, ants or wasps getting in building nests.

Also, if you decide to hang your wetsuit up, make sure to use a hanger that keeps the garment in shape; - especially around the shoulders.

e. Health and hygiene

It is recommended that you use your own mask and snorkel. For example, once you have the correct strap adjustment for your mask you really don't want someone else altering it. Also treat your snorkel and mask like you would other personal items, to prevent infection from others.

B. Types of snorkelling equipment

1. Masks

a. Types

Generally there are three types:

- A split lens (low volume) mask as shown in Figure 4.2, that is recommended for free diving as it is easier to clear and equalise on decent.
- A single lens (large volume) mask as shown in Figure 4.3 which often has a wider field of view.
- The relatively new full face mask, as shown in Figure 4.4, that covers the eye, nose and mouth making it perfect for beginners to breathe comfortably through your mouth and nose while in the water.

So it is worthwhile seeking advice on what you want to do in the long term rather than buying on line.



Figure 4.1 Sports stores sell basic snorkelling equipment



Figure 4.2 Split lens mask



Figure 4.3 Single lens mask



Figure 4.4 A full faced mask and snorkel

3. Fins

The design allows energy from your foot to be directly transferred to the fin creating less drag in the water and easier kicking on the surface.

a. Types, advantages and disadvantages

Fins fall into two types – open heeled (Figure 5.1) and full foot as shown in Figure 5.2.

- **Open-heeled fins** have larger, stiffer foot pockets with a strap and are more expensive, but are open at the back to accommodate neoprene dive booties. These are heavier and used in SCUBA diving.

The booties fit into the fin and held in place with an adjustable heel strap. With this design, you can walk out to the entry point in your booties, jump into the water and then put your fins on.

- **Full-foot fins** tend to be less bulky than their open-heel counterparts making them well-suited for travel.

They are lighter and give more control for beginners in free diving.

A disadvantage is getting the right size because full-foot fins aren't adjustable – they either fit or they don't. Also, you have to wear reef walkers out to the entry point.

b. Materials used in fins

Rubber, silicone and thermoplastics are used in fin construction. The advantage of silicone is that it is less likely to deteriorate with time if washed in fresh water after use and stored in a dry place out of the sun. Rubber fins will deteriorate with time and last on average 3 to 4 years.

c. Care and maintenance

Fins need to be cleaned and dried out of the sun. If rubber is allowed to heat up in the sun, it loses its shape and perishes quickly. Once dry, they need to be stored flat and arranged so the heel keeps its shape.

4. Personal protection equipment

a. Wetsuits

(i) Materials used, how they work and why wear one?

Wetsuits are made of a kind of rubber called neoprene. The suit traps a thin layer of water between the neoprene and the wearer's skin. Body heat then warms this layer, however you have to wait a minute or so for the water to become warm.

A full length wet suit also protects the body from sunburn as well as cuts and scratches when entering and leaving the water.

(ii) Advantages and disadvantages of wearing a wetsuit

- Advantages include protecting the body against cuts, abrasions, stings, bruises and sunburn, keeping you warm, reducing the effects of losing heat and acting to keep you afloat.
- Disadvantages include occupying a large space when travelling, having to wear a weight belt so you can swim underwater, adding more equipment to carry and very difficult to put on and take off.
- It is also important to realise that the thicker the wetsuit the more buoyant you become and the need for using a weight belt increases.

The choice of suit depends upon type, locality and duration of diving as well as the snorkeller's financial status.

Selection is a matter of budget and personal choice, however, the following points on the next page should be considered.

- The suit should be a close, neat fit to prevent water flow but not so tight as to cause chafing or restrict circulation and breathing.
- When trying on a suit, ensure there are no spaces under the arms, neck, crotch or the extremities of the wrists or calves.

Temp range (°C)	Wetsuit thickness
>24	UV lycra
18° - 24°	0.5 mm - 2 mm
16° - 20°	2 mm - 3 mm
14° - 17°	3 mm - 4 mm
11° - 14°	4 mm - 5 mm
< 14	> 5mm or dry suit

Figure 5.1 Wetsuit thickness guide



Figure 5.2 Stinger suit (L), Shark stop wet suit (R)



Figure 5.3 A wet shirt can be worn under a wetsuit

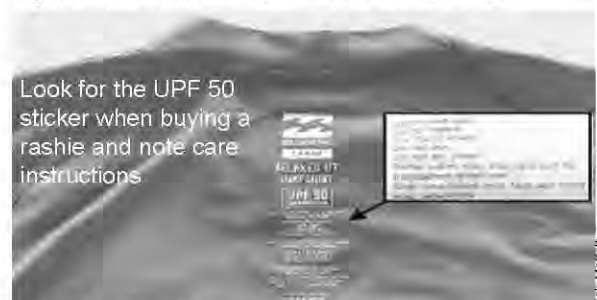


Figure 5.4 UPF 50 identification and care instructions

SECTION 2: SNORKELLING SKILLS

Objectives

- | | |
|--|--|
| <p>A. Describe how to fit a mask, snorkel and fins.</p> <p>B. Discuss water entries and exits.</p> <p>C. Describe finning and diving techniques.</p> | <p>D. Describe clearing your snorkel, mask and preventing fogging up.</p> <p>E. Describe how to ditch a weigh belt.</p> <p>F. Identify safety signals.</p> <p>G. Discuss rescue methods.</p> |
|--|--|

H. Design a snorkelling certificate incorporating:

1. Fitness distance swim, underwater swim and treading water
2. Fitting a mask, snorkel and fins
3. Water entries and exits
4. Finning the length of a pool
5. Duck dive, clearing your snorkel and ears
6. Clearing a mask and how to stop it fogging up
7. Safety signals
8. Drills used in rescue methods.

A. Fitting your mask, snorkel and fins

Here are some suggestions - *There are plenty of others on YouTube.*

- Adjust the strap so the mask feels comfortable making sure it is not around your ears. If you have to pull the straps tight to get a fit, or if you have big red marks around your face when it comes off, you have it too tight.
- Fit the snorkel on the left side of the mask with the snorkel keeper. Traditionally it goes on the left to avoid entangling with SCUBA regulator hoses on the right side.
- Push all your hair out from behind the mask, and then pull the mask on your face so that the strap is in the middle of the back of your head.
- Now align the snorkel to beside your temple so that when your head is down, the snorkel will be at right angles to the water surface.
- Put the snorkel in your mouth so your teeth touch the bite tabs. Extend your lips so the snorkel mouthpiece seals between your teeth and your lips. Some instructors have called this the "Mick Jagger look".
- Remember that you will need to use defogging agent or spit into your mask while in the water, to stop it from fogging up.
- Before going underwater, look in a mirror, or ask your buddy to see if everything lines up.

Fitting your fins

If you have closed healed fins, try using a sock to fit the fin first.

- The fin should be snug so that your heel does not move up and down, you can put one finger down either side of the fin and with a sock on, the fin is easy to remove.
- Wearing a sock while in the water is optional.

B. Water entries and exits

1. Entry

Two ways to enter the water are shown in Figure 6.3. Your plan should include, checking to see if the entry path is clear and wearing as a minimum, a wet suit, fins and mask and snorkel.

The push off or submerged entry

Simply sit at the side of the pool or boat snorkelling platform, put your hand on your mask and push off with the other. From a boat you can climb down the ladder and then hold onto the mermaid line. Ask your buddy to throw you your fins one at a time, put them on and then wait for your buddy. It's then just a matter of submerging keeping an eye on each other following the one up, one down rule (see page 16).

The safety step out or giant stride

Press your mask against your face and step into the water with a scissor kick. The idea of the kick is to minimise going too far underwater. If used to jump into a reef pool, make sure your jump is big enough to clear the coral.

2. Exits

Examples

Your plan should include where to exit safely and, wearing as a minimum, a wet suit, fins and mask and snorkel and some way of protecting your feet.



Figure 6.1 Three mask fitting hints



Figure 6.2 Adjustments are made at the side



Figure 6.3 Two types of water entry

E. Ditching a weight belt

If you put a weight belt on you must know how to take it off quickly. Here is one suggestion:

- Slap your hands against your hips, then slide them up to the belt and forward until they reach the buckle. This ensures you'll find the buckle even if it has shifted away from centre.
- Now, simply release it.
- Once you've released the belt, pull it completely away from your body, and let it go.

F. Safety signals

The safety signals shown below are essential in emergencies and you should practice these before you go open water snorkelling.

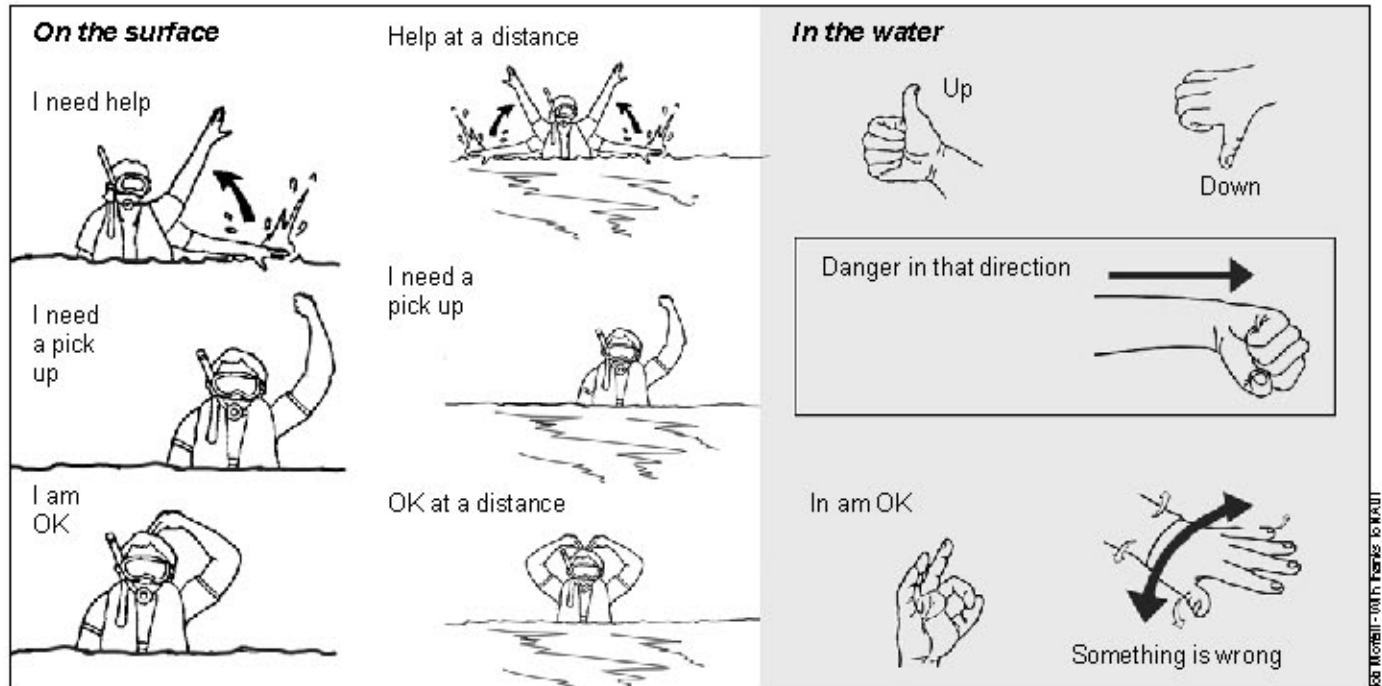


Figure 7.1 Snorkelling signals

G. Rescue methods

Rescue skills and physical fitness go hand in hand, so practice in a pool before you go into open water. Part H describes the basic skills that are important to snorkel safely in open water. If you are doing a course at school, you probably will be asked to complete these in a pool.

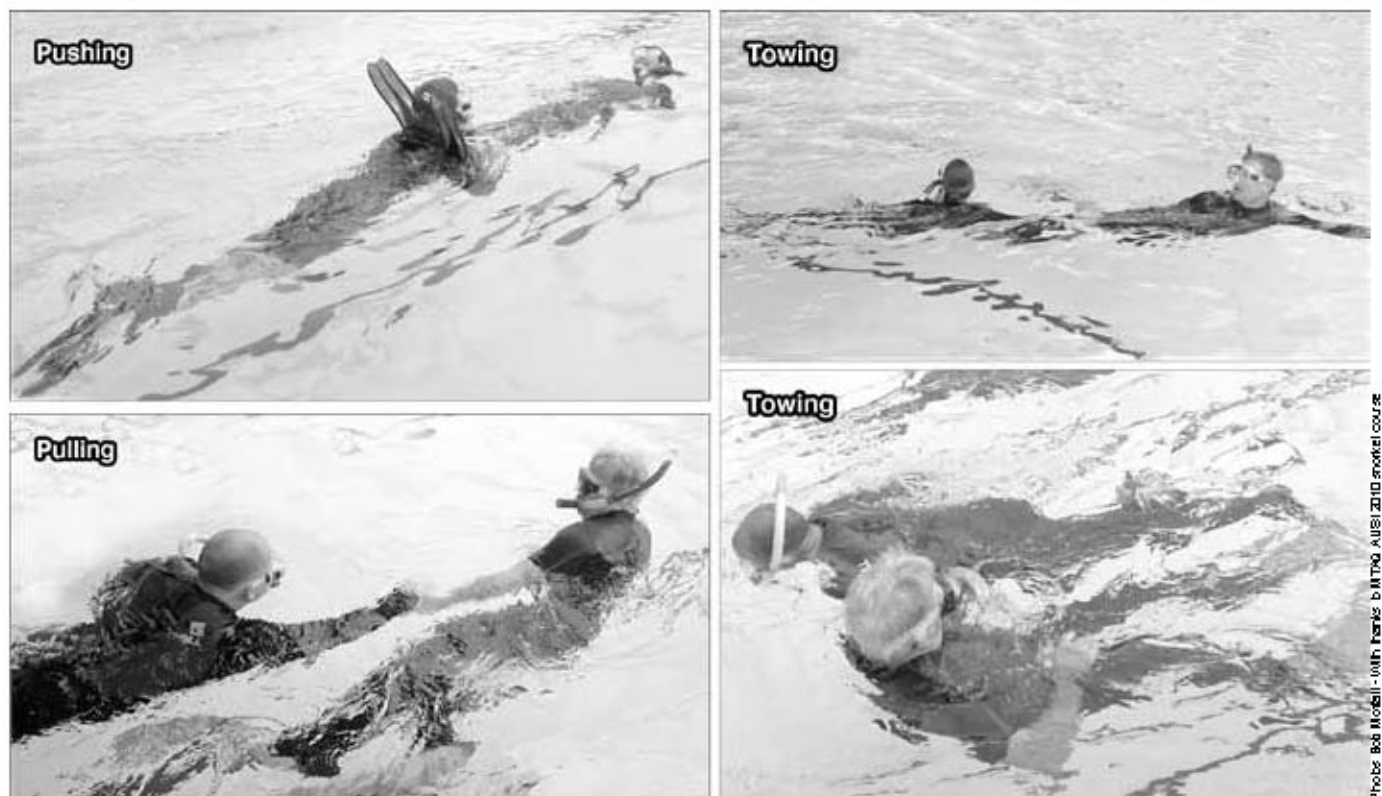


Figure 7.2 Snorkelling rescue techniques

Hypothermia treatment includes:

- Seek urgent medical help
- Remove patient from the elements into shelter
- Remove wet clothing and warm patient gradually
- Encourage patient to drink warm liquids
- Continue monitoring patient

4. Cramps

Hazards

Cold water temperatures, poor muscle condition, over-exertion, incorrect fitting equipment.

Preventative measures

Recognise poor muscle condition or overexertion

- Warm-up and warm-down exercises can help with muscles that are not used all the time.
- Avoid cycling with your legs while finning.

Recognise incorrect fitting equipment

For example, make sure your fins are not too tight so as not to impede circulation.

Learn safety signals and rescue techniques

See also page 18.

Figure 8.3 shows the signal if you need a pick up.

Surfboards, life buoys or anything else that floats can also be used for rescues.

Treatment

So, if you get a cramp in your leg:

- Stop, relax, and pull the tip of the fin toward you to stretch out the leg muscles.
- Continue to swim slowly so that the muscle can recover but if it persists, you need to get out of the water.

If your buddy has a cramp:



Figure 8.1 Drying agents for the ear

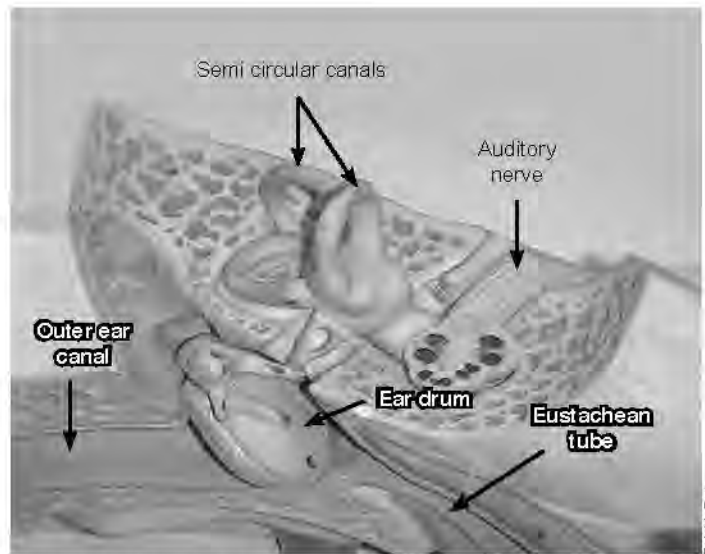


Figure 8.2 Model of an ear

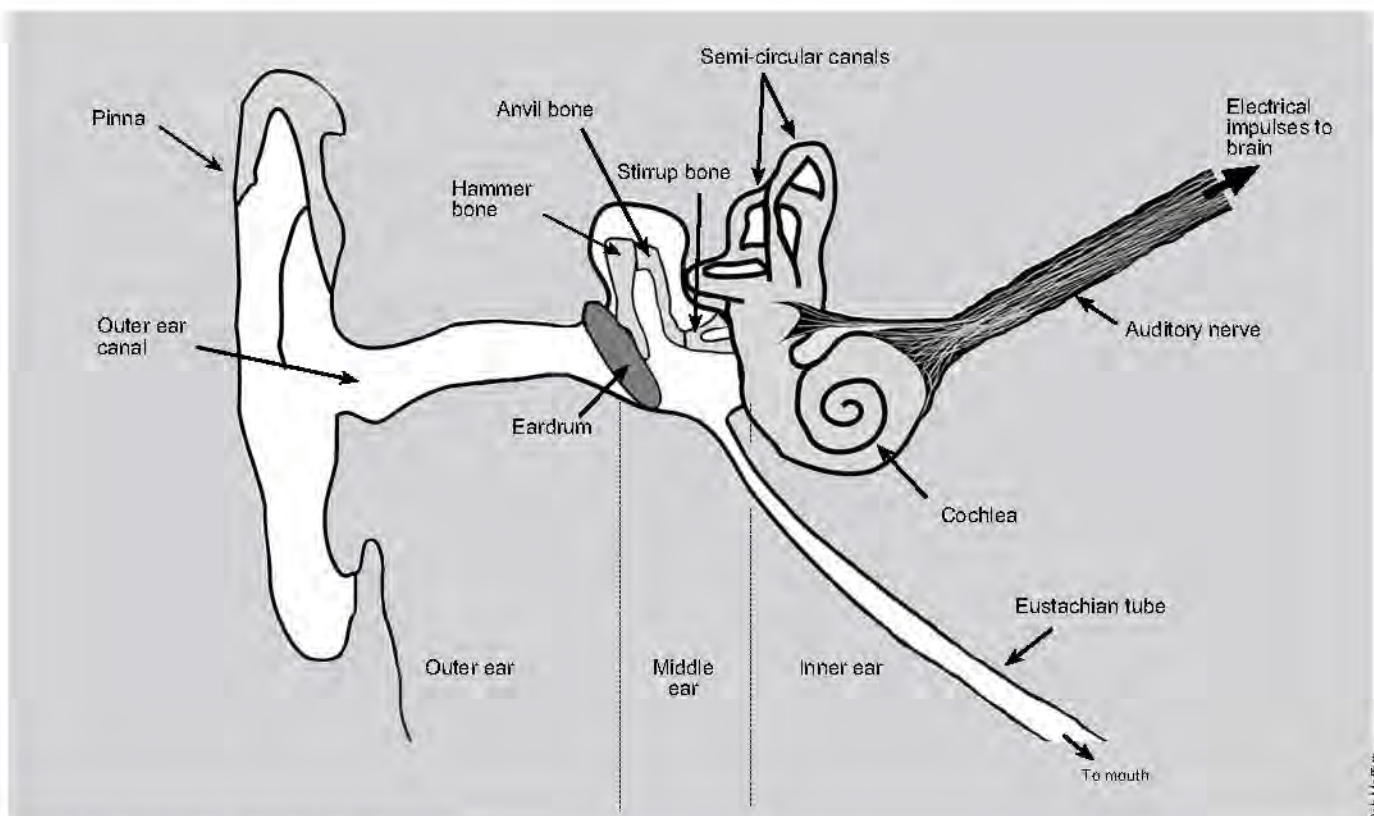


Figure 8.3 Features of the ear affecting hearing

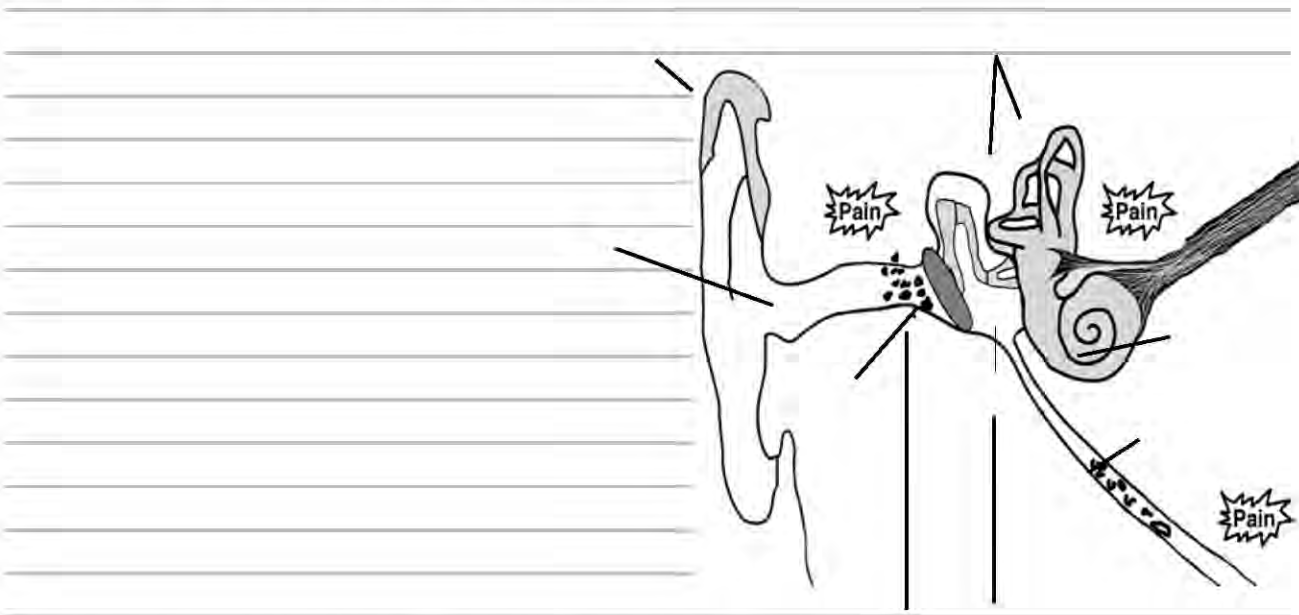
WORKSHEET 5: EYES, EARS AND SINUSES

Q1. What can cause major damage to the eyes while on the water and what should you do to prevent it? (Page 24)

Q2. What causes ear infections and what can be done to prevent them? (Page 25)

Q3. In the diagram of the ear below: (Page 25)

- a. Mark in the following: Pinna, outer ear canal, eardrum, semicircular canals, cochlea, eustachian tube
- b. Distinguish between the outer, middle and inner ear
- c. Mark in where mucous and bacteria can develop and grow
- d. Mark in where pain develops as a result of infection



Q4. What is the eustachian tube and why is it important in snorkelling? (Page 25)

Q5. Describe the three common ear infections listed below and list one treatment for each (Page 25 and 26)

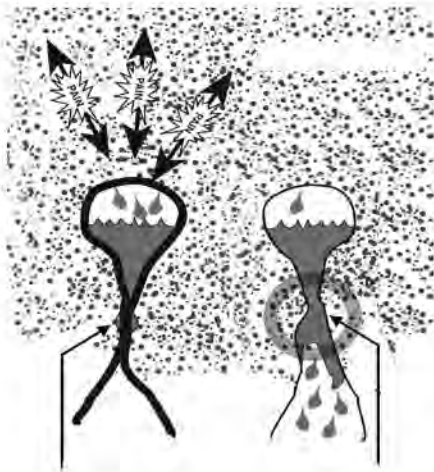
Q6. Define the term barotrauma (Page 26)

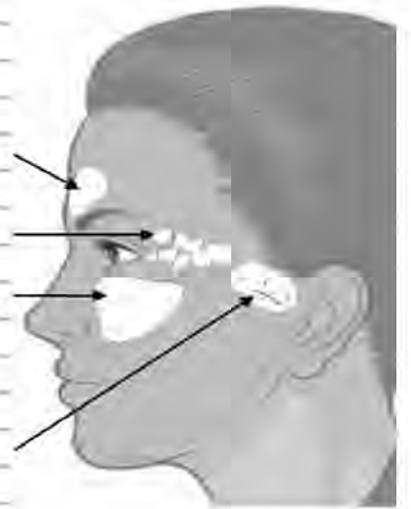
Q7. Two places barotrauma can affect the body while snorkelling are listed below. Fill in the missing words to identify the cause, one way to reduce and one way to prevent the effect. (Pages 26 and 27)

Ear

Sinus

Q8. What are sinuses and when can they cause pain when snorkelling? Complete the two diagrams to explain your answer. (Pages 27)





Q9. What should you do if you have blocked sinuses but still want to go snorkelling? (Page 27)

Q10. What is the physiological cause of sea sickness (Page 27).

Q11. List any three things you can do to prevent seasickness (Page 27).

Q12. What could one golden rule be to prevent seasickness and why? (Page 27)

WORKSHEET 6: UNDERLYING HEALTH CONDITIONS

Q1. What are the hazards associated with diabetes and snorkelling? (Page 28)

Q2. Identify 4 common triggers for a asthma attack when snorkelling? (Page 28)

Q3. List 4 common personal medications and safety items that people carry with underlying health conditions carry (Page 28)

Q4. What is nervousness and how can it be reduced? (Page 29)

Q5. What is saltwater mist, what concerns does it raise for snorkellers and how can it be prevented? (Page 29)

Q6. What happens in your lungs when you drown? (Page 29)

Q7. List any two things you can do to avoid drowning while snorkelling (Page 29).

Q8. a. What is hyperventilation and b. why is it dangerous when snorkelling? (Page 30)

Q9. List three things a diver can do to prevent drowning from hyperventilation (Page 30)

Q10. Give two examples of stupidity and describe their consequences (Page 30)

SECTION 4: ENVIRONMENTAL HAZARDS

Objectives

A. Define and give examples of an environmental:

1. Risk
2. Hazard
3. Preventative measure

B. Explain how a risk level can change, using a snorkelling platform as an example.

C. Describe hazards and preventative measures associated with:

1. Boat operators
2. Weather, including:
 - a. Waves
 - b. Wind
 - c. Rain
3. Heat
4. Turbidity

5. Currents (strength and direction)
6. Entry and exit points
7. Deep water and free diving
8. Sound
9. Dangerous marine creatures, including:
 - a. Sharks
 - b. Coral, oysters and barnacles
 - c. Stingrays
 - d. Sea urchins

- e. Bristle worms
- f. Blue-ringed octopus
- g. Cone snails
- h. Stonefish
- i. Scorpion fish
- j. Bluebottle
- k. Box jelly and Irukandj
- l. Fire weed and stinging hydroid

A. Definitions

1. Environmental risk

An environmental risk is the likelihood that harm will occur from exposure to an environmental hazard.

2. Hazard

A hazard is something with the potential to cause harm.

3. Preventative measure

Preventative measures are actions that can be taken to reduce the potential of exposure to or removal from a hazard.

Example

A snorkelling platform as shown in Figure 12.1, can be a hazard and the following sequence of preventative measures could be followed:

1. **Eliminate** the hazard. *Eg, Don't use the platform*
2. **Substitute** the hazard with a lesser risk. *Eg, use a ladder, snorkel out from the beach.*
3. **Isolate** the hazard - Weather bad day, waves on platform - *Eg, do not go snorkelling off the platform.*
4. **Use engineering controls** - *Eg, install rubber mats over metal areas, install grab rails.*
5. **Use administrative controls** - *Eg, use instructions - tell your buddy to keep a hold onto platform support for balance.*
6. **Use personal protective equipment** - *Eg wear snorkelling gloves, booties and full length wet suits to protect body.*

B. Risk levels change

Look back to Figure 21.2 (Page 21), that shows a table that is commonly used to determine the risk levels. This table is variable as stated in the previous section and preventative measures can change based on your situation awareness.

For example, if there were say 2 adults and six children on the platform in and the wake from a large vessel was approaching, the risk level would go up from low to very high in a matter of seconds.

C. Hazards and preventative measures

1. Boats and their operators

Figure 12.2 shows a boat approaching a snorkelling site at speed and two kayakers. In this example:

Hazards and their effects

- Boat hull striking snorkeller's head in the water.
- The wake of other vessels affecting entry/exit points.
- Boat prop cutting body parts while spinning (Figure 12.3).
- Kayak paddle or hull inflicting a head wound.

Preventative measures

- Display dive flag
- Monitor boats in area, sound warning signals if necessary
- Be aware of the prop when approaching a boarding ladder.



Figure 12.1 A wet and rocking snorkelling entry/exit platform can be a hazard



Figure 12.2 Boats and wrecks can be a hazard



Figure 12.3 Boats and their props can be a hazard

2. Weather

a. Waves

Hazards

- Waves on entry and exit causing falls.
- Rough seas causing seasickness.

Preventative measures

- Interpret weather maps and tide charts (or apps) for the following conditions:
 - Good weather, no wind, lack of rain for a period of time and sunny days make for ideal safe snorkelling conditions. For example, water surface should be calm and swell should be less than 0.5 metre.
 - Cancel the day or find an alternative site - might be as simple as going to the other side of an island.
- Know your snorkelling site and plan for the weather.

b. Wind

Hazard

- Saltwater mist, poor visibility

Preventative measures

- Isolate those affected by unfavourable surface conditions, don't lose sight of buddy, choose alternative site, get out of the water.

c. Rain

Hazard

- Slippery surfaces, reduces visibility between observer and snorkellers.

Preventative measures

- Issue a warning to always have a hand hold.
- Wear protective clothing.

d. Heat

Hazard

- Hot metal surfaces, for example seats in tinnies.

Preventative measures

- Put a towel on a hot aluminium seat of a tinny, to protect the backs of legs getting burnt when seating.

e. Turbidity (poor visibility)

Hazard

- Obstructed vision of dangerous objects causing cuts.

Preventative measures

- Underwater visibility should be at least 3 metres. Isolate by cancelling diving or find an alternative site.

3. Tides and currents (strength and direction)

Hazards

- Panic
- Being swept away towards other dangers or a distance where you are unable to swim back to the shore or the dive boat.

Preventative measures

Currents can be permanent or can form with the tide, especially during the middle phases of the tide so if snorkelling during these times, be aware of your position so ...

- Check tide charts or apps.
- Seek local advice on currents.
- Use mermaid lines.
- Have a boat and skipper/lookout close by as you snorkel.



Figure 13.1 Rough sea conditions pose many safety issues



Figure 13.2 Waves at a snorkelling site

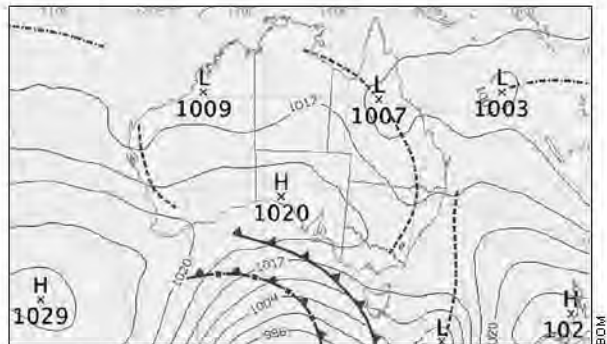


Figure 13.3 Check the weather map or an app for weather and tides as they affects hazards



Figure 13.4 Keep an eye on your position

- Avoid snorkelling when the rise and fall of the tide is the greatest unless planning a drift snorkel advised by local dive shop.
- Always check your position every minute.

SECTION 5: EMERGENCY PLANNING

Objectives

A. Evaluate snorkel trip planning by:

1. Determining a group's ability to use equipment.
2. Inspecting proposed site entry/exit hazards.
3. Establishing emergency communication site locations.
4. Determining group member underlying medical conditions.
5. Interpreting weather maps and tide charts for alternative sites.
6. Preparing a water entry safety brief.

B. Snorkelling first aid

1. Describe how to stop and treat bleeding, including:
 - a. Coral cuts
 - b. Body lacerations

- c. Bites from fish
- d. Bleeding from the ear and nose

2. Distinguish between the treatment of tropical and non-tropical stings.

C. Describe emergency procedures including:

1. DRSABCD
 - a. Danger
 - b. Response
 - c. Send for help now
 - d. Airway
 - e. Breathing
 - f. Compression
 - g. Defibrillation (if available)

2. When to stop CPR.
3. Use of personal defibrillators.
4. How to control shock.

D. Demonstrate:

1. CPR to the recognised standard
2. The recovery position.

E. Search applicable government web sites for safety guidelines, for example:

1. National guidelines: www.australianaas.org.au
2. WA Education: www.education.wa.edu.au
3. NSW Education: <https://app.education.nsw.gov.au>
4. Queensland worksafe: www.worksafe.qld.gov.au

A: Evaluate snorkel trip planning

It is not the intention of this workbook to address any commercial regulations as outlined in the references detailed in Figure 14.1, rather suggest a snorkelling plan for a family group with children aged 10 - 18, whose adult leader has:

- Extensive snorkelling experience.
- Been on a supervised commercially run tour to learn about the snorkelling site and noted the safety briefing and procedures from Figure 14.1, and;
- Held discussions with a dive shop operator/local marine rescue of safe snorkelling conditions, tide times and emergency procedures.

Example trip plan

Having evaluated the commercial operators regulations, the leader would then most probably devise a following six part family snorkelling plan, starting with the reasons for each part.

1. Determine ability to use equipment

Reason: To avoid having to spend time in the water adjusting masks, defogging masks or dealing with sunburn after the snorkel, for example:

- Check sunscreen, mask, snorkel, wetsuit, sandals, closed healed fins, rashies, snorkelling gloves and venetian blind cord to secure shoes around waist.
- Check essential snorkelling skills, for example in a swimming pool.

2. Evaluate the proposed site for hazards

Reason: To predict how the site is affected by weather and tides, the ability of the group and the nature of the entry exit surfaces, for example:

- Check snorkelling site beforehand with a local tour operator to familiarise with all possible hazards.
- Determine entry/exit points and snorkel route for a variety of snorkelling locations.

3. Evaluate emergency communication sites

Reason: To check for mobile phone coverage and if unavailable check for alternate emergency communications and first aid stations.

For example, confirm with the local dive shop or marine rescue of what backup emergency procedures would be available and/or read available signage at snorkelling site as shown in Figure 14.2.



Figure 14.1 Make sure you know emergency points.

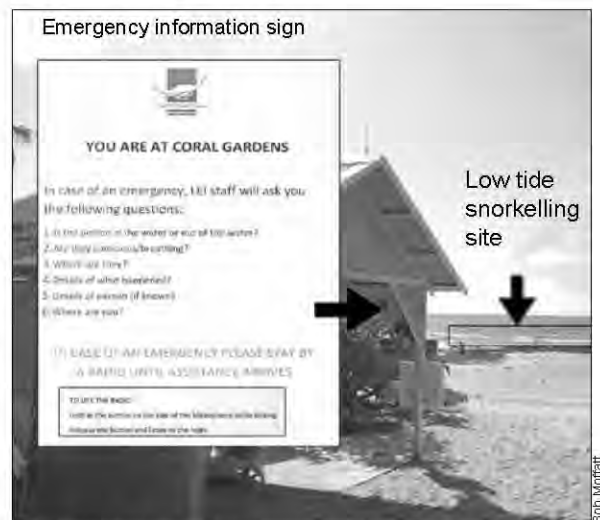


Figure 14.2 Evaluate emergency communications

WORKSHEET 10: DANGEROUS MARINE CREATURES

Complete the following worksheet using pages 39 - 42.



Name: _____

Hazards: _____

Prevention: _____

Treatment :

Q1. How hot should water be when used on a patient?

Q2. Where can you get hot water from in the field?



Name: _____

Hazards: _____

Prevention: _____

Preventive measures:

Treatment:



Name: _____

Hazards: _____

Preventive measures: _____

Treatment



Name: _____

Hazards: _____

Preventive measures: _____



Name: _____

Hazards: _____

Preventive measures: _____

Treatment:



Name: _____

Hazards: _____

Preventive measures:

Treatment:

Q. How hot should water be when used on a patient?

B. Respiration and SWB

The lungs and respiratory system allow oxygen in the air to be taken into the body, while also exhaling carbon dioxide.

1. Oxygen

Every few seconds, with each inhalation, air fills a large portion of millions of small sacs in the lungs called alveoli - Figure 16.1.

In a process called diffusion, oxygen moves from these alveoli into the blood through the capillaries (tiny blood vessels) lining the alveolar walls. A protein, called haemoglobin in the red blood cells, then carries oxygen first to the heart, then the brain and then around the rest of your body.

Shallow water blackout

Shallow water blackout, SWB, is an underwater 'faint' due to a lack of oxygen to the brain and can be understood if we compare the two graphs shown to the right.

2. Normal dive

In a normal dive, Figure 16.2, the snorkeller takes a normal breath and dives underwater.

The level of carbon dioxide increases for a time, then returns to normal after a breath is taken.

Put another way, during the dive the level of carbon dioxide in the snorkeller's lungs increases approaching the oxygen blackout zone, causing the brain to tell the snorkeller to surface for air.

Upon surfacing, the snorkeller takes fresh breath of air and avoids the blackout zone.

3. Dive with hyperventilation

In Figure 16.3, the snorkeller takes a series of quick breaths before the dive called hyperventilating the lungs.

As a result, the carbon dioxide level falls rapidly and the oxygen blackout zone moves to the left in the graph or begins just before the dive.

Now during the dive, the trigger to breathe does not kick in as the carbon dioxide levels are still low.

As a result, oxygen levels continue to fall to a point where the brain is starved of oxygen and the snorkeller then blacks out.

In some divers the urge to breathe then kicks in, the unconscious snorkeller takes a breath of seawater, the lungs fill, no more oxygen can get to the body, organs shut down and the snorkeller drowns. Others simply suffocate or die of other causes brought on by the breath-holding.

Shallow water blackout this thought to be the number one cause of drowning among competent snorkellers and free divers.

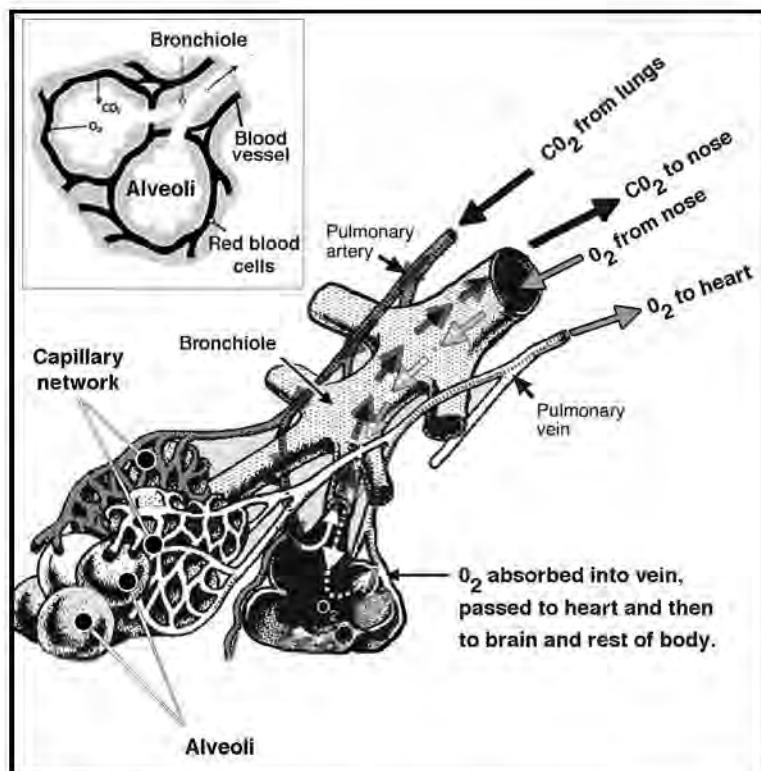


Figure 16.1 Effects of normal breathing on carbon dioxide levels

NORMAL DIVE

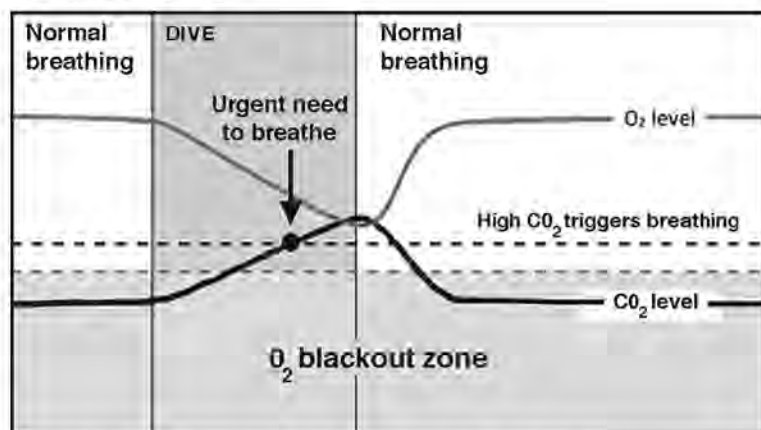


Figure 16.2 Effects of normal breathing on carbon dioxide levels

DIVE WITH HYPERVENTILATION

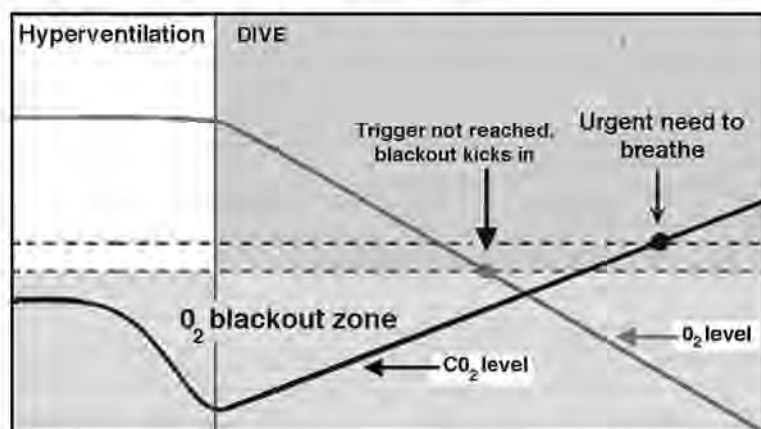


Figure 16.3 Effects of hyperventilation on carbon dioxide levels

Suggestions from a diver's blog who had to deal with a buddy who had a SWB.

Blacking out is your body's way of relaxing muscles around your neck so you can breathe. If your buddy blacks out underwater, block their nose and mouth before they surface and that way they will swallow less water and hopefully have a better chance of survival. This is why the one up one down rule is so important.



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