

Safe Snorkelling Workbook

Second Edition



Wet Paper

Bob Moffatt

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Published by

Wet Paper Publications
PO Box 540 Coolangatta 4225
www.wetpaper.com.au



ISBN 978-1-86283-178-0

Principal consultants

Adam Richmond and Gail Riches

Acknowledgements and attributions

Mick O'Connor, Phil Smith, Simone Baker, Neville Coleman, Mike Sugden, Lady Elliot Island, Worksafe Queensland, Scuba doctor, Cressie Sub Aqua, MTAQ/AUSI Snorkel Instructors 2010 course, Staff and Students from Gladstone, Benowa State High Schools and the Moffatt Family Children and Grandchildren.

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Publication dates

Hard copy 1st Edition April 2022 Harding Colour, Brisbane.

E Copy 2nd Edition 2023 Wet Paper Publications

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INTRODUCTION

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.

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.

About the worksheet questions

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.

Best wishes

Bob Moffatt
Wet Paper Publications

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 3.1 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 silite x 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 3.2, 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 3.3 which often has a wider field of view.
- The relatively new full face mask, as shown in Figure 3.4, 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 3.1 Sports stores sell basic snorkelling equipment



Figure 3.2. Split lens mask



Figure 3.3. Single lens mask



Figure 3.4 Full faced mask and snorkel

b. Selecting

When selecting a mask in the shop it should:

- Be a comfortable, watertight and fit preferably with a soft silicone seal.
- Have a nose pocket to allow for equalising the ears.
- Be made of good quality rubber or silicone and tempered glass (Figure 4.1).

A simple check is to place the mask on your face (without the straps in position) and inhale gently through the nose.

If the mask is a good fit it will cling to the face due to the slight vacuum created (see Figure 4.2). Note: Some masks have purge valves making clearing water out of a mask easier.

c. Adjusting

The mask is adjusted with a release clip or buckle found on the strap.

The release clip and button as shown in Figure 4.1, is a much better mechanism, as it avoids the problem of getting long hair tangled.

By pushing this clip, the strap tension releases, allowing the strap to be adjusted. Others come with a clip only which works on the same principle.

In both cases you simply pull on or loosen these until the tension feels right.

d. Care and maintenance

A new mask will have a protective film or dirt and grit from the manufacturing process, which has to be cleaned off or removed at the store you purchased the mask from.

- So read the cleaning instructions that came with the mask or ask the sales rep for advice.
- One common suggestion is to scrub the surface using toothpaste.

This will reduce fogging by allowing defogging solutions or spit to adhere to the glass.



Figure 4.1 Mask and adjustment points



Figure 4.2 A simple mask fitting check

Equipment care and maintenance

- All masks need to be washed clean with fresh water after diving, dried away from the sun and stored in a container.
- Never leave masks near a heat source or pool chemicals.
- Consider buying a storage box for your mask or keep the one that it came in.



2. Snorkels

A snorkel enables you to breathe while you are swimming at the surface while looking down into the sea.

a. Types

Snorkels are made of a hard plastic that forms the snorkel tube and flexible rubber or silicone piece that is used in the lower section and mouthpiece.

They come in three forms and have a number of features as shown in Figure 5.1, namely:

- A smooth contoured “J” shape tube without any sharp bends to reduce drag in the water to allow for smoother breathing. Some have a splash guard and close function.
- A mouth piece and bite tabs to fit into your mouth and
- A snorkel keeper clip, to attach to the mask strap.

With time, the mouthpiece can become damaged causing water to constantly leak in, so before each use, check the seals and if needed, buy a new mouthpiece.

b. Attachment

The snorkel is attached to the mask strap with a keeper clip. Alternatively a hair tie or rubber band is sometimes used.

While this is not a huge deal, it should be noted that snorkels are traditionally worn on the left side of the head.

This is because snorkels are a necessary accessory for scuba diving, and are positioned on the left side to avoid entangling with the regulator hoses on the right side.

c. Bore size

Young children or people with a low lung capacity should use a small bore snorkel to decrease the amount of water trapped inside making it easier to blow out.

Figure 5.2 shows a comparison of snorkel bore sizes.

d. Purge valves

These are simple mechanisms under the mouthpiece (Figure 5.3), that help you clear water from inside the snorkel saving your energy.

e. Close function

A mechanism on top of the snorkel that allows water to be blown out of the purge valve when closed, saving your energy - Figure 5.4.

f. Care and maintenance

After snorkelling, all equipment should be carefully washed in fresh water and dried out of the shade.

Remember salt particles stick to your equipment and allow corrosion and deterioration.

- Sunlight will quickly perish rubber if exposed for too long.
- Then put it in a bag with a draw string and store in a dry place to stop insects getting in.
- Purge valves can get sand and grit in them, so make sure all of this is removed with a good rinse under a tap.
- It is possible to buy replacement mouth pieces.
- Above all - don't throw your wet snorkelling gear under your bed and hope it will be ready for use next week!

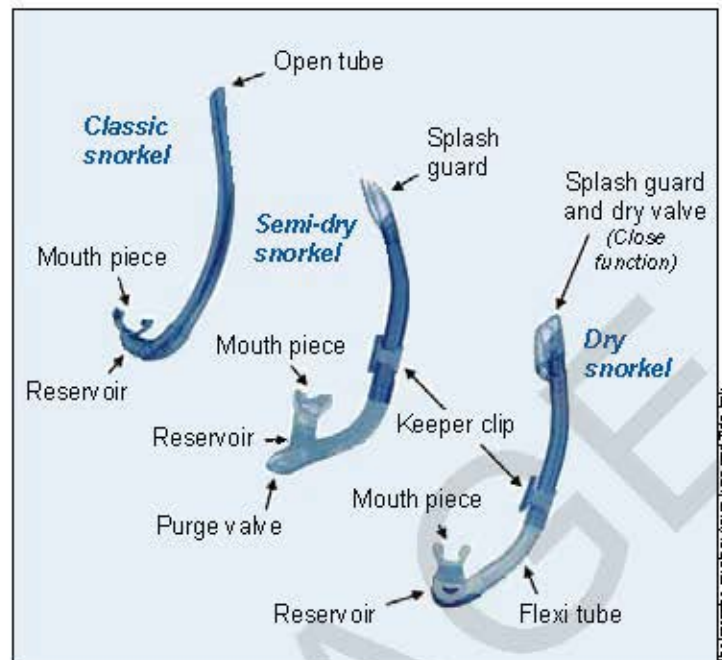


Figure 5.1 Three types of snorkel and their parts



Figure 5.2 Snorkel bore sizes

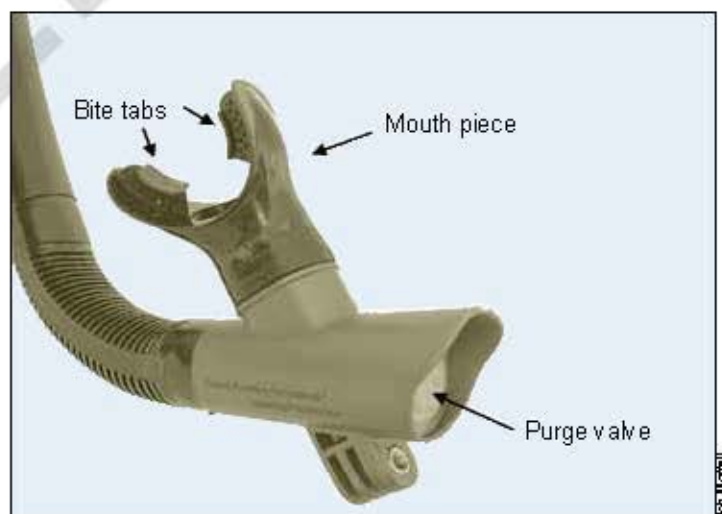


Figure 5.3 Snorkel mouthpiece, purge valve and bite tabs

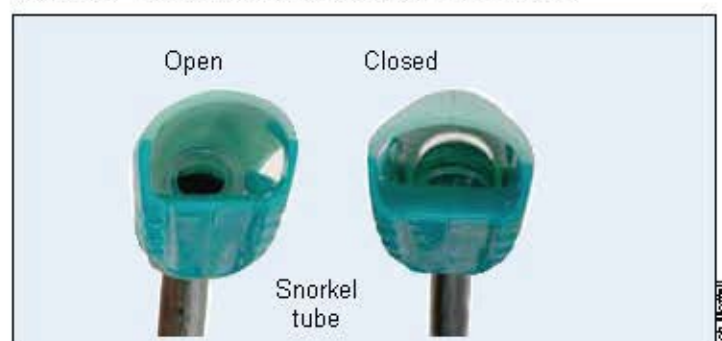


Figure 5.4 Close function on a snorkel

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 6.1) and full foot as shown in Figure 6.2.

- **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.



Figure 6.1 Open heeled fins and booties



Figure 6.2 Full foot (or closed heeled) fins



Figure 6.3 Wet suits

Wetsuit fitting tip

If you have trouble getting your feet down through the legs, first put them into a plastic bag and they should slide down easier.

- 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.
- Lined seams reduce water leakage thus keeping the snorkeller warmer, while sewn seams strengthen the joints.
- The thickness of the suit is dependent upon the temperature of the water in which snorkelling is to take place.

A 2-3 mm thick suit is quite adequate in warm tropical waters, however a 5-7 mm diving suit is used in cold water in southern states (See Figure 7.1).

(iii) Care and maintenance

Make sure you hang it out to dry and then either hang it up in a cupboard or fold it flat and store in your snorkelling box. Zippers could be lubricated to prevent jamming or corrosion, but if washed clean, salt should not build up.

- A suit hanger can be used to keep the garment in shape - especially around the shoulders.

b. Sharkproof wetsuits

In 2022, a wetsuit called shark stop, using a polymer fabric called UHWMPE, or ultra-high-molecular-weight polyethylene was released in Australia - see Figure 7.2 right.

Materials used

The suit and can be found by looking up *shark stop* in the search engine of your computer where the manufacturers claim the materials are capable of withstanding a shark bite.

c. Stinger suits

These are full-body suits made of lycra designed to protect the body from the stings of dangerous jellyfish. They are much lighter than wetsuits and are well suited to the Great Barrier Reef's tropical waters, (Figure 7.2 left), and designed to be worn in the summer months, October to May.

Care and maintenance

Stinger suits are also treated against UV light and can provide a very effective way to protect your skin against intense sunlight. They need to be washed, dried and then best stored in their original packet.

d. Rash vests

(i) Materials used and UPF

A rash guard, also known as rash vest, wetshirt or rashie, is an athletic shirt made of spandex and nylon or polyester.

They are designed to protect the skin from sunburn and life time skin damage by having a ultraviolet protection factor called the UPF rating.

This is a measure applied to fabrics that tells you how much of the sun's UV radiation is blocked, and therefore how much protection it provides.

For example, a UPF of 50 allows 1/50 or 2% of UV radiation to penetrate, while a UPF of 5 lets 1/5 or 20% of UV radiation through.

These shirts can also be worn under wetsuits as shown in Figure 7.3 are useful when snorkelling in warm waters and good protection against marine stingers.

A rating of plus 50 is commonly accepted as a suitable value to prevent skin damage from harmful ultraviolet rays (Figure 7.4).

(i) Care and maintenance

Hang wet shirts out of the sun to dry. Then fold up and put away when dry.

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 7.1 Wetsuit thickness guide



Figure 7.2 Stinger suit (L), Shark stop wet suit (R)



Figure 7.3 A wet shirt can be worn under a wetsuit



Figure 7.4 UPF 50 identification and care instructions

Instructions for washing include hand wash with cold water, dry flat in the shade and do not use bleach or iron.

A suit hanger will keep a garment in shape however in time the fabric slackens, the rash vest loses its shape and needs to be replaced.

The worst thing to do

The worst thing to do is throw the wet garment on the floor, kick it under the bed and hope it will be useful next time you want to use it.

If left for long time wet under your bed, mould will grow and totally ruin the garment.

e. Snorkelling vests and life jackets

A snorkelling vest is different from a life jacket in that it can be deflated a little to keep you neutrally buoyant at the surface, or can be inflated more if you get tired (Figure 8.2).

It is also yellow making it easier to be seen by a person observing you.

A life jacket also good if you do not wish to dive and can be fastened by straps around the chest.

The one shown in Figure 8.2, is easier for a beginning snorkeller, because once it's on, you can concentrate on snorkelling.

f. Snorkelling hood

In the tropics a snorkelling cotton balaclava is a very good option, as it not only covers the back of your neck, your ears, it covers your face and forehead (Figure 8.3).

For cold climates a diving wetsuit hood is used to keep your head warm.

g. Gloves

Diving gloves as shown in Figure 8.4, can be cumbersome if you wish to take photos or need the full dexterity of your hands, however they are ideal for protection against rocks, shell or fish life and can be a real comfort to the beginner especially if snorkelling around wrecks.

Gardening gloves are an inexpensive snorkelling solution especially if they have toughened materials.

Care and maintenance

Gloves, like anything that has been in salt water, need to be washed clean, dried and stored in a container for future use.

h. Carry bags

Carry bags as shown in Figure 8.4 not only protect your gear and help keep it clean.

If you are going on a trip, they also allow you to attach your name to your gear so it does not get mixed up with others.

Care and maintenance

Bags need to be washed clean and dried before being put away.



Figure 8.1 Allow snorkelling gear to dry in the shade



Figure 8.2 Snorkelling vest and life jacket



Figure 8.3 A snorkelling hood for sun protection



Figure 8.4 Gloves and carry bag

i. Knives

A knife is an essential part of your equipment if you are diving or using scientific gear underwater and anytime rope is involved in water.

Care and maintenance

It should be sharp enough so that it can cut you out of difficulty, and should be carried in a strong sheath strapped to your leg.

Knives need to be kept dry, lightly oiled and kept in their scabbard.

j. Weight belts

Weight belts are used to secure lead dive weights around your waist and are made of webbing, rubber or silicone and allow the snorkeller to achieve neutral buoyancy in water especially when wearing a wet suit.

When selecting a weight belt it must have a quick release buckle, as shown in Figure 9.2, which should be easy to adjust and be able to be removed quickly with one hand, while wearing gloves.

So how much weight do you use to become neutrally buoyant? The answer is not simple as factors such as your body shape, the thickness of the wet suit, the depth you want to be neutrally buoyant at, and the time you want to spend under water.

However, research of many snorkelling free diving and spearfishing web sites seems to come up with the following rule of thumb.

Start by adding 1 kg for every millimeter of your wetsuit thickness - then add 2kg. So, for an average 80kg person of medium build the calculation is as follows:

- 3mm wetsuit = $3 + 2 = 5$ kg of weight (approx 4 x 3 pound weights)
- 5mm wetsuit = $5 + 2 = 7$ kg of weight (approx 5 x 3 pound weights)

If you have slim body shape, you may need to add only 1.5kg however if you are larger, add on 2.5kg, but experiment in a pool making sure you don't drop the weights and break the tiles.

Care and maintenance

Weight belts and weights also need to be washed clean of salt, dried and stored away from insects and mould.

Check buckles for corrosion, sand and grit and apply lubricant/corrosion spray (for example: Inox).

5. Underwater cameras and housings

Modern digital cameras now have underwater settings which take great photos.

Most manufacturers sell underwater housings (Figure 9.3) which allows underwater use.

An action camera or action cam is a digital camera designed for recording action while being immersed in water. They are waterproof, easy to use and have very good underwater image quality (Figure 9.4).

Care and maintenance

- Make sure you wash the camera case many times to remove ALL the salt

If you use a camera without a case, then open and close the lens in the sink in clean fresh water at least 6 times to remove any salt crystals.

- Allow all components to air dry and then do a close inspection to see if there is any sand or salt crystals left. Sand is the greatest enemy to any camera.



Figure 9.1 Different types of knives



Figure 9.2 Weight, belt and buckle



Figure 9.3 Underwater cameras and housings



Figure 9.4 Go pro underwater camera

B. Evaluate shark deterrent devices

In recent years, inventors have come up with a variety of devices to deter sharks from divers, surfers and snorkellers.

1. Shark biology

Located around the front of a shark's head is an extremely sensitive system of sensors, which scientists believe help sharks to locate prey and to navigate in response to the earth's electro-magnetic fields.

These bio-electrical sensors, known as the ampullae of Lorenzini, are jelly-filled pores, which can detect extremely faint electrical currents generated by the earth's magnetic field and by other living creatures.

Scientists have found that the ampullae of Lorenzini, as shown in Figure 10.1, are so sensitive that great white sharks are able to detect the heartbeat of a perfectly still mammal from a distance of 3 metres, just by sensing electrical currents the heartbeat sends out into the water!

Modern shark repellent devices employ an electrical field which is said to disrupt the function of these bio-electrical sensors.

You can read more at:

https://en.wikipedia.org/wiki/Ampullae_of_Lorenzini

2. Shark bands

These use magnets in a waterproof case which can be strapped to the wrist or ankles (Figure 10.2).

Web reference: [sharkbanz](http://sharkbanz.com)

3. Shark shields

A Shark shield is a diving device that creates a six-meter-long electrical field that keeps sharks away (Figure 10.3). The manufacturers claim it gives you up to six hours of protection from all predatory sharks. It can be used at depths of up to 50 meters.

Web reference: [Shark shield](http://Sharkshield.com)

C. Spearfishing

Spearfishing is a method of fishing that involves impaling fish with a straight pointed object such as a spear or harpoon.

Dive shops run spearfishing courses in freediving as there are many health and safety considerations involved and can advise on the type of gear you will need.

Web reference: spearfishing.com.au

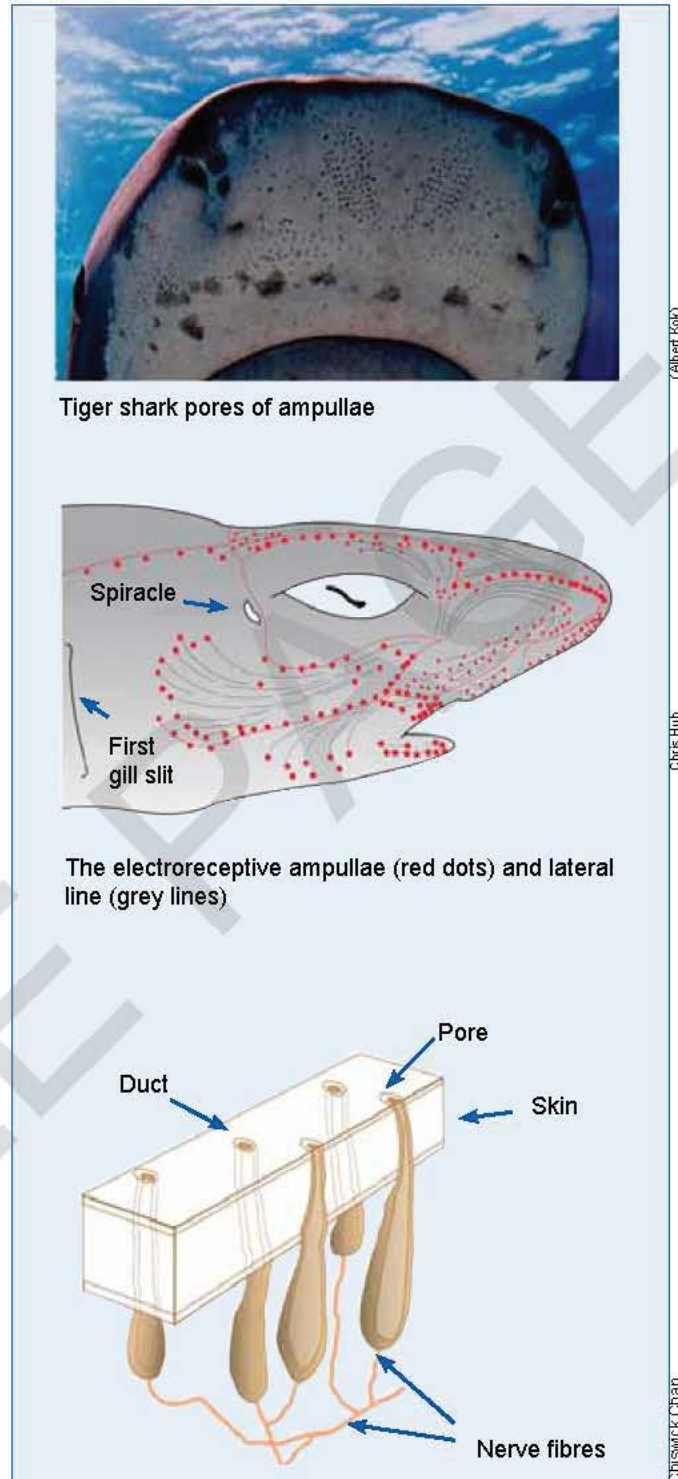


Figure 10.1 Shark neuromast system

For creative commons attributions see page 2



Figure 10.2 Shark band (left) and shark shield (right)

D. Snorkelling PPE experiment

Based on an original activity by Mick O'Connor

Objective: To experiment with snorkelling PPE swimsuit materials to determine equipment care.

Part A: Swimsuits and heat

Aim

To analyse how heat affects materials used in snorkelling equipment.

Materials

- Old swimsuit or wetshirt
- Hair dryer or heat gun
- Retort stand and clamp
- Thermometer
- Scissors

Method

1. Note the composition of the swimsuit.
2. Cut the clothing into 10 cm by 2 cm strips.
3. Using retort stand, hold a strip between two clamps.
4. Clamp a thermometer close to the fabric.
5. Using the hair dryer or heat gun, subject the fabric to different temperatures and record your observations in a table.

Part B: Swimsuits and chemicals

Aim

To analyse the effect of common chemicals on swimsuits.

Materials

- Old swimsuit or wetshirt
- Bleach
- Petrol
- Nail polish remover
- Methylated spirits

Method

1. Note composition of swimsuit.
2. Cut the clothing into 10 cm by 2 cm strips.
3. Put one chemical on each strips.
4. Observe the results and record them in a table.

Results

Conclusions

Extended response

Analyse your results so you can prepare a warning statement that could go on the garment at a retail outlet.

WORKSHEET 1: EQUIPMENT SELECTION

Q1. Identify five basic pieces of equipment required for snorkelling (Page 3).

Q2. List any three pieces of advice to take when purchasing equipment giving reasons for your answer (Page 3).

Q3. Give two reasons why you should use your own equipment (Page 3).

Q4. Why should you check equipment after taking it out of storage? (Page 3)

Q5. Name three types of mask describing one features of each (Page 3).

Q6. What are any three things to consider when selecting a mask? (Page 4)

Q7. What is a simple check to see if a mask fits properly? (Page 4)

Q8. How is a mask adjusted? (Page 4)

Q9. Why does a new mask have to be cleaned before use? (Page 4)

Q10. What three things do all snorkels include and for what purpose? (Page 5)

a.

b.

c.

Q11. What is a purge valve and why is it useful? (Page 5)

Q12. Give one reason why a close function is useful on a snorkel? (Page 5)

Q13. On what side of the head should a snorkel go? (Page 5)

Q14. Describe two types of fins and state one advantage and disadvantage of each. (Page 6)

Q15. a. What is a stinger suit? b. Why is it used? c. When and where should it be worn? d. What is it made of? (Page 7)

a.

b.

c.

d.

Q16. a. What is a wetsuit? b. why is it used? b. What is it made of? c. Where should it be worn? (Page 6).

a.

b.

c.

Q17. Describe the relationship between water temperature, wetsuit thickness and buoyancy (Pages 6 and 7).

Q18. a. What is a UPF 50 rash vest? b. What is it made of? c. Why is it used and where should it be worn? (Page 7).

a.

b.

c.

d.

Q19. a. What is a weight belt and b. why is it used? (Page 9).

a.

b.

Q20. Calculate how much weight to add to a weight belt for a 3mm wet suit for an 80kg snorkeller (Page 9).

Q21. What is the difference between a shark repellent magnetic band and an electromagnetic field? (Page 10)

Equipment care and maintenance

Q22. What two things can you do to care for your equipment? (Pages 3 - 9)

a.

b.

Q23. Describe equipment care and maintenance procedures for each of the following pieces of snorkelling equipment. Snorkel/ face mask purge valve, wet suit, rashie, camera, knife, gloves, weight belts (Pages 3 - 9).

Q24. Name one thing you should not do with your wet snorkelling gear, giving a reason (Page 8).

SECTION 2: SNORKELLING SKILLS

Objectives

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

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 14.3. 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 14.1 Three mask fitting hints

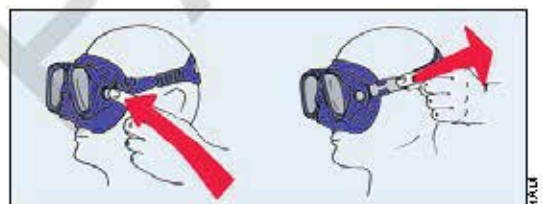


Figure 14.2 Adjustments are made at the side

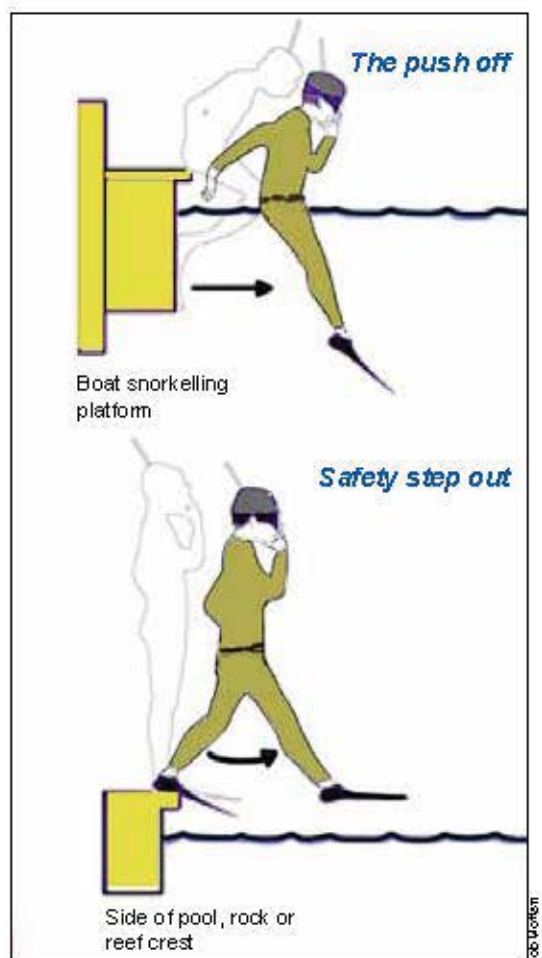


Figure 14.3 Two types of water entry

To a rescue boat - Simply swim back to ladder or platform, take your fins off, hand them to someone on board, and climb up the ladder.

To a beach, rock wall - Swim back at high tide and when in very shallow water roll on your side, take your fins off and walk up the beach or clamber up the rocks using three points of contact.

High tide reef - Swim over the coral trying not to strike it with your fins, then do a beach exit. Keep your mask on, as some coral cays often have waves at high tide. If snorkelling at low tide is the only option, look for well worn entry/exit points and use these.

Waves on a beach - Plan to exit between waves. Throw fins up onto the beach, have your mask around your neck so you don't lose it, and exit making sure you keep your eyes on waves.

Rockwall lowtide, waves and wind - Throw your fins as far up as you can or tuck them under your arms. Your mask and snorkel should be around your neck so you don't lose them, and keep three points of contact as you clamber out. A better plan is to use stairs if available.

C. Finning and diving

1. Finning

The best method is to keep your leg fairly straight, and initiate the action from your hips. Ideally you want your hips and legs to be in line with your torso, and your knees only bending slightly with the upward stroke (see Figure 15.4a).

With the right fins, you can maintain control even through strong currents but also quietly observing reef fish, corals, and other animals without harming or disturbing them.

Don't bent your knees and avoid cycling as shown in Figure 15.4b, as this uses up too much energy and can lead to cramping.

Floating

Sometimes just floating as shown in Figure 15.2, with your hands out or arms folded is a great way to save energy and forces you to look at things in the water. It's amazing how much more you see when you actually just float and look.

2. Diving

a. The diver's flag

The dive flag in Figure 15.3 is blue and white and means there is a diver down below in this area, keep well clear at least 30 metres and pass at a slow speed. Taking a dive flag, as shown on the inside cover, while snorkelling, will hopefully mean you won't get run over by a boat.

b. The one up / one down rule

Means your buddy stays UP on the surface, watching you while you are DOWN diving because if you black out, and go limp, your buddy can dive down and rescue you.



Figure 15.1 Finning

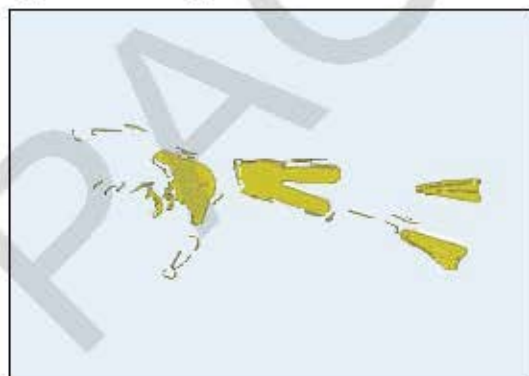


Figure 15.2 Floating



Figure 15.3 The diver's flag

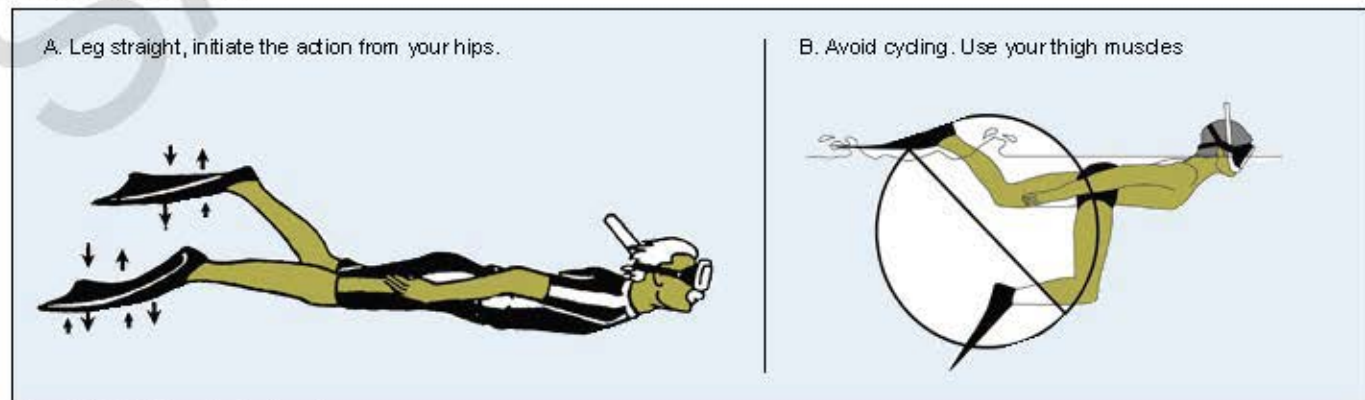


Figure 15.4 Finning the right and wrong way

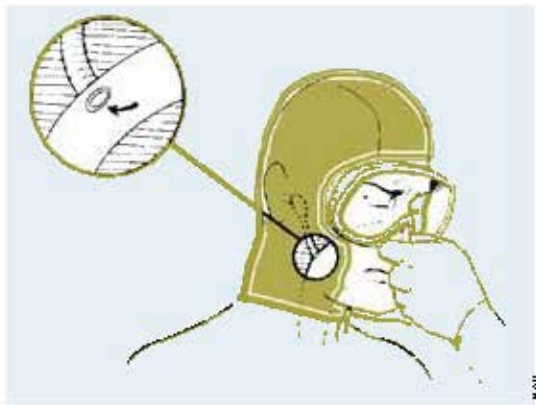


Figure 16.1 The Valsalva manoeuvre

c. Equalising your ears

Note: The personal hazard of not equalising is discussed in Section 3.

If you are diving to a depth greater than a metre, you will need to equalise the pressure on either side of your eardrum as shown in Figure 16.1.

Equalising tips

When equalising - close your mouth, pinch your nose and blow gently. If you don't feel your ears 'pop' initially, try tilting your head back (which will open the eustachian tube wider) then try one or all of the following.

- Equalise very metre that you decent on each alternate fin kick.
- Don't wait till it hurts, always equalise BEFORE you feel the pressure.
- Chew gum before snorkelling.
- Pop your ears at the surface before going down.
- Pinch nose, wriggle jaw and or swallow.
- Move your head and neck slowly from side to side to stretch out the tube that connects your inner ear to the back of your throat (Figure 16.1).
- Yawn (sometimes difficult while underwater)
- If you cannot equalise your ears, then don't dive underwater. That doesn't mean you can't snorkel, just don't dive or you will end up with very sore ears, a headache and may damage to your eardrum.
- Always start equalising your ears the moment you start to dive (even at the surface).

d. Safety dive

This is used whenever there is danger of underwater snags or obstacles close to the surface or where visibility is limited and the dive area is not known. In this dive the snorkeller simply submerges and looks around before duck diving.

e. Duck dive

This starts with taking a good deep breath.

The waist is then bent and the legs kicked into the air allowing the weight of the legs to provide you with the momentum to force you down. Wait for your fins to become submerged before you start kicking.

When you do start kicking, make sure they are long slow kicks rather than many short fast ones. This will also help you preserve your oxygen supply.

Avoid using your arms as their use will burn through your oxygen reserves while providing little in terms of propulsion. Let the strong muscles of your legs and fins do all the work.

Don't forget to equalize! One hint is to keep a rhythm of equalizing every time you kick with your right foot.

Slow and easy is the best approach when it comes to duck diving followed by a short swim horizontally parallel to the ocean floor or at a depth you can feel comfortable.

As soon as you feel the need to breathe, swim to the surface, looking up, hand pointing up, no need to equalise and turning in a slow 360° movement to make sure you don't collide with other snorkellers.

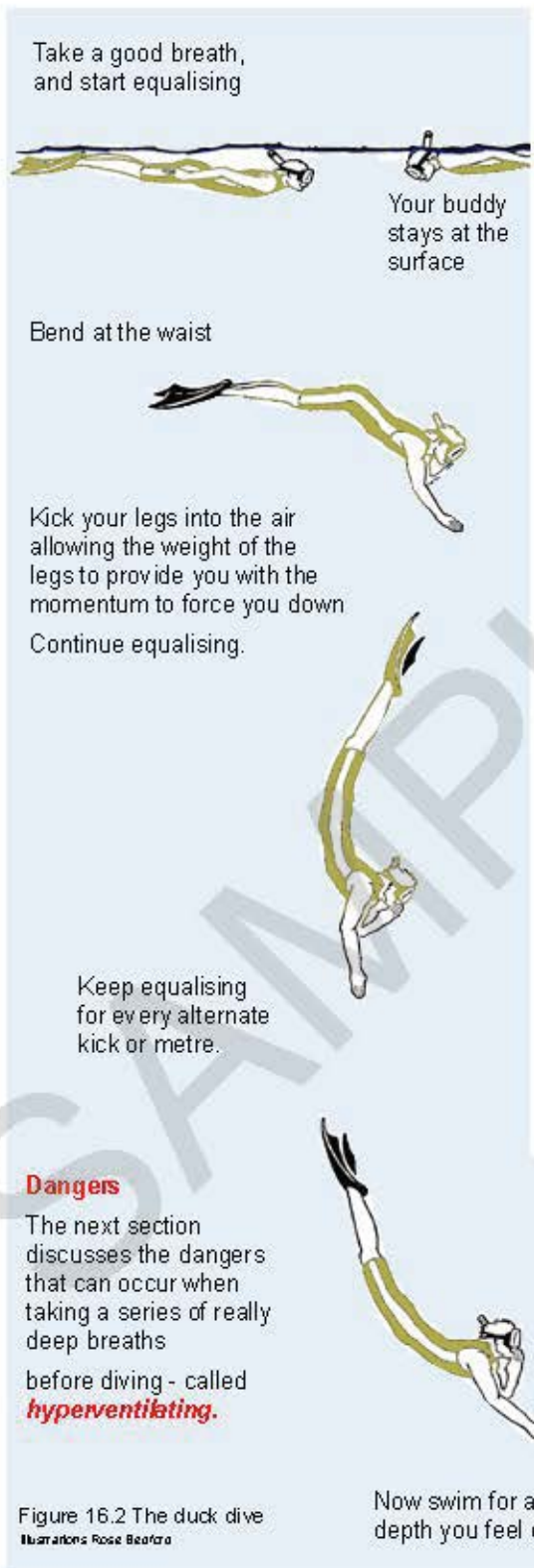


Figure 16.2 The duck dive
Illustrations Rose Beafora

D. Snorkel and mask clearing

1. Snorkel

Depending on the type of snorkel you have, there are three ways to clear it when you are surfacing.

a. Blast method

If you have a classic snorkel, duck your head under the water until the snorkel fills. Now raise your head until your ears are level with the surface, move your tongue to the roof of your mouth to act as a splash guard and blast clear the snorkel.

Remember you need to keep a little reserve air in your lungs at the end of a dive to do this.

b. Purge valve

If you have a semi dry or dry snorkel, you can use the purge valve. This is located in a space below the mouthpiece where excess water collects and opens when you forcefully exhale to clear the tube.

With a light exhale, there is enough force for the water to just drain down through the valve (instead of having to blow it back up through the tube with a huge gust of air).

You can do this with a normal exhale, from the position you're in, without having to blast the water out.

c. Displacement method

This was the classic way of clearing a snorkel as shown in Figure 17.2. As you come back up to the surface, look straight to the sky and reach one of your hands straight up to the surface.

Once your hand touches the surface, puff a small amount of air out of the tube. Ensure the end of the snorkel is lower than your mouthpiece - looking up as you surface accomplishes this. The air you blow out of the tube will displace the water and cause it to exit the tube. Once you make it to the surface, look down, so your snorkel is pointing upward.

2. Clearing your mask

There are two ways.

a. Without a purge valve

Press the top ridge of your mask firmly to your forehead while slowly opening the bottom seal and blowing air through your nose as shown in Figure 17.3.

Tilt your head back slightly, looking up while exhaling through your nose and the air you blow out will push the water out of the mask.

b. With a purge valve

Tilt your head so the purge is at the mask's lowest point, exhale through your nose, and the water all drains out of the purge valve as shown in Figure 17.4.

3. Stopping your mask fogging up

a. Spit

Dunk the mask briefly in fresh water and then tip the water to drain out. Now spit in the middle of the mask and rub your saliva over the glass with your finger and then rinse out. The idea is to leave a thin film of saliva on the inside of the mask. Alternatively a few drops of watered down baby's shampoo rubbed into the mask and then rinsed out just before snorkelling will again put a thin film on the mask.

b. Commercial defogging agents (Antifog)

These products are designed to coat the lens and many people find these better than spit.

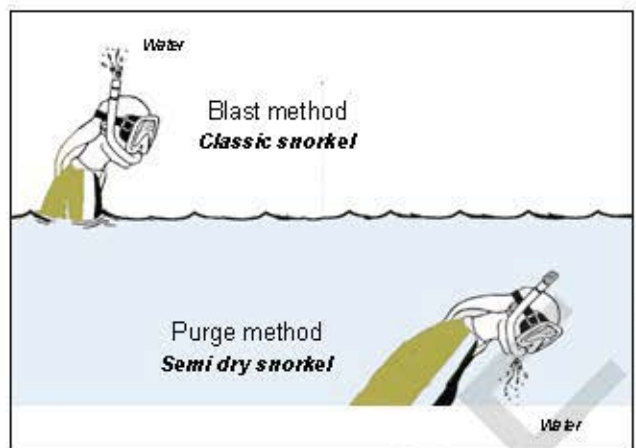


Figure 17.1 Blast and purge valve methods

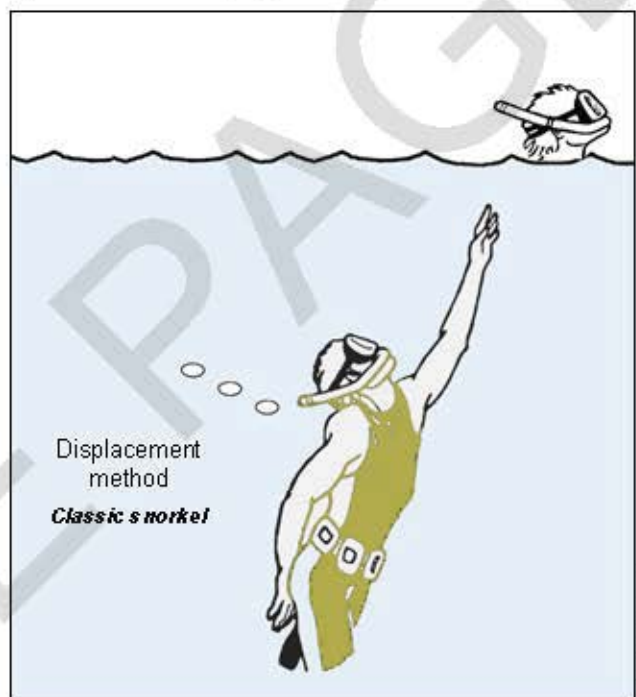


Figure 17.2 The displacement method of clearing a snorkel

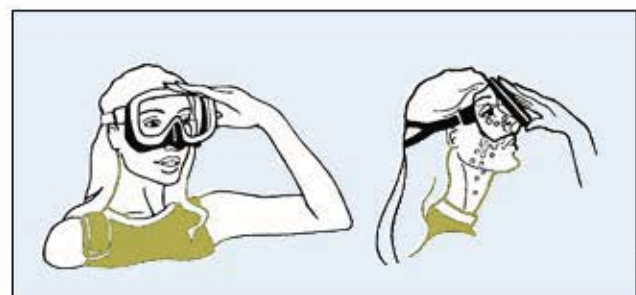


Figure 17.3 Clearing a mask (no purge valve)



Figure 17.4 Masks with purge valve

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.

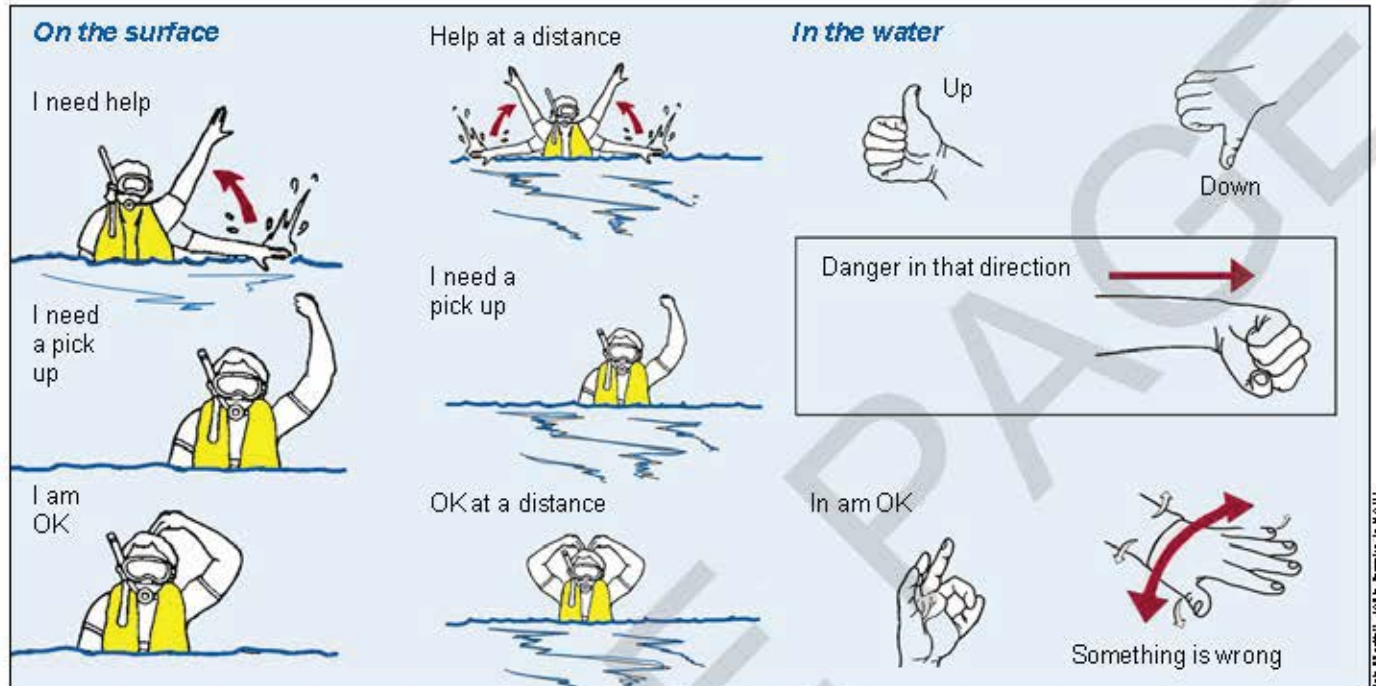


Figure 18.1 Snorkelling signals

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.

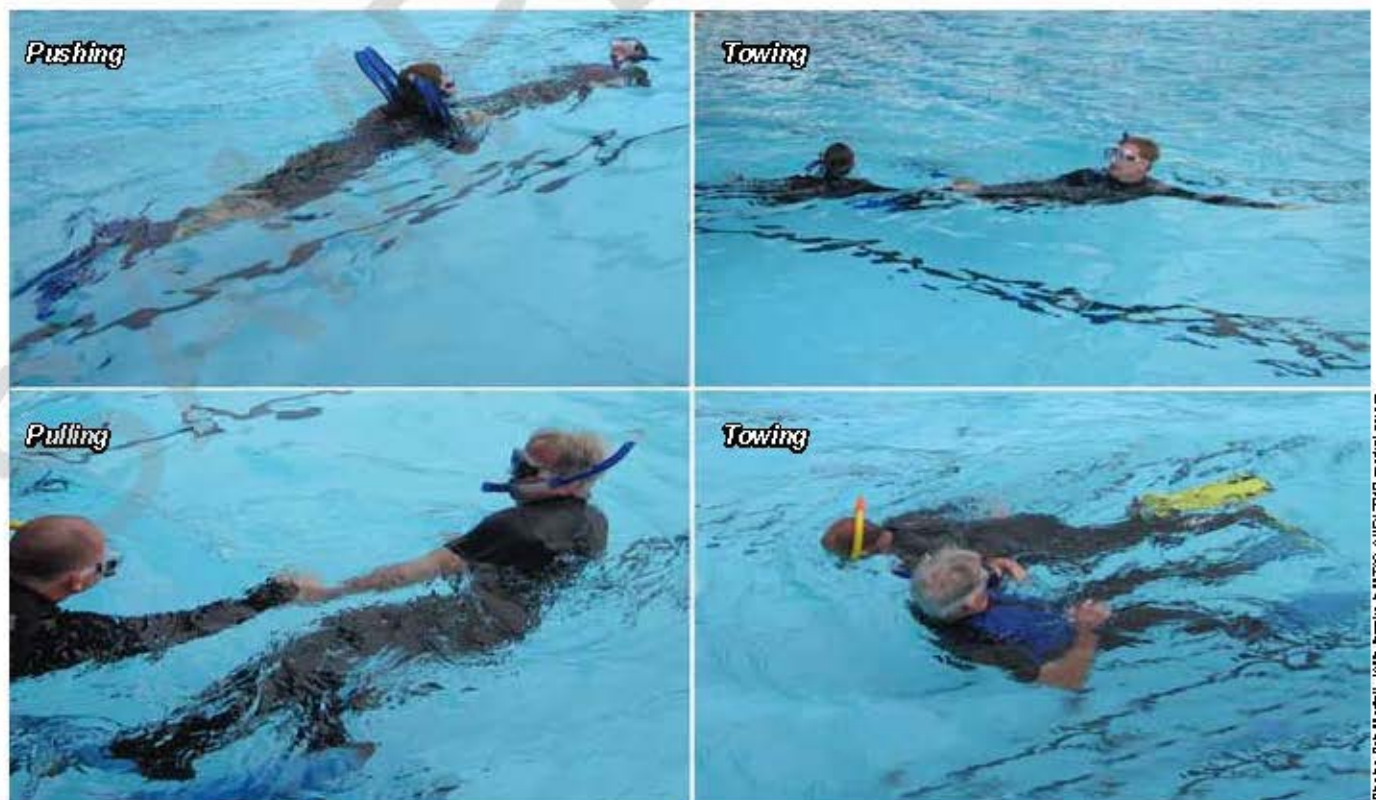


Figure 18.2 Snorkelling rescue techniques

ACTIVITY: SNORKELLING CERTIFICATE DESIGN

Design a snorkelling competency certificate with the aim of recording your personal physical fitness skills so you have the stamina to swim out and back to a snorkelling site, duck dive and have fun for about 30 minutes as well as demonstrating the stamina to rescue your buddy and keep afloat for 10 minutes until help arrives. Here are some suggestions:

Part A: Physical fitness

Checklist

- Tread water 10 minutes
- Underwater swim one breath, no push off or dive
- Distance swim 200m non-stop any stroke no time limit
- Underwater swim using three breaths during swim

Part B: Snorkelling skills

Checklist

- Select and fit a mask.
- Select and position a snorkel correctly.
- Defog and clear a mask in and out of the water.
- Fit a set of closed or open healed fins so they are snug and tight.
- Select and fit a rashie/stinger suit or wet suit to correct size and thickness appropriate to the area to be snorkelled.
- Step out from a pool edge as if it were entering from a rocky or reef edge.
- Push off from a pool edge as if you were entering from the beach or from a dive platform or ladder.
- Duck dive, equalise ears, swim along the pool floor and surface.
- Clear a snorkel
- Demonstrate signals for:
I need help, I need a pickup, OK at surface and underwater, danger - in that direction, something is wrong.

WORKSHEET 2: SKILLS KNOWLEDGE

Q.1 Why do you need to demonstrate the physical skills listed in Part A above? (See top of this page)

Q2. What's the difference between the safety step out (giant stride) and push off water entries from the pool and boat? (Page 14)

Q3. On what side of your head do you fit your snorkel and why? (Page 14)

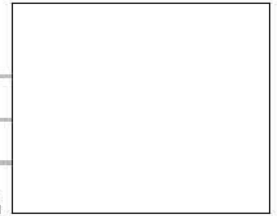
Q4. How do you know if your fins are fitted correctly? (Page 14)

Q5. What is the best technique to use with your fins? (Page 15)

Q6. What should you avoid while finning and why? (Page 15)

Q7. Why is floating while looking down a good idea while snorkelling? (Page 15)

Q8. Draw a dive flag and colour it in. Why is it necessary to take while snorkelling? (Page 15)



Q9. a. What is the one up / one down rule? b. Why is it compulsory for a buddy to obey? (Page 15)

a. _____
b. _____

Q10. How do you equalise your ears? (Page 16)

Q11. How do you duck dive? (Page 16)

Q12. What are three ways to clear a snorkel? (Page 17)





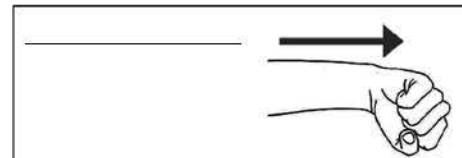


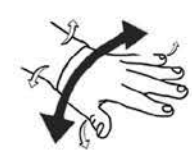
Q13. What are two ways to clear a mask? (Page 17)

Q14. Name two ways you can stop your mask from fogging up (Page 17)

Q15. Describe how to ditch a weight belt (Page 18)

Q16. Name three rescue methods (Page 18)

Q17. Identify the signals in the illustrations below: (Page 18)

<i>On the surface</i>	<i>In the water</i>
 <p>_____</p>	 _____  _____
 <p>_____</p>	
 <p>_____</p>	 _____  _____

Bob Moffatt - 30th thanks to NAUI

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 21.1, 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 21.1, 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 21.2.



Figure 21.1 Make sure you know emergency points.



Figure 21.2 Evaluate emergency communications

4. Evaluate groups medical conditions

Reason: To avoid unexpected emergencies, or personal health issues after the snorkel, for example:

- Check on the current health of the group - asthma, colds, sniffles, nervousness.
- Check the fitness of the weakest member and brief the group the snorkel may need to be modified if need be, according to this capacity.

For example: If one member was not a strong swimmer, the group would need to stay close to the reef crest.

A very useful suggestion would be to download and follow the government form used by commercial operators as a guide. See inside back cover for a web page reference.

5. Evaluate weather and tides for safety

Reason: To check tides, wind speed and direction for the day to determine the best snorkelling conditions and to identify any hazards, for example:

- Check weather map to confirm offshore conditions, no waves, visibility > 3m, no rain in recent days.
- Check tides to determine safe entry and exit points and change if necessary.

6. Plan what to say in a safety brief

Note: This is an example. Your safety plan may be different.

Reason: To check everyone knows what is going to happen and where to exit in case of an emergency by drawing a mud map in the sand as shown in Figure 22.2. Your briefing might go something like this:

“Here is a mud map of where we are going.....”

- *When we take off our reef walkers (HERE arrow out), tie them around your waist, put your fins on and take a big jump out into the water or tie your reef walkers around your waist, throw your fins into the water to me, jump in and I’ll help you put them on.*
- *We are all then going to swim out for about 5 metres and float down along the dots with the current on the inside of the bommie staying close to the reef edge (HERE) and the no go zone is (HERE - marked with the crosses).*
- *We will be in the water for about a hour, but if you get cold or a cramp, let me know and we will find a place for us to get out of the water (HERE where the stick is).*

If this exit is too dangerous, we will all have to swim down to the exit point (HERE arrow in).

- *If someone wants to dive down, the rule is one buddy up while the other is down.*
- *When we get to the exit point, get close to the reef crest, crawl out as best you can or ask for help. Then take your fins off and put your reef walkers back on.*
- *So who is your buddy? What’s the one up one down rule mean? What is the safety signal for:*
 - I need help?
 - OK?

You also may need to evaluate the comprehension of the group and if necessary ask them to repeat it.

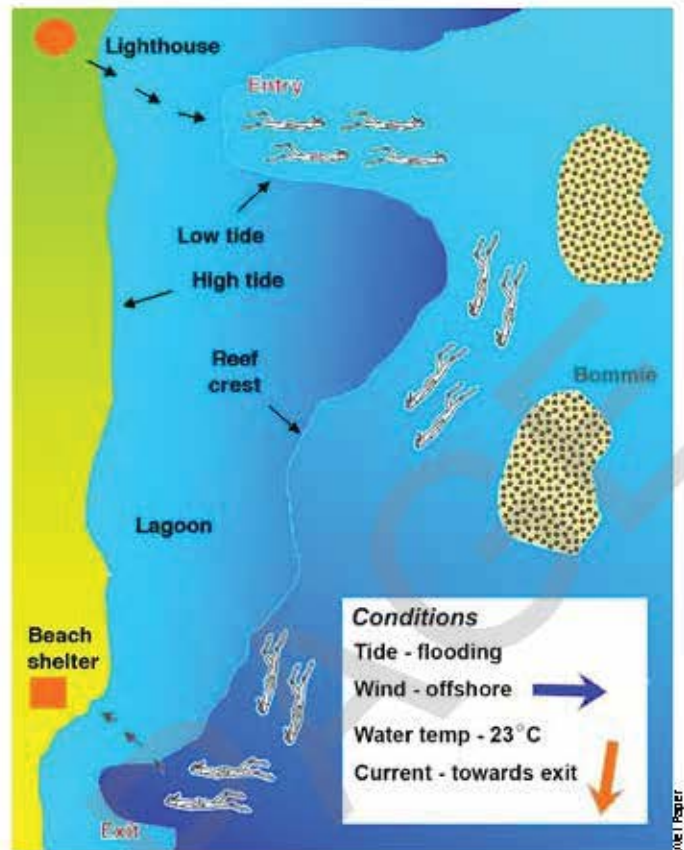


Figure 22.1 Always have a plan to the conditions at the time of entry



Figure 22.2 Draw a map in the sand with a stick before entry



Figure 22.3 Make sure everyone knows what to do.

B: Stop the bleed

On average we have about 5 litres of blood and severe bleeding resulting from bites from large predators or lacerations can deplete this reserve quickly.

If too much blood is lost from the body, the supply of oxygen to cells is reduced resulting in shock and finally death. If this looks the case, quick action and calling for emergency help is required, so don't hesitate to call 000.

Severe bleeding

The best way to stop bleeding is:

- To apply immediate pressure - use a towel, tourniquet or anything to stop bleeding (see Figure 23.1).
- Elevate the bleeding area.
- Rest the patient - treat for shock if necessary.
- Clear the area of skin around the laceration and apply a dressing, check tetanus injection records.

1. Coral cuts

These need special cleaning to remove all grit and washing with antiseptic, then application of an antibiotic cream to prevent further bacterial growth as shown in Figure 23.2. The use of betadine should be as a last resort as it slows the growth of new skin.

It may be worthwhile contacting your doctor before a trip to get a tube of antibiotic cream before departure, for example *mupirocin* is an antibacterial cream/ointment which is used to treat small areas of skin infection.

2. Lacerations

Lacerations can occur from severe coral cuts, knife wounds, coral or rock cuts, glass or boat propellers.

Action

- Control the bleeding by pressure, elevating the lacerated limb and rest
 - Clear the area of skin around the laceration, apply a non-stick sterile dressing, then bandage to stop the bleed.
 - Superficial foreign matter should be removed, but anything deep should be left to a doctor as stitches may be required.
- If you have broken skin check your tetanus injection records.

3. Bleeding from the ear and nose

Ear

This may indicate a skull fracture or damage to the ear drum.

Action

Position the patient on the side with the affected ear down and seek urgent medical advice.

Nose

If a serious injury is suspected, medical advice should be sought immediately.

Action

You have to sit, lean slightly forwards and pinch the nostrils for 20 minutes while breathing through the mouth. Try not to sniff or blow the nose and place a cold pack at the back of your neck.

4. Bleeding from big fish bites

Action

Tourniquets, Figure 23.1, should only be used when bleeding cannot be stopped by the use of direct pressure alone, or if direct pressure cannot be effectively applied for any reason.

1. Apply pressure with hands



2. Apply dressing and press



3. Apply tourniquet



Figure 23.1 Hints on how to stop bleeding (after *Stop The Bleed*).

Coral cuts need special attention because they are most likely to become infected. Thoroughly clean the wound as soon as possible after the injury. Scrub foreign material such as sand out and apply antiseptic lotion or local antiseptic powder.

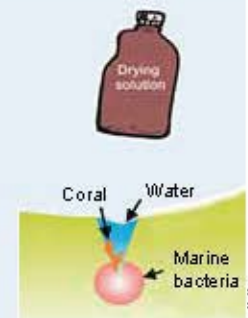


Figure 23.2 Treatment of coral cuts



Figure 23.3 Coral cut

Heavy and uncontrolled bleeding can cause death within minutes, so it's necessary to act quickly when dealing with a traumatic wound. They can only be used on limbs and seek urgent medical advice if you are the first responder on when to release it.

SECTION 6: SNORKELLING SCIENCE

Objectives

A. Vision underwater

1. Complete a diagram to illustrate how the human eye functions.
2. Explain why marine life appears bigger underwater when using a mask.
3. Describe how the penetration of light frequencies changes with depth.
4. Compare how a mask focuses an image on the retina of the human eye with and without a mask.

B. Respiration and SWB

1. Define shallow water blackout.
2. Explain SWB given graphs comparing oxygen and carbon dioxide levels of dives with normal breathing and hyperventilation.

C. Buoyancy and snorkelling

1. Explain why we float
2. Discuss the difference between positive, neutral and negative buoyancy.

D. Archimedes Principle

1. Recall Archimedes Principle and state the formula for calculating density.
2. Explain how you would predict if a object would float or sink.
3. Calculate the mass of water displaced by a snorkeller and the mass of a weight belt using a formula for density.
4. Estimate the apparent mass of an object when placed in water.

E. Effects of pressure

1. Define pressure.
2. Discuss the effect pressure has on our bodies when we dive underwater.

F. Boyle's Law

1. Define Boyle's law.
2. Describe an experiment used to prove it.
3. Discuss the relationship between pressure and volume when we dive underwater.

A. Vision underwater

1. How the eye functions

Light enters the eye through the cornea, lens and eye fluids and then bends towards the retina (see Figures 24.1 and 24.2).

- The eye focus light onto the retina by means of a lens that can be contracted or relaxed by a set of the ciliary muscles.
- The sclera helps maintain the eye's shape and is the outside covering of the eye, sometimes called the white part of the eye.
- The slight bulge in the sclera is called the cornea and the clear membrane that covers this is called the conjunctiva.
- The ciliary muscles focus a lens onto the retina which has a set of light sensitive cells processing millions of dots of light that fall onto it.
- The retina then sends information to the brain through the optic nerve.
 - Note that the eye has a blind spot which is located where the optic nerve leaves the retina.
 - Try the experiment described opposite to see how the eye spot can be proven.
- Having two eyes allows us to see depth, so try closing one eye and attempting to put one index finger exactly on top of the other.

At first, the brain cannot interpret depth so you miss, and has to readjust for looking through one eye.

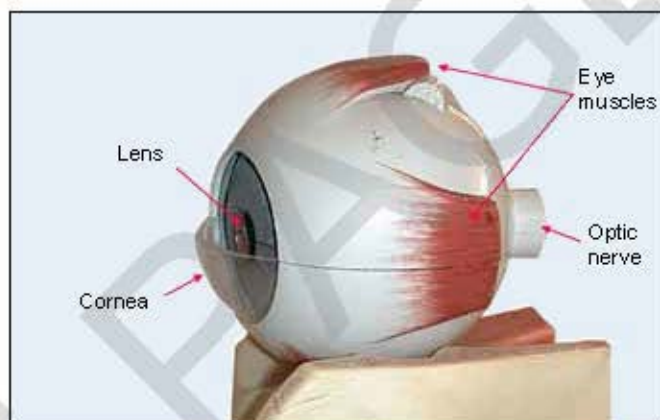


Figure 24.1 Model of the eye

Blind spot experiment



To draw the blind spot tester on a piece of paper, make a small dot on the left side separated by about 15 - 20 cm from a small + on the right side.

Close your right eye. Hold the image about 60 cm away.

With your left eye, look at the +.

- Slowly bring the image (or move your head) closer while looking at the +.

- At a certain distance, the dot will disappear from sight. This is when the dot falls on the blind spot of your retina.

Reverse the process. Close your left eye and look at the dot with your right eye. Move the image slowly closer to you and the + should disappear.

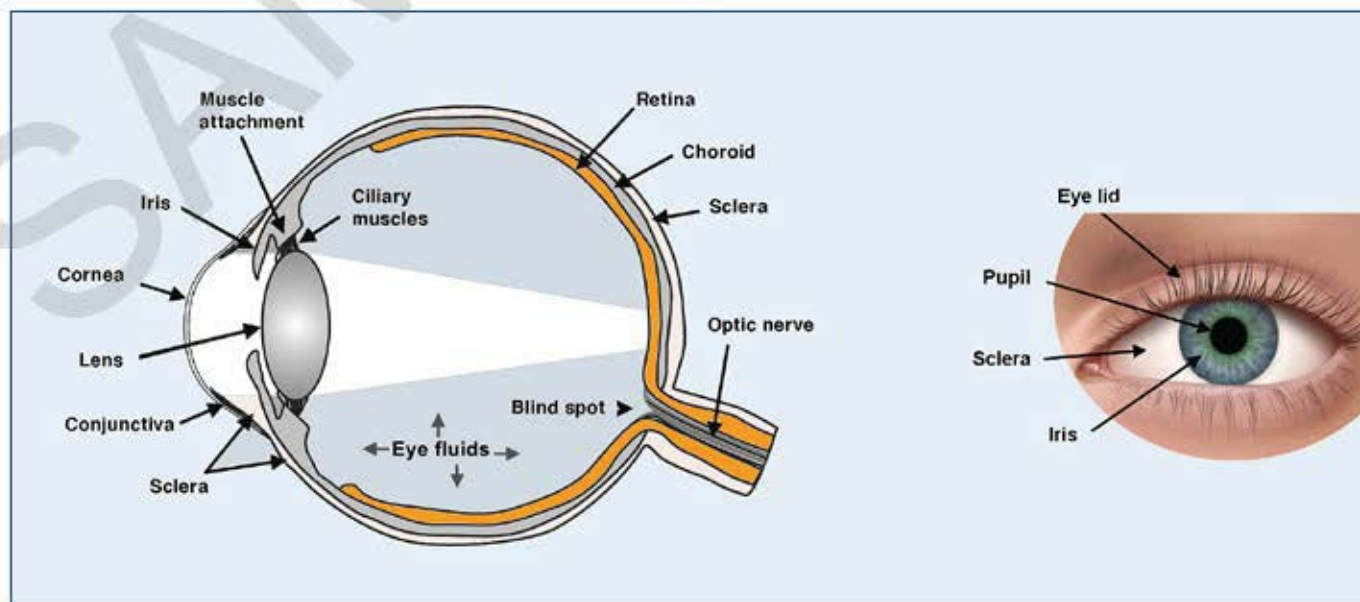


Figure 24.2 Features of the eye affecting vision

In water, this depth perception is affected by bending of light as it passes from water to the glass of the face mask and then into the eye.

By wearing a face mask we see more clearly underwater as it provides an air space so that the rays of light can focus on the retina.

This is shown in Figure 25.1.

2. Light and size

Light behaves differently in water than it does in air, because as it moves through a different medium, it bends.

So, when a ray of light passes from water (a more dense medium) to air (a less dense medium) it bends away from the surface of the face mask.

In water, rays of light are not bent as far, and images focus behind the retina.

This is why fish appear blurred when seen without a mask, shown again in Figure 25.1.

3. Apparent images

When a mask is used, the rays of light enter the eye normally and the image is clear. However, the mask has a magnifying effect and objects appear closer and one third bigger.

When there is a layer of air between our eyes and water, objects appear to be one third larger and closer than they actually are, as shown by the apparent image in Figure 25.2.

4. Colour and depth

As depth increases, the range of visibility and the intensity of colour, especially at the red end of the spectrum, decreases due to the diffusion and absorption of light, hence brightly coloured marine life appears greeny-blue.

Also with depth, rays of light become more diffused (spread out) and more of the light is absorbed.

Different colours can also penetrate different depths as shown in Figure 25.3 whereby upon descent, red is absorbed first, and blue is absorbed last.

Implications for research

Look again at Figure 25.3.

What colour will a red fish appear to be at a depth of 6 metres? Could this diffusion of light affect the colour types of algae found in the sea?

When conducting underwater observations and recording data, you need to be aware that size and colour appear different underwater.

For example, coral trout appear red-brown at depth but bright red on the surface. Also, their apparent size is different from their actual size when viewed through a mask. You could devise a method to account for this by taking some type of measuring device or colour chart underwater.

Many researchers also use underwater flash photography or a torch to capture the true colours of their subjects.

Research

Search for colour and size variations of marine life at depth.

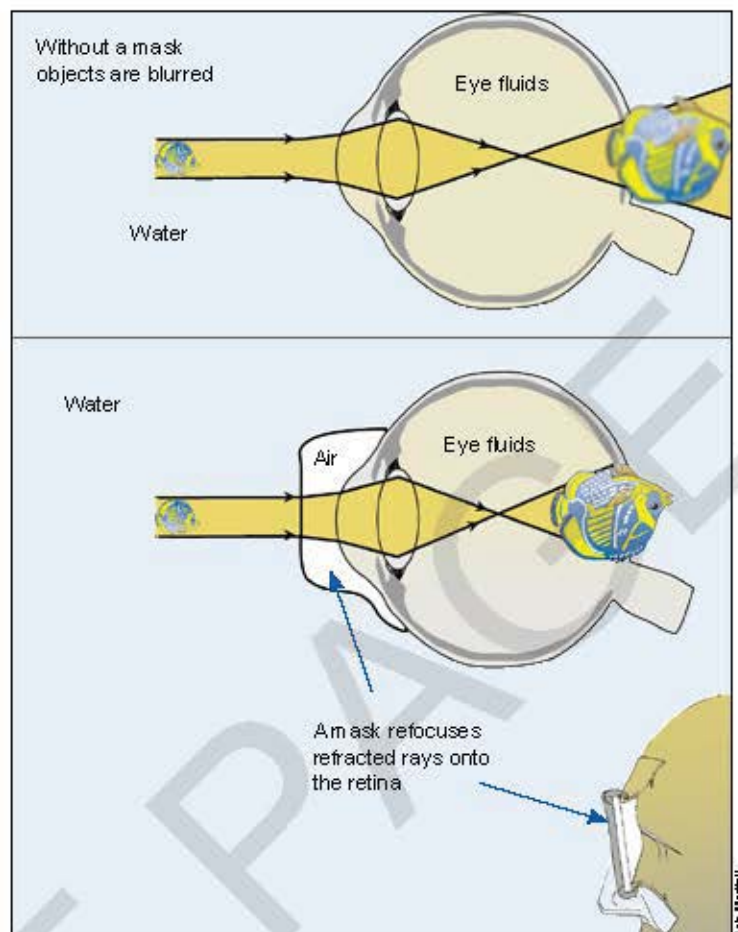


Figure 25.1 A mask helps us focus objects in the water

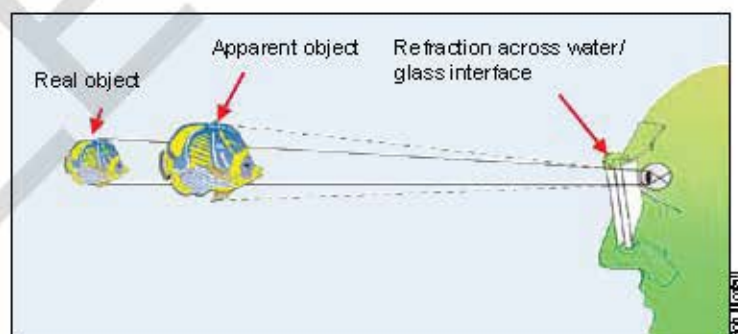


Figure 25.2 A mask makes objects appear bigger

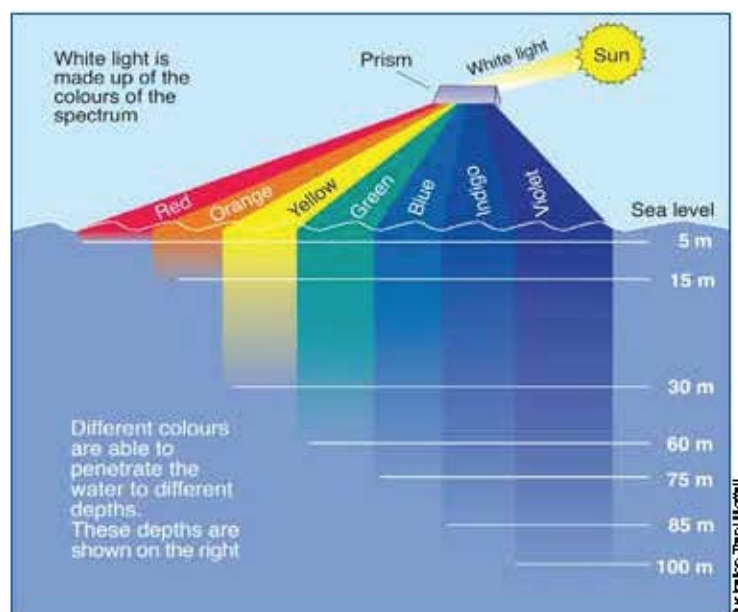


Figure 25.3 Different colour frequencies penetrate different depths.

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 26.1.

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 26.2, 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 26.3, 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.

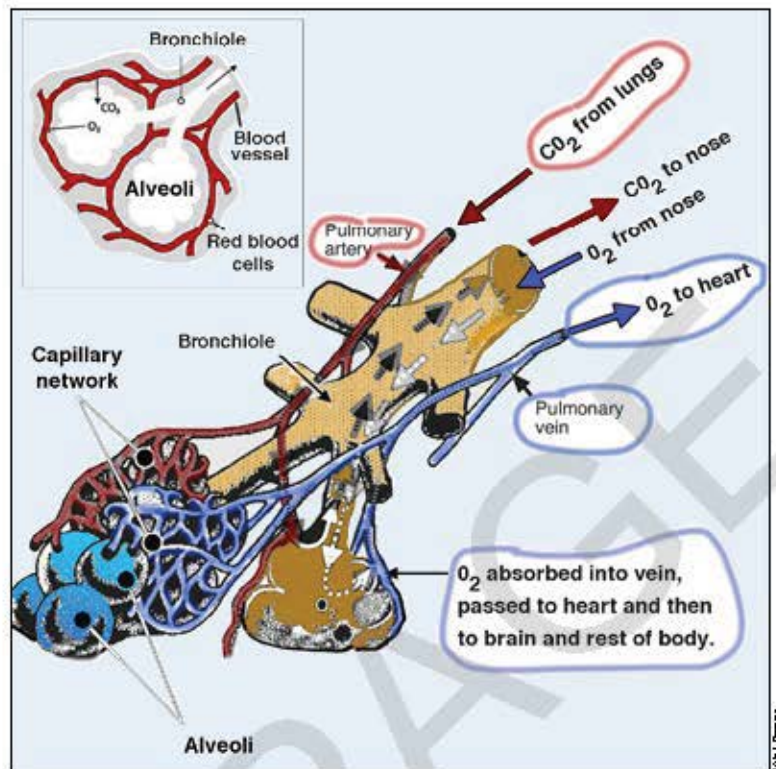


Figure 26.1 Effects of normal breathing on carbon dioxide levels

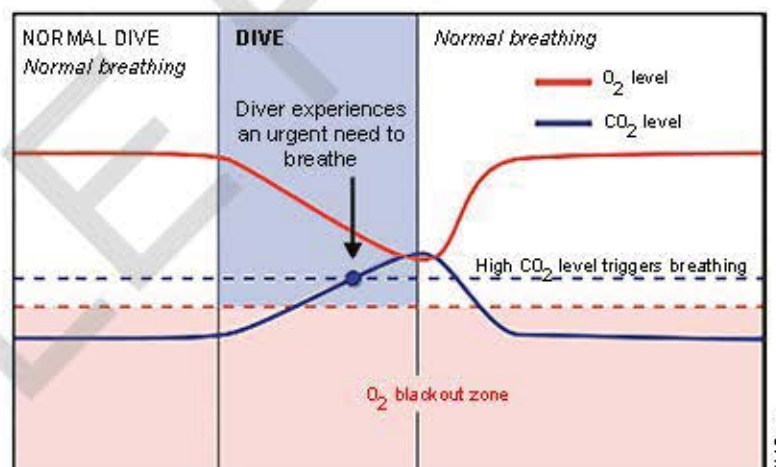


Figure 26.2 Effects of normal breathing on carbon dioxide levels

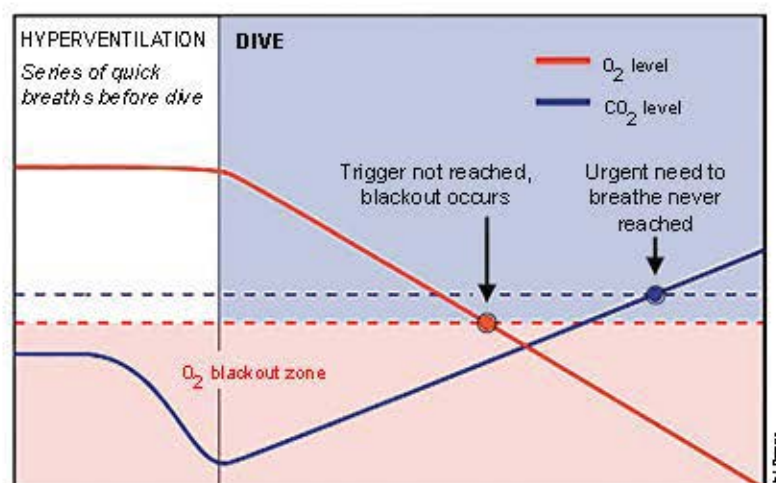


Figure 26.3 Effects of hyperventilation on carbon dioxide levels

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.

WORKSHEET 13: SHALLOW WATER BLACKOUT

Q1. Fill in the missing words from the ones in the box to the right.

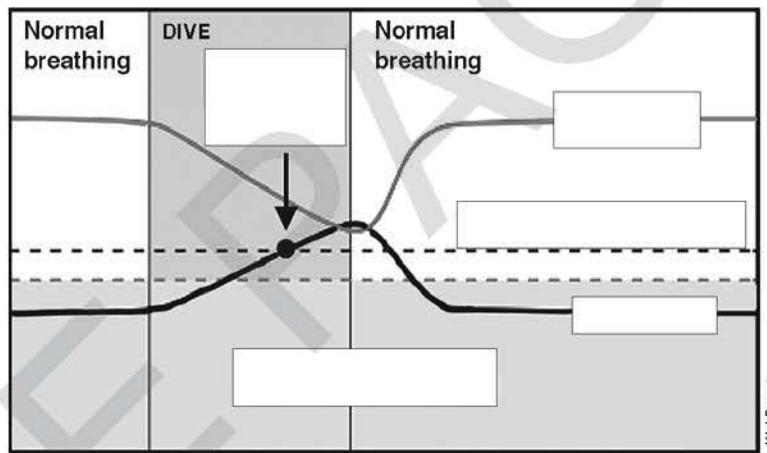
Every few seconds, with each _____, air fills a large portion of the millions of small sacs in the _____ called _____. In a process called _____, oxygen moves from these alveoli to the blood through the _____, (tiny blood vessels), lining the alveolar walls. A protein, called _____ in the red blood cells, then carries _____ first to the _____, then the _____ and then around the rest of your _____.

- Word list
- | | |
|------------|-------------|
| heart | brain |
| inhalation | oxygen |
| body | diffusion |
| lungs | capillaries |
| alveoli | haemoglobin |

Q2. Define SWB.

Q3. Complete the missing words in the graph to the right and use colours to indicate the oxygen and carbon dioxide levels.

NORMAL DIVE



Q4. Compare the levels of carbon dioxide in the two figures before and during a dive relating this to the oxygen blackout zone.

Q5. Complete the missing words in the graph from Page 60 and use colours to indicate the oxygen and carbon dioxide levels.

Q6. Compare the levels of carbon dioxide in the two figures before and during a dive. Relate this to the oxygen blackout zone and describe how the snorkeller drowns. (Page 60)

DIVE WITH HYPERVENTILATION

