SNORKELLING WORKBOOK

6th Edition

Bob Moffatt

Wet Paper

Contents

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Section 1: Physics and Physiology

Why do we see better underwater with a mask? What makes us buoyant? Can pressure make us faint? This section looks at some of the science behind snorkelling underwater.

The physiological differences which the snorkeller or diver must adapt to can be summarised under the following headings:

The eye, the respiratory system, the ear, effects of pressure, Boyle's law, the skin and buoyancy.

The eye

Light enters the eye through the lens, cornea, aqueous humour and vitreous humour all of which bend the light towards the retina (see Figures 3.1 and 3.2).

- The eye can focus light onto the retina by means of a lens that can be contracted or relaxed by a set of the ciliary muscles.
- The aqueous and vitreous humours maintain the eye's shape. The sclera helps maintain the eye's shape and is the outside covering of the eye.
- The retina has a set of light sensitive cells which process dots of light that fall ono it. The retina then sends information to the brain through the optic nerve. Note that a blind spot forms where the optic nerve leaves the retina.

  Try the experiment described opposite to demonstrate your blind spot.

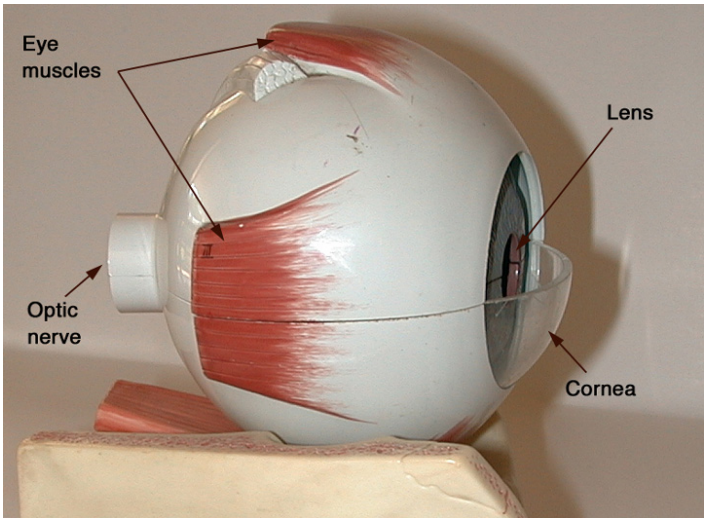

Figure 3.1 Model of the eye
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Blind spot experiment

• +

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.

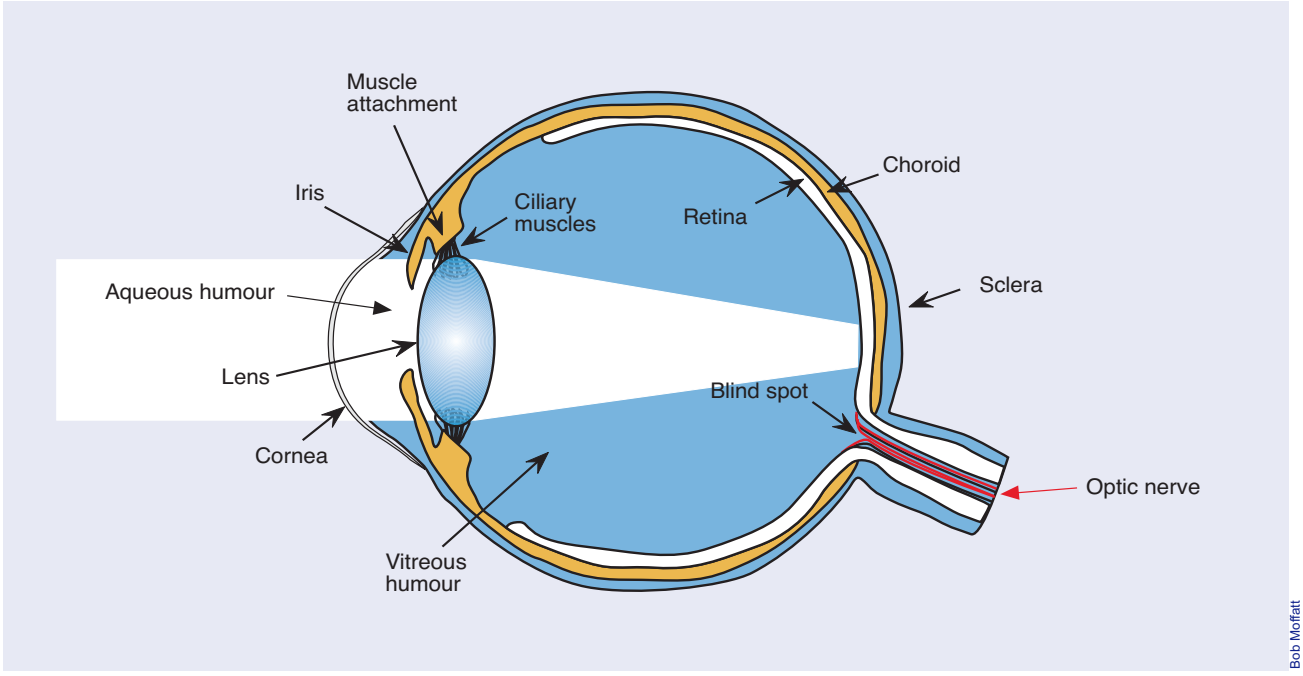

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Figure 3.2 Features of the eye affecting vision

Having two eyes allows us to see depth. In water, this depth is affected by the bending of light as it passes from water to the glass of the face mask and then into the eye.

The wearing of a face mask allows us to 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 4.1.

Light and size

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

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

The process by which light is bent as it passes from one medium to another (eg from water to air) is called **refraction**.

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.

How a face mask works

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 in Figure 4.2.

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, ie, spread out, and more of the light is absorbed.

Different colours can also penetrate different depths as shown in Figure 4.3. Red is absorbed fastest, whereas blue penetrates the furthest.

Look again at Figure 4.3.

What colour will a red fish appear to be at a depth of 6 metres and could this science fact affect the colour types of algae found in the sea?

Implications for research

When conducting underwater observations and recording data, you need to be aware that size and colour may be different and you are faced with the moral dilemma of stressing or killing animals to bring them to the surface to validate their size and colour.

You could devise a method to account for this by taking some type of measuring device or colour chart underwater.

The problem is greatly magnified by underwater flash photography and if you go on to obtain your SCUBA (self contained underwater breathing apparatus) certification.

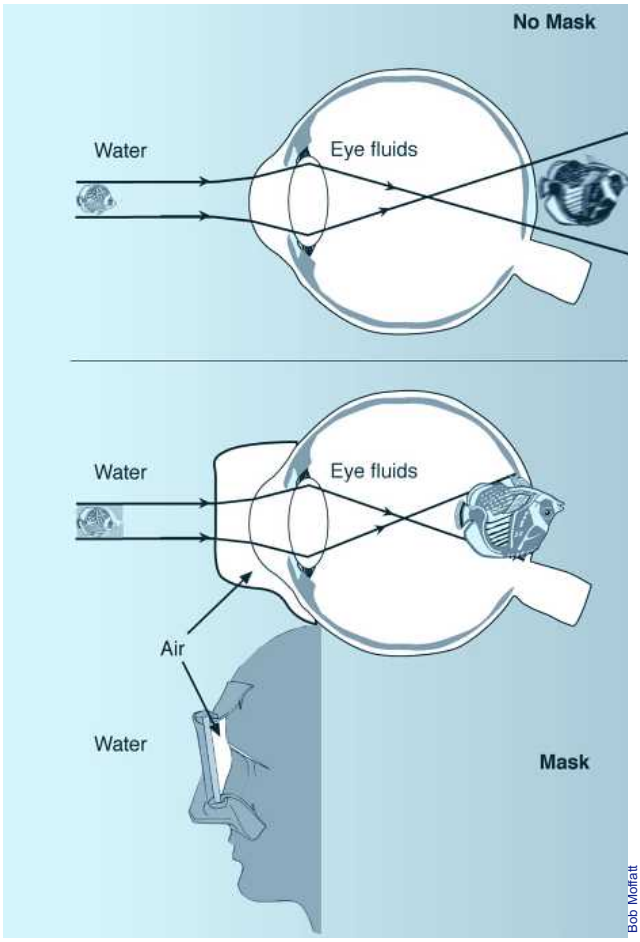


Figure 4.1 A mask helps us focus

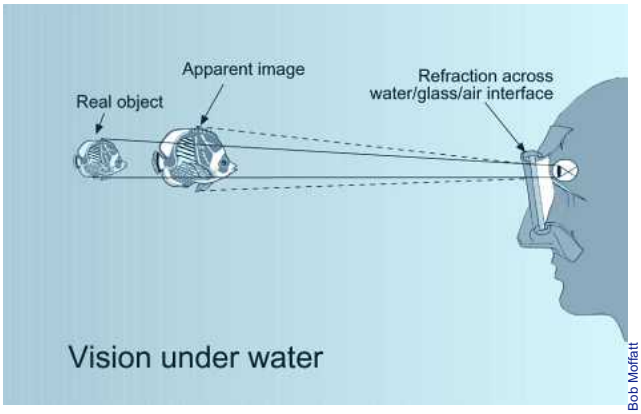


Figure 4.2 A mask makes objects appear bigger

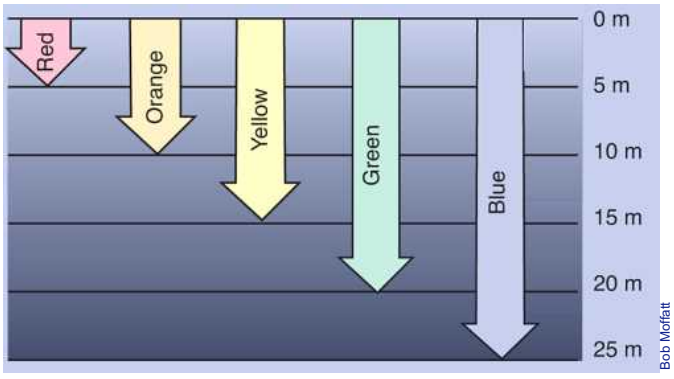
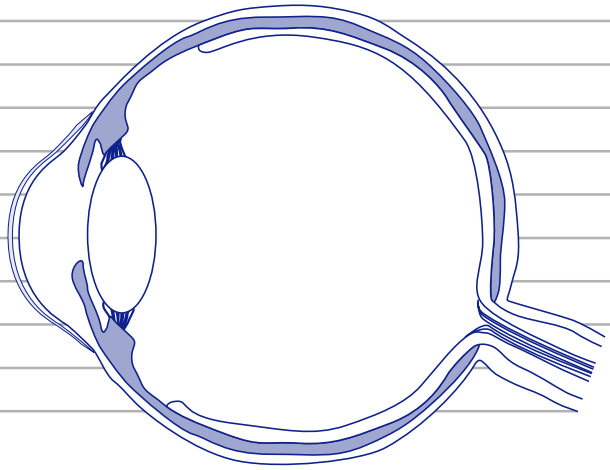


Figure 4.3 Different colour frequencies can also penetrate different depths.

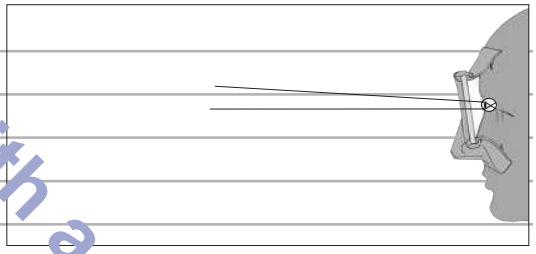
WORKSHEET 1 SNORKELLING AND THE EYE

Questions:

Q1. Explain how the eye functions. Complete the diagram below to illustrate your answer. (Page 3)

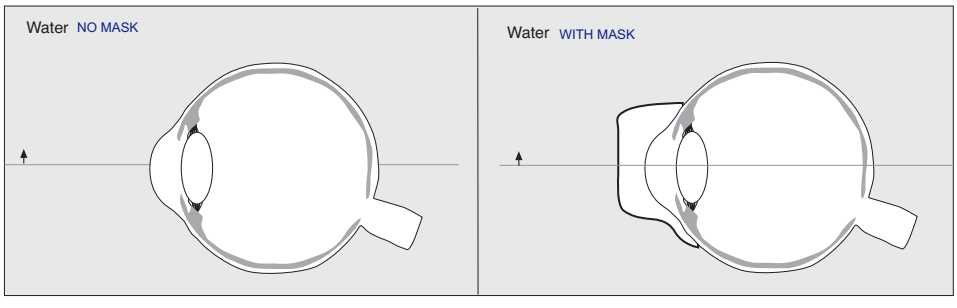


Q2. Explain why marine life appears bigger underwater when using a mask. Complete the diagram opposite to illustrate your answer. (Page 4)



Q3. Describe how the penetration of light frequencies changes with depth. Redraw Figure 6.4 to illustrate your answer. (Page 4)

Q4. Compare how a mask focuses an image on the retina of the eye with and without a mask. Complete the diagram below to illustrate your answer. (Page 4)



Respiratory system

Breathing underwater is a very new experience as you will learn when you first use a snorkel. On land our automatic nervous systems takes control of our diaphram sucking air into our body (Figure 6.1).

The system is called respiration and refers to the inhalation and exhalation of air as well as the metabolic processes of using oxygen to gain energy for the body.

The air we breathe is 21% oxygen, 78% nitrogen and a small amount of trace gases. This descends to our lungs through the trachea, bronchi, bronchioles and then to the alveoli (Figure 6.3).

At the end of the bronchiole a series of large bulbous sacs called alveoli which help the gases - oxygen and nitrogen dissolve into the blood. These gases dissolve through microscopic blood capillaries which surround the alveolar sac.

Once in the blood, the nitrogen and oxygen pass around the blood system where the oxygen is used by cells to give us energy. As a result cells produce carbon dioxide as a waste by-product which must be removed from the body.

Carbon dioxide is returned to the lungs by the blood system where it is discharged into the alveoli over the blood capillaries. From here it travels up the bronchi to the trachea and is exhaled through the mouth and nose.

The harder we work, the more oxygen is used and the more carbon dioxide is produced by the cells.

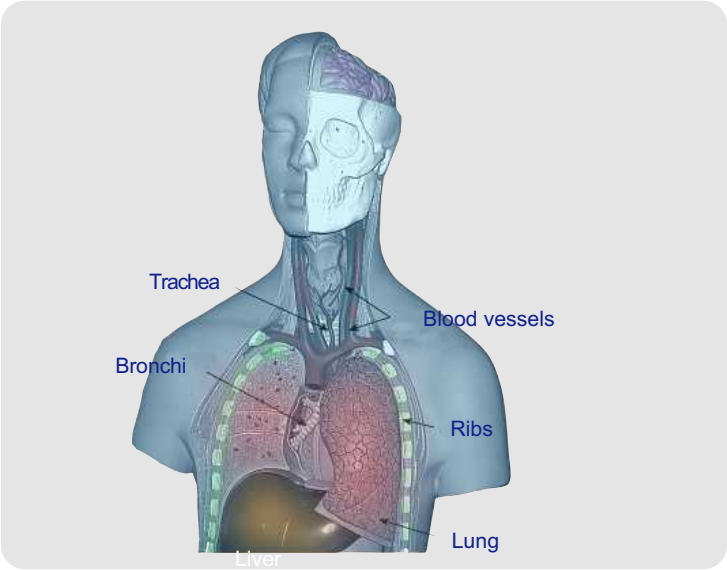


Figure 6.1 Respiratory system

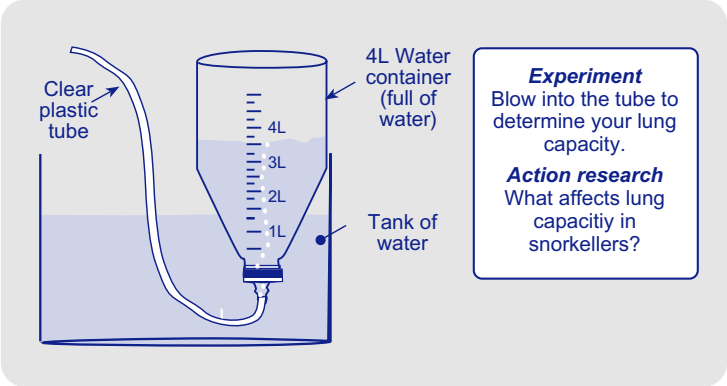


Figure 6.2 Lung capacity experiment or demonstration

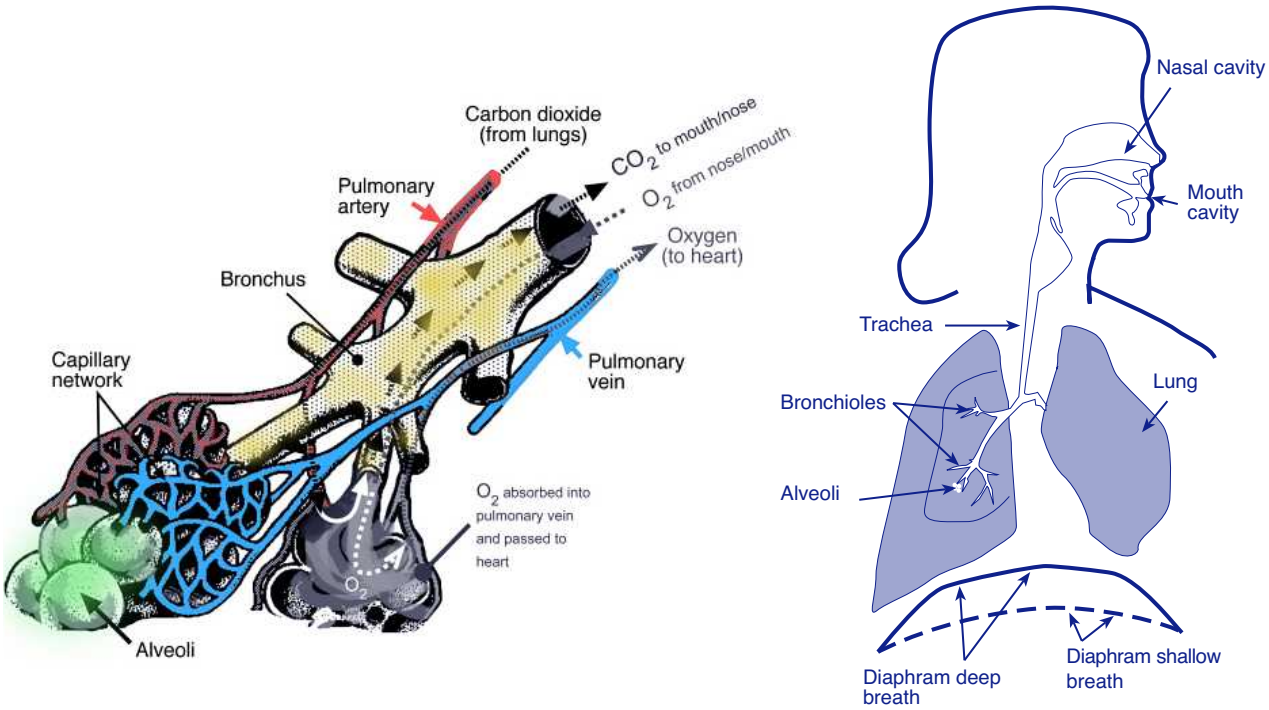


Figure 6.3 Capillaries, alveoli and gaseous exchanges

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Normal breathing

The urge to breathe is caused by this build up of carbon dioxide. If this urge is suppressed it causes a delay in breathing leading to you feeling dizzy and you could faint. Underwater, this can be **fatal**.

Shallow water blackout

Shallow water blackout is when a snorkeller becomes faint underwater leading to unconsciousness. It is caused by a fall in carbon dioxide in the body combined with low oxygen levels as shown in Figure 7.1.

By taking a series of quick deep breaths you can lessen the amount of carbon dioxide in the lungs. This is called ***hyperventilation*** and leads to a shallow water blackout. If this occurs, snorkellers must be rescued immediately to prevent drowning.

This is why you MUST snorkel with a buddy, use the one up one down principle and your buddy MUST have some basic rescue skills.

Circulatory system

One function of this system is to take the oxygen from our lungs around the body to our cells where it combines with food from the digestive system to give use energy to snorkel.

This energy is used by our muscles and one by product is carbon dioxide which is then taken back to the heart and finally to the lungs where it is exhaled.

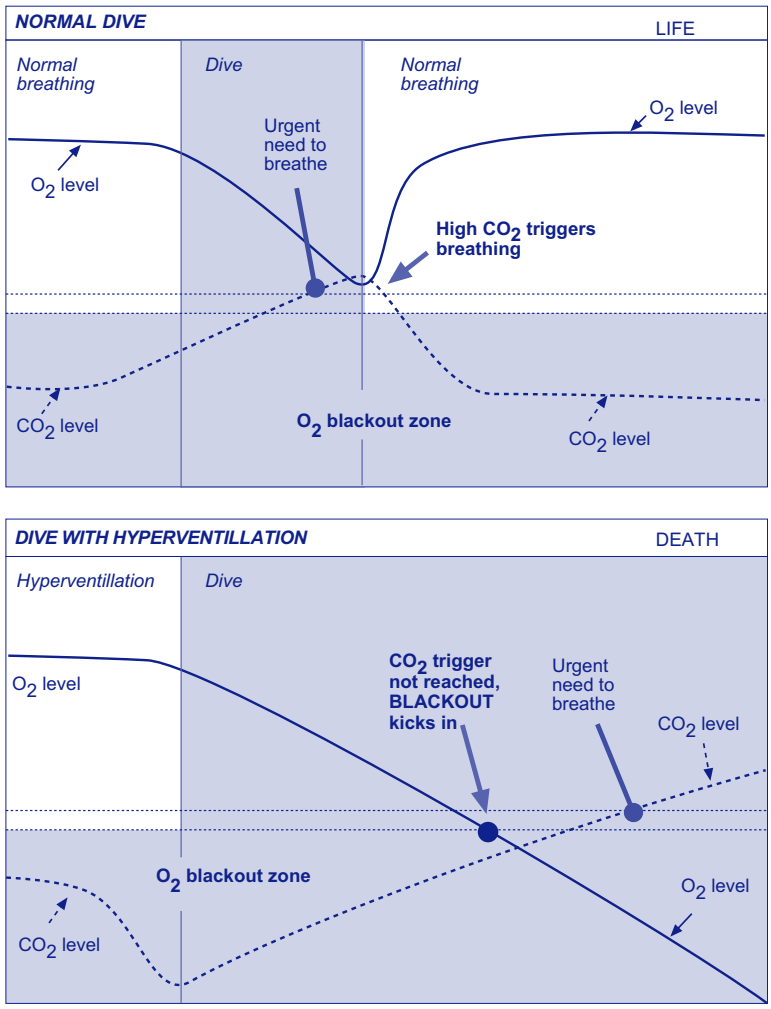

Figure 7.1 How shallow water blackout occurs

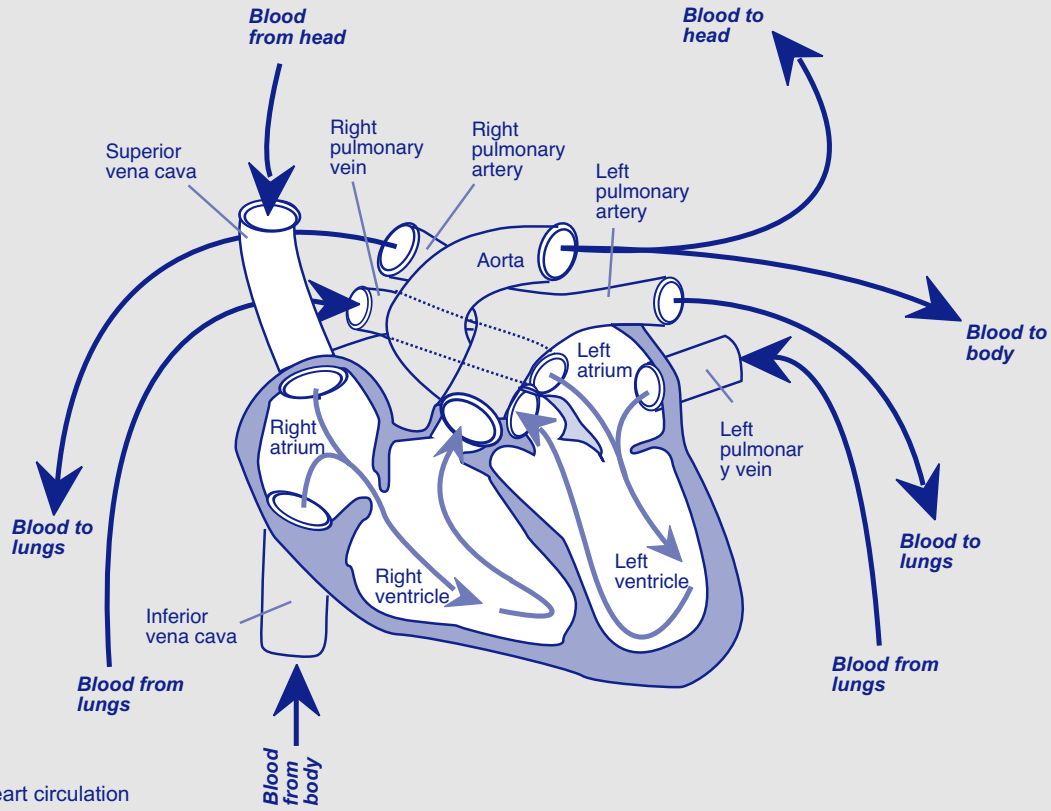

Figure 7.2 Heart circulation

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Pressure and the sinuses

Pressure is a force per unit area on a material and can be felt in your ears if you dive down underwater.

Pressure also effects other organs in particular the sinuses. These are air filled sacs on either side of the nasal cavity (Figure 8.1) and are designed to clean the air we breathe, regulate heat and moisture in the skull as well as assist voice control and smell.

When a snorkeller gets a cold, sinuses fill with mucous and the air gets trapped. Under pressure this air expands and causes pain. The only cure is not to dive, just be content to snorkel at the surface. Diving will only cause a severe headache.

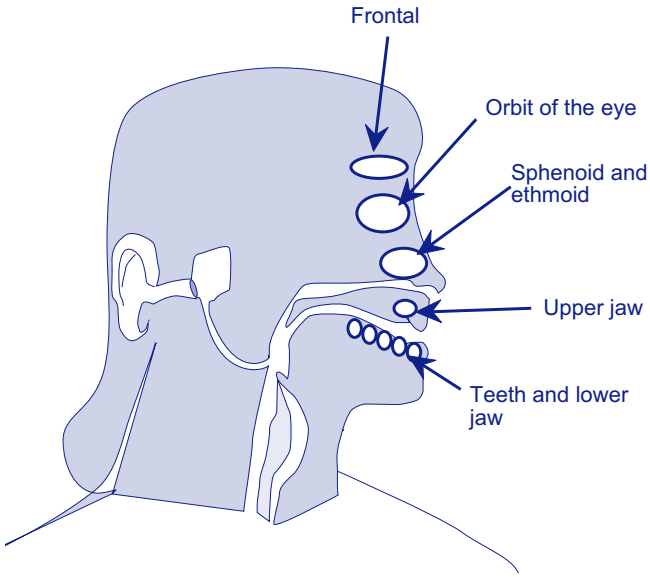

Figure 8.1 The sinuses of the head

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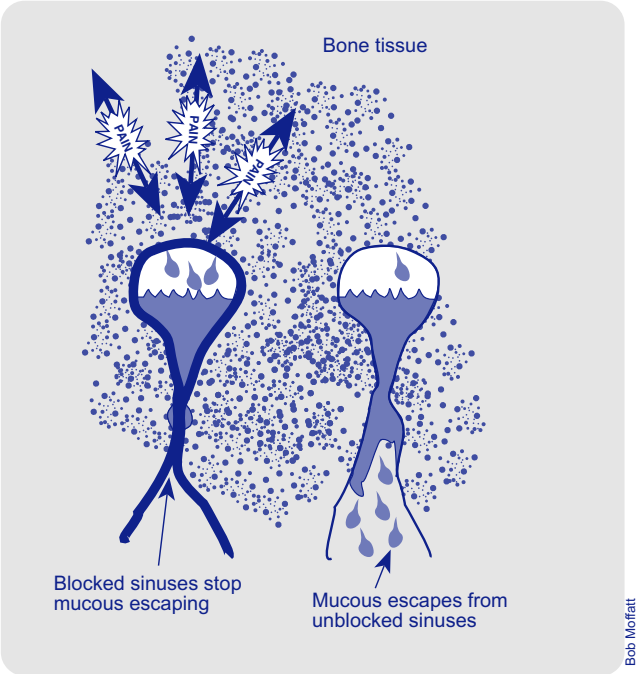

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Figure 8.2 The congested sinus on the left cannot allow mucous to escape causing a build up of pressure in the sinus and pain

Health hints

- Never snorkel dive with a cold.
- Equalize your ears every time you dive underwater.
- Dry the outer ear canal with a solution such as *aquaear* or *earwash*.

Circulation, cramps and energy

The correct use of snorkelling equipment, coupled with correct techniques are essential in conserving energy.

For example you can use a less energy with the correct use of fins and by keeping your hands by your side. If you use your legs in a cycling motion this increases the amount of energy you burn up and can lead to muscle cramping.

Section 3 will show you how to use correct snorkelling techniques to enhance the function of your circulatory system.

Temperature control

In open water the snorkeller will experience temperature changes called thermoclines, of between 10 - 20 °C between the surface and depth.

This combined with the fact that water is a good conductor of heat, should make the diver aware of the need to prevent heat loss, which can cause cramps and/or hypothermia.

Therefore the snorkeller should wear a wet suit.

Heat loss in water

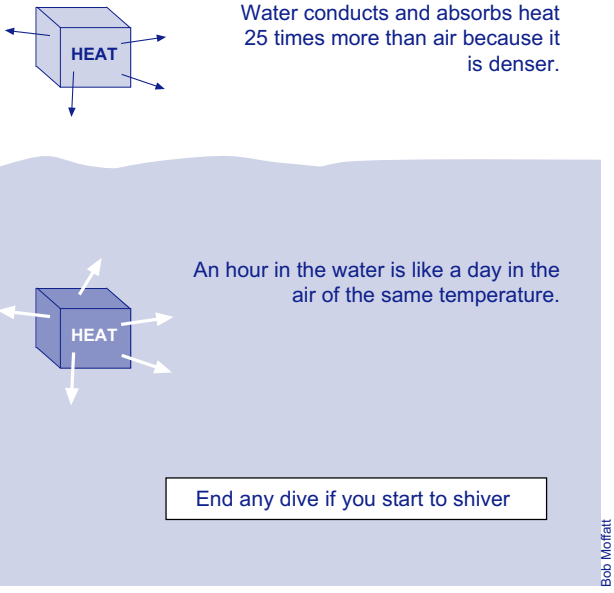

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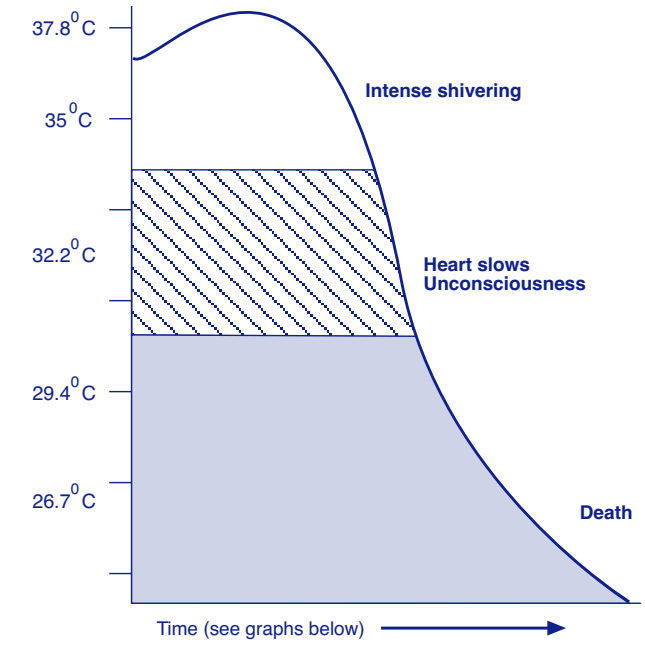
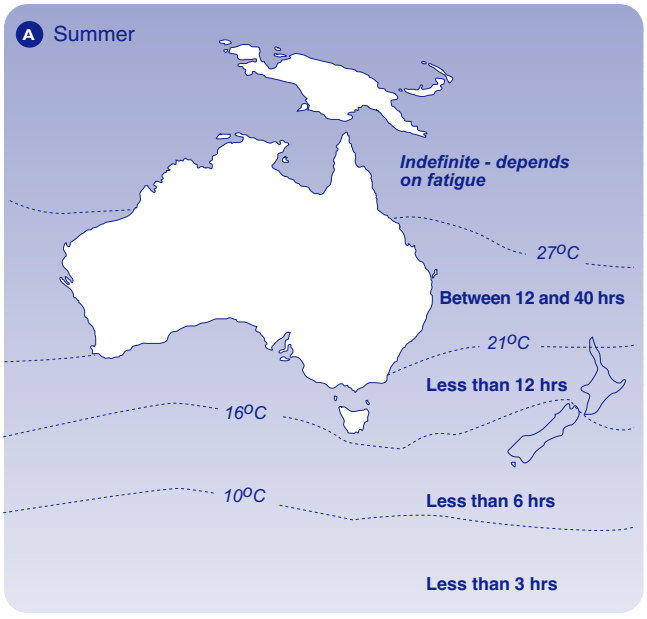
Figure 8.3 The snorkeller will lose heat 9 times faster in water compared to air





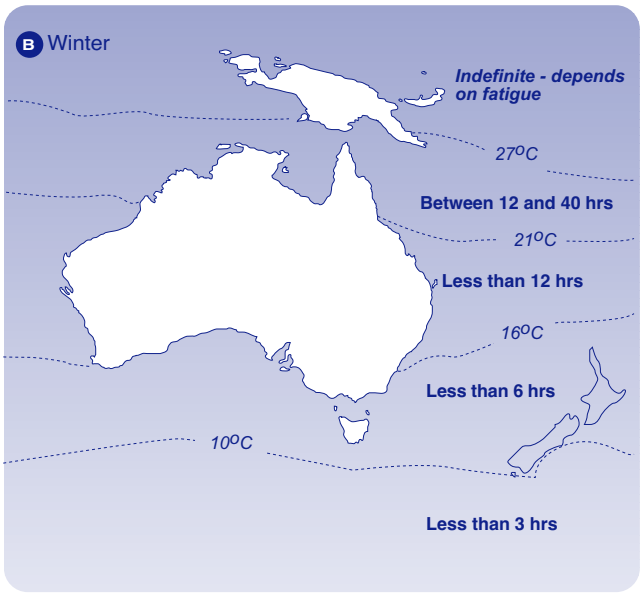


Figure 9.2 Expectancy survival times at sea
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Hypothermia

Hypothermia is caused when the body temperature drops to the point it cannot recover as shown in the graph opposite.

At sea, when the body is continually getting wet, this cooling extends to the blood vessels below the skin lowering the temperature of the blood.

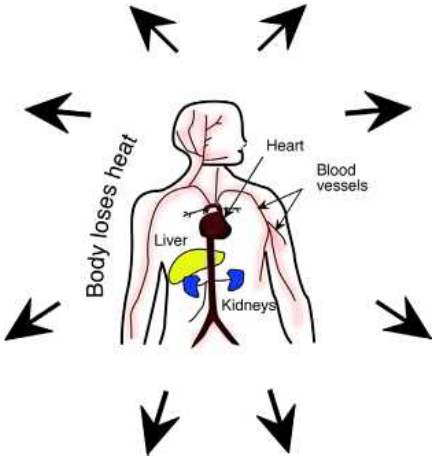

Figure 9.1 Loss of heat from body can result in hypothermia
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Continued cooling of the blood will affect the organs to which it flows and their normal functioning.

Internal cooling of the body is called **hypothermia** and when the body temperature drops below 26 degrees, death occurs. To help mariners and divers, charts, as shown in Figure 9.2, are drawn of life expectancy survival times at sea.

Protection

As up to 50% of body heat is lost through the head, a hood can be worn to reduce cooling.

Another method, called the HELP position, is to cross your legs and pull them up to your chest while folding your arms around something that floats.

These two methods are shown in Figure 9.3.

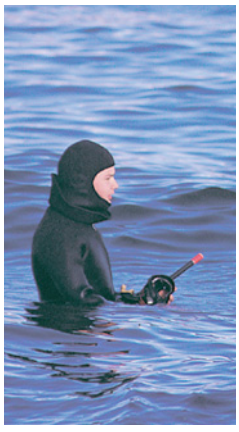

Figure 9.3 Body protection from cold
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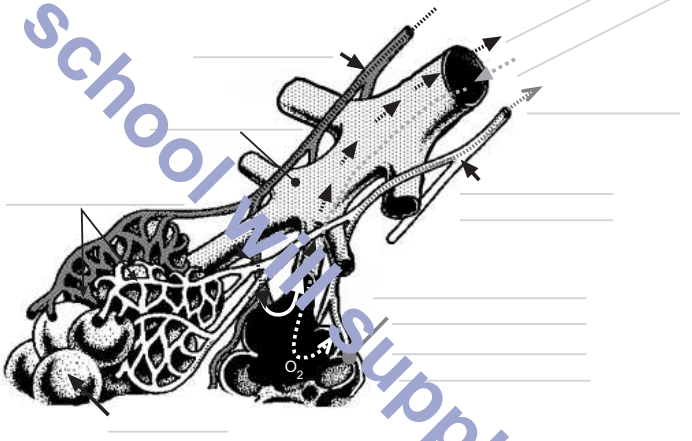
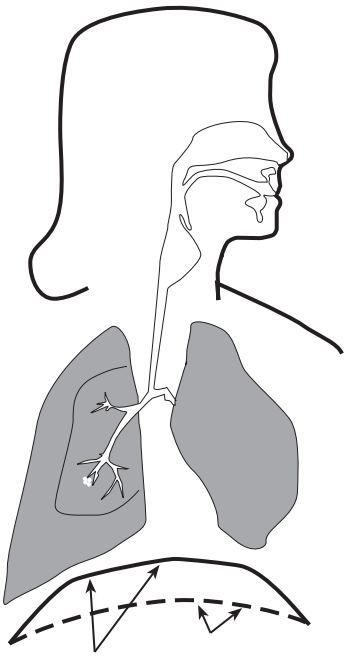
WORKSHEET 2 RESPIRATION AND SNORKELLING

Questions

Q1. Complete the diagrams below to explain how oxygen and carbon dioxide enter and leave the body (Page 6).





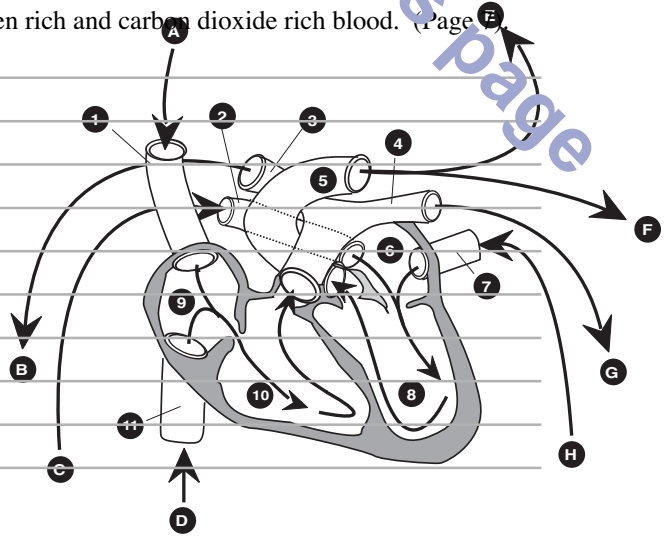
Q2. Distinguish between the percentage of air we breathe as oxygen and nitrogen (Page 6).

Q3. Explain what happens in a shallow water blackout and list two causes (Page 7).

Extension questions

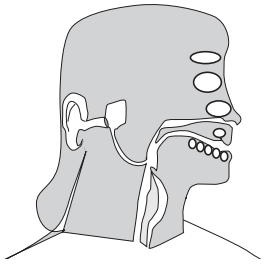
Q1. What is hypotoxic blackout and is it different to shallow water blackout? (Internet).

Q2. Research the names for the numbers in the diagram opposite and use then use the letters to describe how the heart functions. Use red and blue colours to distinguish between oxygen rich and carbon dioxide rich blood. (Page 7).



WORKSHEET 3 THE SINUSES

Questions



Q1. Describe the functions of the sinuses. Complete the diagram opposite to illustrate your answer (Page 8).

Q2. Explain why you should never dive with a congested sinus (Page 8).

Q3. List three health hints involving your ears and sinuses (Page 8).

WORKSHEET 4 CIRCULATION AND TEMPERATURE CONTROL

Questions

Q1. Describe the function of the circulatory system as it relates to oxygen and carbon dioxide (Page 7).

Q2. Explain how correct snorkelling techniques can maximize the function of the circulatory system (Page 8).

Q3. Suggest one cause for cramps in the legs while snorkelling (Page 8).

Q4. Discuss the dangers of hypothermia while snorkelling (Page 9).

Q5. Compare the heat loss of a snorkeller in air and water (Page 8).

Q6. Compare your life expectancy if you fell out of a boat without a wetsuit in Cairns and Tasmania. Suggest ways to improve your chances of survival (Page 9).

Pressure and the lungs

Pressure is measured in atmospheres and increases with depth which can be demonstrated if we fill a plastic drink bottle with coloured water and then prick some holes in the sides.

This is shown in Figure 12.1 where the distance the drops are out from the side of the bottle at D is roughly double that compared to position A.

At the side of a pool or at sea level, the pressure is one atmosphere (or just atmospheric pressure) as shown in Figure 12.2. The pressure at 10 metres is 2 atmospheres and increases by one atmosphere for every 10 metres.

In fact the greatest change in pressure on your body is in the first 10 metres - where it **doubles**.

Partial pressures

However this is not the only effect of pressure. Air is made up of a number of gases the majority of which are nitrogen (78%) and oxygen (21%). In your lungs, each gas exerts its own pressure called the partial pressure.

- 78% of nitrogen in the air is at 0.78 atmospheres pressure and the 21% of air is at 0.21 atmospheres.
- Because at 10 metres the pressure doubles - the air pressure in your lungs has doubled as well.
- You are breathing nitrogen at 1.56 atmospheres (2 x .78) and oxygen at 0.42 atmospheres (2 x .21).
- The carbon dioxide will also be at double the pressure it was at sea level or beside the pool.

Effects of partial pressures

At 10 metres, the gases in the lungs will be absorbed into the blood under pressure by a process called in-gassing.

The body can adapt to these increased gases and when we return to the surface, the gases dissolve out of the blood and are breathed out in a process called out-gassing. This pressure can have a number of effects.

Oxygen

Pure oxygen can be toxic at 2 atmospheres and compressed air at 10 atmospheres. Because snorkellers would not go beyond these pressures and these depths, oxygen is not an issue for snorkellers.

Carbon dioxide

This can be toxic at any pressure and can cause fatigue. If you are diving to the bottom of the pool and feel dizzy or fatigued, come out and rest.

Lack of carbon dioxide and oxygen

As discussed earlier lack of carbon dioxide and oxygen can cause shallow water blackout and be fatal to a snorkeller underwater.

- The risk is increased greatly for divers who hyperventilate by taking repeated deep breaths before diving below the surface or who undertake deep dives.
- Learn how to use the buddy system where two snorkellers make sure they are always within a short distance of each other and keep a watch on each other's safety.

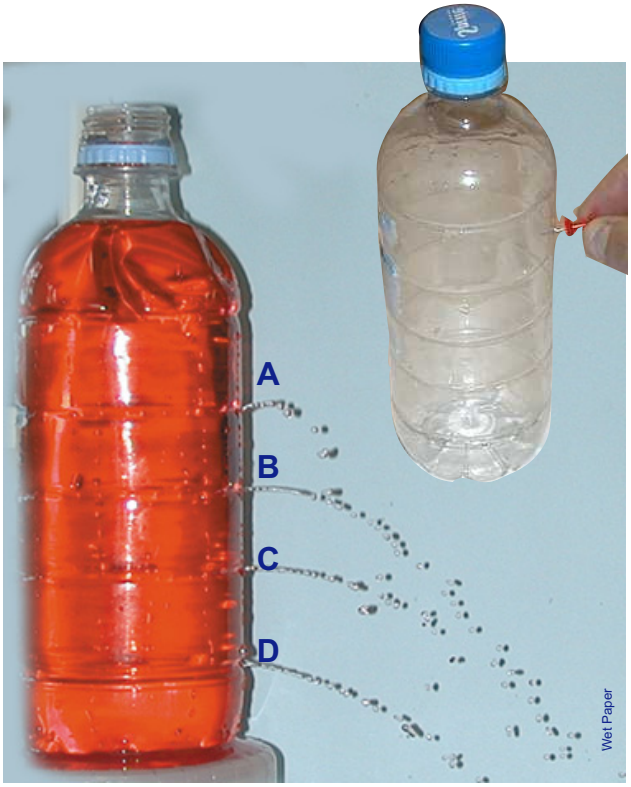


Figure 12.1 The water at the bottom spurts out the furthest due to pressure as shown.

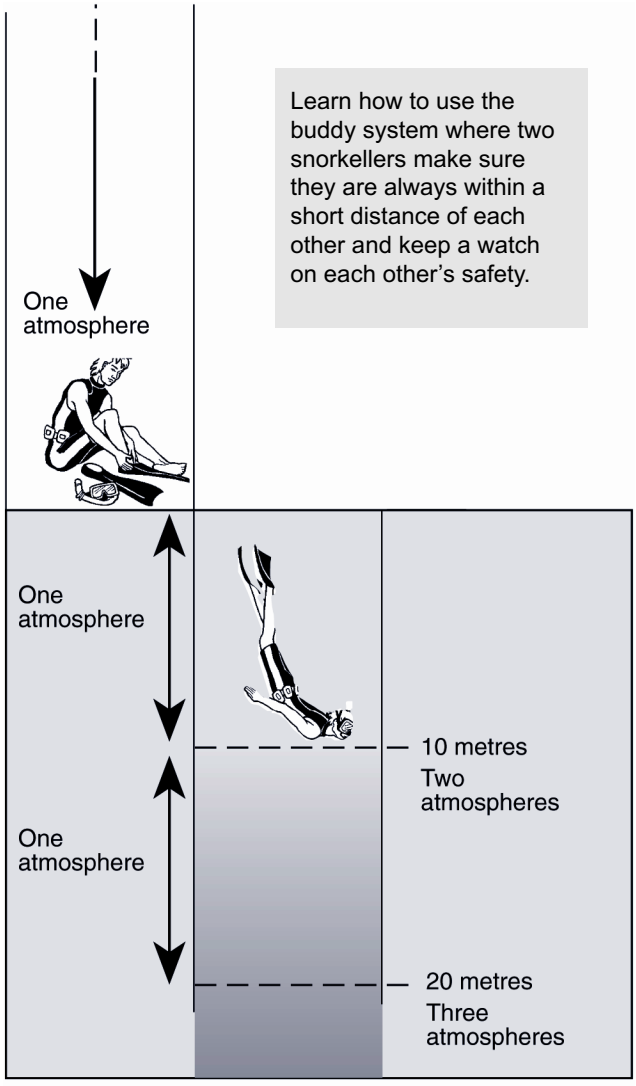


Figure 12.2 Pressure facts
(After Hall, S. 1991)

WORKSHEET 5 EFFECTS OF PRESSURE

Questions *(All answers on page 12)*

Q1. What is the atmospheric pressure on your lungs if you were sitting at the edge of a swimming pool?

Q2. Calculate the pressure in your lungs if you dived to a depth of 10 metres.

Q3. Recall the percentage concentration of oxygen and nitrogen in the air.

Q4. Explain the term partial pressure as it relates to gases.

Q5. At one atmosphere, recall the partial pressure of nitrogen and oxygen in your lungs.

Q6. At 10 metres, describe how these partial pressures have changed.

Q7. Explain how lack of carbon dioxide and oxygen can be dangerous at depth. Describe possible effects and symptoms.

Q8. Calculate how many litres of nitrogen and oxygen there are in three litres of air.

Boyle's law

As depth increases so does the pressure.

As pressure increases, the volume a given amount of air occupies, also decreases and there is a specific relationship between the pressure of gas compressed and the volume the gas occupies.

This relationship was first discovered by *Robert Boyle*.

Pressure in diving is also measured in atmospheres. The pressure at the surface of the sea is 1 atmosphere.

The relationship between pressure and volume can be worked out by a controlled experiment.

Figure 14.1 shows the results of such an experiment where a series of bricks were added to the top of a syringe as shown in Figure 14.2.

We can see that when P is multiplied by V a constant value of 12 is reached each time.

When we plot a graph of PV v's P we get a straight line proving that PV is a constant, ie,

P x V = K

Where P is the pressure, V the volume and K the constant

The relationship

So if,

$\mathbf{P_1 V_1} = K$

and $\mathbf{P_2 V_2} = K$ (the same constant in a new situation)

then $\mathbf{P_1 V_1} = \mathbf{P_2 V_2}$

Now if we double the volume, we halve the pressure as follows:-

If $P_1 = 1$, $V_1 = 1$, $V_2 = 2$, what will $P_2 = \mathbf{X}$

$P_1 V_1 = P_2 V_2$

$1 \times 1 = \mathbf{X} \times 2$

$\mathbf{X} = 1/2$ (the pressure has been halved)

Calculations

The formula $\mathbf{P_1 V_1} = \mathbf{P_2 V_2}$ can be used in a variety of calculations by oceanographers to calculate volumes and pressures.

At 10 metres, the volume of air in a person with a lung capacity of 4 litres is halved.

Before you can enrol in a SCUBA diving course you need to have your lung capacity measured by a qualified practitioner. The average lung capacity is about 4 litres.

Once you know your lung capacity you can calculate, using Boyle's Law, how much air you will have in your lungs at 5, 10, 15 or even 20 metres.

Boyle's law becomes important when you go SCUBA diving.

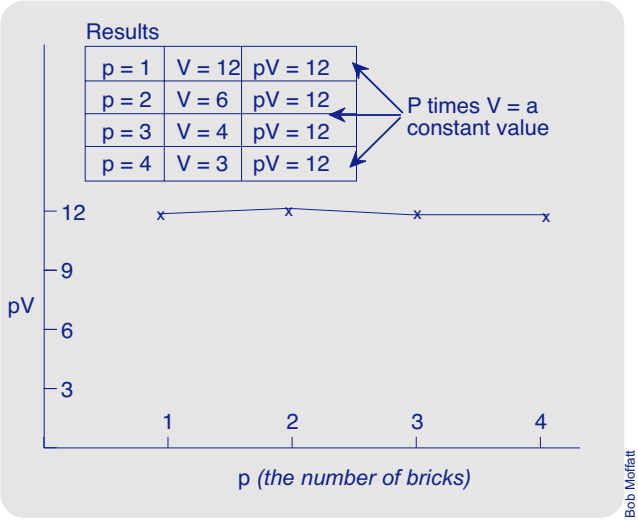


Figure 14.1 Boyle's Law results from a controlled experiment

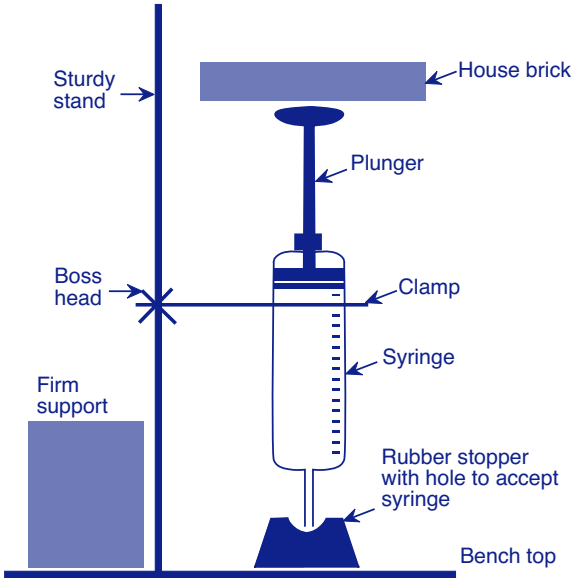


Figure 14.2 Boyle's Law experiment schematic diagram

Bob Moffatt

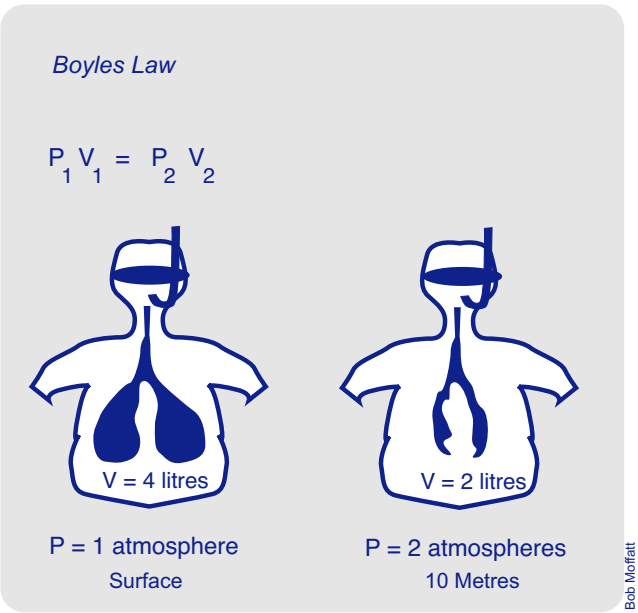


Figure 14.3 As pressure increases, volume decreases

WORKSHEET 6 BOYLE'S LAW

Questions *(All answers on page 14)*

Q1. Describe the relationship between pressure and depth.

Q2. Many students have diving tests at a doctor's to establish their lung capacity before they can do a dive course. Explain why is this important and research what average lung capacity is.

Q3. Derive the formula for Boyle's Law using the symbols: P_1 , V_1 , K , P_2 , V_2

Q4. Calculate the pressure in a snorkeller's lungs if the volume is 4 litres and she dives to 10 metres. Show all working.

Q5. Calculate the volume in a divers lungs whose lung capacity at the surface was 3.8 litres, if the pressure at 25 metres is 3.5 atmospheres. Show all working.

The ear

A study of the ear is important because it is one of the most common sources of problems associated with snorkelling.

How the ear works

Figures 16.1 and 16.2 show some of the features of the ear. The outer ear has a pinna or ear flap, which is used to collect sound waves.

After sound waves enter the outer ear, they travel through the ear canal and make their way to the middle ear. The middle ear's main job is to take those sound waves and turn them into vibrations that are delivered to the inner ear. To do this, it needs the eardrum, which is a thin piece of skin stretched tight like a drum.

Sound comes into the inner ear as vibrations and enters the cochlea, a small, curled tube in the inner ear. The cochlea is filled with liquid, which is set into motion, like a wave, when the ossicles vibrate.

The cochlea is also lined with tiny cells covered in tiny hairs. When sound reaches the cochlea, the vibrations (sound) cause the hairs on the cells to move, creating nerve signals that the brain understands as sound. The brain then puts it all together.

Ear infections and damage

Infections in the outer ear will often result from not allowing the ear canal to dry. Divers and swimmers in tropical areas are most prone to these infections.

Diving emergency number

First-aid

Seek medical advice for all ear infections especially if blood comes from the ear.

For immediate help - call 1800 088 200 and they will connect you to a diver emergency doctor.

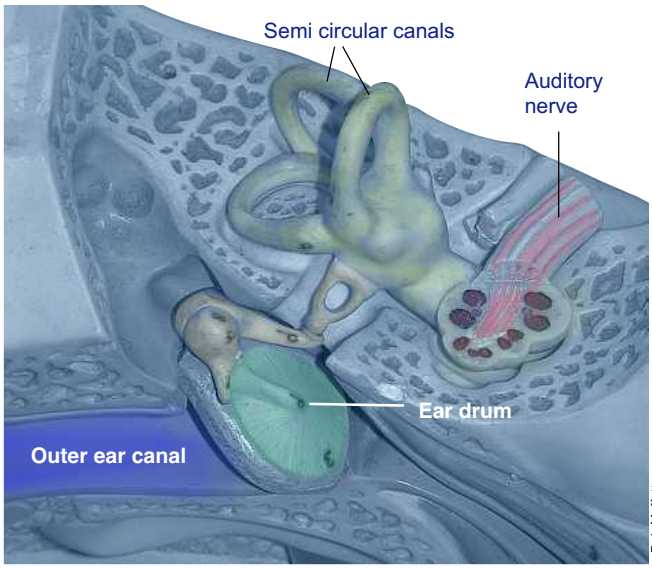


Figure 16.1 A model of an ear

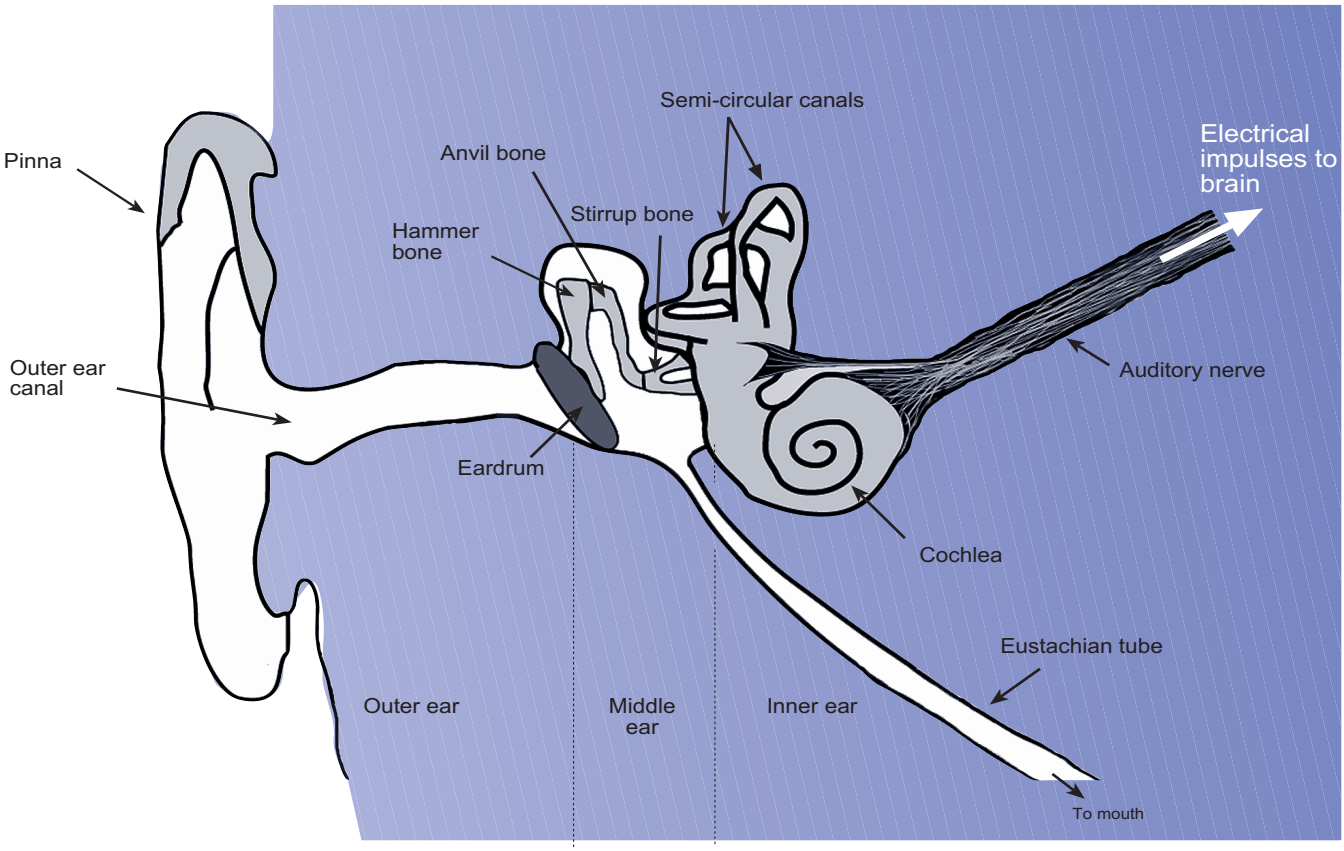


Figure 16.2 Features of the ear affecting hearing

Proper drying of the ear canal is important. Commercial products such as "Aquaear" should be used as a preventative measure against problems such as:

- inflammation caused by bacteria and fungal infections
- the eardrum can be damaged by pressure
- wax can build up with age and impair hearing.

It has often been said that the smallest thing you should put into your outer ear canal is your elbow. This is good advice because you can push wax or other materials against the eardrum providing a great place for bacteria to grow.

Inner and middle ear

Deafness, vertigo and especially "ringing in the ear" are all symptoms of inner ear damage.

- If any of these occur seek urgent medical advice as permanent damage can occur.
- For immediate help - call 1800 088 200 and they will connect you to a diver emergency doctor.

Pressure and the ear

As you go down under the water, the pressure increases on the eardrum. Air in the middle ear is trapped and can expand or contract with changing pressure.

This air affects the eardrum which must be protected by "clearing your ears".

The air in your mouth or throat can be blown into the middle ear through the eustachian tube - see Figure 17.1. This makes the pressure on the outside of the eardrum the same as the inside.

In snorkelling or diving, pressure causes the air to expand or contract inside the ear. This pushes against the eardrum causing pain. If this pressure goes unchecked it can burst the eardrum.

This can be avoided by a technique called ***equalising***.

Equalising your ears

Equalisation is the process by which the pressure on either side of the eardrum is made equal and damage to the eardrum can be avoided if the snorkeller does this before and during diving.

The most common method is the Valsalva manoeuvre as shown in Figure 17.3 which is the *attempted exhalation against the closed nose and mouth*.

Forced exhalation is not recommended as it may damage the eardrum. Practise this on the surface, first by tilting your head to one side, pinching your nose and blowing gently.

The idea of turning your head is to stretch the eustachian tube. If you do this underwater, you will equalise the pressure on both sides of the eardrum thus making diving underwater possible.

Figure 17.2 shows how the air from the mouth can be blown up the eustachian tube and into the middle ear to equalize the pressure on either side of the eardrum.

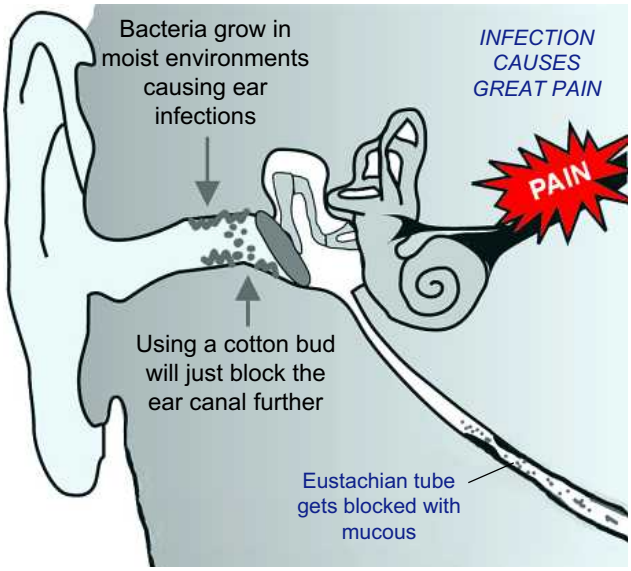


Figure 17.1 The ear, infection and eustachian tube
Bob Moffatt

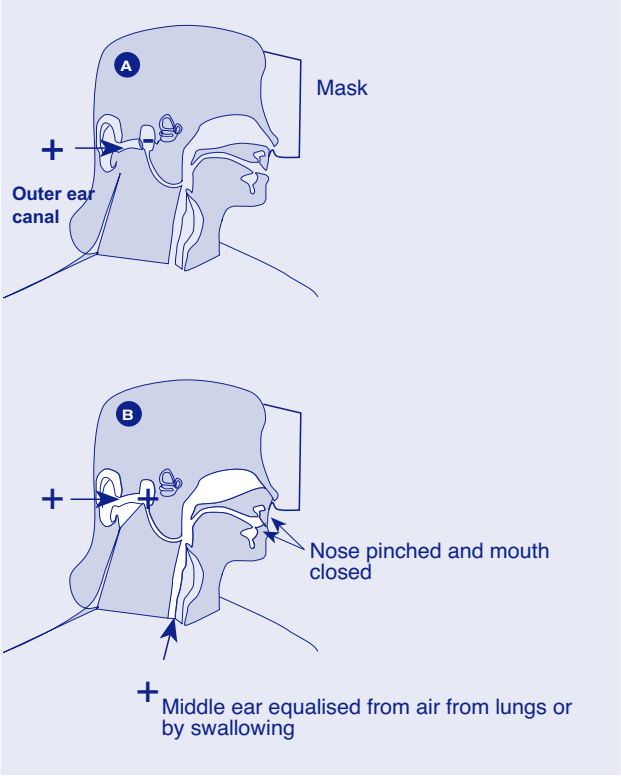


Figure 17.2 How the ear is equalised

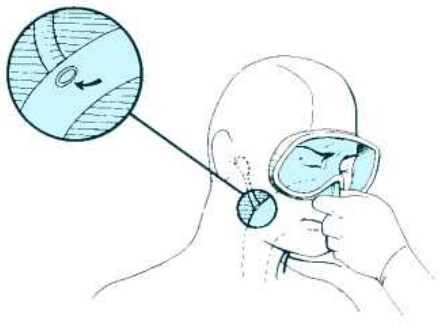


Figure 17.3 The Valsalva manoeuvre (Illustration courtesy NAUI)

If this is not done the pressure will build up on the inside of the ear causing great pain.

If the pressure is allowed to continue, bleeding from the ear could occur, severe dizziness, pain, impaired hearing or nausea may be observed.

Equalising tips

When equalising the middle ear space - 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.

- chew gum before snorkelling.
- pop your ears at the surface.
- pinch nose and swallow
- swallow
- wriggle jaw
- move head and neck and yawn (sometimes difficult while underwater)
- pop your ears all the way down to the required depth.

Important note

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 and a headache and will do damage to your eardrum. So either pinch and blow gently or swallow as you dive.

Never wait till the pressure asks you to equalise, always start equalising your ears the moment you start to dive (even at the surface).

Now submerge underwater without a mask and equalise. Your instructor will demonstrate this to you if you are unsure.

Figure 18.1 Equalising all the way down, by gently blowing into your mouth to clear your ears

Remember

Don't dive with a cold

Seasickness

The semicircular canals are responsible for balance, and if disturbed may induce seasickness as shown in Figure 18.1.

The canals are filled with a jelly and contain small otoliths. These are tiny balls which roll around in the jelly stimulating nerve endings to fire and send messages to the brain.

If the body moves on land, the otoliths move and send impulses to the brain which can correct the body's position and muscular adjustments can be made.

However if the body is pitched and rolled by a ship, the otoliths cause an over excessive stimulation of the brain and seasickness results.

First-aid and medications

These days a variety of medicines can be used to try to correct this interpretation by the brain.

Seasickness pills, patches which are worn behind the ears or acupuncture pressure points on the wrists can be used in some cases.

If you think you will be seasick take some medication before you go to sea. Remember - *its better to stay well than get sick.*

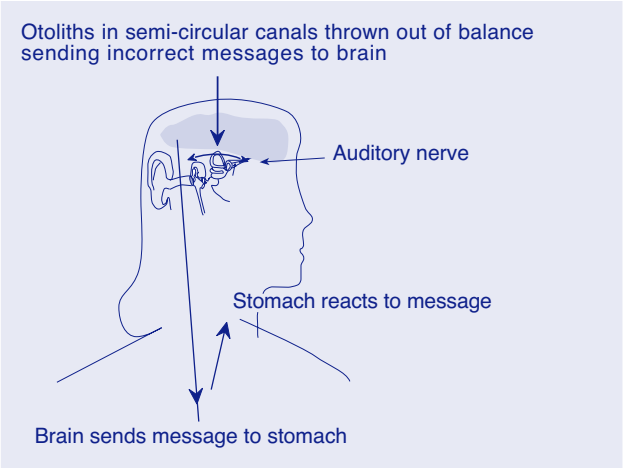


Figure 18.2 Seasickness

***Remember* - its better to stay well than get sick.**

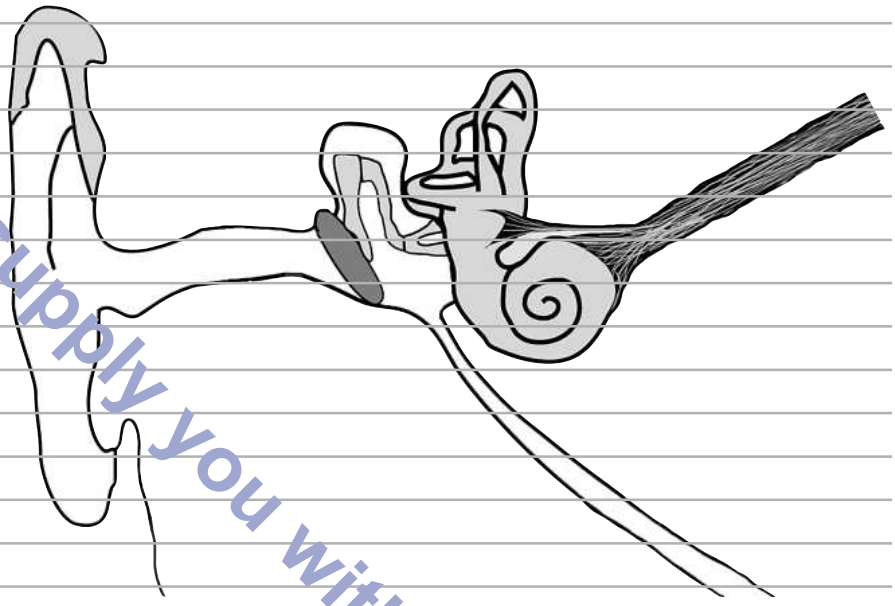
Injections are sometimes given on board ships for people with serious seasickness.

However after a few days at sea most people get used to the movements of a ship and sea sickness subsides.

WORKSHEET 7 SNORKELLING AND THE EAR

Questions

Q1. Explain how the ear functions by completing the illustration below (Page16).



Q2. List three problems that can develop with the outer ear when swimming or snorkelling (Pages 16-18).

Q3. Argue a case for not snorkelling when you have a cold (Pages 16-18).

Q4. Evaluate the statement - *You should never use a cotton bud to dry your ears* (Page 17).

Sound underwater

Sound produced underwater travels greater distances and at a speed four times faster than in air.

If you put your ear to a metal railing and have a friend tap on it some distance away, you will hear the sound through the railing faster than through the air.

As a result of this increased speed, sound seems to come from all directions, as shown in Figures 20.1 and 20.2.

This tends to confuse our responses until we adapt to it. In fact, sound travels through dense mediums faster overall.

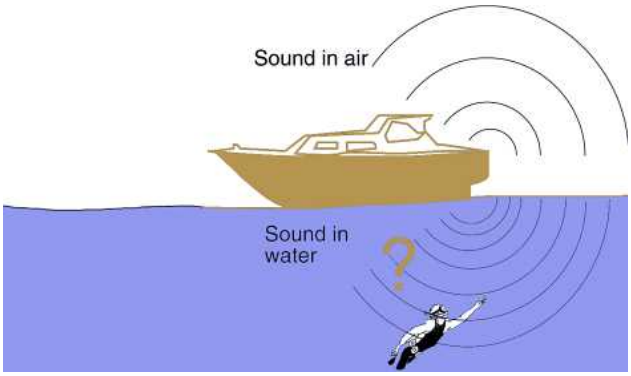


Figure 20.1 Sound in water

Bob Moffatt

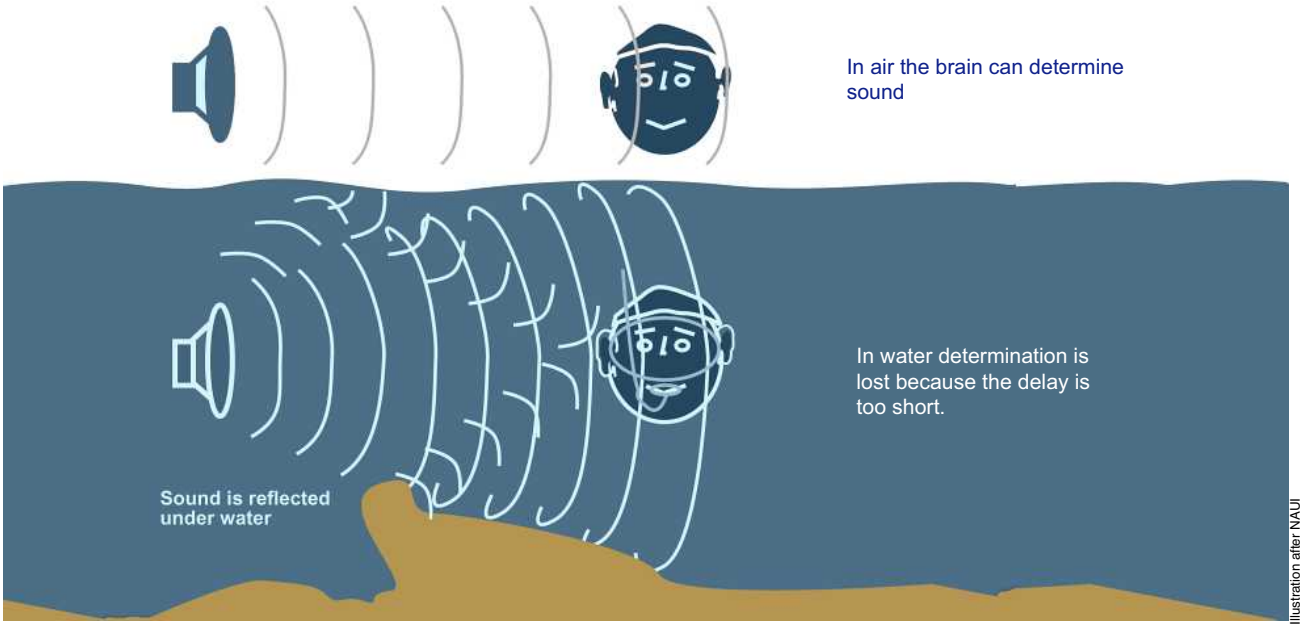
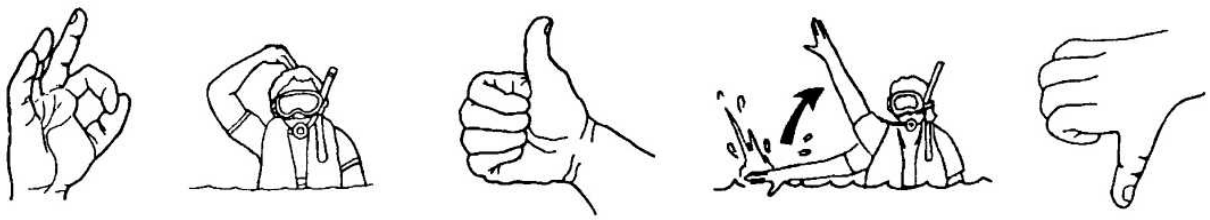


Figure 20.2 Sound seems to lose direction in water

Communication hand signals in water

Almost no sound is transmitted from air to water or water to air - the diver may need to adjust to the silence underwater. More importantly, the snorkeller must be very aware of the dangers of boats when surfacing.

So communication underwater is limited to a set of standard hand signals some of which are shown in Figure 20.3.



Are you OK? | Yes - I am OK | Up | HELP - "Come and pick me up - *TAXI*" | Down

Figure 20.3 Some important hand signals

Illustrations after NAUI

WORKSHEET 8 PRESSURE AND SOUND

Questions *(All answers on page 20)*

Q1. Describe the effect of pressure on the inside of the ear while snorkelling.

Q2. Explain why clearing the ears is important as you snorkel under the water.

Q3. Describe the Valsalva manoeuvre.

Q4. List three other methods you can use to help equalise your ears.

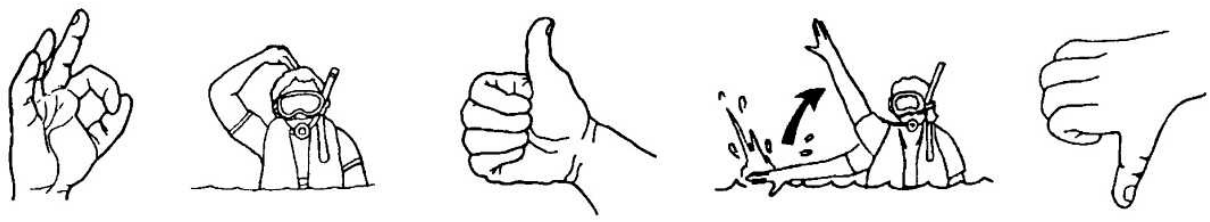
Q5. Explain how people get seasick.

Q6. List two ways to minimise seasickness.

Q7. Explain what an outer ear infection is and how can it be prevented.

Q8. Sound produced underwater travels greater distances and at a speed four times faster than in air. Describe what problems this causes.

Q9. Identify the names of the following hand signals.



Buoyancy

We float because there is a force called upthrust pushing us up as shown in Figure 22.1.

- This upthrust on the snorkeller is equal to the mass of the volume of water displaced as shown.

  Look at Figure 22.2. When a snorkeller is placed in water so that the person totally immersed, the snorkeller will displace a volume of water equal to the volume of the person immersed.

  - If the upthrust is greater than the weight, the snorkeller will be positively buoyant and if less, the snorkeller will be negatively buoyant.
  - This is shown in Figure 22.3.

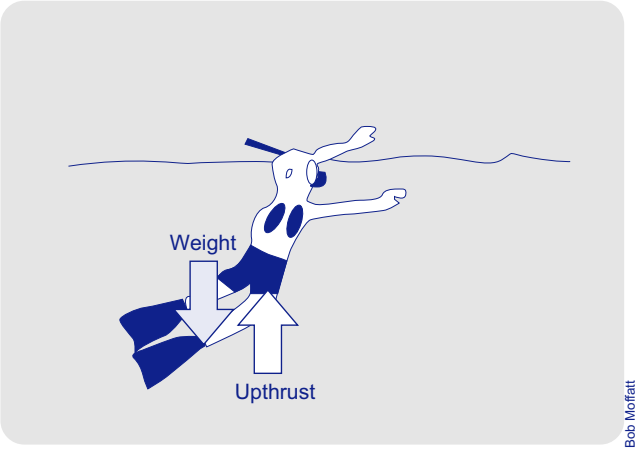


Figure 22.1 Buoyancy

Snorkelling and upthrust

If you are wearing a wet suit the upthrust is greater and you will have great difficulty diving against this upthrust. So if you want to dive, you need to work out your buoyancy.

To test this, enter the water wearing all your equipment with no weights and in a location where you can reach out and hold onto something. For example a snorkelling platform where you can have weights close by.

- The water should be deep enough so your fins don't touch the bottom.

With the snorkel in your mouth and your body hanging vertically in the water, take a deep breath, relax and see where you float.

- If you float with your eyes at the surface of the water, theoretically you are perfectly weighted and neutrally buoyant.
- If your head is out of the water you are positively buoyant and so add weights of between 1-2kg at a time to achieve neutral buoyancy.
- If you sink, swim quickly to the surface and remove some of the weights.

As a guide the snorkeller should always be slightly positively buoyant.

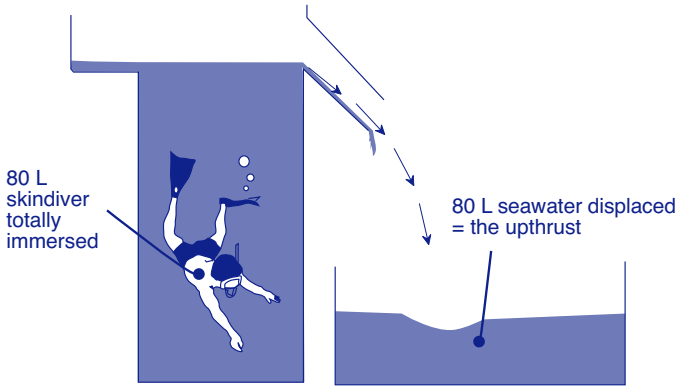


Figure 22.2 The upthrust on the snorkeller is equal to the mass of the volume of water displaced

Bob Moffatt

Experiment

Using small containers (film canisters are ideal), sinkers, polystyrene and water, make the canisters positively, negatively and neutrally buoyant.

As a demonstration put a can of coke and diet coke in a big tub of water, and explain what happens. (Note - a bit of salt in the water can help)

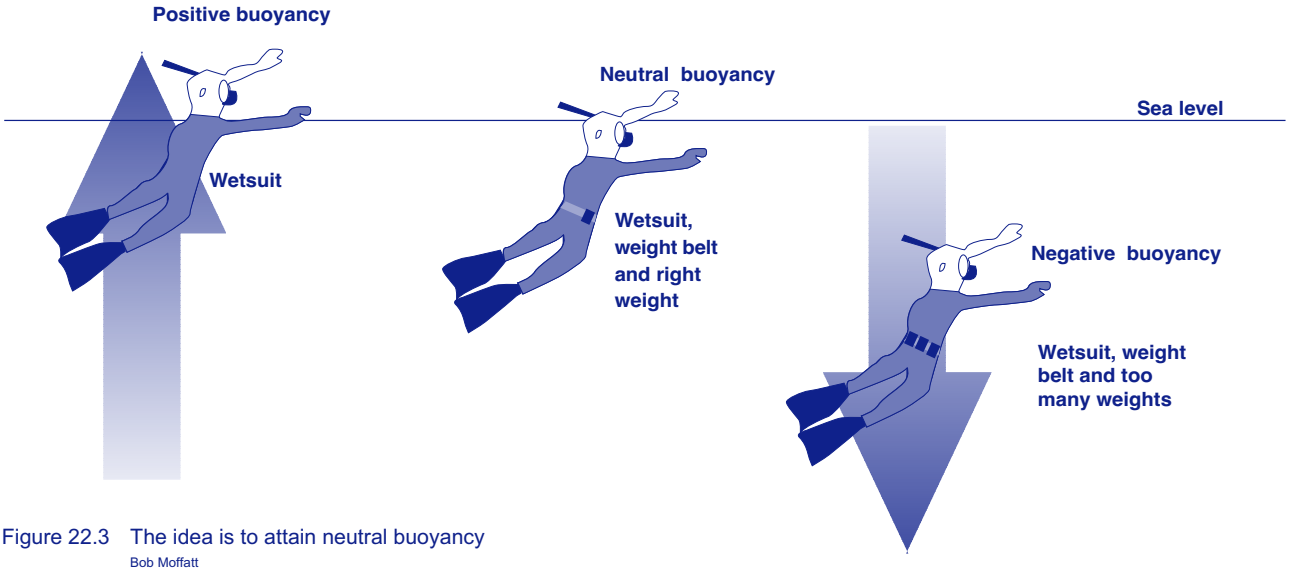


Figure 22.3 The idea is to attain neutral buoyancy

Bob Moffatt

Archimedes Principle

A long time ago a famous scientist called Archimedes discovered that when an object was immersed in water it would displace a volume of water whose mass is equal to the upthrust. Scientists know that the formula to calculate the density of an object is

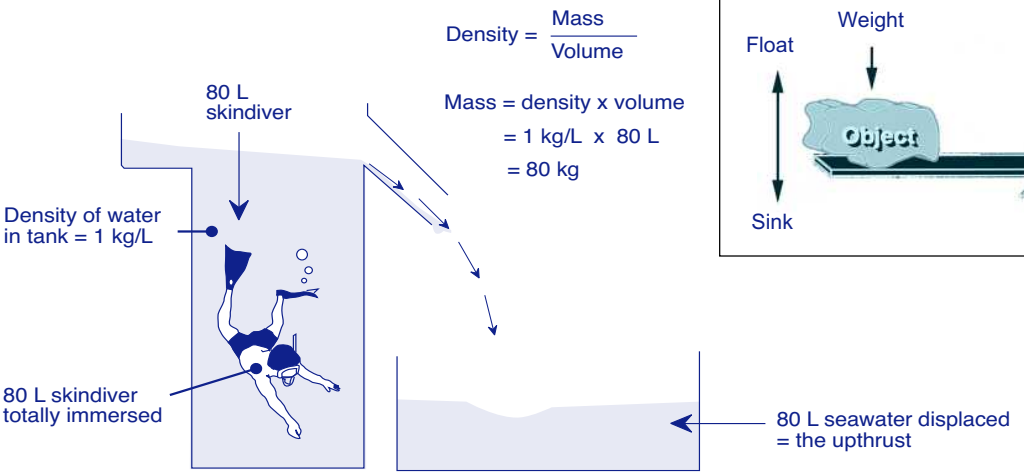
mass/volume

They also know the density of water is 1 kg/L.

So we are able to calculate the mass of the water displaced by this formula:

Mass of the diver is 1 kg/L x 80 L

= 80 kg.



Look again at Figure 23.1.

If we place an 80 kg snorkeller in a barrel full of water, Archimedes Principle says that 80 litres of water will be displaced and that the upthrust is equal to the volume of the water displaced by the object.

So the upthrust is 80kg.

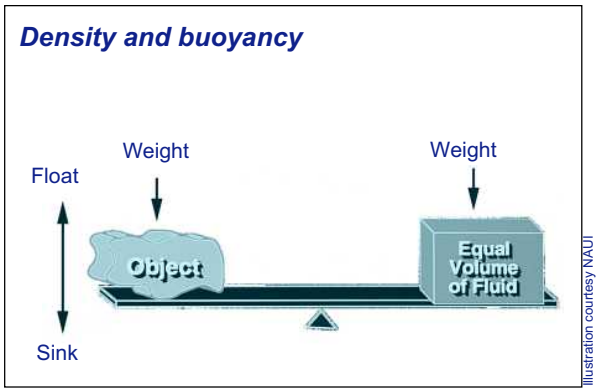


Figure 23.1 The upthrust on the snorkeller is equal to the mass of the volume of water displaced
Bob Moffatt

Will a snorkeller sink or float?

Can we use Archimedes Principle to see if an object will float or sink? If we apply the rule: *if the mass of the snorkeller in air is greater than the upthrust the snorkeller will sink.*

Sample problem

Our snorkeller is found to have a volume of 55 L and a mass of 60 kg, when weighed in air on the scales. Will the snorkeller float or sink?

If the snorkeller sinks, how can we make her float and once we have made her float, how can we give her neutral buoyancy? There are three parts to the answer.

Part A Positive or negative buoyancy?

Step 1 Calculate the upthrust

Volume of object = 55 L

Mass of H_2O displaced = 55 L x 1 kg/L = 55 kg ***(Upthrust)***

Step 2 Apply the rule

Mass in air = 60 kg, upthrust = 55 kg. The snorkeller will sink.

Part B How can we make our snorkeller float?

If we put her into a wet suit, she will have more volume and displace more water. However she will also weigh more. Wet suits however have air bubbles trapped in the fabric. She puts on the wet suit and weights 61 kg but when immersed in the barrel displaces 64 litres of water.

Step 1 Calculate the upthrust

Volume of object = 64 L

Mass of H_2O displaced = 64 L x 1 kg/L = 64 Kg ***(Upthrust)***

Step 2 Apply the rule

Mass in air = 61 kg, upthrust = 64 kg. The snorkeller will float.

Part C How can we make her neutrally buoyant?

Step 1 Calculate the apparent mass

Apparent mass = Mass in air – Upthrust

= 61Kg – 64 Kg = – 3 Kg

Ans: Apparent mass = – 3 Kg

A negative answer does not mean you will sink.
All it means is that you need 3kg's of weights to be neutrally buoyant.

Step 2 Add weights equal to the apparent mass

If we put on a weight belt and weights equal to 3 kg, the snorkeller should theoretically now be neutrally buoyant.

WORKSHEET 9 BUOYANCY AND SNORKELLING

Questions *(All answers on pages 22-23)*

Q1. Recall Archimedes Principle and state the formula for calculating density.

Q2. Explain how you would predict if a snorkeller would float or sink.

Q3. Calculate the mass of the water displaced (upthrust) of a snorkeller if the density of water is 1 kg/L and the snorkeller displaces 65 Litres when immersed in a barrel of water.

Q4. Calculate the density of a weight belt in Kg/L if the volume is 300 mLs and a mass of 4 Kg.

Q5. A weight from a weight belt has a density of 10 kg/L and a volume of 500 mLs. Calculate the mass of the weight.

Q6. An object has a volume of 75 L and a mass of 150 kg, when weighed in air.

a. Estimate the apparent mass of the object when placed in water.

b. Decide if it will float or sink.

Q7. A diver has a volume of 80 litres and a mass of 75 kg, when weighed in air. Density of water = 1 kg/litre.

a. Calculate the apparent mass when placed in water

b. Decide if the person will float or sink giving a reason for your answer

c. If the person floats, calculate how much weight will have to be added to make the snorkeller neutrally buoyant.

Q8. Explain the difference between positive and negative buoyancy.

The skin

Your skin is your body's first line of defence against external threats, such as sunlight, cold weather, dirt, dust and viruses. It provides your body with a robust barrier of protection from injury and infection.

Blood vessels, hairs and sweat glands in your skin play a vital role in managing your body temperature (Figure 25.2)

When you are hot and need to cool down, the blood vessels in your skin expand and allow heat to escape. You also start sweating and your hairs lie flat to allow the escaping heat to pass out of the body.

When you are cold and need to retain heat, the opposite happens. Your blood vessels tighten, you produce far less sweat and your hairs stand on end in an attempt to trap warm air around your body.

Sun exposure

Snorkellers are constantly exposed to the sun and must take precautions to avoid dehydration, overheating and getting sun burnt. Sun burn is a major problem.

Everyone is at risk of developing skin cancer. Fair-skinned people with reddish or fair hair are at greatest risk; people with an olive complexion and dark hair have a lower risk, but still require protection.

Education stakeholder programs

The experience of more than 25 years of skin cancer prevention in Australia shows broad-based public education programs can have an impact on improving a population's sun protective behaviours and reducing sunburn, a short-term marker of skin cancer risk.

Bob Moffatt

Figure 25.1 Increased protection is required when on the water

SLIP SLOP SLAP

Effect on cancer rates

Since this campaign was introduced along with advertisements and a jingle, the incidence of the two most common forms of skin cancer (basal-cell carcinoma and squamous cell carcinoma) in Australia has decreased. However, the incidence of melanoma - the most lethal form of skin cancer - has increased.

As you will probably arrange a doctors visit to check your health before signing your medical disclosure, you may wish to have a skin check at the same time.

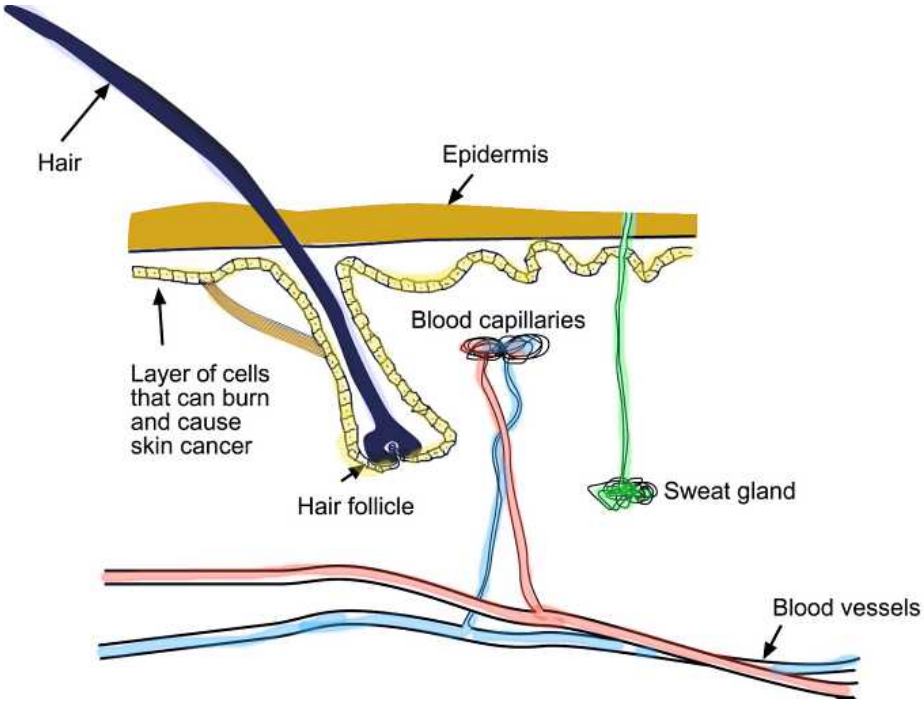


Figure 25.2 Generalised drawing of the skin

Bob Moffatt

ALWAYS protect the skin from harmful rays by covering up with a wetsuit or rashie or use 50plus sunscreen.

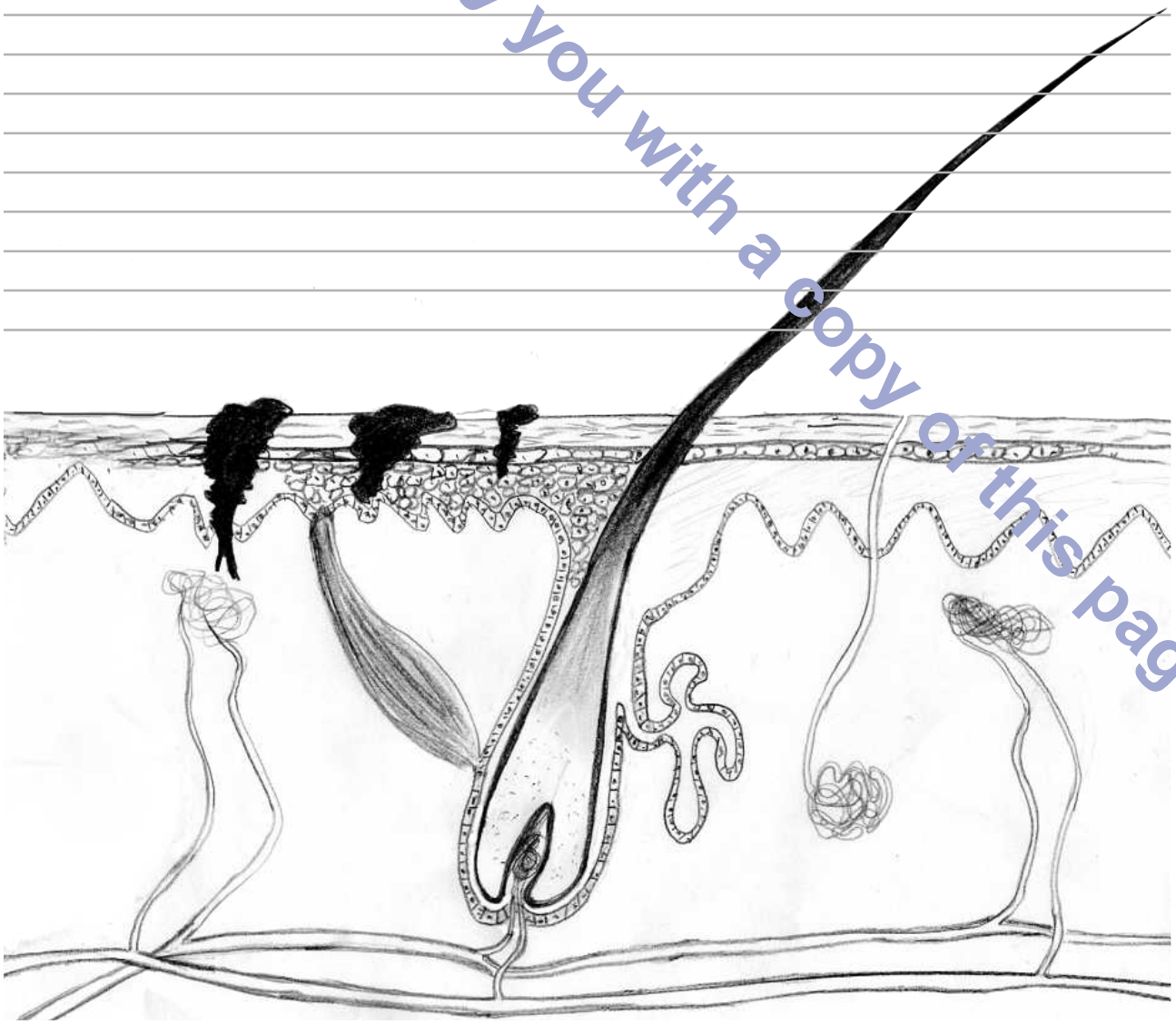
At night it often gets very cold at sea and you should ensure you have adequate clothing.

During the day look for situations that could involve sunburn or create overexposure and slip on a shirt, slop on some sunscreen and slap on a hat.

WORKSHEET 10 SKIN CANCER

A student researching this topic made a drawing of the skin in an attempt to show a melanoma (the most dangerous form of skin cancer), a basal cell and squamous cell carcinoma.

- Identify or correct the main parts of the skin shown (*Use web references to complete*)
- Distinguish between the three types of cancers and identify which is the most dangerous
- Outline three personal lifetime decisions you would make to prevent contracting any deadly forms of skin cancer



Section 2 Snorkelling equipment

The basic equipment for snorkelling is a mask, snorkel, fins, wet suit, stinger suit (for tropical summer climates), booties and a weight belt. In general, the choice of equipment is based on three things:

1. Comfort: Any piece of equipment selected must be a good, firm but comfortable fit which can be worn for long periods without causing any discomfort.
2. Financial status of the snorkeller: Look for quality when purchasing equipment even though it may cost more.

   Cheap inferior equipment does not last as long, and in some cases may even be a threat to the safety of the snorkeller e.g. safety glass in the mask is a bit more expensive but is less likely to damage the eyes if broken.
3. Suitability: Different localities or activities may require specialised types of equipment. For cold climates thicker wet suits are required. Lycra stinger suits are required for snorkelling in tropical waters in the summer months.

Safety, hygiene and comfort

For hygiene and comfort it is recommended that you use your own equipment. When not in use equipment should be stored away from light and not with pool-maintenance materials.

- Look for standards markings and always check equipment before use for any signs of deterioration or faults.

  If the equipment is non-conforming, then place it in a clearly marked box or area and report faulty parts or arrange for repair.
- Stinger suits should be considered in northern parts of Australia in summer months and wet suits are preferable in all parts of Australia in nearly all months of the year due to the buoyancy and comfort they offer.
- Leaders should carry a knife, and if snorkelling vests are used, they should conform with Australian standards.

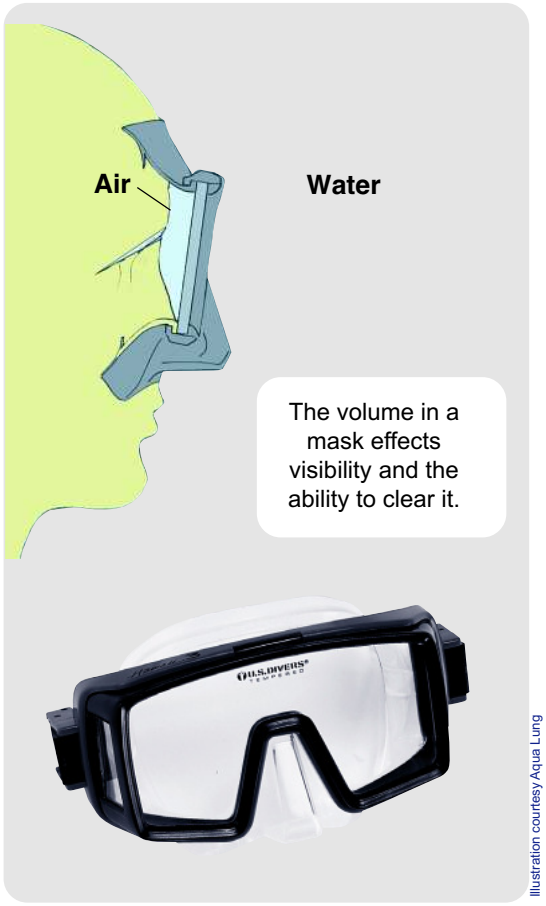


Illustration courtesy Aqua Lung

Figure 27.1 A mask places a layer of air between the eyes and the water

Masks

As mentioned earlier, these place a layer of air between the eyes and the water, thus allowing clearer vision beneath the surface as shown in Figure 27.1.

Types of mask

Four types are generally available and include the following:

- Silicone masks are made from a variety of grades ranging from inexpensive to very expensive. The advantage of silicone is that it is less prone to deteriorate and tends to be more comfortable on the face.
- One lens masks have a single plate and may suit some faces better.
- Split lens masks have the advantage of a lower volume and so could be easier to clear. Some snorkellers claim that it is easier to see with this type of mask.
- Masks with corrective lenses allow people who wear spectacles to see better underwater.

  If you really love snorkelling and are visually impaired, it's worthwhile buying a mask with a preset focal length or have a special mask made to suit your focal length.

Bob Moffatt

Figure 27.2 Check your mask with your instructor to see if it is the right size

Selecting the right mask

When selecting a mask consider the following points:

- The mask should be a comfortable, watertight fit preferably with a soft, double seal.

  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.

- The face plate(s) must be made of safety glass to guard against breakage or scratching (indication of this is printed on the face plate). The mask should have a nose pocket to allow for equalising the ears.

  Check your mask with your instructor if you have any question

- It should be made of good quality rubber or silicone and have compensation depressions in the bottom. Purge valves are optional devices which make clearing the mask of water easier, but may be the cause of leaks.
- A flexible but heavy split strap with easily adjustable locking devices provides greater security and comfort underwater.
- A mask with low volume is easier to clear, and increases the diver's field of vision.

After you have bought your new mask, one suggestion to remove the manufacturer's film is to scrub the surface using a soft toothbrush and toothpaste. This will reduce fogging.

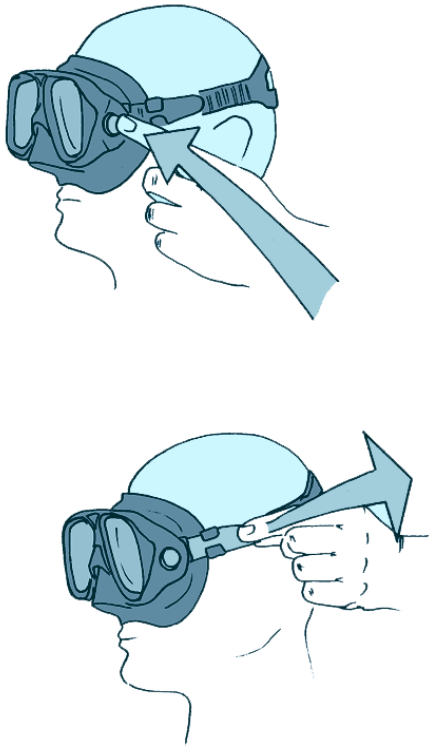
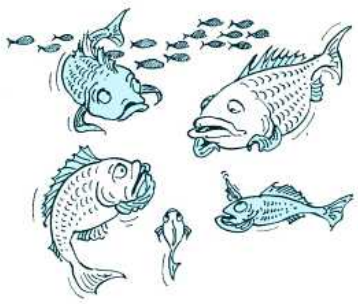


Figure 28.1 Adjustments to the mask are made at the side
Illustration courtesy Aqua Lung

Figure 28.2 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.

Safety and care

- Goggles should NEVER be worn when snorkelling as there is no way of equalising pressure around the eyes or clearing water from inside during a snorkel or dive.
- 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.



Snorkels

The snorkel enables you to breathe while you are swimming at the surface and can be made of silicone, plastic or rubber (silicone lasts longer).

Selecting a good snorkel

The snorkel should have a smooth, contoured "J" shape without any sharp bends in it. This reduces drag in the water and allows for smoother breathing.

The mouthpiece (Figure 29.3), should be a comfortable fit and be firmly attached to the tube. The tube should be made of a flexible material to reduce risk of injury.

Take care of snorkels with flexible parts around the mouthpiece as these can cause *salt water aspiration* (build up of salt in the lungs). Asthma sufferers should avoid this type of snorkel.

An average length of 30-40 cm and a diameter of 2 cm is recommended - longer tubes increase the volume of stale air re-breathed and also the potential for snagging.

When selecting a snorkel, it should be attached to the mask straps on the left side of the head, placed in position and checked for comfort and the location of the opening. This can be done with a snorkel keeper or a rubber band.

The top 5-7 cm should be brightly coloured (eg orange/red) to provide better identification against the water background.

Three types of snorkel are shown in Figure 29.1.

Problems with snorkels

Snorkels with a smooth bore, decrease the amount of water trapped inside and smaller bore snorkels should be used with young children or people with low lung capacities. This is shown in Figure 29.2.

Snorkels with an oversized bore require more air and can cause difficulty in breathing for people with a low lung capacity.

Safety

- Younger children or people with small lung capacities require a snorkel with a small bore. The snorkel in Figure 29.2 A has a larger bore than the one on the left.
- Try to avoid snorkels with valve devices or table tennis balls on top. These can create dangerous situations as the ball may block the top of the snorkel on the surface cutting off the air supply.

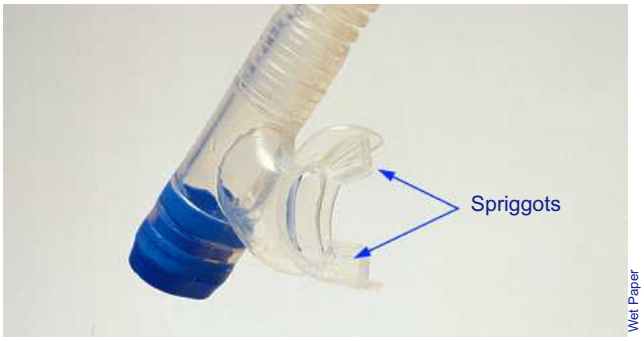


Figure 29.3 Snorkel mouthpiece and spriggots

Figure 29.1 The snorkel should have a smooth, contoured "J" shape without any sharp bends in it.
Photographs courtesy Aqua Lung and Impulse

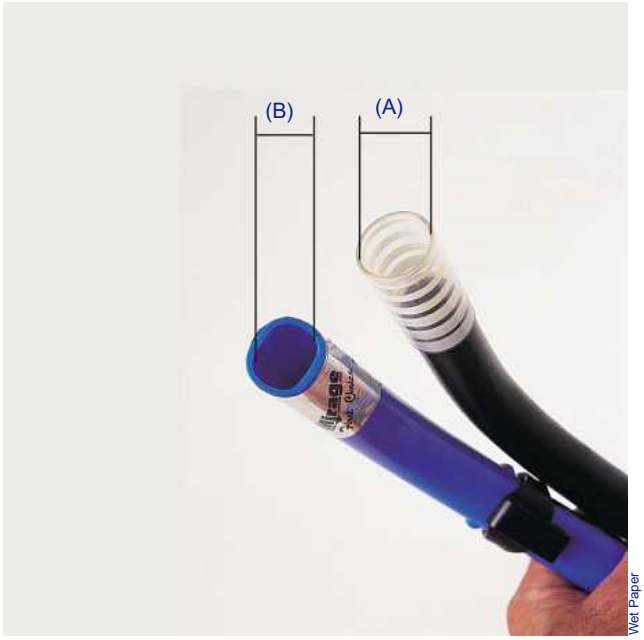


Figure 29.2 The smaller bore (B) should be used with young children or people with low lung capacities compared to (A)

To help the observer you may be issued with a coloured tag to indicate your experience level or specific activity eg diving, photographing

Figure 29.4 Snorkel tags to indicate level of confidence or specific activity eg diving

Fins

These propel the snorkeller through the water.

Categories

Fins fall into two categories – open healed and full booted.

Selection is a matter of budget and personal choice, however, the following points should be considered:

- Open heel fins, (Figure 30.1) require wet suit booties which are worn inside open heel fins. They should be light, neutrally buoyant, with a semi-rigid wide blade extending forward of the toes and ending in a flexible whip tip. Booties are particularly useful when snorkelling in rocky or coral areas as you are able to walk to your snorkelling site.
- Full booted (or closed heeled) fins as shown in Figure 30.2, are less expensive and should be sized slightly larger than shoe size to reduce cramps and incorporate the features of the open heel fin.

  Full booted fins come off quite easily and are very good when snorkelling entries are to be made from vessels at sea.

Wet Paper

Figure 30.1 Open healed finds

Materials used in fins

Rubber and silicone 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.

All materials are subject to abrasion from rocks or coral and the more they come in contact with sharp substrata, the more they will wear.

Problems with fins

These arise from fins that don't fit. Cramps and blisters can occur if fins are too tight or you can lose a fin that is too loose. A good fitting fin should feel like a good fitting shoe.

Using booties can also overcome many problems but increases the cost involved.

Bob Moffatt

Figure 30.2 Full booted (or closed heeled) fins

Stinger suits

In northern parts of Australia stinger suits are often used to protect the body against the box jellyfish as shown in Figure 30.3.

These suits are made of a light material called lycra and can also help prevent sunburn. A full stinger suit is recommended when snorkelling in known jelly fish habitats.

Wetsuits and rashies

The wetsuit is made of rubber neoprene impregnated with millions of tiny nitrogen filled cells. If cut, it will look like a sponge. The function is to reduce heat loss and therefore reduce the chances of cramps or hypothermia.

It does this by keeping out the cold water and warming a layer of water between the suit and the skin.

- The difference between a wet suit and a dry suit is that the dry suit keeps water out and is used for snorkelling in very cold water.

Bob Moffatt

Figure 30.3 Stinger suit (L) and storage packet (R)

A wet suit allows a thin layer of water to be trapped between the skin and the rubber as shown in Figure 31.1. This stops the water from circulating and in fact heats up due to friction and heat loss from the body.

It is important to have a snug fit so that none of this heated water can escape while the snorkeller is in motion. For complete warmth, booties and a hood are added to the outfit.

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 should be considered:

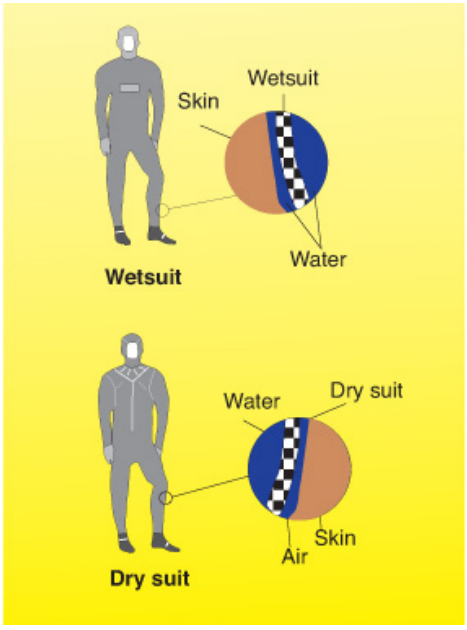
- a surfer's spring suit is different from a diver's suit in that the zipper is on the back.
- the suit should be a close, neat fit to prevent water flow but not so tight as to cause chafing or restrict circulation and breathing. When trying on a suit, ensure there are no spaces under the arms, neck, crutch or the extremities of the wrists or calves.
- a "tailor made" suit may be more expensive but necessary if an adequately fitting suit cannot be purchased "off the rack".
- tapes protect seams and provide easy identification. 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; 3 mm thick suits are quite adequate in warm tropical waters, however 5- 7 mm diving suit is used in cold water in southern states.
- there are many different styles of wet suit - jackets can be made with zippers in a coat form or can be pulled on like a pullover.

  Hoods can be attached to the jacket or worn separate; trousers can finish at the waist or extend over the shoulders - called steamer suits.

Advantages of wearing a wet suit

A wet suit is a very handy piece of equipment because it can:

- protect the body against cuts, abrasions, stings, bruises and sunburn.
- keep you warm and reduce the effects of hypothermia.
- act to help buoyancy.



Bob Moffatt

Figure 31.1 The difference between wet and dry suits


Photographs courtesy Aqua Lung

Figure 31.2 Wet suits

Rashies (Wet shirts)

A variation of the stinger suit is the wet shirt which comes with a sun block protection.

Plus 30 is commonly accepted as a suitable rating to prevent skin damage from harmful ultraviolet rays.

These shirts can also be worn under wet suits as shown in Figure 31.3 and are useful when snorkelling in warm waters.

Moffatt

Figure 31.3 A wet shirt can be worn under a wet suit

Weight belts

Ideally, an ocean snorkeller should weight him/her self for neutral buoyancy with a snorkelling vest. This makes snorkelling really easy. For added safety it is recommended that beginners are weighted so they are slightly buoyant.

Weight belts 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 32.1, which should be easy to adjust and be able to be removed quickly with one hand, while wearing gloves.

Wire buckles are more difficult to adjust than flat lever buckles. The buckle should be clear of excess strapping but not trimmed off so short that extra weights cannot be fitted.

Figure 32.1 Weight belt

Photographs courtesy Aqua Lung

Gloves and carry bags

Gloves 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. An inexpensive alternative is a pair of gardening gloves.

Carry bags as shown in Figure 32.2, not only protect your gear and help keep it clean, but also allow you to attach your name so your gear does not get mixed up with others.

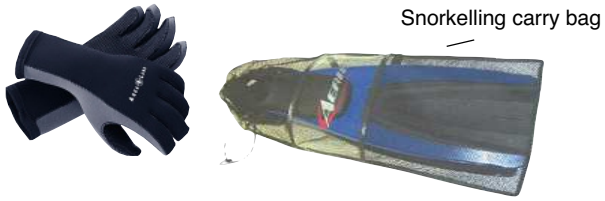


Figure 32.2 Gloves (L) and snorkelling carry bag (R)

Photographs courtesy Aqua Lung

Knives

A knife is an essential part of your equipment if you are using scientific gear underwater. Stainless steel knives have a stainless or synthetic handle which controls corrosion.

It is hard to keep an edge on stainless steel and it must be regularly sharpened. A knife should be sharp so that it can cut you out of difficulty, and should be carried in a strong sheath strapped to your leg.

Figure 32.3 Different types of knives

Snorkelling vests

The vest allows you to relax on the surface while being "positively" buoyant. It should remain in position when it is 3/4 inflated, and have controls that are easy to locate and operate.

A snorkelling vest is recommended as an essential item of equipment required for open ocean snorkelling in some states as they are usually made of brightly coloured waterproof fabric. The one in Figure 32.4 is yellow.

A snorkelling vest can be inflated a little to keep you neutrally buoyant at the surface, or can be inflated more if you get tired. Wearing a snorkelling vest can be a good idea when wearing a weight belt as it creates a slightly positively buoyant effect at the surface. A life jacket is also an alternative if you do not wish to dive.

ıtes

Ensure that the vest fits you and is comfortable to wear.

When diving is finished for the day, ensure that the vest is washed inside and out with fresh water and allowed to dry away from the direct sun.

Figure 32.4 Snorkelling vests

Photographs Courtesy Aqua Lung

Specialized scientific gear

Compass

This allows you to align scientific data with navigation charts or aerial photography. These expensive pieces of equipment need to be treated with great care.

Figure 32.5 Compass

Photographs Courtesy Aqua Lung

WORKSHEET 11 EQUIPMENT USE

Questions

Q1. Compare types of equipment that would be required if you were to snorkel in a tropical climate in summer with equipment you would use around a rock outcrop in winter (Page 27).

Q2. Evaluate the use of open heeled fins and full booted fins (Page 30).

Q3. Analyse common problems associated with incorrect fitting fins (Page 30).

Q4. List the advantages of wearing a wet suit (Page 31).

Q5. Evaluate the use of stinger suits in tropical Queensland (Page 30).

Q6. List three characteristics of a good snorkel (Pages 28-29).

Q7. Critically evaluate one problem a person with a small lung capacity may have when using a snorkel with an oversized bore (Pages 28-29).

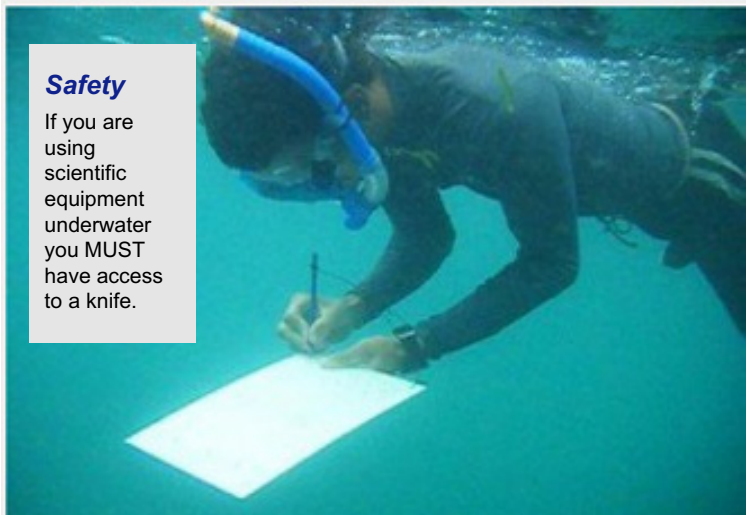
Q8. Critically evaluate a snorkel with a ping pong ball in it for use in an ecotourism program (Page 29).

Q9. You have been asked to collect data from your local area. Suggest a list of scientific equipment you would take giving reasons for your choice (Pages 34-35).

Underwater slates

These are used to write underwater and record data. Its important to have then strapped to you arm in a way that allows east removal in case of entanglement. But also attached so you can drop them to assist snorkelling.

Its best too practice in the pool before going into open water so you can improve your underwater writing skills.



Safety

If you are using scientific equipment underwater you MUST have access to a knife.

Courtesy Aqua Lung

Figure 34.1 Underwater slate

Underwater cameras and housings

Modern digital cameras now have underwater settings which take great photos. Most manufacturers sell underwater housings (Figure 34.2) which allow you to take photos underwater.

Safety

Make sure you attach equipment to your wrists

Figure 34.2 Underwater cameras and housings

Illustration courtesy Cannon

Survey digital video cameras

As digital technology increases, so does the range of underwater recording devices (Figure 34.4). It is now possible to buy waterproofing solutions and housings for tablets, Ipads and phones.

In the not too distant future, you may be taking your tablet underwater to record data.

GPS and marine radio

This device allows you to take your GPS while at a research site. Figure 34.4 shows other emergency features. In Australia you have to have a licence to operate a VHF radio.

Figure 34.4 Marine radio and GPS

Photographs liquid image

Figure 34.3 Specialized survey digital video cameras in mask

Photographs liquid image

Quadrat and transect equipment

If you are studying marine science you will be asked to collect data in the field involving specialised underwater equipment. Two ways of doing this are transect sampling along a line, or quadrat sampling using a quadrat square.

- A transect is simply a line we stretch over an area of the sea we want to study. The line must have regular measurements marked off like a tape measure and is held straight and stationary.
- A quadrat is where a square is used to collect data (Figure 35.3) that is set at regular intervals along a quadrat lines as shown below.

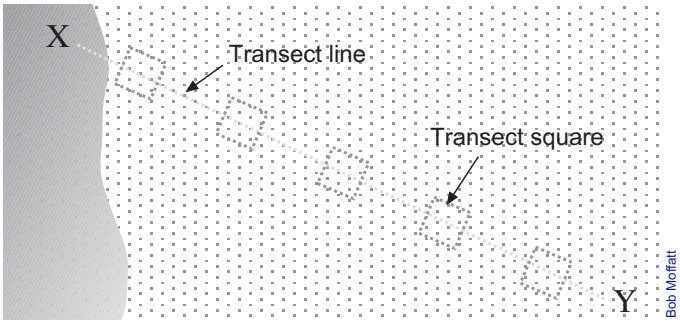


Figure 35.2 Transect details

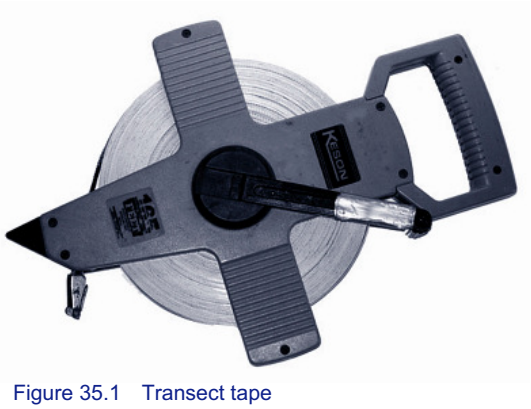


Figure 35.1 Transect tape
Photographs Courtesy Selbys

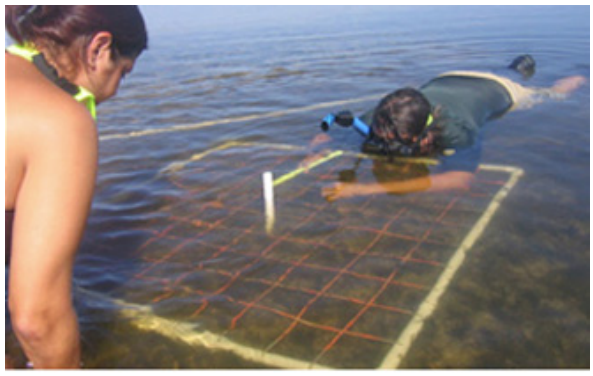


Figure 35.3 Transect square and snorkelling
Charlotte Harbour Aquatic Reserves Seagrass Monitoring Program

Care of specialized equipment

General care

- After snorkelling, all equipment should be carefully washed in fresh water and dried out of the sun. Remember salt particles stick to your equipment and allow corrosion and deterioration. Sunlight will quickly perish rubber if exposed for too long.
- Take care to protect the mask face plate from scratching or leakage and store fins flat to prevent curling.
- Keep all equipment away from pool chemicals as these will corrode materials.

  The best way to protect your suit in storage is to hang it out to dry and then store it in a plastic bag to create its own environment. This also protects the cellular materials from being flattened by folds. Zippers should be lubricated regularly to prevent jamming or corrosion.
- Most swim fins, masks and snorkels wear well as long as they are washed with fresh water and kept away from heat. A good simple maintenance practice is to keep a lightweight box liberally filled with talc, for storage of your mask, fins and snorkel.

  It is an easy matter after drying these items to load them in the box, seal and shake. Later when you need them just blow off the talc and rinse in water before use.

Cameras

- 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.

Transect tapes

Soak the tape in clean water in a tub. Then unravel it all to air dry. Wind up and wipe when dry.

Underwater slates and transect squares

Wash in clean water and then air dry. Check pencils on slates and sharpen. Clean wrist bands and cord.

Transect squares can be washed with a hose and allowed to air dry. Make repairs as required.

Figure 35.4 Allows snorkelling gear to dry in the shade

WORKSHEET 12 EQUIPMENT CARE

Design procedures for the care and storage of snorkelling equipment based on the materials used in construction. Use the table below to summarise your answers.

Snorkelling piece	Materials use in construction	Procedures for care and storage
Mask & snorkel		
Transect squares		
Fins & booties		
Wet suit & rashies		
Weight belt		
Snorkelling vest		
Knife		
Gloves		
Cameras		
Transect tapes		
Compass		
Underwater slates		

WORKSHEET 13 AQUATIC MATERIALS AND THE SEA

Environmental effects on equipment

Based on an original activity by Mick O'Connor

Part A: Swimsuits and heat

Aim

To analyse how heat affects snorkelling suits.

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.

Results

Conclusions

Extended response

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

Part B: Swimsuits and chemicals

Aim

To see 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.

Section 3 Snorkelling Practices

Your first snorkelling lesson should be in a pool or a quiet, safe place. Not too deep, with few currents and on a warm day off a sandy beach.

Safety

There are **three** main things to consider before you begin snorkelling.

Respect for the sea

Overconfidence can place you and your buddy in a potentially dangerous situation. However, being terrified also prevents you enjoying one of nature's wonders. There is nothing wrong with being scared, it is usually a natural human reaction to things that you do not know about or understand.

Work co-operatively with your buddy

He or she may be a very competent swimmer, be the most physically fit, have the greatest attitude, but if stung by a jelly fish can turn to putty. Always remember to stay with your buddy at all times and know your rescue drills.

Try the one up and one down safety tip where you stay on the surface to keep an eye on your buddy as he or she dives down and vice versa.

Don't panic if you can't dive all the time

For example if you cannot clear your ears, usually there is a medical reason - hay fever, allergies or a cold blocking the eustachian tube are but a few examples. Most times a simple visit to the doctor will diagnose and solve your problems.

Fitness

Two simple tests can be used to see how fit you are.

- **The swim test.**
  Swim a distance of 200 metres, nonstop, any stroke.
- **Treading water.**
  Survival swim of 10 minutes, drownproofing or floating.

What to wear

- If you are entering the water in swimming pools be careful of the edges. If you dive in tropical waters in the summer months, take special notice of box jellyfish.
- If it is cold, wear a wet suit. If it is hot, put plenty of sun block on the face, neck and exposed parts of the body. Remember the backs of the legs and if you have short hair, the tops of your ears and the back of your neck. Also, modern lycra suits can offer protection from the sun in summer.

> ***Hint with wetsuits***
> Sometimes it's difficult to get your feet down the leg of a full length wetsuit. Try using a plastic bag over your foot to make it slide easier.

Figure 38.1 Learn to work with your buddy.

> ***Being afraid is normal***
> The sea is a new environment and it's natural to be a little bit scared. Don't be afraid to hold onto your buddy's hand while you get used to your new environment.

Figure 38.2 What you wear will be determined by location, water temperature and level of fitness

Figure 39.1 Here are some hints to make sure your mask fits properly.

Fitting your mask and snorkel

Figure 39.1 shows some hints to make sure your mask fits properly. In summary these are;

- Adjust the strap so the mask feels comfortable.
- Get all your hair out from behind the mask.
- Make sure your snorkel has a keeper and fits comfortably.
- Use some baby shampoo or spit to make sure the mask does not fog up before you use it.
- When you think you are happy, gently submerge underwater and have your buddy have a good look at how your mask is fitting underwater
- Ask your instructor to check that you have it right.

Floating

Once in the water, pull the mask over your eyes and adjust the snorkel so that the water does not get in, then go for a short snorkel. Breathe easily through the snorkel and float. Breathe in and out with your arms outstretched.

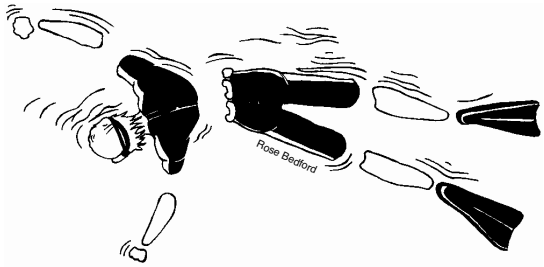


Figure 39.2 Floating is one way to become comfortable
Wet Paper

Water entries

There are many ways to enter the water as shown in Figure 39.3. If you are in a boat the backward roll method is preferred by some snorkellers while others tend to use the safety jump.

The backward roll

Hold the mask with your hand pressing against the face. Now roll backwards so that your legs do not strike the gunwales (sides of the boat). If you are in a small boat have others move to balance the craft. (Not to be done from a pool edge).

The safety jump or giant stride

Press your mask against your face and jump into the water with a scissor kick. The idea of the kick is to minimise going too far underwater.

The push off or submerged entry

Simply sit at the side of the pool, put your hand on your mask and push off as shown in the figure opposite.

From a boat you just climb down the ladder of the boat, put your head underwater and gently submerge. Your instructor will demonstrate these now if you are unsure.

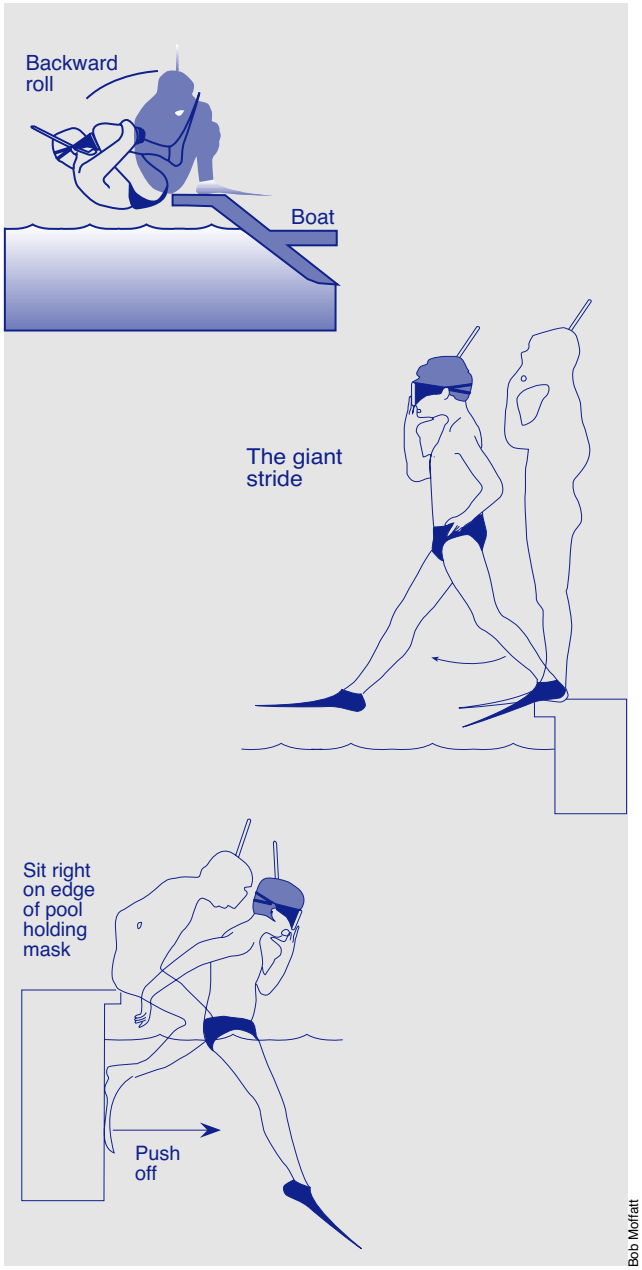


Figure 39.3 Three types of water entry

WORKSHEET 14 ENTRY AND EXIT

Questions *(All answers on pages 38-39)*

Q1. List three main things to consider before snorkelling.

Q2. Describe two simple tests to see how fit you are.

Q3. Suggest three ways you could enter the water indicating one safety hint for each.

Q4. Explain why floating is such a useful exercise when learning how to snorkel.

Q5. Describe one precaution that should be taken when exiting from a rock pool.

Q6. Discuss questions a - d below in a group on things to do when exiting from a swimming pool. Then record the group consensus answers in the space provided.

a. Should the fins be removed first and why?

b. Should the mask and snorkel be left on and why?

c. There are other people sitting beside the snorkeller. What precautions should be taken not to injure them?

d. If the snorkeller is wearing a weight belt, should this be taken off before exiting? What reasons did class members give for this answer.

Finning

To get the most power from your fins it is important to use the correct method.

Without fins, a snorkeller tends to kick from the knees down, using the calf muscles to raise and lower the legs.

These muscles are small compared with the muscles of your thigh so you should try to use these when using fins.

Usually the hands are held by the side to conserve energy.

Wet Paper

Figure 41.1 Finning

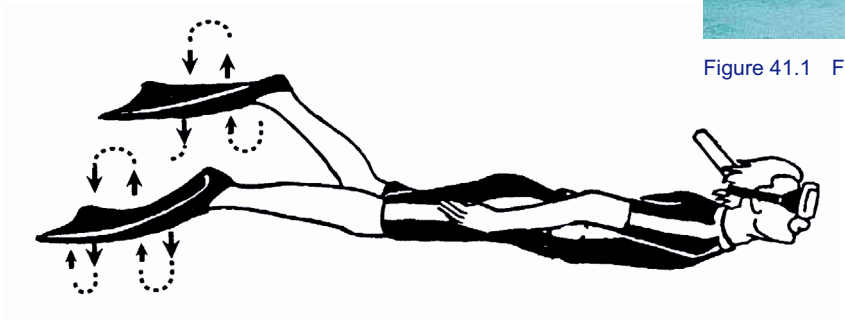


Figure 41.2 Finning the right way
(Rose Bedford)

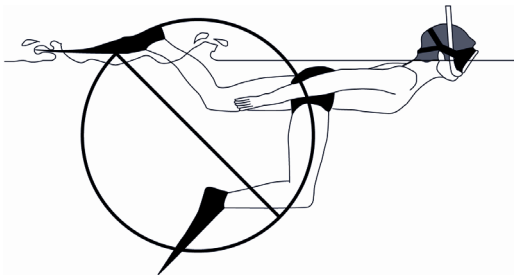


Figure 41.3 Avoid cycling. Use your thigh muscles

Safety

Most cuts and bruises occur when you enter and leave the water. Here are some hints to minimise the risk of injury while entering the water.

- Check out the entry point for potential dangers such as damaged or slippery surfaces.

  Put your mask and snorkel on before you get in to keep your hands free.
- Make sure you can handle all your gear. If you are taking a camera make sure its securely attached to you. Losses can be expensive.
- It is best to enter via steps, with mask on the head and fins on. If you sit at the side of a platform and launch yourself in from a sitting position, make sure you don't injure your back.
- As you become experienced, its quicker to put your fins on and take them off in the water.
- Watch out for others in the group as they dive. You can end up with a fin in the face if you are not careful.
- Avoid walking in fins as they may trip you. If you have to walk, walk backwards.
- Be careful of slippery edges when leaving the water.
- If you snorkel in a reef, river, creek or bay be careful of broken glass or sharp edges that will cut your hands. Gloves are a handy piece of safety equipment.

Bob Moffatt

Figure 41.4 The divers flag

Boating safety and the diver flag

The dive flag in Figure 41.4, is the international code A flag. The flag means - I have a diver down, keep well clear at least 30 metres and pass at a slow speed.

I have a diver down, keep well clear at least 30 m and pass at a slow speed.

WORKSHEET 15 FINNING

Questions *(All answers on page 41)*

Q1. Describe the type of leg action a snorkeller tends to use when swimming without fins.

Q2. Describe the effect on a person who cycled his/her legs while snorkelling for an hour.

Q3. Explain how to best conserve energy while snorkelling.

Q4. Suggest two possible reasons for wearing a weight belt.

Q5. Predict what type of wetsuit you would recommend be worn for snorkelling in different water temperatures.

Q6. Draw and colour in a diving flag to show its distinguishing features. State the boating rule that applies when this flag is displayed?

Q7. List two things you should be able to do in a swim test. Give reasons for your answer.

Q8. List six hints to minimise the risk of injury while entering the water.

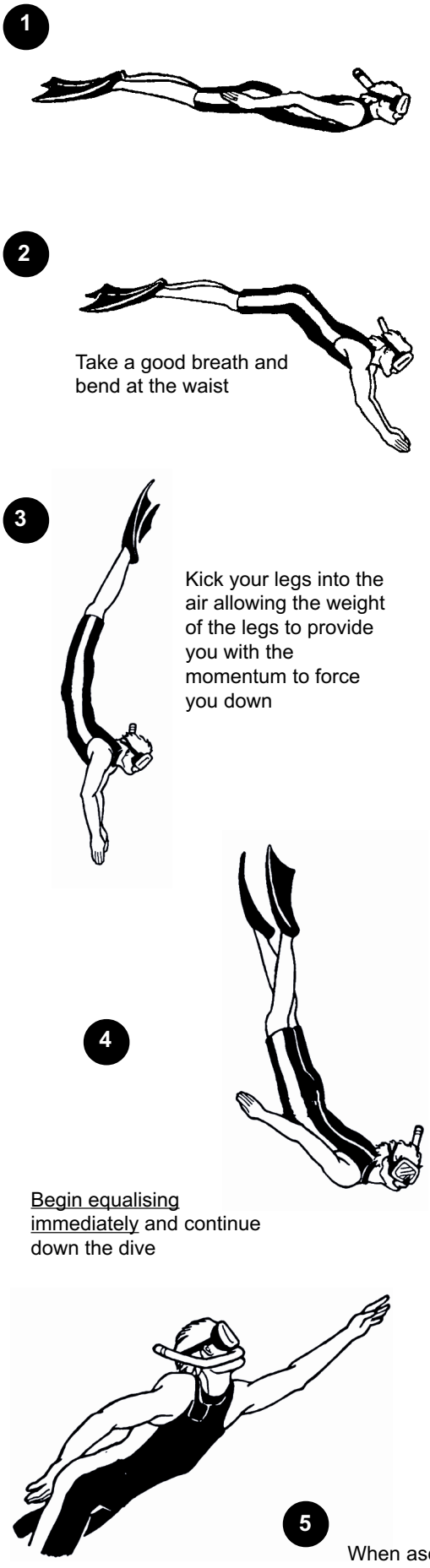


Figure 43.1 The duck dive

Illustrations Rose Bedford

Diving

Two possible dives are the duck dive and the safety or submerging dive. The duck dive involves making a pike, swimming down, turning and swimming underwater and then surfacing.

Submerging or safety dive

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.

- Practise the submerged dive followed by a forward underwater swim.
- Now surface and see if you can duck dive.

Time underwater

The length of time you can stay underwater depends on many factors. Body temperature, water temperature and physical fitness are some.

The desire to breathe is caused by a carbon dioxide build up in the lungs. Nerve endings send messages to the brain, telling you to take a breath. On land this is fine but underwater it is a different story.

Hyperventilation

The desire to breathe can be reduced by taking deep breaths in quick succession but can have fatal consequences.

Taking a series of quick deep breaths lessens the amount of carbon dioxide in the lungs which gives us the urge to breathe.

The process is called *hyperventilation*.

By *hyperventilating,* divers no longer have nature's safety valve. It's a dangerous thing to do. If you don't breathe in when your body wants more oxygen, it can cause you to blackout! This could kill you if it happens underwater.

It's no big deal to stay under water the longest, so use your common sense and *listen to your body* telling you when to surface and take a breath.

Duck diving

The duck dive starts with taking a good deep breath.

Now bend at the waist and kick your legs into the air allowing the weight of the legs to provide you with the momentum to force you down.

Begin equalising immediately and continue down the dive. Swim horizontally parallel to the floor of the pool.

When ascending to the surface, always look up, point and turn in a slow 360^0 movement - this is done to prevent any head collisions with boats or schools of sea jellies.

WORKSHEET 16 DUCK DIVING

One up / one down

Get used to the method of one up one down with the person up keeping an eye on the one down and the surrounding environment.

Questions *(All answers on page 43)*

Q1. Look at Figure 44.1 and answer these questions.

a. State what type of dive it is.

b. Describe each of the steps 1 - 5 in your own words.

c. Explain any two problems you or your friends had when you first attempted duck diving.

Q2. You are ascending at point 5 and notice a school of jellyfish. Explain what should you should do.

Q3. At point 4 you see a stingray. Explain what should you should do.

Q4. Upon surfacing you cannot clear your snorkel and your mask is full of water. Explain what should you should do.

Q5. Argue the case for the one up and one down buddy principle.

Q6. Explain what hyperventilation is and why it should be avoided. Draw a graph to illustrate your answer.

Clearing your mask

While you were floating, a little water may have entered your mask and the glass may have fogged up.

Stand up now and take your mask off, spit in it and rub the saliva around inside.

Then rinse the mask and put it back on. If your mask fills while underwater, it is easy to clear.

How to stop your mask fogging up

Spit in it

Spit in the middle of the mask and rub it around with your finger. Dunk the mask briefly in fresh water. The idea is to leave a thin film of saliva on the inside of the mask.

Baby shampoo

A few drops of watered down baby shampoo rubbed into the mask and then rinsed out just before snorkelling will again put a thin film on the mask.

Commercial defogging agents

These products are designed to coast the lens and many people find these better than spit. Make sure you keep enough agent to coast the inside of the mask.

A mask with a purge valve

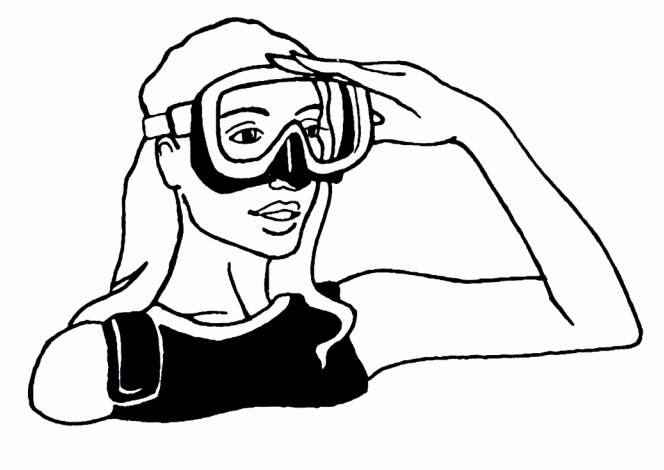
A purge valve is a one way value that allows the snorkeller to clear the snorkelling mask of any water that may have entered the mask without having to take the mask off.

The air rises to the top of the mask and water flows out from the bottom. In a **purge valve mask**, the water flows out the one way in the nose of the mask, so the head is tilted forward during the clearing process.

With a non-purge valve mask the head is tilted back and air is exhaled into the mask from the nose so the water can flow out over the edge of the skirt at the bottom of the mask.

Remember, you must begin exhaling before tilting your head back so water will not run up your nose.

A steady exhalation is more effective than short, strong bursts of air (which tend to escape instead of remaining inside the mask).



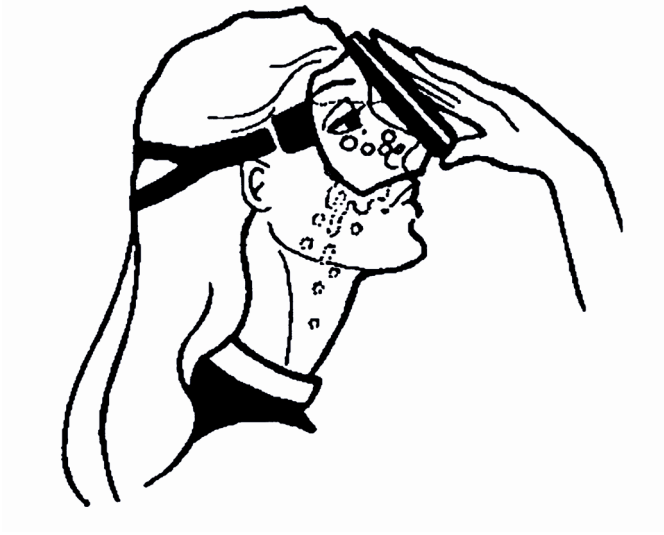


Figure 45.1 Start exhaling through your nose with your head down, then look up, continue exhaling until all water is out.

Illustrations Rose Bedford, NAUI and Bob Moffatt

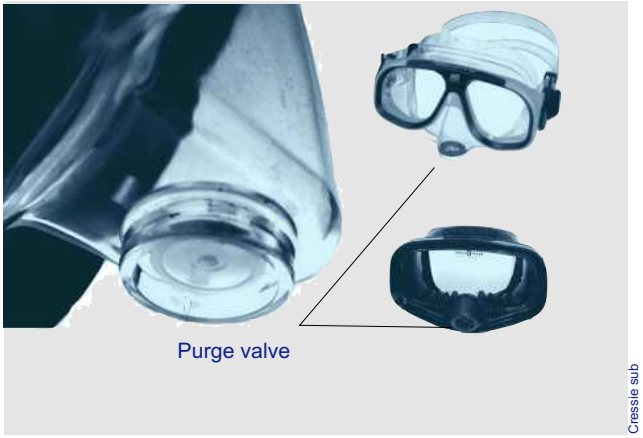


Figure 45.2 A mask with a purge valve

Hints when using a mask

- Adjust the strap so the mask feels comfortable.
- Get all your hair out from behind the mask.
- Make sure your snorkel has a keeper and fits comfortably.
- Use some baby shampoo or spit to make sure the mask does not fog up before you use it.

Clearing your snorkel

The blast method

In shallow water, the preferred method is to blast the water out while on the surface (Figure 46.1).

To try this, kneel in shallow water, put your face in the water, and breathe in and out through the snorkel.

Now inhale, hold your breath and place your tongue in the mouthpiece of the snorkel.

Duck your head under the water until the snorkel fills. Now raise your head until your ears are level with the surface, take your tongue out of the mouthpiece and blow the air out.

Don't inhale too deeply next as there may be some water in the snorkel. Hint: When you surface tilt your head back and some of the water will drain out by gravity. This will decrease the amount of water that has to be blown out of the snorkel.

Figure 46.1 The blast method of clearing a snorkel
Illustration Rose Bedford

The displacement method

In this method a small amount of air is trapped in the snorkel prior to the dive.

The idea is to trap air in the snorkel so that as you resurface that air displaces the water that fills in the snorkel.

- To learn this method, stand in water that is chest deep, inhale and plug your mouthpiece as before.
- Submerge and swim along the bottom of the pool. Now surface at an angle, remove your tongue and blow a small amount of air into the snorkel.
- Keep surfacing with your head tilted back and the snorkel pointing towards the bottom.
- As you break the surface, the air will displace the water and any further water can be blown out.
- The key to getting the water out is to keep the tip of the snorkel pointing towards the bottom.
- If some water enters the snorkel tube, blow it out with the air that is still in your lungs.
- If you can't do this then stop, take out the snorkel and get a fresh breath of air. Then head down again and keep snorkelling. Congratulations, you have made a good start!

Figure 46.2 The displacement method of clearing a snorkel
Illustrations Rose Bedford

Snorkels with purge valves

To clear a snorkel with a purge valve, return to the surface then breathe out steadily and breathe in carefully.

Hints when using a snorkel

- Make sure your snorkel has a keeper and fits comfortably.
- Extend your lips so the snorkel mouthpiece seals between your teeth and you lips.

  Some call this the "Mick Jagger" look.

WORKSHEET 17 CLEARING YOUR MASK AND SNORKEL

Questions *(All answers on pages 45-46)*

Q1. Explain why you tilt your head up when you clear your mask.

Q2. As you breathe out through your nose, air displaces the water. Explain why.

Q3. Describe what a purge valve is and what it does.

Q4. Explain what is different about clearing a mask with a purge valve.

Q5. Describe how to clear a mask.

Q6. List three ways to stop your mask from fogging up.

Q7. List two hints when using a snorkel.

Q8. Describe two safety precautions you should adopt when surfacing.

Q9. Explain how to clear a snorkel with a purge valve.

Section 4
Snorkelling First Aid

The sea can be a dangerous place. However careful you are, accidents will happen. The way you respond could be vital to your own survival or the people involved.

The information in this chapter can never replace a first aid course such as those run by St John Ambulance Association, Red Cross or your local ambulance service.

First aid relevant to dangerous marine creatures and snorkelling accidents is covered in these courses.

Web references

www.health.qld.gov.au; www.resus.org.au; www.betterhealth.vic.gov.au; www.emedicine.com
Note: Methods are constantly changing so for the latest information consult your state health web site.

The DRSABCD action plan

First aid is the treatment given to an injured person while waiting for qualified treatment from professionals. There is an important priority to be established in any emergency. We can remember this if we remember the DRSABCD action plan. The illustrations over summarise the sequence as given below.

- Danger
- Response
- Send for help now
- Airway
- Breathing
- Compression
- Defibrillation (if available)

Danger

As a first aider, your first priority must be yourself. You are no use to anyone if you are hurt trying to help an accident victim. Other rescuers would then have two patients to deal with.

- Consider the risks involved in helping another person.
- Some examples are trying to rescue a snorkeller in distress if you are a poor swimmer; assisting a person on a reef in bare feet; trying to remove stinger **tentacles** from a patient using bare hands instead of gloves or diving in to rescue a person who was being washed away in a strong current.

Response

The most common method used to get a response is to touch and talk to them. Remember **COWS.**

Can you hear me? **O**pen your eyes.

What's your name? **S**queeze my hand.

For example, your buddy does not surface. You dive down, swim him/her to the surface and then to the rescue board. You then need to get a response ASAP to assess how hurt he/she may be.

NOTE: FIRST AID PROCEDURES CONSTANTLY CHANGE

If you have an earlier edition of this book, then you need to keep up to date EACH year. So check one of the following

www.stjohn.org.au, www.resus.org.au, slsa.com.au

These pages also do not replace a practical course in resuscitation run by either St. John Ambulance Association, Red Cross, Surf Life Saving Association, The Royal Lifesaving Council, your local ambulance service or any accredited rescue service provider.

Check for signs of life

CPR should only be performed when a person shows no signs of life; that is, when they are:

- Unconscious
- Unresponsive
- Not breathing normally
- Not moving.

Send for help NOW

Call out to the snorkel observer. If you are asked call 000 for an ambulance or find someone with a mobile and ask them to dial 112.

Remain calm while answering questions and state the exact location of the incident, the phone number you are calling from and what has happened.

Airways

Depending on what happened, a patient's breathing may be obstructed. Lay the patient on their side, kneel near their shoulders and remove any obstacles such as sand, seaweed or false teeth from their mouth with your fingers.

It is very important to make sure the airway is open.

Breathing

Check for breathing by looking for chest expansion, listening for the sound of breathing and feeling for breathing movement on your cheek. If the patient is breathing, lie them on their side in the recovery position.

Compression

Compress 30 times and follow with 2 breaths.

Adults – place heel of hand in centre of chest. Place other hand on top of the first.

Children 1 – 8 years – place heel of hand in centre of chest.

Infants <1 year – place 2 fingers in centre of chest. Compress 1/3 depth of chest.

Continue until ambulance arrives or person regains consciousness or it becomes impossible for you to continue.


Defibrillator and patches

Defibrillation

Follow the voice prompts on the machine if one is available. If injured person shows signs of recovery, roll onto side and check if they are breathing. Reassure the person and bystanders.

Call triple zero (000) in an emergency

ask for ambulance, stay with the person and resuscitate

1 Check for Danger

Ensure safety for yourself, bystanders and casualty.

If safe, remove casualty from water as soon as possible.

2 Check Response

Can you hear me?

Open your eyes.

What's your name?

Squeeze my hand.

3 Send for help NOW call triple zero (000)

Phone for an ambulance.

Remain calm while answering the questions:

- exact location of the incident
- phone number you are calling from
- what has occured.

Follow the instructions from the ambulance service.

4 Clear Airway

If water or vomit is present in mouth, roll casualty on side, tilt face downwards and clear mouth with your fingers.

5 Check for normal Breathing

Look and feel for rising and falling chest.

Listen and feel for breath sounds.

If the patient is not breathing normally, commence resuscitation.

6 Start Compressions

Adults – place heel of hand in centre of chest. Place other hand on top of first.

Children 1 – 8 years – place heel of hand in centre of chest.

Infants <1 year – place 2 fingers in centre of chest. Compress 1/3 depth of chest. Compress 30 times.

7 Position the airway

Adults and children – tilt head backward. Place one hand on the forehead and use the other hand to lift the chin.

Infants <1 year – do not tilt head. Place one hand on the forehead and use the other hand to support the chin.

8 Start breaths

Adults and children – seal nose and give 2 breaths into mouth.

Infants <1 year – give 2 breaths into mouth and nose.

Watch for chest to rise.

9 Repeat breaths & compressions

Repeat 30 chest compressions and 2 breaths.

Continue until ambulance arrives or person regains consciousness or it becomes impossible for you to continue.

10 Attach a Defibrillator as soon as available. Follow the prompts

If injured person shows signs of recovery, roll onto side and check if they are breathing.

Reassure the person and bystanders.

Figure 49.1 Summary (Modified after Queensland Ambulance)

Cardiac compression

Cardiac compressions (sometimes called external cardiac compression ECC).

- Place the heel of one hand on the lower half of the person's breastbone.
- Place the other hand on top of the first hand and interlock your fingers.
- Press down firmly and smoothly (compressing to 1/3 of chest depth) 30 times.
- Administer 2 breaths.
- The ratio of 30 chest compressions followed by 2 breaths is the same, whether CPR is being performed alone or with the assistance of a second person.
- Aim for a compression rate of 100 per minute swapping every four minutes if more than one rescurer is present.
- Maintain CPR – continue, repeating the cycle of 30 compressions then 2 breaths. Keep going until professional help arrives.
- Don't check the pulse. Regular recovery (pulse) checks are not recommended as they may interrupt chest compressions and delay resuscitation.

Locate the compression point

Position the heel of the other hand in the middle of the sternum

Place one hand over the other and compress

Rescue breathing

Use mouth-to-mouth (rescue breathing) – if the person is not breathing normally, make sure they are lying on their back and:

- Open the airway by tilting the head back and lifting their chin.
- Close their nostrils with your finger and thumb.
- Put your mouth over the person's and blow into their mouth.
- Give 2 full breaths to the person (this is called 'rescue breathing').
- Make sure there is no air leak and the chest is rising and falling. If their chest does not rise and fall, check that you're pinching their nostrils tightly and sealing your mouth to theirs.
- If still no luck, check their airway again for any obstruction.

Surfing Australia

Using a rescue board to secure a patient

The Royal Lifesaving Society of Australia

Patient is in maximum head tilt ready for a quick start.

The Royal Lifesaving Society of Australia

Blowing air into patient

The Royal Lifesaving Society of Australia

If the chest rises, turn your head so it is close to the patients mouth and so you can hear air coming out and see the chest fall.

Changes to procedures

If you have an earlier edition of this book, then you need to know the Resuscitation Council of Australia issued new resuscitation guidelines in 2006. For the latest information on resuscitation please check.

http://www.resus.org.au

These pages also do not replace a practical course in resuscitation run by either St. John Ambulance Association, Red Cross, Surf Life Saving Association, The Royal Lifesaving Council, your local ambulance service or any accredited rescue service provider.

Stopping CPR

Generally, CPR is stopped for one of the following reasons:

- The person revives and starts breathing again on their own.
- Medical help, such as ambulance paramedics, arrive to take over.
- The person performing the CPR is forced to stop from physical exhaustion.

Recovery position

If pulse and breathing are present or once they return, lie the patient in the recovery position as shown in Figures 51.1– 51.3, being careful to avoid spinal injuries. Regularly check their airway, breathing and circulation so do not leave the patient unless absolutely necessary.

If you didn't do it before, now is the time to get help.

Continuing care

While you are waiting for expert help to arrive, you must still care for the patient. Keep the patient under constant observation and record everything that has occurred (if possible).

Control shock

- Shock occurs when blood pressure drops for a prolonged time.
- Shock can damage vital organs such as the heart or brain, or cause death if there is a lack of oxygen to these areas.
- Manage the situation by trying to remove the cause of the shock, then lie the patient down, with their feet higher than the head.
- Give some reassurance to calm the patient.

Further references

- www.stjohn.org.au
- www.resus.org.au
- slsa.com.au

Drowning

Water in the lungs is not the main reason for drowning as it is caused by suffocation where not enough oxygen reaches the tissues. However a patient who has been revived from drowning should be observed for up to 72 hours to avoid secondary drowning caused by water in the lungs blocking the small lung air sacs called alveoli.

Figure 51.1 Grasp the patient's leg, hips and head

Figure 51.2 Lift the leg

Figure 51.3 Gently roll the patient over and observe them until the patient recovers or expert help arrives

WORKSHEET 18 WATER SAFETY SKILLS (DRSABCD)

Sending for help

- Send a runner with written or verbal instructions. If verbal, get them to repeat it back to you.
- Call triple zero
- Use a marine radio - channel 88 27mhz or 16 VHF to send a PAN PAN call.
  - you will learn more if you do a marine radio course.

Q1. Recall what is the most important thing to consider before commencing resuscitation (Page 48).

Q2. Explain why is it important to check the patient's airway properly (Page 48).

Q3. Recall the rates for compressions to inflations in a rescue situation (Page 48).

Q4. Explain how often resuscitation should be varied if more than one person is present (Page 48 and 50).

Q5. Fill in the blank spaces in the box below, to show you understand the correct steps involved in the DRSABCD plan. (Page 49).

1 

2 

3 

4 

5 

6 

7 

8 

9 

10 

WORKSHEET 19 WHAT IF?

Q1. What do the letters DRSABCD stand for? (Page 48).

Q2. Someone has just been electrocuted in the Marine Studies building and is lying on the floor. What would you do?

Q3. What do the terms rescue breathing and ECC mean? (Page 50).

Q4. A student in a snorkelling class comes out of the water near you and collapses. He does not appear to be breathing but when you feel his carotid artery, you can feel a pulse. You remember where the VHF radio is located. Write down the steps you would take to attempt to revive the patient.

Q5. While attempting to revive the student, his pulse stops. You can see the snorkelling supervisor. Outline how you would attempt to revive the patient and for how long you would continue this activity.

Q6. Two friends arrive and offer assistance. They know nothing of first aid. Outline the instructions you would give them to continue to revive the patient.

Q7. One of the students becomes traumatised and faints. What you should do? (See shock treatment page over)

Q8. What could be some symptoms that this unconscious student would show? (Page 48).

Q9. The next day you decide to do a St. John's First Aid course. Use your laptop to research the following.

a. What is the telephone number and address of St. John's Ambulance in your State? Is the course recognised and accredited?

b. You want to advise the parents of the child where to do a Royal Life Saving Society rescue course when their baby grows up. What is the address and telephone number in your State?

c. You also decide to get a surf bronze certificate. How could you go about doing this?

Section 5 Dangerous creatures

The ocean ecosystem includes all levels of creatures from scavengers to predators.

More accidents are caused by cuts and scratches from barnacles and oysters than other marine creatures.

However there are two main categories of dangerous marine creatures that can affect snorkellers - the retaliators and the aggressors.

Retaliators are a large group including stingrays, seajellies, stone fish, sea-snakes, cone shells and the blue ringed octopus. They tend to only attack when provoked or disturbed.

Aggressors will attack humans to defend their territory or if they consider us as part of their diet, which is usually by accident. Fortunately there are very few creatures in this group which includes saltwater crocodiles and a few species of sharks.

Sharks

Sharks are at the top of the ocean food chain and swim everywhere in the sea. Out of approximately 350 species of shark only a few have been associated with fatal attacks on humans. These include the great white, tiger, bull, whalers, reef, mako and hammerhead.

Fear

There is an old rule in snorkelling that the only shark you should be afraid of is the one you don't see. Most shark attacks occur by accident with the shark mistaking the victim for food. The chances of being attacked while snorkelling are very slim, but remember that when you go snorkelling you are entering the shark's habitat and they should be treated with a great deal of respect.

Great white sharks

These large, efficient predators are responsible for most of the fatal shark attacks on humans throughout the world. They are also called white pointers due to their cone-shaped heads and pointed snouts.

Like most sharks, they have excellent eyesight and can see much better in water than humans. They spend considerable time circling and studying prey before attacking.

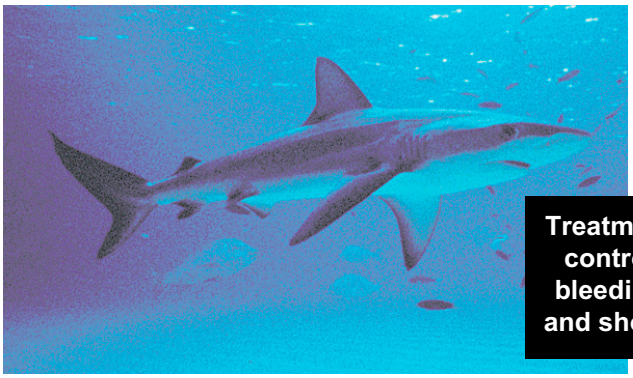
The great white is the only shark that can hold its head vertically out of the water. This enables them to observe prey on the surface or on shore, such as seals on rocks.

What do you do if a shark attacks?

Although the risk of shark attack is very remote, you may reduce the risk even further by following this advice.

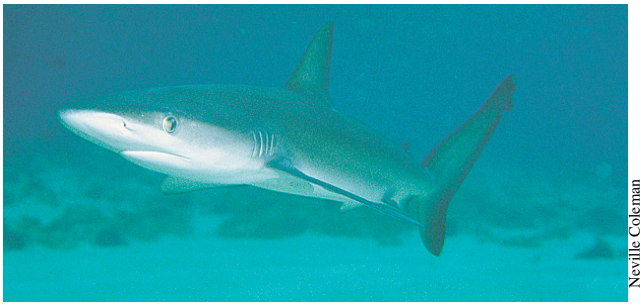
Try to remain calm and raise the alarm. If you see the shark before it attacks, be aggressive and attempt to beat it off.

Many sharks, even large great whites, have been discouraged and driven off by people beating fists in the water or on their snouts.



Treatment control bleeding and shock

Figure 54.1 Reef shark in aggressive mood – pectoral fins down



Neville Coleman

Figure 54.2 Reef shark in non aggressive mood – pectoral fins up

Treatment of shock

The INITIAL signs and symptoms of shock include:

- Pale appearance
- Cold clammy skin
- Altered breathing - rapid and shallow
- Rapid, weak pulse
- Faintness
- Nausea/vomiting
- Shaking and trembling

The signs and symptoms of SEVERE shock include:

- Deterioration of the level of consciousness
- Thirst
- Blue lips and fingertips (cyanosis)

Carry out DRSABCD and control SEVERE bleeding.

Treatment

Monitor the casualty's breathing and pulse regularly. If the casualty becomes unconscious, place them in the lateral position.

Reassure the casualty

Raise the casualty's legs above the level of the heart (unless they are fractured)

Apply splints for fractures

Dress wounds or burns

Keep the casualty warm

Give NOTHING by mouth. You can moisten the lips but DO NOT give any food or drink to the casualty.

Figure 54.3 Shock treatment

Control of bleeding

Acknowledgement is made of the Royal Life Saving Society Swimming and Life-saving 2004 Manual. (Figure 55.1) and the Queensland Department of Health's Web Site (Figure 55.2) which were used as a source of information for this section.

Nothing can replace a first aid certificate and the notes given here are designed to highlight first aid you may need while on a snorkelling adventure and it is recommended you do a first aid course from a accredited provider such as the Australian Red Cross, TAFE, St. John Ambulance or Royal Life Saving.

If blood is lost from the body, the supply of oxygen to cells is reduced resulting in shock and finally death. Cuts are common in snorkelling from coral or sharp rocks. Severe cuts can result from bites from dangerous animals or knives.

www.royallifesaving.com.au

Figure 55.1 Royal Life Saving Society Swimming and Life-saving Manual

Action

First aid requires the wearing of gloves or avoid contact with blood.

Severe bleeding

The best way to stop bleeding is;

- To apply pressure - use a towel or anything to stop bleeding.
- Elevate the bleeding area.
- Rest the patient - treat for shock if necessary.

Bleeding from the 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. Do not plug the ear.

Bleeding from the nose

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

Action

- Ask the patient to sit up, lean slightly forwards and pinch the nostrils for 10 minutes while breathing through the mouth.
- Advise the patient not to sniff or blow the nose.
- If bleeding persists seek medical advice.

Bleeding from lacerations

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

Action

- Control the bleeding by pressure, elevation and rest.
- Clear the area of skin around the laceration and apply a sterile dressing.
- Those with broken skin should check their tetanus injection records.
- Large cuts may require stitching
- Superficial foreign matter should be removed, but anything deep should be left to a doctor

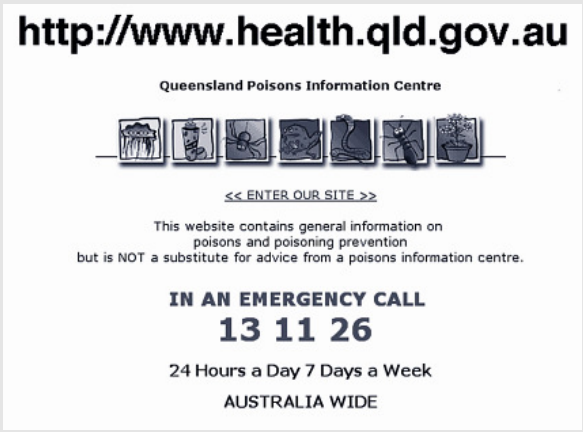
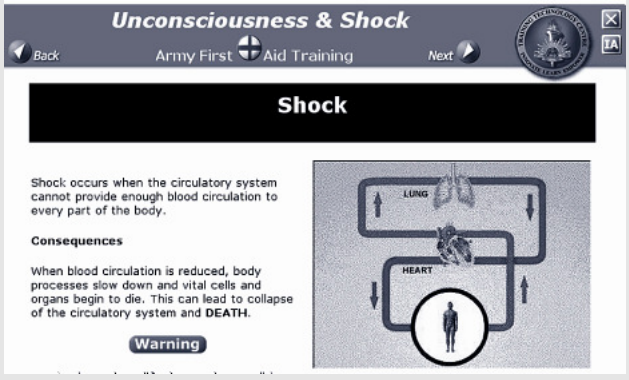


Figure 55.2 Queensland Department of Health's Web Site



www.defence.gov.au/army/1stAid/shock.htm

Figure 55.3 A good video on treatment of shock can be found on the Australian Army's defence force page

Figure 55.1 Control of bleeding

Figure 56.1 Initial treatment for burns is cold running water

Burns

A burn is damage caused to the skin or tissues from excess heat, friction, chemicals, electricity or radiation.

Snorkelling burns can occur from the sun, pool chlorine, camp fires, cooking utensils or motors. They can result in destruction in layers of the skin, blood vessels and cause severe pain, blistering, infection and shock.

Hypothermia

Hypothermia is caused when the body temperature drops to the point it cannot recover.

Symptoms of hypothermia include:

- Intense shivering
- Numbness
- Apathy and decreasing levels of consciousness

The best way to avoid hypothermia is to wear a wet suit.

Treatment for hypothermia

- If possible, remove the patient from the elements and into dry shelter.
- Remove any wet clothing and replace with warm, dry clothing or blankets.
- \Warm the patient gradually to avoid the onset of dangerous heart rhythms.
- . If the patient is able, encourage them to drink warm liquids.
- . Monitor the patient and seek medical help.

Treatment for burns

The best way to relieve pain is cool the burned area with cold running water. Do not break blisters or apply lotions, ointments or creams.

Action

- DRSABCD
- Cool the burned area under cold running water.
- Cover the burn with a sterile non stick dressing.
- Transport the patient to a doctor or hospital.

Scalds

These could be caused from cooking spills on snorkelling trips.

Action

- Cool the burned area with cold water for 10 minutes.
- If no water is available, remove thick clothing unless stuck to the skin.

Flames

Action

- Smother the flames with a blanket or piece of clothing.
- Lie the patient on the ground.
- Douse the burned area with cold water for several minutes.
- Remove clothing not sticking to the skin and cover the burned area with a nonstick dressing.

Electric burns

Action

- Switch off the power.
- Commence CPR if necessary.
- Douse the burned area with cold water for several minutes.

Chemical burns

Action

- Flood the burnt area with water for 10 - 15 minutes.
- Remove contaminated clothing and footwear making sure you are not contaminated yourself.
- Try to identify the chemical.
- If the burn is to the eye, flush the eye for 20 minutes and cover both eyes.
- Seek urgent medical advice.

Envenomations

Envenomation is the embedding of poison in the blood system from a marine animal. Common causes are standing on an animal, eg stonefish or stingray; making contact with an animal, eg fireweed or sea jelly; being bitten, eg snake bite or being stung eg jellyfish.

Blue-ringed octopus

These small, beautiful creatures as shown in Figure 57.1, are highly venomous and have been responsible for many human deaths throughout the world. They are usually found in shallow rock pools at low tides, or in reef pools and areas with high concentrations of shellfish, such as mussels.

When they bite, they release highly toxic venom through a parrot-like beak in the centre of their eight tentacles.

Victims often do not realise they have been bitten because anaesthetic saliva is released with the venom. This often proves fatal because the venom affects the nervous system with paralysis occurring within 30 minutes. When these octopuses are disturbed, brilliant, almost fluorescent, blue rings appear on their arms and bodies, giving plenty of warning to potential predators.

Cone shells

Treatment
URGENT medical Assistance
Pressure immobilization

Cone shells live in reef pools that can be exposed at low tide. They carry a highly developed venom apparatus, consisting of a rapid-acting poison that is injected by means of a dartlike, barbed tooth.

The venom causes a mild sting (puncture wound) that initially is characterized by bee-sting-like pain or, rarely, numbness and blanching. This is rapidly followed by numbness and tingling at the wound site, around the mouth and lips, and then all over the body. If the envenomation is severe, the victim is afflicted with muscle paralysis, blurred vision, and breathing failure. A sting can be fatal.

Stonefish

The stonefish is not known for its attractive appearance. It is, in fact, very hard to see at all, because its camouflage blends in perfectly with its surroundings, as shown in Figure 57.2. Stonefish, found on reefs in tropical and subtropical waters, contain a deadly venom which can kill humans. This venom is contained at the base of 13 sharp dorsal spines. The spines are contained in sheaths which remain folded and hidden if undisturbed. They become erect upon the slightest contact and will immediately puncture the unfortunate victim, releasing the deadly venom. To avoid stonefish, be very observant when diving on reefs.

Treatment for blue-ringed octopus and cone shells

For suspected blue-ringed octopus and cone shell bites, call 000 for an ambulance and have the patient taken immediately to the emergency department of the nearest hospital. While you are waiting:

- Use a wide bandage, pantihose or other suitable material and apply bandage over the area.
- Bandage from the toes/fingers back up over the envenomated area and over the joint.
- Immobilise the limb by using a splint or a sling. Use another bandage to secure the splint.
- Do not wash the area - any residue venom may be used for identification purposes.
- Commence CPR if necessary.

Treatment
Pressure immobilization, Dial 000

Figure 57.1 Blue-ringed octopus

Treatment for stonefish

- For suspected stonefish envenomations call 000 for an ambulance and have the patient taken immediately to the emergency department of the nearest hospital. While you are waiting,
- The use of hot water at about *45^{o}C* has been recommended to ease the pain.
  - *A simple test is to ask the patient to place the uninjured limb in the hottest water they can tolerate.*
  - *You can get hot water from the exhaust of an outboard engine.*

Treatment
Hot water* SEEK URGENT medical Assistance

Figure 57.2 Stonefish - another very dangerous sea creature

Bluebottle

Bluebottles, also called the Portuguese Man o'War, are found in all oceans except the colder regions near the poles. Although more widespread, they are not as deadly as the box jelly.

The bluebottle, as shown in Figure 58.1, gets its name from the colour and shape of its body which looks like a blue, sail-shaped balloon up to 25 cm long. The trailing tentacles are up to 10 m long (over 30 feet), which makes them hard to avoid especially in strong currents or large waves. Although not fatal in most cases, the sting causes severe pain and welts on the skin. Treatment varies according to location. For full details or contact your local ambulance service.

Figure 58.1 Blue Bottle

Box jelly antivenom is available

Box jelly

Box jelly (Figure 58.2A), also known as sea wasps, are the deadliest stinging jelly in the world and have killed many swimmers, particularly children, off northern Australian beaches. They have large, transparent, bell-shaped bodies up to 30 cm across, each with a large, trailing clump of tentacles up to 4 m long, containing millions of nematocysts (stinging cells).

Preferring warmer waters, they are found only in the tropical waters of Australia's far northern beaches between December and March. Beaches from Cairns around to Broome are closed for swimming during this period. Victims, especially children, usually die within minutes of being stung after suffering intense pain followed by paralysis.

Treatment is by calling 000 immediately and requesting an ambulance. Then reassure the patient, restrain anyone from rubbing the sting (especially with sand), apply liberal quantities of vinegar from a minimum of 30 seconds, use a dry cold compress to relieve the pain and begin rescue breathing and chest compressions if required.

Figure 58.2A Box Jelly (Sea wasp)

Treatment
Vinegar
Remove tentacles
URGENT medical Assistance

Irukandji

These are small members of the box jellyfish family with a bell size of about 2 cm (Figure 58.2B) found in coastal waters in Northern Australia. This means they can pass through stinger nets. Although the sting is very minor the pain which develops later (5-60 minutes) and can be incredible. Treatment is to CALL 000 for an ambulance, reassure the patient, restrain anyone from rubbing the stung area and gently apply a vinegar soaked pad to the stung area for a minimum of 30 seconds.

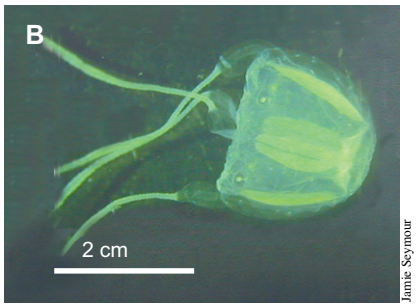


Figure 58.2B Irukandji

Treatment
CALL 000
Seek URGENT medical Assistance

Scorpion fish

Scorpion fish (Figure 58.3) often found free swimming close to reef bommies and are boldly coloured in red, white and black. This colouring however fades in low-light conditions such as dusk and then the stripes serve as disruptive camouflage. With their long fin spines they resemble feather stars which helps them to masquerade, when selecting a ambush site. When they approach their prey, they spread their fins to the side and slightly forward. The fins act as a barrier to cut off the escape of the prey

Figure 58.3 Scorpion fish

Treatment
Hot water
URGENT medical Assistance

Stinging hydroid

Stinging hydroid (Figure 58.4) this can cause painful stings to the skin. The best way to avoid this is learn to identify it and look but don't touch.

Figure 58.4 Stinging hydroid (Fireweed)

Treatment
Cold water

Treatment of stings

The following information has been provided by the Surflifesaving Association of Australia and is current at time of printing. However things change and it is advisable to check each year for the latest advice.

Further information

Surf Life Saving Australia

(02) 9300 4000 slsa.com.au

Surf Life Saving NSW (02) 9984 7188

surflifesaving.com.au

Surf Life Saving QLD (07) 3846 8000 lifesaving.com.au

Life Saving Victoria

(03) 9676 6900 lifesavingvictoria.com.au

Surf Life Saving SA

(08) 8354 6900 surfrescue.com.au

Changes to procedures

Things change as new research comes available.

Keep up to date by reviewing your first aid training at either St. John Ambulance Association, Red Cross, Surf Life Saving Association, The Royal Lifesaving Council, your local ambulance service or any accredited rescue service provider.

Surf Life Saving WA

(08) 9243 9444 mybeach.com.au

Surf Life Saving TAS

(03) 6223 5555 slst.asn.au

Surf Life Saving NT (08) 8985 6588 lifesavingnt.com.au

Or contact your local surf life saving club or ambulance

NEVER RUB SAND INTO A STING

Marine Stingers

Australia's waters contain many sea creatures, including marine stingers. Although they are generally quite easy to avoid, stingers can cause discomfort if you are stung and some tropical species (the Irukandji and the Box Jellyfish, for example) can be lethal.

So, to ensure you enjoy your day at the beach, always remember to swim at a patrolled beach and look out for the safety signs.

Treatment

If you are stung, or are with someone else who has been stung, the treatment will vary depending on where you are, and what type of stinger is involved.

*In tropical waters**

*Generally north of Bundaberg in Queensland and Geraldton in Western Australia.

Jellyfish capable of causing life-threatening stings primarily occur along the tropical coastline of Australia from Bundaberg in Queensland northwards, across the northern coastline and down to Geraldton in Western Australia.

- In areas where dangerous tropical jellyfish are prevalent, (eg Box Jellyfish or Irukandji), if the species causing the sting cannot be clearly identified, it is safer, to treat the victim with vinegar.
- It is recommended that a full-body lycra suit, or equivalent, be worn to provide a good measure of protection against marine stings, particularly during the stinger season, which generally runs from November to March.

For tropical jellyfish stings:

- Remove the patient from the water and restrain if necessary.
- Call for help (dial 000 or get a surf lifesaver or lifeguard to help you).
- Assess the patient and commence CPR as necessary.
- Liberally douse the stung area with vinegar to neutralise invisible stinging cells.
  - do not wash with fresh water.
- If vinegar is unavailable, pick off any remnants of the tentacles (this is not harmful to the rescuer) and rinse sting well with seawater (not freshwater).
- Seek medical assistance with rapid transport to hospital.

*In non-tropical waters**

*Generally south of both Bundaberg in Queensland and Geraldton in Western Australia.

- Keep the victim at rest and under constant observation.
- Do not allow rubbing of the sting area.
- Pick off any remaining tentacles with fingers (a harmless prickling may be felt).
- Rinse the stung area well with seawater to remove any invisible stinging cells.

The next steps are dependent on what type of stinger is involved.

For non-tropical Bluebottle stings

- Place the victim's stung area in hot water (no hotter than the rescuer can comfortably tolerate).
- If the pain is unrelieved by the heat, or if hot\ water is not available, apply cold packs or wrapped ice.

For other non-tropical minor jellyfish stings

- Do not wash the sting with fresh water
- Apply cold packs or wrapped ice for pain.
- If local pain is unrelieved by these treatments, or generalised pain develops, or the sting area is large (half of a limb or more), or if the patient appears to be suffering an allergic reaction to the sting, seek urgent medical help (dial 000 or get a surf lifesaver or lifeguard).

Figure 59.1 Treatment of marine stings (Information based on www.sla.com.au)

Treatment for cuts

1. Wash the cut thoroughly and inspect if any foreign materials are still in the wound.

   A painful but practical way to remove small pieces of coral or grit is with a toothbrush.

2. Apply a drying antiseptic such as betadine and cover the wound with a sterile dressing. Check for allergic reactions by dropping a small amount on a normal piece of skin first.

Treatment for spines

1. Apart from using a needle, one methods is to use a sterile razor blade and shave the skin down until the top of the spine is visible.

   Then try to get the razor into the spine and flick out.

2. For deep spines it would be best to see a doctor and have then surgically removed under anaesthetic.

Stingrays

People have been stung after accidentally treading on, or swimming too close to rays as they lie hidden in the sand on the seabed. Figure 60.1 shows a common stingray.

When such a threat occurs, stingrays respond with a rapid vertical thrust of their tails or slicing motion which drives the barbs deep into the victim's skin and releases toxic venom. It's best to shuffle your feet as you enter the water and they will move on.

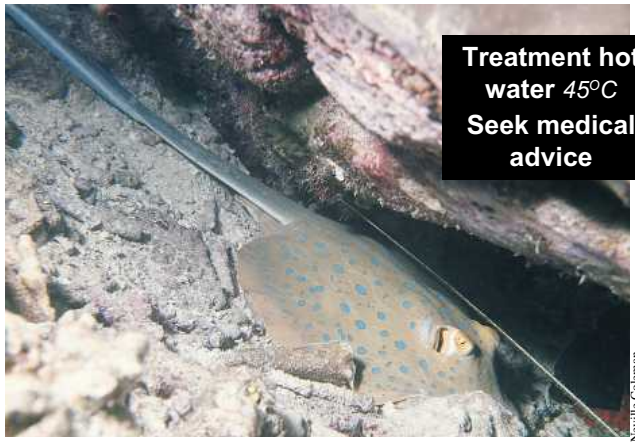


Figure 60.1 Common stingray

Sea urchins

Sea urchins or sea eggs as shown in Figure 60.2, have many long spines that can penetrate a snorkeller's foot. Most injuries occur when snorkelling rocky headlands, as the sea urchin likes to live in rock crevices just under the water. The best way to avoid sea urchin spikes, is to wear booties. The spikes are very painful and are hard to remove so medical assistance is usually required to remove them.

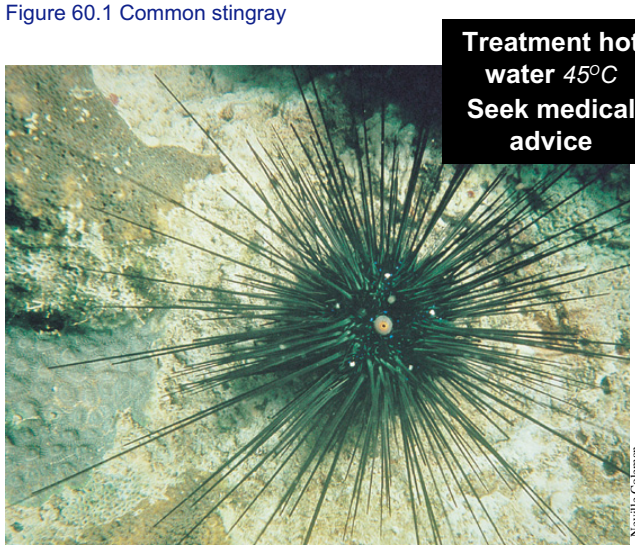


Figure 60.2 Sea Urchin

Bristle worms

These live in crevices and under rocks. The first aid for itching caused by the bristles of a bristle worm is to remove then by applying adhesive tape over the affected area. As the adhesive tape is peeled off, the bristles pill out of the tissues. Apply an anaesthetic ointment to the affected area and seek medical advice of pain persists.

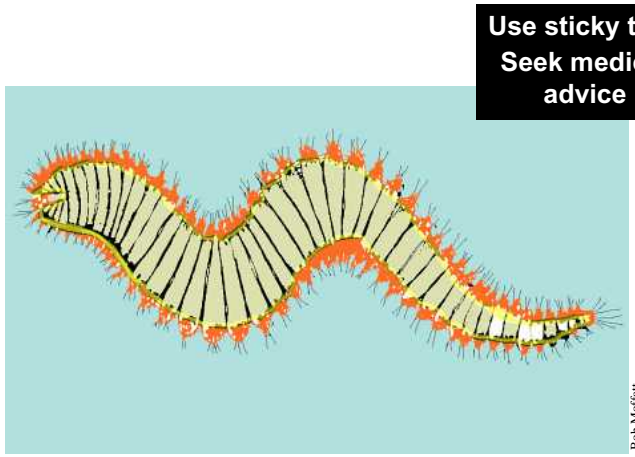


Figure 60.3 Bristle worm

Fish poisoning

Some fish such as red bass can be poisonous if you eat them. Toadfish are also extremely toxic and have caused deaths in Australia. In tropical Australia some fish carry a toxin called ciguateria. Symptoms include tingling in the toes and fingers, reverse hot and cold sensations, nausea and aching muscles.

In all cases of fish poisoning seek medical advice immediately and initiate DRSABCD.

Drowning

Water in the lungs is not the main reason for drowning as it is caused by suffocation where not enough oxygen reaches the tissues.

However a patient who has been revived from drowning should be observed for up to 72 hours to avoid secondary drowning caused by water in the lungs blocking the small lung air sacs called alveoli.

WORKSHEET 20 DANGEROUS CREATURE ID

Identify the following marine creatures, suggest where they may live and assess risk while open water snorkelling. (See Page 65, Fig 65.1)

RISK:

RISK

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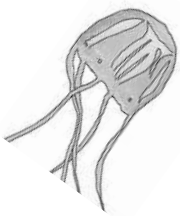

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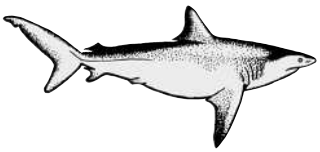

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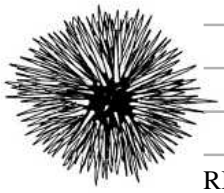


RISK

RISK

WORKSHEET 21 SNORKELLING FIRST AID

Q1. List the steps necessary to control shock (Page 54).

Q2. List the steps you would take to control bleeding from a 40 mm cut to the leg from a propeller (Page 55).

Q3. Explain how to recognise if a patient was suffering from hypothermia and describe what you would do (Page 56).

Q4. List the treatment for stonefish, blue-ringed octopus and cone shells (Page 57).

Q5. List the steps you should take if stung by a blue bottle in Sydney. Explain how this is different from Cairns (Page 59).

Q6. Explain how would you recognise a patient who was stung by a box jelly and describe what would you should do (Page 58).

Q7. Describe the treatment for Irukandji syndrome (Page 58).

Q8. Describe the treatment if you were pricked by a spine of a scorpion (lion) fish (Page 58).

Q9. Explain the difference between the treatment of a cut and a spine (Page 60).

Section 6 Risks, Weather and Safety

If you are going to undertake scientific research using snorkelling, you need to understand the hazards, risks involved and methods used to control these risks.

Hazards, risks and control measures

Hazards

A hazard is something with the potential to cause harm. In this section, some snorkelling hazards discussed are:

- weather, surface conditions and waves
- sun, wind, rain, turbidity, temperature
- rips and currents
- hazardous marine creatures
- entry and exit points, water depth
- other vessels and snorkellers
- physical exertion

Risks

Risk is the likelihood that harm will occur from exposure to the hazard. Figure 63,1 shows a table that is commonly used to determine the risk as either low, medium, high or very high, (note that some tables add extreme).

Look at Figure 63.2. Compare the risks of you being run over by the boat while standing on the bank compared to swimming in the water.

Control measures

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

They employ a six step process that employs elimination, substitution, isolation, using engineering, using administrative and finally using personal protective equipment to reduce the risk of an accident.

The list is usually hierarchical, with elimination the most preferred, and issuing personal protection equipment - least preferred. Modern control measures usually contain a combination at least two, with administrative instructions almost always included.

For example, a snorkelling platform is a hazard and the following sequence of control measures could be followed:

1. **Eliminate** the hazard. *Eg, remove the platform and use rubber duckie with no metal parts.*
2. **Substitute** the hazard with a lesser risk. *Eg, use a ladder.*
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. issue instructions - all snorkellers helped into the water by a crew member.*
6. **Use personal protective equipment** - *Eg issue gloves, booties, wet suits to protect body.*

LIKELIHOOD	CONSEQUENCES				
	Insignificant	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Very High	Very High
Likely	Medium	Medium	High	High	Very High
Possible	Low	Medium	High	High	Very High
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Medium	Medium	Medium

Figure 63.1 Risk assessment table

Wet Paper

Figure 63.2 Boats can be a hazard

Wet Paper

Figure 63.3 Reef entry and surrounding waters contain many hazards

Wet Paper

Figure 63.4 The snorkelling platform can be a hazard

Weather, surface conditions and waves

Good weather, no wind, lack of rain for a period of time and sunny days make for ideal safe snorkelling conditions.

Water surface should be calm with minimal or no 'sea' (the 'chop' of the water), and swell (unbroken waves) should be less than 0.5 metre. Waves can cause a mist resulting in salt water aspiration which can affect people who suffer from asthma.

Control measure suggestions

- Eliminate - Interpret the weather map and cancel the day if the weather looks bad.
- Engineer - Know your snorkelling site and plan for the weather. Use additional equipment such as mermaid lines, rescue boards or you could tag the snorkel with a coloured tape to help the snorkel observer.
- Isolate those with the potential to be affected by unfavourable surface conditions (eg Asthma suffers) and supervise more closely.
- Carry oxygen to administer if required.

Sun, wind and rain

The danger period for UV is between 10.00 am and 3.00 pm. Damage can occur before and after these hours, but it takes longer to occur. Reflected UV from the sea surface, light-coloured and shiny surfaces can reach a person under a hat and in the shade. Wind can affect wave height (see over) and rain can make surfaces slippery.

Control measure suggestions

- The best treatment is to avoid sunburn in the first place by wearing long-sleeve rash shirts, a hood or wet suits, a hat, sunglasses and sunscreen.
- For wind and rain wear protective clothing and establish places where you can gain a good grip.

Visibility *(Turbidity)*

Underwater visibility should be at least 3 metres. Poor visibility can prevent you from seeing dangerous creatures, submerged objects or underwater obstructions.

Control measure suggestions

- Isolate by cancelling diving or just snorkel down the boat anchor chain.

Temperature (^{0}C)

The colder the water, the thicker the wet suit required. Apart from being miserable, reduced body temperature can cause cramps and hypothermia.

Control measure suggestions

- Use personal protection by selecting correct mm wetsuits.
- Use instructions by setting a "in water" time.

Currents (strength and direction)

Currents can be permanent or can form with the tide, especially during the middle phases of the tide. They can carry a snorkelling party towards other dangers so check the tide times and heights.

Control measure suggestions

- Check tides, seek local advice, use mermaid lines, rescue board or boat.

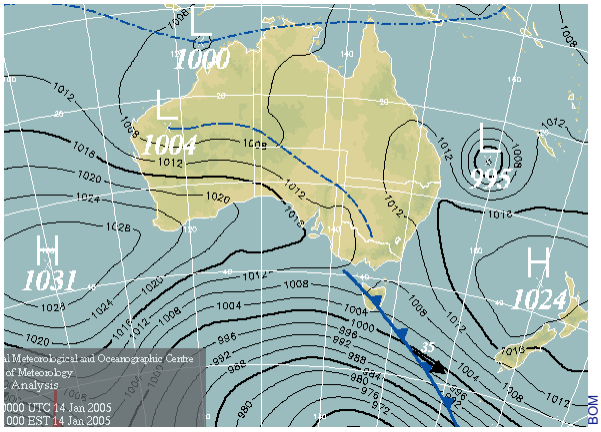


Figure 64.1 Check the weather map as it affects hazards

Figure 64.2 Waves can be a hazard for people who suffer from asthma

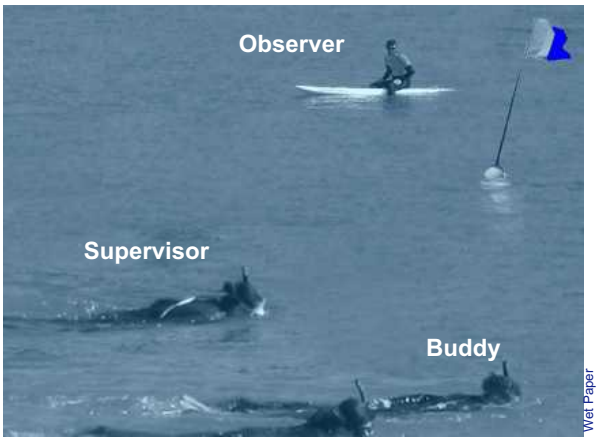


Figure 64.3 Use coloured tags to indicate type of snorkeller

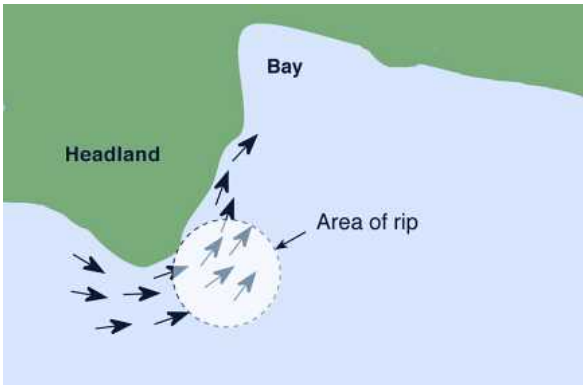


Figure 64.4 Rips can wash a whole snorkelling party away
Wet Paper

Hazardous marine creatures

More accidents are cause by cuts and scratches from barnacles and oysters than other marine creatures, however many other mare creatures pose serious hazards.

Control measure suggestions

- Isolate by not touching marine creatures.
- Use protective booties and gloves or by wearing a stinger suit in the tropics in summer.

Figure 65.1 Oysters on a boat ramp can cause severe cuts

Entry and exit points

A safe water entry and exit should be chosen where there is minimal water movement and suitable access back to the point of water entry.

Control measure suggestions

- Substitute obvious dangerous locations, such as boat traffic, people fishing, water skiers, dangerous marine animals and any other potential hazards with a quite area, well protected with a good base to jump off and return.
- Don't climb down ladders with fins on. Adjust your face mask and snorkel in position and put your fins on in the water or jump into the water with your fins on.

  Never dive head first into the water while wearing a mask.

  When you get into a boat, take your fins off in the water and carefully put them into the boat before climbing in.
- High tide is a good time for a beach entry as you don't have to walk out to the entry point over coral or rocks.

  The exit is also good as you will fin back in and can just roll onto the beach where you can take your fins off.
- However if you use booties and strap on fins, this problem is reduced.

Figure 65.2 Establish rules for using ladders while snorkelling

Water depth (m)

The deeper the water the more experienced you need to be. Pressure can affect ears and sinuses so you should be aware of the physiological hazards that can occur at depths.

Control measure suggestions

- Isolate those who can dive safely from those who may want to stay at the surface.
- Divers to snorkel as buddies. having established the "*one up and one down*" rule.
- Tag snorkels of divers with colour tape can help an observer keep and eye on you.
- Issue instructions warning of the dangers of hyperventilation and isolate those who will be diving.

Figure 65.3 Establish the one up one down buddy rule

Vessels and other water craft

These include boats and other sea craft, so continually assess threat of vehicles/vessels and make sure the dive flag is always visible to all craft in the area.

Control measure suggestions

- A divers flag must be clearly displayed in the snorkelling area. (Hint: Carry a small piece of wire to make sure it unfurls fully to ensure maximum visibility).
- Station lookouts.
- Fit prop guards to motors.

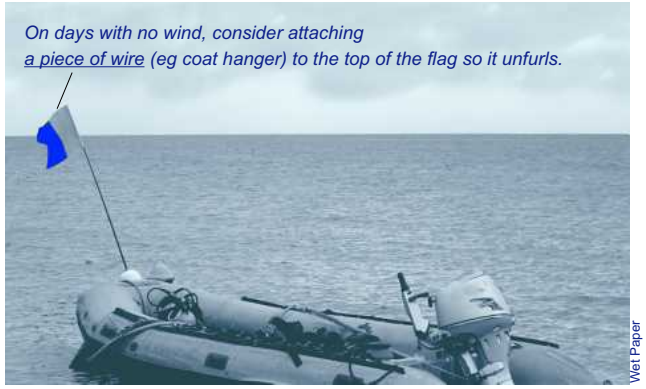


Figure 65.4 Always use a dive flag and consider a rescue boat

Physical exertion or injury

This can include strains and sprains, cramps, exhaustion and fatigue and shallow water blackout.

Control measure suggestions

- Ensuring that appropriate warm-up and warm-down exercises are implemented, continuously monitor for signs of fatigue and exhaustion not hyperventilating.
- Cover all open wounds and treat coral cuts immediately.
- Even though you may have filled out the medical forms and had the necessary checks if you are sick on the day, eg have blocked sinuses, let your snorkel supervisor know.

  You probably still can go snorkelling, but you may not go too far, too long and be prevented from diving as you will end with sever headaches.
- Proper drying of the ear canal is important. Commercial products such as "Aquaear" should be used by those who suffer outer ear problems as a preventative measure.
  - Deafness, vertigo and especially "ringing in the ear" are all symptoms of inner ear damage.

    If any of these occur seek urgent medical advice as permanent damage can occur.
- Know the diving emergency number. For immediate help - call 1800 088 200 and they will connect you to a diver emergency doctor.
- Carry personal medications for alleges. If you require any special medications or have any specific allergies, you need to take these with you. For example, a students personal EpiPen as shown in Figure 66.2.
- Always sign the snorkel roster sheet (Figure 66.4). Note that sometimes you may have to sign out and back if you are on a shallow water reef snorkel transect.
- Make sure you know the emergency plans. There will be clear signals or sounds to alert you in case of an emergency.

  Make sure you know these and respond immediately while keeping calm and organised mentally.
- Always snorkel with a buddy. Learn rescues and observe drills.

  The figures on the next page show a variety of simple rescues you can use if your buddy gets into trouble.

  Surfboards can also be used for rescues and if you use a tinny, students can climb on board using the anti-ventilation plate of the motor, provided the motor is off and the boat has been stabilized.
- A safety boat or line attached to the shore with a float at one end can be useful in drift snorkels.

Cramps

- Having your buddy pushing you fin back is by far the easiest if you have a leg cramp.
  - You can stretch out the muscle to relieve the pain. But get out of the water as soon as you can so you can stretch the muscle further.
- Towing and pulling as shown in the photographs on the next page are also very useful.

Wet Paper

Figure 66.1 Warm up exercises

Figure 66.2 Student's personal medications and epipen
Wet Paper


Wet Paper

Figure 66.3 Always have a buddy


Wet Paper

Figure 66.4 Always sign in and sign out

Drills and rescue methods

Drills are essential in emergencies and you should practice these before you go open water snorkelling.

Towing

Towing

Rescue

Pushing

Pulling

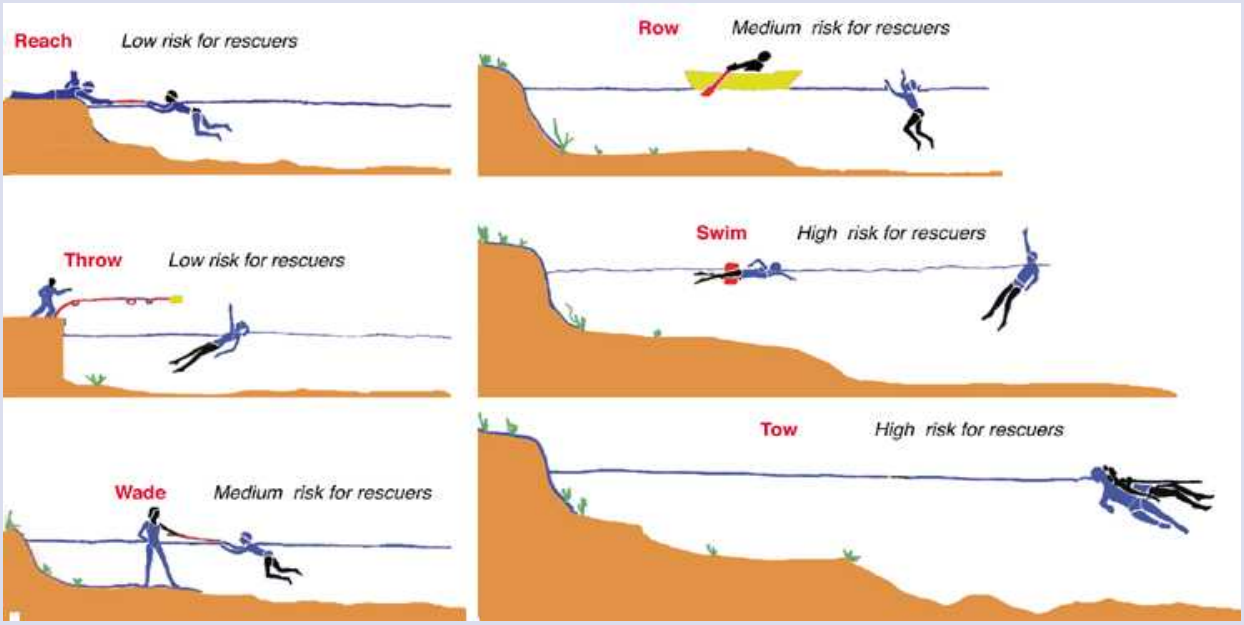


Figure 67.1 Some rescue techniques

Wet Paper (Thanks to teachers from MTAQ and AUSI Steve Sinclair)

Equipment care and maintenance

Critical equipment that needs to be checked daily for good operation includes:

- The dive flag - make sure it can be seen. On a calm day, attach a wire to the top of the flag so people can see it.
- Check batteries in communication equipment. Do a radio check.
- First aid kit including access to hot water and vinegar.
- Rescue equipment - if a boat is used, the school will have a safety management system. If you are studying boating, the Wet Paper powerboating workbook outlines a complete set of procedures.
- Flotation devices and mermaid lines.
- Oxygen bottle and means of transport. Make sure serviced according to manufacturers specification. Check this site for the most up to date details on compliance.

  www.deir.qld.gov.au/workplace

Emergency planning

A snorkel emergency during a school snorkelling activity could include:

- Rescues, eg group carried away by rip, your buddy does not surface.
- Missing persons, eg, missing signature from snorkel roster.
- Marine stings, bites, cuts and envenomation
- Evacuation - presence of dangerous animal, eg, a shark.

Define the area and make a map

The area of the activity should be well defined.

- Identify tidal influences, currents, poor visibility, large amounts of underwater vegetation, known dangerous marine life.
- Mark the area out for the best possible entry! Avoid rocks with sharp barnacles and areas where waves crash on rocks or reefs.

Establish the roles of supervisors

- At school or on a organised snorkelling tour, you will be under the control of a supervisor who uses a lookout over the group.
- Check the following website for the roles and responsibilities.

  www.deir.qld.gov.au/workplace

Establish communications

Some form of contact should be established between the base and the snorkelling party in case an emergency plan had to be put in place. A whistle and a flag are two common pieces of equipment used for this purpose.

Boats usually carry marine radios, but if snorkelling from the shore, the nearest telephone or car should be well known.

A hand held VHF marine radio like the one shown in Figure 68.3 , is a very good way to ensure communications.

Site risk assessment includes

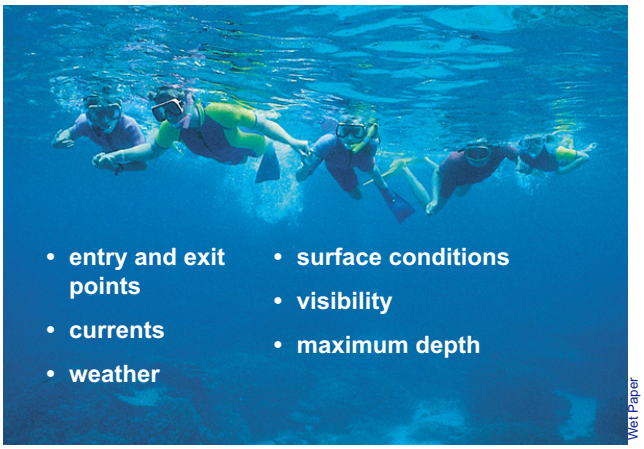


Figure 68.1 Six elements of risk assessment

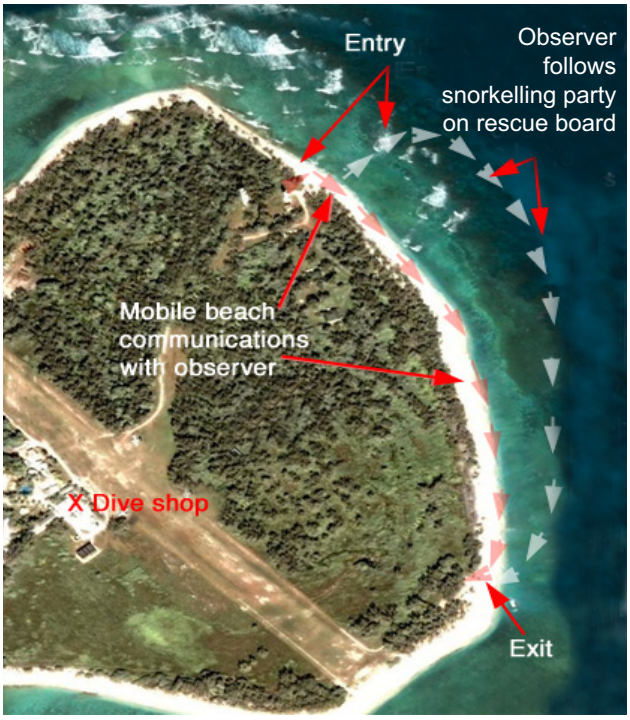


Figure 68.2 Make sure you know where all emergency points are located. These are marked with an X.

Figure 68.3 Establish communications and signals

Locate emergency equipment

First aid equipment and treatment needs to be available at entry/exit point for treatment of marine stings, bites and cuts.

An oxygen system capable of providing a spontaneous breathing person with an inspired oxygen concentration of as near to 100%. This can be on the beach or in the snorkel boat. Although qualifications are required to use this equipment, it is useful to know where it is located so you can pass on the information. Make sure the location is known by the entire snorkelling party.

Establish confidence

- Everyone is different and everyone has fears. You may be grouped according to your ability. You may be asked to hold hands while snorkelling and you may have to wait up for less confident snorkellers.
- This is all in a days snorkelling, but above all have fun, take your time allowing for time to get used to your gear and then finally on observing marine life.

Do buddy and group briefings

Just before you enter the water do one final briefing. Then ask the buddies to repeat this. For example

- *OK we enter at the lighthouse, swim out to bommie and follow the current down on the inside of the bommie.*
- *One buddy up while the other is down (is that OK?).*
- *Then we snorkel back to the reef and follow it along till we see the beach shelter.*
- *Exit is at high tide on the beach so we would be able to swim right in.*

Evaluate the plan

For example, your buddy surfaces with panic from a serious sting causing your excruciating pain

The buddy

- Signals for HELP, reassures the patient, monitors vital signs.

Snorkel supervisor

- Sends snorkel guide for assistance.
- Alerts evacuation of the water by deploying an air horn, whistle and or raising a red flag.
- Alerts dive shop of incoming injury and possible emergency. UHF Channel 68.
- Prepares first aid kit and potential treatments hot water, vinegar.

Snorkel guide (DRSABCD)

- Assesses danger - struggling, panic.
- Response - swim patient to shore to meet first aid kit.
- Administers first aid, monitors vital signs.
- Commences CPR if necessary till help arrives.

The dive shop

- Deploys rescue craft with full medical kit.
- Alters airfield for possible evacuation.

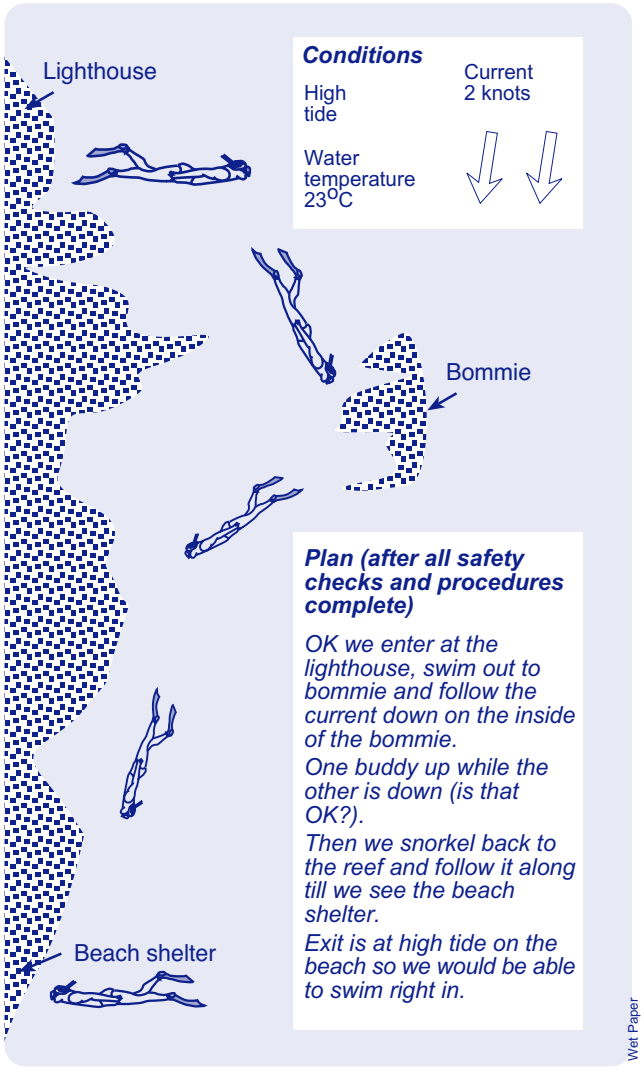


Figure 69.1 Always have a plan

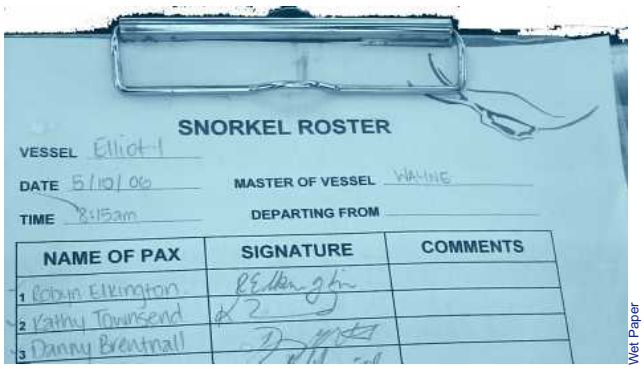


Figure 69.2 Establish who is missing

Case studies and further examples

The website

www.deir.qld.gov.au/workplace

has some excellent resources for the development of school emergency plans.

You can check out these if you search in this website for snorkelling code of practice.

WORKSHEET 22 REDUCING SNORKELLING RISKS

Describe how each of the following hazards could cause harm to a snorkeller on a school trip you are about to undertake. Then identify the type of control measure used justifying it with a short statement

Control measure

1. Eliminate the hazard
2. Substitute the hazard with a lesser risk
3. Isolate the hazard
4. Use engineering controls
5. Use administrative controls
6 Use personal protective equipment

Hazard	Control measure/s and justification
Weather	*Eg: Rough seas, high winds, cancel boat trip, snorkel in pools. Risk reduced, hazard eliminated*
Surface conditions	
Waves	
Sun	
Wind and rain	
Turbidity	
Temperature	
Rips and currents	
Hazardous creatures	
Entry and exit points	
Water depth	
Physical exertion	
Vessels	

WORKSHEET 23 SAFETY CONSIDERATIONS

Q1. Evaluate the risks of a-c occurring on a school trip and propose a simple emergency plan for consideration by your teacher.

Eg: cannot swim or have a fear of water or submerging

Isolate - put life jacket on, tag snorkel with red tape so observer can see, advise to swim close to observer

a. are physically challenged

b. suffer from any fears e.g. sharks, sea snakes, etc.

c. get seasick in small boats

Q2. Justify your decisions to use the following pieces of rescue equipment in a snorkelling program and comment on where you would use each item and in what sort of situation.

Eg: float. Students able to swim to, supervisor able to attach mermaid lines,

• lifebuoy

• pole with looped rope or inflated tube

• dive flag

• safety boat

• float rope

• mermaid line

• marking a snorkel with coloured tape

• VHF radio

• whistle

• snorkel manifest

Q3. Why is oxygen carried onboard a vessel taking people open water snorkelling and how is it serviced?

WORKSHEET 24 EMERGENCY PLANNING

Q1. Draw a map of the area you will be snorkelling and the location of emergency equipment and construct a buddy briefing for a high tide snorkel.

Q2. Design emergency plans for the following situations

Eg: Rescue for your buddy who has a cramp.

Assess danger eg it may be better just to signal for immediate help. Reassure patient. Adopt the pushing rescue position and swim patient to rescue boat or shore.

a. Missing persons - your buddy does not surface.

b. Marine stings, bites, cuts and envenomations - your buddy stung by something, their is not much pain.

c. Evacuation - you hear the emergency horn sound and your buddy has just dived down to take some photographs.

d. You get out of the water and notice your buddy has blood streaming down her ankle.

Q3. Your buddy surfaces with panic from a serious sting causing excruciating pain. Draw a flow chart of an emergency plan for this type of marine accident.

Flow chart

WORKSHEET 25 RESEARCH PROJECT RISK ASSESSMENT

During your research assignment or snorkelling activity, there will be specific hazards that create risks that need to be controlled. Use the table on page 63 to identify these and again justify your decisions based on what you have learnt so far.

Hazard	Risk level	Control measures *(include these with your report)*

SECTION 7 ACTION RESEARCH PROJECTS

See inside covers for colour photography.

What is action research?

The following is adapted from the QSA Marine Science Syllabus.

- Action research may be used when actively investigating issues and problems in the marine environment.
- It involves you using your knowledge to formulate a plan for an investigation. The plan may change and evolve over the course of the research project as you gain more and greater knowledge.
- Snorkelling is an excellent way to gain an appreciation of the difficulties of marine research. For example:

  In project 1, (see inside front cover) you could go snorkelling and follow a friendly fish.

  - You could observe and record general structure, noting size, position and movement of fins, colours, mouth parts. Then you could record methods of locomotion, catching or obtaining food, responses to changes waves, light, other fish, any special behaviours.

  In project 2, you have to snorkel over sandy patches in the lagoon close to the beach.

  - You then focus your vision about 2-3 metres in front of you and look directly down into the sand. Moving very slowly you keep your eyes open for a pale little fish with large eyes lying on the sand at the entrance to a hole. Once you have found the fish, you need to be very still and observe for at least five minutes. During this time a small transparent shrimp should appear. Record what happens.

  In project 3, you locate a cleaner wrasse by looking carefully for the fish in the photograph.

  - Using your underwater slate you record the behaviour of this fish and the fish it cleans. You could can take some underwater movies and then devise a method for recording movement.

  In project 4 you could become involved in stakeholder groups, eg Coral Watch.

  - Coral Watch project integrates global monitoring of coral bleaching with education about coral reef conservation and developed and validated the Coral Health Chart which monitors coral bleaching using a colour reference card.

    This chart standardises changes in coral colour, providing a simple way to quantify bleaching and monitor coral health. The Coral Health Chart is used by dive centres, scientists, school groups, and tourists.

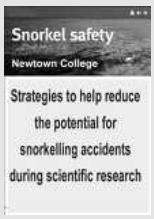
Marine research skills

So action research involves the use of marine research skills to gain an appreciation of or a perspective on the environment that will help the investigation where primary data is gathered through these research skills.

Design a snorkel safety booklet

Download the Qld Government Snorkel Safety guidelines to create a school snorkel safety booklet for your marine science class entitled

- Snorkel safety - strategies to help reduce the potential for snorkelling accidents while undergoing scientific research



Plan a snorkelling transect

Acknowledgement to staff at Sunshine Beach SHS

Identify and have approved a Marine Science based hypothesis suitable for testing in the field at Lady Elliot Island, Heron Island or other Reef Islands.

Establish the investigation by conducting a preliminary literature search to establish a research focus for the independent research (IR) and develop a hypothesis that relates to the research focus.

Develop an investigative process for the IR.

Once approved some equipment such as quadrat frames, measuring equipment may be borrowed for the field data to be collected. You must check that the school can provide the equipment as early as possible. A list of equipment being taken by the school to the island will be provided, any additional requests must be made well in advance.

- Conduct and manage the investigation to ensure efficient collection of data in a safe environment.
- Analyse and discuss data to identify patterns and trends. This extends to developing models to explain collected data in terms of the underlying concepts and ideas.
- Evaluation of investigative processes used and consider the validity of the hypothesis in relation to collected data.

Reef based

- Factors affecting distribution of Sea Cucumbers
- Factors affecting territory of crabs/sea snails etc
- Factors affecting nest spacing of various species of seabird
- Daily patterns of plankton concentrations
- Human impact on marine, vegetation or seabird life
- Impact of hypersaline water on beach and seashore fauna
- Relationship of sand grain size to species distributions
- Distribution of seaweed species.

Local area based

- Abiotic and biotic factors along a rocky shore.
- Chiton distribution versus substrate type.
- Population of specific organisms in relation zonation.

Research life on the reef

Q: How does life survive on the reef?

Collect primary data and propose a hypothesis involving the survival of life on the reef from a list of projects.

Look at the projects the colour photographs on the inside covers of this workbook. Read pages 394 – 407 of your textbook - *Marine Science for Australian Students* then select one individual from organisms photographed on the inside covers.

- Propose a hypothesis on how the individual survives from a detailed description of structural and behavioural adaptations.
- Support this with internet research of physiological adaptations, U tube video clips and any other recorded relationships.

  Note size and scale and by making a sketch, record colour patterns, locomotory body parts, size and shape of mouth parts.

  Devise a record sheet which is easy to use and record data in the field. Allow room for recording of factual data such as measurements and numbers for statistical analysis to support the hypothesis.

Project 5: Sponge spicules and body form

Use forceps to obtain a small piece of sponge*. (Note the number of the sponge from which you are sampling). Place the piece of sponge in a well on the well plate and cover with 2-3 drops of bleach solution. Allow the solution to dissolve the sponge (approx. 2 minutes). Using a pipette, place a drop or two of the dissolved sponge on a microscope slide and cover it with a cover slip. Examine the preparation using a microscope and draw the spicules you see in the space on your answer sheet. Propose a hypothesis relating to physiological adaptations.

Project 6: Parrot fish contribution to reef sediments

Compare high tide and low tide activities. High tide snorkel over the reef till you reach a school of parrot fish (usually on the reef crest). Remain still and listen carefully. If your underwater camera has sound, see if you can record the feeding. Observe the fish carefully and record its feeding patterns. Ask your buddy to make drawings notes. Record numbers and any differences that may give you a clue if they are different species.

At low tide walk over to the reef crest, don fins and snorkelling gear and find a school close to the reefs edge. Do the fish appear as active? Are they in schools and are they as active as at high tide? Propose a hypothesis of how these fish contribute to coral sand.

Project 7: Issues with reef habitat mapping.

Attempt to map an area of reef, listing species in a certain area. Compare this area with say the reef crest that is exposed at low tide. Use a range of abiotic data as the basis of the comparison. Suggest a variety of hypothesis for testing and list the problems you would have in controlling variables.

Project 8: Do relationships exist between species from different Phyla on a reef?

At high tide snorkel out to a coral microattol or clump, then focus your vision about 2-3 metres in front of you and look directly down into crevices. Moving very slowly you keep your eyes open for the clownfish shown in the photograph that darts back and forth. Once you have found the fish, you need to be very still and observe for at least five minutes. Record its behaviour and movement and then compare this with the movement in the film - Finding Nemo. Evaluate the accuracy of the film.

Project 9: Fish family biodiversity and the reef crest.

Use reference materials to become familiar with common fish families Eg: Scaridae parrot fish), Labridae (wrasses), Serranidae (Cods); Chaetodontidae (butterfly fish) and Pomacentridae (damsel fish and blue pullers).

Create a outline observation slate before you go snorkelling and then firstly identify the families and then devise a methods to record population densities.

Propose research methods for estimating population densities. You may wish to do a manta tow.

Project 10: Sea cucumber populations and distribution.

Warning: Avoid touching eyes after handling sea cucumbers as material from these animals may irritate the eyes. At sample points every 20 metres count the sea cucumbers around a 2 square metre. Work out the average number of square metre on the reef top. Use an air map (google) to work out the total area on the reef top. Suggest statistical methods for comparison and propose a future hypothesis based on your results.

Natural forces and the reef

Project 11: Sediment movement and tides.

In places where deposits of sand are forming, air, water and other living things influence the sediment to produce distinctive underwater features as shown in the photograph. As the tide goes out, walk along the beach and set up a transect line to draw a profile of the sand structures. Make notes of wave direction. Use google earth to analyse a map of the entire reef and use the primary data to predict how the shape of the sand patterns can change. Also propose how sand is made and predict if the shape of the coral cay could move on the reef. Propose a hypothesis based on ecological succession.

Human impacts on the reef

Project 12: Damaging effects of tourism.

Look at project image. In some places there are permanent moorings drilled into the reef to reduce damage of mooring tourist vessels. There may be also be rubbish and debris in your study site. Go to www.projectaware.org, download the worksheets and make a report of human impacts. Suggest further research methods on how to study marine debris and the actions stakeholder groups could undertake.

***Permits will be required**

Analyse snorkelling ecotourism

Q: How successful is snorkelling as an ecotourism venture?

Figure 76.1 shows a snorkelling platform on an offshore reef to which over 250 people come on a daily eco-tour.

Over 70 of these visitors will go snorkelling and this means jobs for supervisors, guided tour operators or just deckhand help with assisting tourists putting on fins, masks and other gear.

However it will definitely decrease if no one will want to swim in the sea because our water has become polluted by cans, cigarette butts and rubbish from our stormwater drains.

The challenge for us all is to keep our seas crystal clean with an abundance of animals and plants so that people will want to continue to come back and see the wonders of the undersea world.

Snorkelling and ecotourism

Ecotourism has possibly the greatest potential to generate new jobs. In recent times many different commercial operations have had different views of ecotourism. Some operators have just changed their billboards and marketing brochures to read eco-tours. Others appear to be making a genuine effort to present a tour that is informative about ecological and environmental ideas while embracing the ecotourism concept.

For example, a glass bottom boat that ran with a smelly oil soaked engine and served take-a-way food in plastic wrappers with no rubbish bin would rate rather low on an eco-tour scale of 1 - 10. It would rate even worse if it served tea and coffee in styrofoam cups with tea bags and coffee in sachets, with biscuits in individual wrappers, with serviettes and plastic spoons.

However, a snorkelling eco-tour that involved participants sea kayaking to an offshore marine national park, where snorkel trails had been set for high tide and where lunch consisted of home made salad sandwiches, served on crockery plates, with billy tea in crockery cups, with home made biscuits and fruit — the scraps of which could be taken off the island, would rate a lot better.

So really if you want to work in the tourist industry, there are a lot more practical things to learn than just running the tour. There are a lot of simple practical ideas you can implement to make ecotourism a truly new commercially viable venture and make other people talk about your tour. Word of mouth marketing is one of the strongest marketing tools a small business can have.

If snorkelling ecotourism is done correctly and in conjunction with other outdoor eco-tour ventures, it can open up a new business endeavour from which we can all benefit.

Your task

Locate a snorkelling adventure trail eco-tour.

Critically evaluate the nature of the operation, what services are offered and how this venture caters for the ecotourist.

Collect marketing brochures and find out how many jobs are available in this type of work, the conditions and rates of pay and evaluate the economic visibility of the operation.

You could add one of the projects from the previous page to enrich your answer.

Figure 76.1 Snorkelling platform on an offshore reef to which over 250 people come on a daily eco-tour

WORKSHEET 26 POOL SCIENCE ACTIVITIES

Complete the following two activities and answer the questions below.

Part A: Observe underwater creatures

(See Figure 77.1)

A. Sit at the side of the pool as shown in Figure 77.1 with all your snorkelling gear on.

B. Now submerge to the bottom, equalise your ears and swim towards the crate marked C

C. Hold position for 5 seconds and make observations on the side of the box.

D. Surface, clear snorkel and describe to your buddy your observations.

Now try this with an underwater slate.

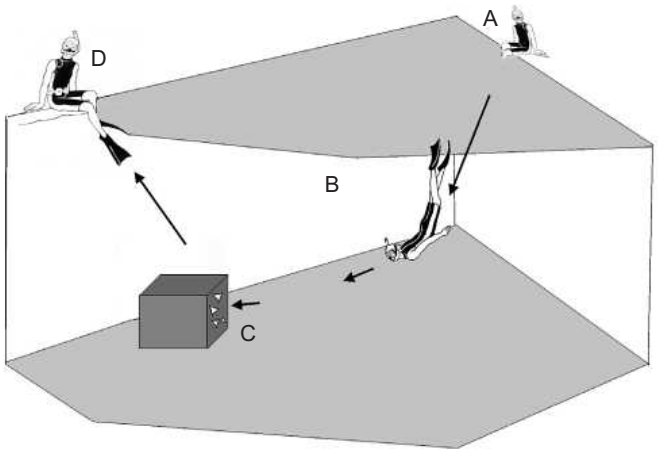


Figure 77.1 Underwater observation

Part B: Record data along a transect line

(See Figure 77.2)

Set up a make-believe set of coral clumps at the bottom of the pool with milk crates and attach some designs to represent animals

Now set a transect line joining the crates.

A Snorkel over the crate taking making observations.

B Record data on an underwater slate.

C. Take photographs of the shapes or objects on this crate

D. Take a sample of rocks from under the crate and place it in a collection bag.

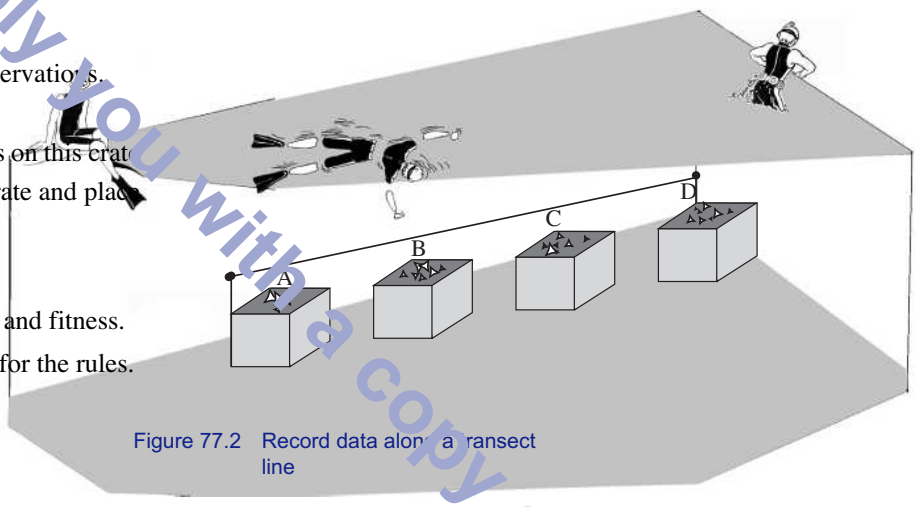


Figure 77.2 Record data along a transect line

Part C: Underwater hockey

This is an activity which sharpens your skills and fitness.

- Google the underwater hockey association for the rules.

Questions

Q1. Describe the things you saw and collected.

Q2. Devise an experiment to see if size changes underwater.

Results

Section 8: Regulatory requirements

The underwater environment is exciting and beautiful and snorkelling is an ideal way to enjoy it. It can however, be dangerous as it can be a strenuous physical activity even in calm water. Health and safety risks can also rise for persons suffering from the following conditions.

- Any medical condition that may be made worse by physical exertion, for example, heart disease, asthma and some lung complaints.
- Any medical condition that can result in loss of consciousness, for example, some forms of epilepsy and some diabetic conditions.
- Asthma that can be brought on by cold water or salt water mist.
- Older persons are more likely to suffer from diagnosed and undiagnosed medical conditions that may be made worse by physical exertion, for example, heart disease and stroke so keep an eye on your teacher.

So before you go snorkelling at school, it is a State Government requirement to sign a medical declaration form (see page 79). The best way to determine your medical fitness is to discuss this with your local doctor.

Safety information for snorkellers

The following are suggestions and are not intended to supersede you school snorkelling safety plans*.

- Be aware that snorkelling can be a strenuous physical activity even in calm water.
  - You should inform the snorkelling supervisor or guide if they have any concerns about any other medical condition.
- If you cannot swim, have not snorkelled before or have any concerns, talk to your snorkelling supervisor or snorkelling guide before entering the water.
- Snorkel in buddy pairs and confirm your snorkelling plan just before you enter the water.
- Always stay in an area which allows your supervisor or instructor to offer close supervision.
- To avoid sunburn, use sunscreen and wear suitable clothing.
- It is a good idea to practice snorkelling beside a platform, boat or in shallow water before venturing into more open deeper water.
- Take into consideration your own limitations when snorkelling. If in doubt wear a flotation device, for example a life jacket or buoyancy vest.
- Note the location and availability of life jackets, wetsuits or other flotation devices that can be used by snorkellers.

* Worksafe Queensland has also made other suggestions for commercial operators at www.worksafe.qld.gov.au.

Neville Coleman

Figure 78.1 The underwater environment is exciting and beautiful and snorkelling is an ideal way to enjoy it.

- Learn how to tread water so you can lift and keep your face clear of the water.
- Learn how to communicate with supervisors and other snorkellers by using hand signals so that you will know when to return to the boat and how to communicate if you do need assistance.
- Learn how to use the buddy system where two snorkellers make sure they are always within a short distance of each other and keep a watch on each other's safety.
- If you are intending to hold your breath and dive below the surface be aware of the risk.
  - Establish the *"one up, one down"* duck diving rule with your snorkelling buddy.
  - The risk is increased greatly for divers who hyperventilate by taking repeated (more than three or four) deep breaths before diving below the surface or who undertake deep dives.
- Take careful note of the environment in which you will be snorkelling.
  - With the assistance of the snorkelling supervisor or instructor, identify boating channels, marine animals, wind and tide strength and direction.
- If you are using research equipment, make sure you carry a knife and have practiced your skills in a pool before you try open water.
  - Make sure you have emergency plans in place, NEVER snorkel alone and have radio communications in place if deemed necessary.
- Follow the instructions of your snorkelling supervisors and lookouts and do not drink alcohol before snorkelling.
  - Complete the medical declaration form that will be provided to you.

State government regulations

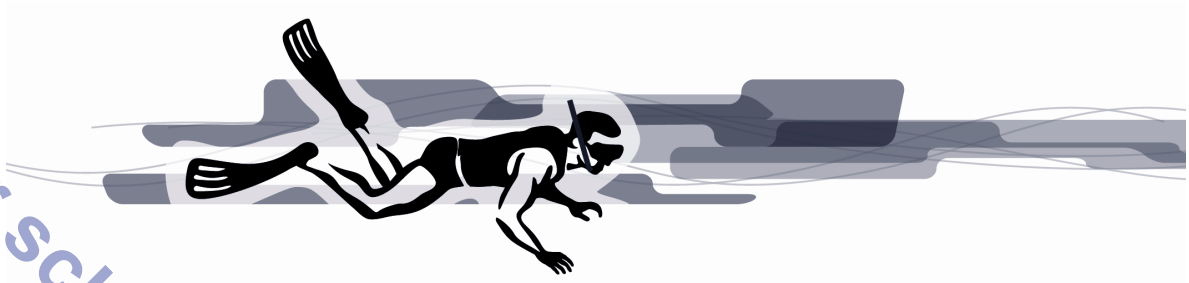
Schools are required to check information EACH year at the following web site to make sure the latest form is used.

Download and sign the medical form (sample page 80)

www.deir.qld.gov.au/workplace/resources/pdfs/divingrecreational_code2010.pdf

or

www.worksafe.qld.gov.au



DOCUMENTED METHOD OF PROVIDING ADVICE ABOUT MEDICAL CONDITIONS TO PROSPECTIVE RECREATIONAL SNORKELLERS

Reference the Workplace Health and Safety Regulation 1997 Section 86I and the Compressed Air Recreational Diving and Recreational Snorkelling Code of Practice 2005 Section 2.2.2

Medical Declaration – recreational snorkellers

I *(print name)*_____
declare that I have been advised snorkelling can be a strenuous physical activity and may increase the health and safety risks to me if I am suffering from:

A. Any medical conditions that may be made worse by physical exertion.
For example heart disease, asthma, some lung complaints

B. Any medical condition that can result in loss of consciousness.
For example some forms of epilepsy and some diabetic conditions

C. Asthma that can be brought on by cold water or salt water mist

I have been advised that snorkelling can be a strenuous physical activity even in calm water and that older persons are at an increased risk of death and injury due to a higher incidence of medical conditions made worse by physical exertion, such as heart disease and stroke.

I have been advised to tell the lookout, snorkelling supervisor or snorkelling guide if I have any concerns about a medical condition.

Signature _____ Date _____

Parent's or guardian's signature for minors _____

Note: It is recommended persons with a medical condition and older persons intending to snorkel should:

A. Snorkel in an area which allows the lookout or snorkelling supervisor to offer closer supervision.

B. Wear a flotation device that will support the wearer in a relaxed state.

C. Snorkel in a buddy pair

Example swim test - confined water

- Swim a distance of 200 metres, nonstop, any stroke.
- Survival swim of 10 minutes, drownproofing or floating.

Queensland Government
Department of Industrial Relations

Qld Government

Snorkelling suggested competencies*

This is to certify that the following student has demonstrated competencies as checked below.

Name _____ *Date* _____

School _____ *Class* _____

Teacher _____ *Teacher's Initial* _____

*It is suggested you use this list to generate competencies required for you own school snorkelling trips.

Basic skills

Survival

Demonstrate the following swimming skills in a pool.

- ☐ Distance swim of 200 metres, non stop any stroke
- ☐ Tread water for 10 minutes, drown proofing, floating etc.
- ☐ Underwater swim of 9 metres, one breath, no push-off or dive
- ☐ Underwater swim of 18 metres, taking three breaths during swim

Fitting a mask

Demonstrate correct methods for fitting a mask to ensure that:

- ☐ There is an adequate seal
- ☐ The strap is placed in a correct place
- ☐ The strap is adjusted correctly
- ☐ Clear vision is achieved

Fitting a snorkel

Demonstrate correct methods for selecting and fitting a snorkel to ensure that:

- ☐ The correct snorkel is chosen for the correct lung capacity
- ☐ The snorkel is fitted correctly to the mask and on the correct side of the face

Fitting fins

Demonstrate correct methods for selecting and fitting a pair of fins to ensure that:

- ☐ They don't fall off
- ☐ Won't cause a cramp
- ☐ Won't cause blisters

Fitting a wet suit/stinger suit

Demonstrate correct methods for selecting and fitting a wet suit and or a stinger suit to ensure that:

- ☐ You can put it on and take it off without damaging it
- ☐ You can describe how to look after it to prevent deterioration

Optional equipment

Demonstrate correct methods for fitting and using:

- ☐ A weight belt
- ☐ Gloves
- ☐ Knife
- ☐ Other _____

_____

_____

Snorkelling skills

Pool

Rescue skills

Demonstrate the following skills.

- ☐ Distance swim of 400 metres, non stop, using no hands and breathing from snorkel at least one-half the distance
- ☐ Underwater swim of 18 metres, one breath, no push-off or dive
- ☐ Underwater swim of 40 metres, taking no more than three breaths during swim and demonstrating an energy efficient finning technique
- ☐ Recover a 4.5 kg object from the bottom of the deepest part of the pool
- ☐ Transport a snorkeller of equal size 40 metres on the surface
- ☐ Rescue a snorkeller simulating unconsciousness to the surface from the deepest part of the pool
- ☐ Simulate instructions given to other rescuers and methods of transport to emergency care

Science skills

Demonstrate correct methods for using:

- ☐ Underwater slate
- ☐ Transect tape
- ☐ Camera
- ☐ Other _____

Open water

- ☐ Assess buddy skills and group emergency plans
- ☐ Describe snorkelling plan to buddy
- ☐ Adjust weights for proper buoyancy control so as to be able to experience neutral buoyancy
- ☐ Remove and replace mask, fins weight belt (in turn) at the surface
- ☐ Surface dive, descend with deliberate control and proper ascent and surfacing techniques, including snorkel clearing
- ☐ Equalise all air spaces during descent
- ☐ Recover an object from 3 metres of water
- ☐ Demonstrate self-rescue techniques, including ditching weights and relieving simulated leg cramps
- ☐ Demonstrate safe water entry and exit, wearing snorkelling equipment from the following locations:
  - the beach
  - a water entry platform (e.g. duckboard)
  - a boat with ladder

Science skills

Demonstrate correct methods for using:

_____

_____

_____

Syllabus key concepts and objectives

To keep in line with curriculum changes this edition has been significantly enhanced. Specific attention has been paid to the new Queensland Studies Authority *Marine Science Syllabus*. The table below is a summary of key concepts associated with the Marine Research Skills Key Area.

A workbook (V1) which links this unit to Marine Biology and a Teacher's Answer Book have also been developed. For copies and regular updates go *www.wetpaper.com.au*


Len Zell

Year	Pages	Key concepts / elaboration	Learning experiences
11	63-73 78-79	MS 1.1 Regulatory requirements and procedures are essential for dealing with hazards, accidents and emergencies.	Identify statutory requirements from Qld Government Open Water Snorkelling CARA and Code of Practice. Complete medical forms, emergency drills and procedures.
	3-26	MS 2.5 Underwater physics and physiology influence underwater activities and are an important consideration when snorkelling.	Define and describe the effects of snorkelling on the eye, ear, sinuses and skin as well as the effects on the respiratory, muscular and circulation systems including shallow water blackout, skin cancers and ear infections.
			Make predictions on physiology based on scientific principles and laws (eg Pressure, Buoyancy, Gas Laws, Sound in water).
11 12	27-37	MS 2.4 Snorkelling equipment is used observe or survey underwater ecosystems, including conducting transect studies.	Identify and describe effective storage and safe use of various types of masks, snorkels, fins, protective suits, weight belts, gloves, knives, emergency communications and specialised science equipment for transects and photography.
	38-48 77 80	MS 2.4 Snorkelling practices are used to observe or survey underwater ecosystems, including conducting simulated or open water transect studies.	Demonstrate snorkelling proficiency and describe methods used in equipment selection, mask fitting and clearing, duck diving, snorkel breathing and water entry.
			Describe methods used in underwater data collection and analysis by observation and transect.
12	68-73	MS3.1 Marine communication devices (e.g. GPS, radio,) and procedures are used for coordination and snorkelling safety.	Identify waterproof GPS and marine radio snorkelling and diving equipment. Describe procedures used in communication to effect snorkelling emergency planning.
	38-3 68	MS 1.3 Water safety skills and first aid procedures are important when undertaking marine activities.	Describe the DRSABDC first aid sequence with snorkelling as an example. Identify rescue methods. Describe common first aid procedures relating to snorkelling, eg, cramps, cuts, burns, heat exhaustion, salt water aspiration.
	54-62	MS 1.4 Dangerous marine organisms are identified and administration of first aid treatment is conveyed.	Identify potentially dangerous marine creatures. Describe and evaluate first aid treatments for shock, bites, cuts, stings, burns, hypothermia and envenomation.
	63-73	MS 1.2 Risk assessments are carried out before conducting investigations in the laboratory and the field.	Distinguish between hazards, risks and control measures giving examples of each. Evaluate various types of snorkelling plans including a risk assessment on a research project.
	63-65	MS 1.5 Weather forecasts and synoptic charts are interpreted prior to and during investigations with decisions being made according to changing weather conditions.	Describe various control measures for hazards caused by changing weather conditions. Describe procedures used in a school emergency plan.
	68	MS 1.6 Safety equipment relevant to marine activities is used and maintained.	Identify safety equipment and describe procedures used in maintenance for safe use, including oxygen.
11 or 12	74-77	Action research projects	For example, plan a snorkelling transect, design a snorkel safety strategy booklet, prepare a dangerous marine animals talk, critically evaluate snorkelling ecotourism.

Bob Moffatt

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Coral Watch

Marine Science notes

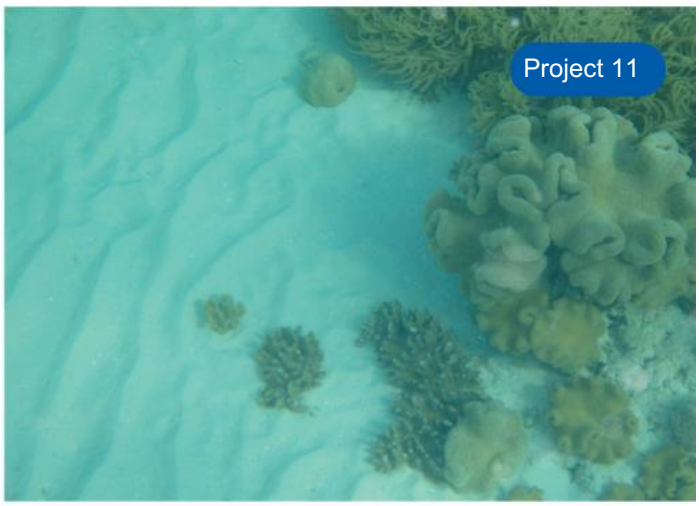
Snorkelling action research projects

If you are studying the Queensland Marine Science Syllabus, you may wish to complete an action research project using snorkelling as a marine research skill.

- Action research may be used when actively investigating issues and problems in the marine environment.
- It involves you using your knowledge to formulate a plan for an investigation. The plan may change and evolve over the course of the research project as you gain more and greater knowledge.
- Snorkelling is an excellent way to gain first hand experiences to gain an appreciation of how difficult marine research is compared to land based research.

The following suggested project outline ideas are discussed on pages 75-77.

1. *Fish shape and efficient movement.*
2. *Effectiveness of burrow sharing with an invertebrate.*
3. *Cleaner fish and the food chain.*
4. *Coral bleaching and the effect on the reef.*
5. *Sponge spicules and body form.*
6. *Parrot fish contribution to reef sediments.*
7. *Issues with reef habitat mapping.*
8. *Relationship abundance in microattols.*
9. *Fish family biodiversity and the reef crest.*
10. *Sea cucumber populations and distribution.*
11. *Sediment movement and tides.*
12. *Damaging effects of tourism.*



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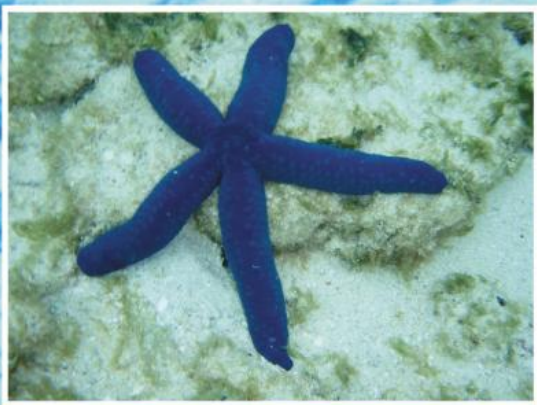

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