# Snorkelling worksheet syllabus match – Marine Research Skills

## Wet Paper Publications

Snorkelling Workbook 6th Edition

ISBN978-1-86283-131-5

*Subject matter and suggested learning experiences*

| **Key concepts / elaboration** | **Learning experiences** | Page | KU | IA | EC |
|---|---|---|---|---|---|
| MS1.1 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.<br>Complete medical forms, emergency drills and evaluate procedures. | 63-73<br>78-79 | ✓ | ✓ | ✓ |
| MS1.2 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.<br>Evaluate various types of snorkelling plans including a risk assessment on a research project. | 63-73 | ✓ | ✓ | ✓ |
| MS1.3 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.<br>Describe common first aid procedures relating to snorkelling, eg, cramps, cuts, burns, heat exhaustion, salt water aspiration. | 38-53<br>68 | ✓ | ✓ | |
| MS1.4 Dangerous marine organisms are identified and administration of first aid treatment is conveyed. | Identify potentially dangerous marine creatures.<br>Describe and evaluate first aid treatments for shock, bites, cuts, stings, burns, hypothermia and envenomation. | 54-62 | ✓ | ✓ | ✓ |
| MS1.5 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.<br>Describe procedures used in a school emergency plan. | 63-65 | ✓ | ✓ | |
| MS1.6 Safety equipment relevant to marine activities is used and maintained. | Identify safety equipment and describe procedures used in maintenance for safe use, including oxygen. | 63-68 | ✓ | ✓ | |
| MS 2.4 Snorkelling equipment and practices are used to 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.<br>Describe methods used in underwater data collection and analysis by observation and transect. | 32-37 | ✓ | ✓ | |
| 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.<br>Make predictions on physiology based on scientific principles and laws (eg Pressure, Buoyancy, Gas Laws, Sound in water). | 3-26 | ✓ | ✓ | ✓ |

Notes: Assessment is based on the words used over in assessment worksheets. Its up to the school to set the emphais on assessment.

# Snorkelling worksheet verbs

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| Worksheet | Title | Verbs used in questions |
|---|---|---|
| 1 | Snorkelling and the eye | Explain, describe, compare |
| 2 | Respiration and snorkelling | Complete, distinguish, explain, research |
| 3 | The sinuses | Describe, explain, list, suggest, discuss, compare |
| 4 | Circulation and temperature control | Describe, explain, suggest discuss, compare |
| 5 | Effects of pressure | Calculate, recall, explain, describe, predict |
| 6 | Boyle's law | Describe, explain, derive, calculate |
| 7 | Snorkelling and the ear | Explain, list, argue, evaluate |
| 8 | Pressure and sound | Describe, explain, list, identify |
| 9 | Buoyancy and snorkelling | Recall, explain, calculate, decide, estimate |
| 10 | Skin cancer | Research, identify, distinguish, decide |
| 11 | Equipment use | Compare, evaluate, analyse, list, critically evaluate, suggest |
| 12 | Equipment care | Design, complete |
| 13 | Aquatic materials and the sea | Experiment, analyse |
| 14 | Entry and exit | List, describe, discuss, suggest |
| 15 | Finning | Describe, explain, suggest, predict, draw |
| 16 | Duck diving | Describe explain, argue the case for |
| 17 | Clearing your mask and snorkel | Explain, describe, list |
| 18 | Water safety skills (DRSABCD) | Recall, explain, complete |
| 19 | What if? | Write the steps, decide, research, recall |
| 20 | Dangerous creature ID | Identify, describe |
| 21 | Snorkelling first aid | List, explain, describe |
| 22 | Reducing snorkelling risks | Describe, identify, justify |
| 23 | Safety considerations | Evaluate, justify, describe |
| 24 | Emergency planning | Draw, design, draw a flow chart |
| 25 | Research project risk assessment | Identify, justify |
| 26 | Pool science activities | Describe, devise |

# 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 5.1 and 5.2).

- 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.

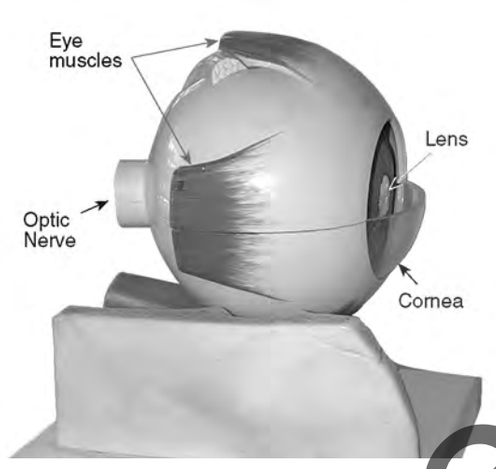



Figure 5.1 Model of the eye
Bob Moffatt

***Blind spot experiment***

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

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

With your left eye, look at the +.

- Slowly bring the image (or move your head) closer while looking at the +.
- At a certain distance, the dot will disappear from sight. This is when the dot falls on the blind spot of your retina.

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

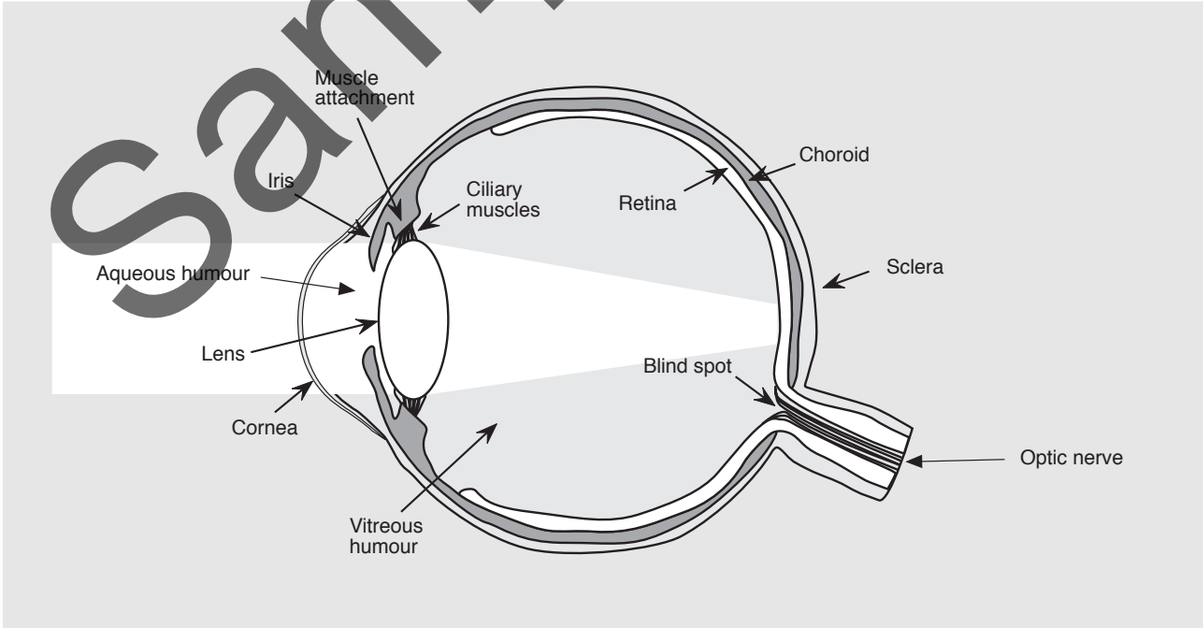
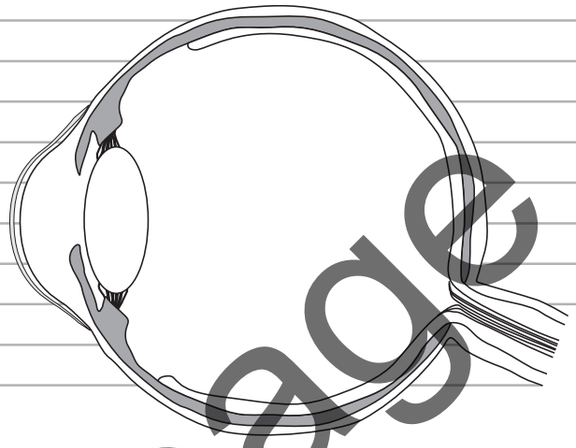



Figure 5.2 Features of the eye affecting vision

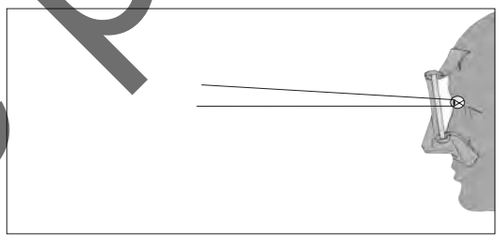
# WORKSHEET 1 SNORKELLING AND THE EYE

## Questions:

Q1. Explain how the eye functions. Complete the diagram below to illustrate your answer.

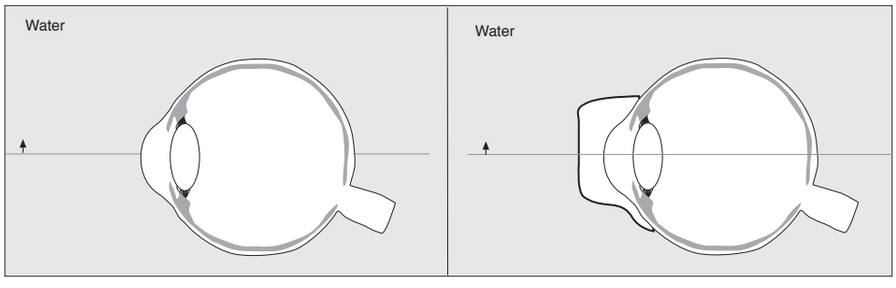


Q2. Explain why marine life appears bigger underwater when using a mask. Complete the diagram opposite to illustrate your answer.



Q3. Describe how the penetration of light frequencies changes with depth. Redraw Figure 6.4 to illustrate your answer,

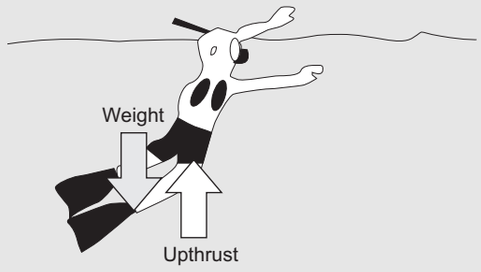
Q4. Compare how a mask focuses an image on the retina of the eye with and without a mask. Complete the diagram below to illustrate your answer.



# Buoyancy

We float because there is a force called upthrust pushing us up (Figure 23.1).

- Look at Figure 23.2. 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.
- The upthrust on the snorkeller is equal to the mass of the volume of water displaced as shown.
- If the upthrust is greater than the weight, the snorkeller will be positively buoyant and if less, the snorkeller will be negatively buoyant as shown in Figure 23.3.




Bob Moffatt

Figure 23.1 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.

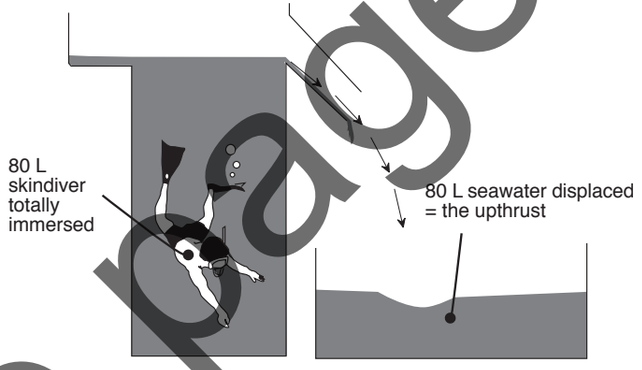



Figure 23.2 The upthrust on the snorkeller is equal to the mass of the volume of water displaced

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)

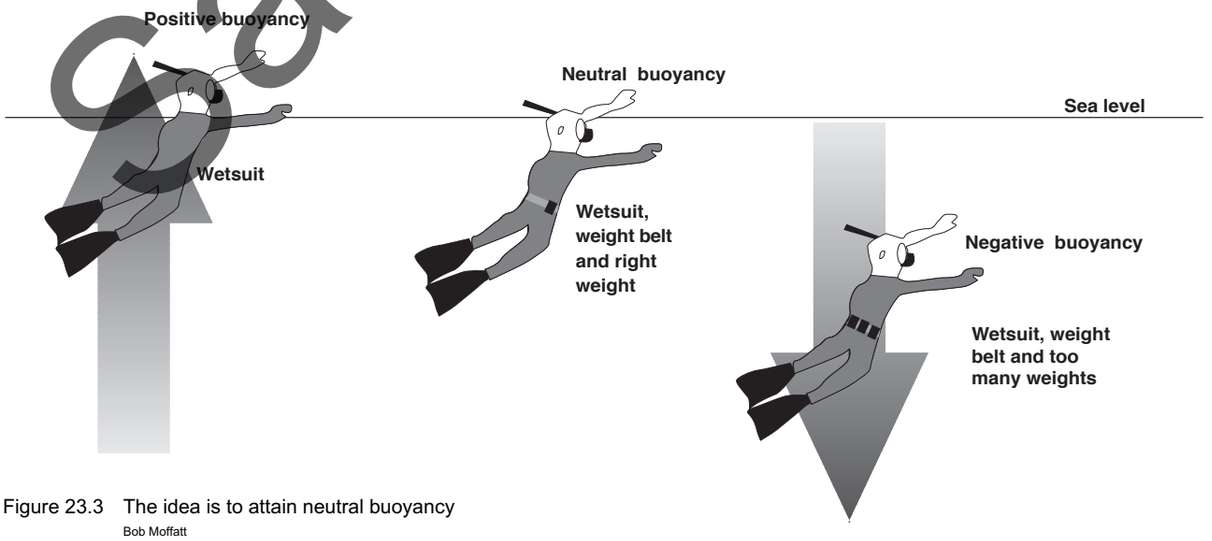



Figure 23.3 The idea is to attain neutral buoyancy

Bob Moffatt

## 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.

## Underwater cameras and housings

Modern digital cameras now have underwater settings which take great photos. Most manufacturers sell underwater housings (Figure 35.3) which allow you to take photos underwater.

## Survey digital video cameras

As digital technology increases, so does the range of underwater recording devices (Figure 35.4). 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 VHF radio

This device allows you to take your GPS while at a research site. Figure 35.4 shows other emergency features. In Australia you have to have a licence to operate a VHF radio.


Figure 35.1 Underwater slate

***Safety***

Make sure you attach equipment to your wrists

Figure 35.2 Underwater cameras and housings
Illustration courtesy Cannon


Figure 35.4 VHF radio and GPS

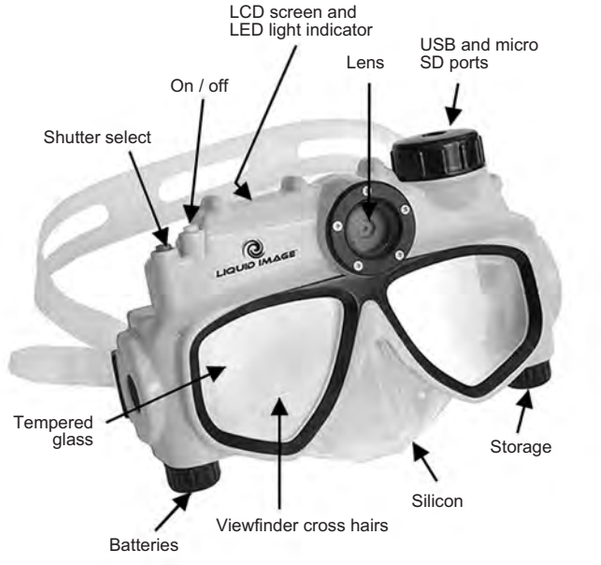



Figure 35.3 Specialized survey digital video cameras in mask
Photographs liquid image

# SECTION 4 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 51,1 shows a table that is commonly used to determine the risk as either low, medium, high or very high. Look at Figure 51.2. 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 - *Remove the platform and use rubber duckie with no metal parts.*
2. **Substitute** the hazard with a lesser risk - *use a ladder.*
3. **Isolate** the hazard - Weather bad day, waves on platform - *Do not go snorkelling off the platform.*
4. **Use engineering controls** - *Install rubber mats over metal areas, install grab rails.*
5. **Use administrative controls** - *Issue instructions - all snorkellers helped into the water by a crew member.*
6. **Use personal protective equipment** - *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 51.1 Risk assessment table


Figure 51.2 Boats can be a hazard


Figure 51.3 Reef entry and surrounding waters contain many hazards


Figure 51.4 The dive platform can be a hazard

# WORKSHEET 22 SAFETY CONSIDERATIONS

In class or as a small group, evaluate each of the following situations

Q1. Discuss the following problems and propose a safety snorkelling action plan for people who:

a. cannot swim or have a fear of water or submerging

b. are physically challenged

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

d. get seasick in small boats

Q4. 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.

- float
- 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

2. Why is oxygen carried onboard a vessel taking people open water snorkelling?

## 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. If a wire is to be used on a calm day, make sure it works.
- 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

  *www.deir.qld.gov.au/workplace*

## Emergency planning

A snorkel emergency during a school snorkelling activity could be caused by any of the following:

- Rescues
- Missing persons
- Marine stings, bites, cuts and envenomations
- Evacuation - presence of dangerous animal eg. 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 help VHF marine radio like the one shown in Figure 58.3 , is a very good way to ensure communications.

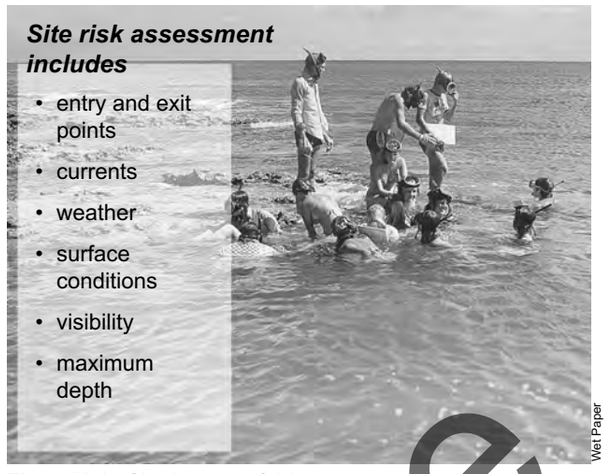



Figure 58.1 Six elements of risk assessment

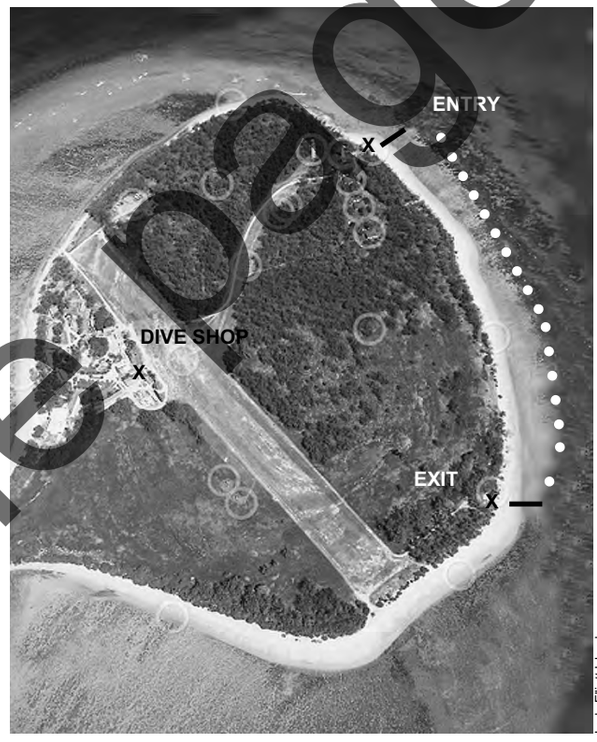



Figure 58.2 Make sure you know where all emergency points are located. These are marked with an X.


Figure 58.3 Establish communications and signals

# 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; being stung eg cone shell.

## Blue-ringed octopus

These small, beautiful creatures as shown in Figure 72.1, 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

Cone shells are beautiful, yet potentially lethal cone-shaped molluscs. They carry a highly developed venom apparatus, consisting of a rapid-acting poison that is injected by means of a dartlike, barbed tooth.

**Treatment**
URGENT medical Assistance
Pressure immobilization

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 72.2. 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 72.1 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 72.2 Stonefish - another very dangerous sea creature

# WORKSHEET 27 DANGEROUS CREATURE ID

Identify the following marine creatures, suggest where they may live and describe their first aid treatment.