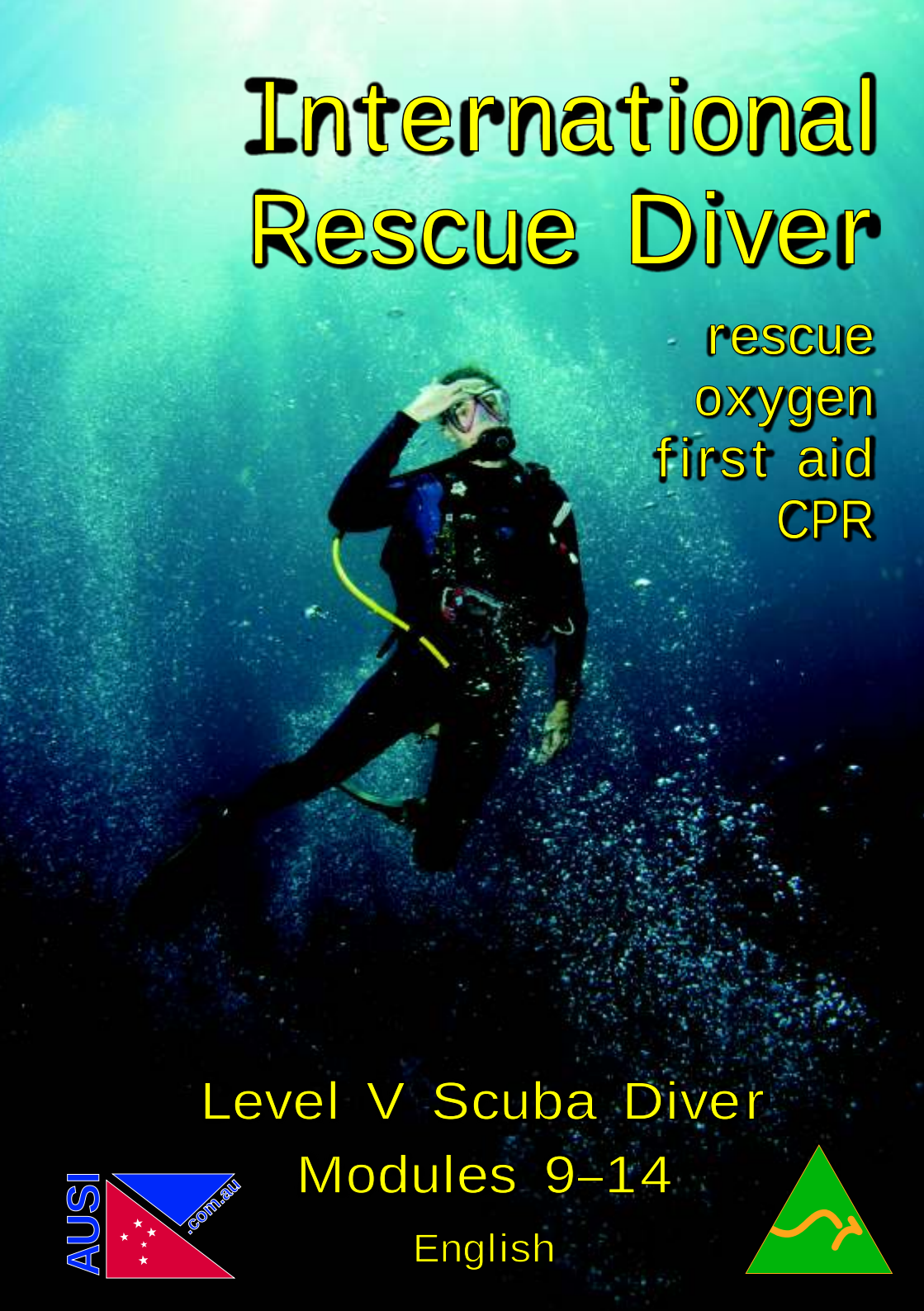
International Rescue Diver

rescue
oxygen
first aid
CPR



Level V Scuba Diver

Modules 9–14

English



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Disclaimer

The theory and requirements of snorkel and scuba diving as expressed in this book represent the author's view of current learning as of August 2009. However, the reader is cautioned that scuba diving is a relatively new and dynamically changing discipline. As such, as our understanding and knowledge increase, certain currently held beliefs (some of which are presently subject to some conjecture) may be disproved or modified. The reader is strongly advised to read new literature as it is released and, if necessary, to reassess areas of the text of this work accordingly.

While great care and effort have been taken in the preparation of the material presented in this book, neither the authors nor publisher warrants that the contents of this work will be entirely suitable for all circumstances which the reader may encounter. It is stressed that first aid procedures vary from time to time and should never be used or adopted to the exclusion of, or in substitution for, medical consultation.

AUSI Rescue Diver Course Notes

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Course notes

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If you have any comments regarding your course, please write to AUSI: **info@ausi.com.au**.

AUSI Rescue Scuba Diver (Rescue Diver)

Qualification

The Rescue Diver course is designed to train divers in self-rescue, scuba diver rescue techniques, diving physiology, oxygen equipment & delivery, first aid and resuscitation.

Prerequisites

- Be at least 15 years of age
- Be medically fit to scuba dive
- Be a certified AUSI Level II Scuba Diver or approved equivalent

Assessment

Continuous throughout all facets of course, including:

- Lesson reviews
- Theory test
- Practical skills performance

Certification requirements

- Satisfactory theory test
- Satisfactory completion of practical skills
- Completion of all relevant records

DAN qualifications

Upon completion of the AUSI Rescue Diver course, you may be eligible for the following:

- Oxygen Provider
- First Aid
- CPR

Divers who have completed AUSI Level IV Scuba Diver and AUSI Rescue Diver can be certified as AUSI Level V Scuba Divers

Welcome back to the exciting adventure of scuba diving

Your AUSI Rescue Diver scuba course consists of the following:

- Administration
- Classroom presentations (six lessons plus test)
- Practical skills training (six sessions including rescue, resuscitation and oxygen provision)
- Ocean diving (one session, including a series of scenarios)

Administration

Before you commence your training you must complete the following documentation:

- The AUSI Medical History Form
- The AUSI Scuba Diver Participation Agreement

During your course, as the course progresses, you must complete the relevant sections of the AUSI Scuba Diver Training Record.

Before you receive your certification, you must sign the AUSI Scuba Diver Certificate of Completion.

If you wish to upgrade your laminated certification card to a plastic certification card, please go to: **www.ausi.com.au**.

Theory

During classroom presentations, your scuba instructor will guide you through these course notes carefully explaining all the relevant information important to your **safety** and **enjoyment**. After each lesson you are required to complete a lesson review in private, and your instructor will then discuss the review to guide your **understanding** and **learning**. At the conclusion of the classroom presentations, you will be required to pass a test designed to **assess** your understanding of scuba diving at the appropriate level.

Practical skills training

Before commencing training in rescue skills, your instructor will conduct a practical skills review, which should be conducted in a pool, whenever possible.

During the practical session your instructor will review:

- Regulator skills
- Mask skills
- Out of air procedures
- Buoyancy control

Your rescue training will include:

- Rescue techniques
- Resuscitation
- Oxygen provision

Ocean diving

During your course you will be required to participate in a series of scuba diving scenarios which will be conducted in open water.

Never exceed your training or experience in an effort to perform a rescue

Scuba Learning Module 9

Dive safety overview 2

Dive preparation

- Fitness 3
- Training 4
- Skills 5
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- Equipment 9

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Accident Management

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- Incident & accident management 23



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Definitions

- An **incident** is an error or unplanned event that reduces the safety margin of a dive
- An **accident** is an unchecked incident resulting in injury that requires first aid and/or treatment

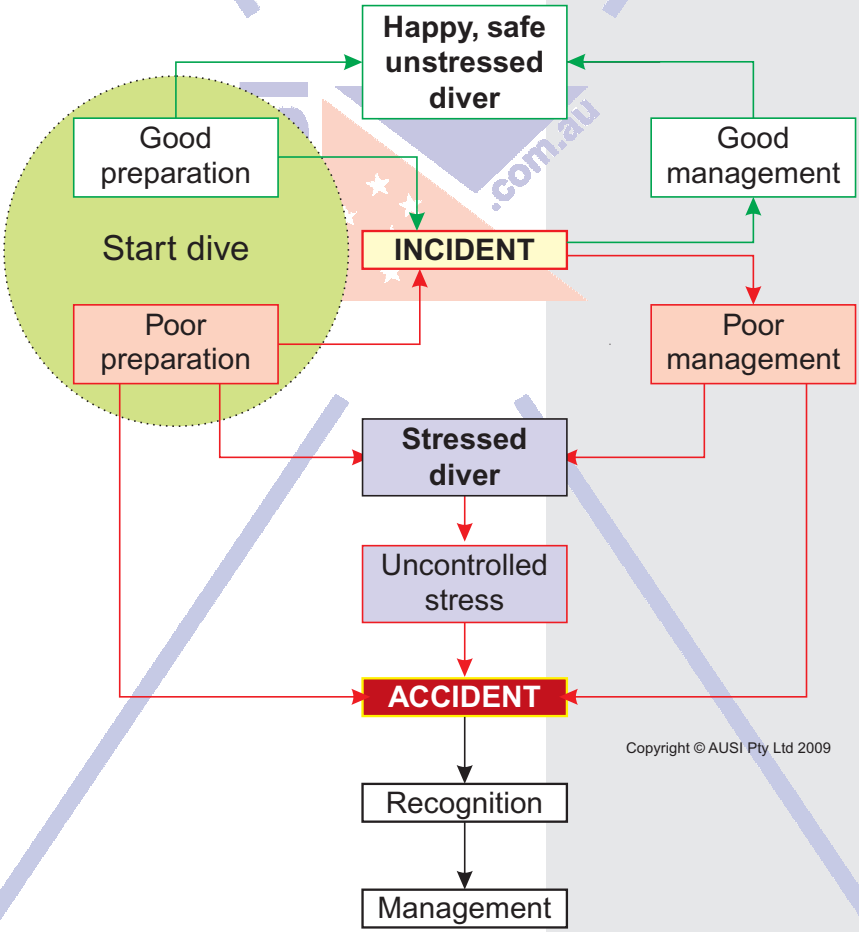
Both are significantly reduced by proper dive preparation.

Dive preparation

Proper preparation is the result of:

- Adequate level of **fitness**
- Appropriate **training**
- Acquisition of **skills**
- Careful **planning**
- Correct **equipment**

Dive management flowchart



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General fitness

You need to be physically and medically fit to dive **safely** and **enjoyably**.



Smoking drugs & alcohol

- Do not mix with diving never dive under the influence
- Do not dive with a hangover (causes dehydration)
- Don't smoke, particularly for some hours before diving

Medication

- Do not dive when on medication unless cleared by a diving doctor



Ears, sinuses & lungs

- If you cannot equalise, do not dive
- Do not dive with a cold, flu or any allergy that affects ears, lungs or sinuses

Teeth

- After an extraction do not dive until socket is healed (7–10 days)
- Have regular check ups



Donating blood

- Do not dive for 24 hours after donating blood

Medical fitness

- Keep diving medical current:
  - Every five years if under 30 years
  - Every three years if over 30 and under 50 years
  - Every year if over 50 years
- After major illness or injury get clearance from a diving doctor before diving again

If any illness associated with lungs, heart, ears, fitting or loss of consciousness develops consult a diving doctor.

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Appropriate training

Must be adequate for the level of diving being planned:

- Check training by sighting certification card
- Check logbook to confirm experience

The following table is a summary of scuba diving certification levels:

Levels	Common equivalencies	Depth limit
Level I	Supervised open water	18 metres (60')
Level II	Open water	18 metres (60')
Level III	Advanced	30 metres (100')
Level IV	Deep diver	40 metres (130')
Level V	Deep diver + Rescue diver	40 metres (130')
Level VI	Dive Master	40 metres (130')

- Dive to the level of the least experienced diver in the group
- Build experience up slowly
- Regularly revise and practice emergency skills
- Do an **Area Orientation** if unfamiliar with conditions
- Do a **Refresher Course** with a qualified scuba instructor if you have not dived for six months or lack confidence
- **Continuing education** improves confidence, skill level, knowledge and experience

Specialty courses

- Underwater Photographer
- Underwater Naturalist
- Sinkhole Diver
- Cavern Diver
- Wreck Diver
- Technical diving
- Hookah Diver
- Plus many more...

Never exceed the limits of your training and always seek further education

Skills must be instinctive, which is only gained from good training and practise

Minimum skills

The following minimum skills are essential for safe diving at all levels of qualification.

Surface skills

- Snorkel comfortably in varying conditions
- Determine correct weight for neutral buoyancy
- Correct utilisation of buoyancy compensator
- Regulator/snorkel exchanges on surface

Mask skills

- Clear mask effortlessly with one hand
- Remove and replace mask confidently
- Breathe comfortably without mask

Regulator skills

- Clear regulator by both blast and purge methods
- Recover regulator from behind body
- Comfortably exchange regulators

Out of air drill

- Must have safety (octopus, alternate air source) regulator
- Must be an instinctive skill

Monitoring air consumption

- Conscientiously monitor your own and your buddy's air
- Set conservative low air warning points
- Plan to be back on surface with minimum of 50 bar (atm) (750 psi) in cylinder
- Choose appropriate size cylinder
- Carry redundant air supplies for deep or penetration dives



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Buoyancy control

Good buoyancy control prevents injuries.

On surface

- Ensure neutral buoyancy on surface
- Partially inflate buoyancy compensator (BC) for positive buoyancy **before** entering water–except surf entry (remain deflated)
- Enter with regulator in mouth
- Exchange regulator for snorkel
- Make way to descent line

Commencing descent

- Signal buddy
- Exchange snorkel for regulator
- Maintain contact with descent line
- Deflate buoyancy compensator
- "Pop" ears
- Descend feet first

During descent

- Always maintain contact with descent line
- Continually "pop" ears before pain is felt
- Continually add air to BC in small amounts to maintain control of descent
- Breathe out through nose to prevent mask squeeze
- Check depth gauge to avoid going too deep

At depth

- Adjust equipment (especially weight belt)
- Maintain neutral buoyancy using BC
- Continually monitor air supply
- Stay with buddy–within two metres (6')

Commencing ascent

- Signal buddy
- Locate rope/reference
- Commence ascent with adequate reserve air of 100–70 bar (atm) (1500–1000 psi)

Never hesitate to ditch your weight belt if trouble occurs on the surface, but check below first

During ascent

- Breathe normally, don't hold breath
- Maintain contact with rope/reference
- Watch depth gauge and do not ascend faster than maximum recommended ascent rate of 9m/minute (30 ft/min)
- Maintain neutral buoyancy by releasing small amounts of air from the BC
- **Use fins, not BC**
- Stay with buddy and regularly signal OK
- Do safety stops–1 min at 6m (10') and 3 min at 3m (10')

On surface

- Inflate BC
- Keep mask on face
- Signal OK to buddy
- Exchange regulator for snorkel
- Signal boat, if appropriate
- Stay with buddy until exited

Safety stops not only minimise bubble formation, but enhance in-water skills & buoyancy control

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The buddy system is fundamental to safe diving and increases enjoyment



"Be the buddy you wish to dive with."

Buddy system

The following is essential for correct operation of the "Buddy system", and will help prevent accidents:

- Help each other gear up
- Do thorough pre-dive safety checks
- Warn your buddy of any potential problems (eg. seasickness, anxiety, ears, etc)
- Familiarise yourself with your buddy's equipment–particularly buoyancy compensator (BC) operation
- Check understanding of hand signals
- Be at your buddy's side at all times–within two metres (6')
- Monitor the well being of your buddy
- Maintain the dive plan

In the event of an incident or accident, your buddy provides essential support such as:

- Assistance when entangled
- Alternate air supply
- Giving first aid
- Getting trained medical assistance

Buddy selection

- Check certification:
  - Where was training done? **Area Orientation** may be required.
  - What is the level of certification?
- Check logbook:
  - When was last dive? **Refresher** may be required.
  - Check experience since training
- Check equipment
- Check fitness
- Check interests, are they compatible ie photography, sea food

Dive planning stages

Dive planning is critical to safe diving and all stages **must** be considered prior to the dive.

Pre-dive

- Select an appropriate buddy with similar training, experience and interests
- Check fitness to dive
- Obtain local knowledge from an expert
- Select an appropriate site
- Ensure minimal hazards and boating traffic
- Monitor weather reports for expected swell and wind conditions
- Check for safe entry and exit points
- Select an appropriate time to dive taking into consideration tides, currents and weather
- Organise and check required equipment
- Inform someone of where and when you are diving and when you expect to return
- Have a diver's flag and/or float

On site

- Check prevailing conditions, eg current, waves, visibility and weather
- Erect dive flag
- Determine safe entry and alternative exit points
- Check for hazards
- Formulate and agree upon a dive plan
- Assist in gearing up
- Do safety checks on each other

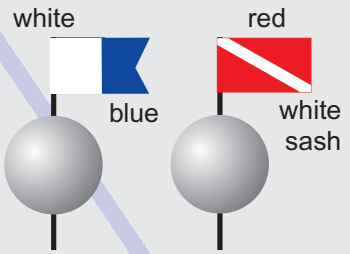
Post dive

- Check health
- Notify of return
- Fix faulty equipment
- Discuss and record dive in logbook
- Avoid predisposing factors for Decompression Illness

Never force anyone to dive

Never be afraid to abort a dive—it is better to be on the boat wishing you were at 30 m (100') than being at 30 m (100') wishing you were on the boat!

Danger diver below



"Plan your dive and dive your plan."

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Managing equipment

Make sure all appropriate equipment, including an adequate exposure suit is available.

Essential

- Snorkel
- Buoyancy compensator
- Safety regulator (octopus)
- Depth gauge (with MDI)
- Contents gauge
- Bottom timer
- Dive computer (and back up tables)
- Quick release weight system

Ensure you are weighted for neutral buoyancy on surface

Preferred

- Balanced first stage
- Buoyancy compensator that can lift weight belt
- Appropriate wetsuit thickness
- Wetsuit fits properly
- Compass and/or reel
- Knife

Pre-dive checks

- Check all equipment is functional
- Check all equipment is fitted correctly
- Check buddy's equipment and vice versa

Care & maintenance

- Regularly check hoses, straps and mouthpieces for signs of damage, wear or perishing
- Wash in fresh water after use
- Repair any problems immediately

Servicing

- Must be done annually by a qualified service technician
- Best done before storage rather than after
- Recheck before using after storage

Spares

Important spares to prevent divers being tempted to go down with unsafe equipment:

- Set of regulators
- Full cylinder
- Weight belt
- Mask and fin straps
- Mouthpieces
- O-rings
- Hoses





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Definition

Stress is mental or physical tension caused by physiological or psychological stimuli.

Physiological stimuli

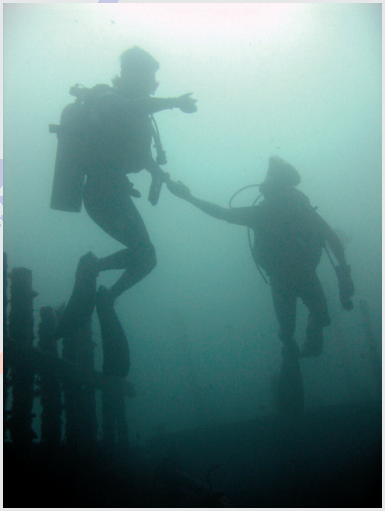
- Exhaustion from:
  - Cold water
  - Poor surface skills
  - Tight wetsuit or equipment
  - Strong currents
  - Lack of physical fitness
- Occurrence of an incident
- Illness or injury
- Nitrogen Narcosis
- Carbon dioxide build-up due to:
  - Tight wetsuit or equipment
  - Over exertion
- Drugs or alcohol

Psychological stimuli

- Perceived danger
- Task loading
- Lack of confidence in ability
- Poor training
- Inexperience

Recognition

- Increased heart rate
- Increased breathing rate
- Anxiety
- Inability to complete simple tasks
- Wide-eyed look
- Removing mask and/or regulator
- Giving up–losing the desire to help oneself
- Panic



Poor vizibility can increase anxiety and stress.

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Self control

- Calm down
- Count to three (this helps prevent panic)

On surface

- Inflate buoyancy compensator (don't over inflate)
- Breathe from regulator
- Lightly grip descent line (so that rope can slip through hand)
- Try to identify and control problem
- Do not proceed with dive unless in full control of breathing

At depth

- Signal buddy that something is wrong
- Control breathing
- Do not proceed with dive unless in full control
- If out of control, abort dive (ascend slowly and carefully) with your buddy

Never ascend without your buddy, except for lost buddy

Control of buddy

On surface

- Reassure
- Gain positive buoyancy by either inflating buddy's buoyancy compensator or ditching their weight belt
- Ensure buddy's mask is on and regulator is in mouth
- Try to get buddy to control breathing
- Have buddy lightly hold descent line (tight grip indicates still stressed)
- Try to identify and control problem
- Do not proceed with dive unless buddy is in full control of breathing

At depth

- Reassure buddy using signals and touch (hold hand or arm)
- Prevent buddy from doing a rapid ascent
- If cannot control the situation, abort dive (ascend slowly and carefully)



Divers on a shot line
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Potential incidents

The following are some of the potential incidents that can occur in a diving situation:

- Buoyancy compensator malfunction
- Broken mask strap
- Burst hose
- Computer malfunction
- Cramp
- Entanglement
- Exceeding planned maximum depth
- Exceeding planned bottom time
- Lost buddy
- Lost weight belt
- Loss of control of ascent rate
- Loss of control of descent rate
- Low air
- Out of air
- Panicking diver
- Regulator malfunction
- Silting
- Weather change
- Tired diver
- Vertigo
- Vomiting underwater

Management

- Recognise incident quickly
- Stop all action and count to three (this helps to prevent panic)
- Assess situation and think it through–don't panic
- Take action as taught during training
- Report incident to dive master
- Observe victim for any signs or symptoms
- First aid if necessary
- Medical aid if necessary

"An incident is an error or unplanned event that reduces the safety margin of a dive."

Dr Chris Acott

(Diving Incident Monitoring Study)

Incident reporting

- In Australia, the Diving Incident Monitoring Study (DIMS) monitors diving incidents
- Any incident should be reported so statistics can be collated to increase awareness and hence safety
- Increased awareness of the types and frequency of diving incidents can be used to improve training

Forms are provided free, contact:

Diving Incident Monitoring Study
GPO Box 400
Adelaide
South Australia 5001
AUSTRALIA
Phone:
+61 8 8222 5116

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Buoyancy compensator malfunction

Auto-inflation

- Try to stop by pulling inflator button out otherwise disconnect inflator hose as quickly as possible
- Dump air as necessary to avoid an out of control ascent
- Check air, signal buddy and abort dive
- Use oral inflation if necessary during ascent

Leakage

- Signal buddy and abort dive
- If not able to achieve enough buoyancy to ascend, link with buddy as for out of air drill and let buddy control ascent with their buoyancy compensator
- If unable to achieve positive buoyancy on surface ditch weight belt
- Only ditch weight belt at depth as a **last resort** as it can lead to an out of control ascent (see Lost weight belt, page 15)

Cylinder slipped out of retaining band

- Get buddy to rectify

Broken mask strap

- Retrieve mask or have buddy get it
- Clear water from mask and hold on to it with one hand and use suction through nose to keep on face
- Signal buddy and abort dive
- If unable to retrieve mask or mask does not seal then link with buddy as for out of air drill and ascend–let buddy assist with buoyancy control and monitor air

Burst hose

- Do out of air drill with buddy
- Abort dive
- On surface may need to orally inflate buoyancy compensator

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Computer malfunction

- Signal buddy and abort dive
- Do safety stops
- Do not dive for 24 hours

Cramp

- Signal buddy
- Locate fin tip
- Stretch leg, pull fin tip towards body

Entanglement

eg fishing line; rope; kelp.

- Stop—don't panic, struggle or rotate
- Attract buddy's attention
- Buddy removes entanglement

Exceeding planned maximum depth

- Determine new maximum bottom time from computer or tables
- Adjust safety stop times and depths for new maximum depth

Exceeding planned bottom time

- If actual bottom time takes dive into a decompression dive then do as much decompression as possible without running out of air
- Observe for signs or symptoms of DCI and treat if necessary
- Do not dive and observe for 24 hours

Lost buddy

- Circle 360°—looking up and down
- Ascend 3–5 metres (10'–15'); repeat above
- If no sighting, then ascend in a spiral to the surface while continuing to look around for buddy
- On surface inflate BC and **wait** for buddy
- If buddy fails to surface call for help



Diver performing lost procedure
©iStockphoto.com/Dave Bluck

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Lost weight belt

- Grab hold of something (eg ascent line, reef, rocks, buddy)
- Immediately dump all air to reduce buoyancy
- If possible retrieve and replace weight belt or else have buddy try to help control ascent rate using their buoyancy compensator
- If ascent is uncontrolled, flare out (spread arms and legs and remain horizontal) to slow ascent rate and **breathe out**
- Observe for signs of DCI and treat if necessary
- Do not dive and continue to observe for 24 hours



Low air

- Signal buddy and abort dive
- Link with buddy as for out of air drill and monitor air continuously during normal ascent
- Only do safety stops if a hang tank is available



Out of air

eg total regulator failure; burst hose; no air.

- Signal
- Donate main regulator to buddy
- Locate and clear safety regulator
- Achieve right arm forearm grip
- Exchange OK signals
- Controlled ascent

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Panicking diver

At depth

- Approach with extreme caution
- Attempt to calm down
- Avoid rapid ascents
- **Don't risk your own life**

On surface

- Approaching no closer than 3m (10')
- Shout instructions to diver:
  - "Drop your weight belt"
  - "Inflate your BC"
  - "Relax"
- **Approach diver with extreme caution**:
  - Only approach if neutrally buoyant and with regulator in mouth to submerge if necessary
  - Ditch diver's weight belt (first check below) and inflate their BC
  - Secure diver from behind

Regulator malfunction

eg free flowing; wet breathing.

- Exchange to safety regulator
- Signal buddy
- Immediately abort dive–buddy also!

Silting

Always use a reel & line if there is any risk of silting:

- Remain calm
- Locate buddy
- Follow line back to exit

Weather change

- Listen to weather reports
- Leave someone aboard the boat able to recall the divers
- Swimming on scuba at about 2–3m (6'–10') below the surface is easier than snorkelling on the surface in rough conditions



Always use a real & line where there is a risk of silt!.

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Photo: Alpha Diving
www.alphadiving.com

Tired diver

At depth

- Stop
- Regain breathing control, regulator in mouth
- Signal buddy
- Don't continue unless the above actions have been achieved, otherwise surface with buddy

On surface

- Stop
- Inflate buoyancy compensator
- Drop weight belt if necessary
- Regulator in mouth
- Mask in place
- Calm down
- **Reassure**

Continuing the dive

- Do not continue dive unless diver is totally calm and in control
- **Always** assist diver back to dive boat or shore if not continuing

Vertigo

- Hang on to something (eg ascent line, rock, buddy)
- Focus on a fixed object
- If it doesn't go away then signal buddy and abort dive

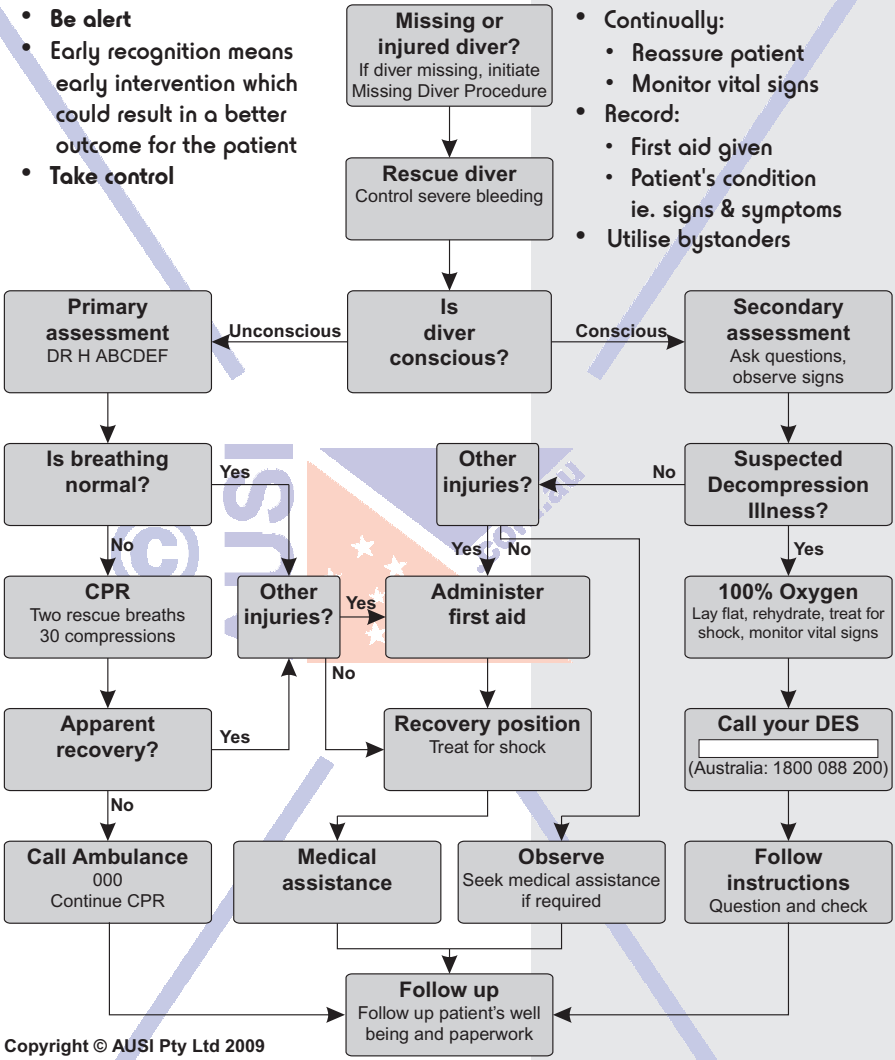
Vomiting underwater

- Vomit into regulator
- Exchange regulator for own safety regulator
- Clean main regulator
- Abort dive–buddy also

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Scuba Accident Management Flow Chart

- **Be alert**
- Early recognition means early intervention which could result in a better outcome for the patient
- **Take control**



- Continually:
  - Reassure patient
  - Monitor vital signs
- Record:
  - First aid given
  - Patient's condition ie. signs & symptoms
- Utilise bystanders

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Early recognition generally leads to a quick recovery —be alert!

Signs of an accident

The following are some of the many possible signs of an accident:

- Abnormal behaviour (eg quiet, agitated)
- Bleeding
- Calls for help
- Collapse
- Convulsions
- Coughing
- Diver surfacing alone–lost buddy
- Excessive sweating
- Experiencing pain
- Holding ear
- Incoordination
- Lying down
- Pale colour
- Rapid ascent
- Rapid or distressed breathing
- Screams, cries
- Shivering
- Unbalanced
- Unfocused gaze
- Urgent or panicky swimming on surface
- Vomiting

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Control

- The most experienced first aider/rescuer should take charge, until proved otherwise assume you are the most experienced
- Remain calm and be confident
- Always act in a professional manner

Assistance

Use other people to perform as many of the tasks as possible so that you can observe, direct and assess. Tasks where helpers can be used include:

- Calling for assistance and directing to site
- Acting as lookouts
- Assembling oxygen equipment
- Recording first aid and vital signs
- Searching for and rescue of victim
- Crowd control

Equipment

Accident management often requires the use of specific equipment such as oxygen equipment and first aid kit:

- Ensure correct equipment is carried and at hand
- Check equipment regularly to ensure correct function
- Regularly practice with equipment to remain proficient in its use

Safety of rescuers (and bystanders)

- The safety of all rescuers (and bystanders) is of primary concern
- Do not risk your own or other rescuers health or safety:
  - Always work in buddy pairs
  - Assess risks to rescuers (eg DCI or hypothermia)



Training will enhance confidence and control

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"Often, the best first aid kit is the one in your head."

Missing diver procedure

- **Immediately mark spot where diver was last seen**, use shot line and/or GPS
- Record time
- Post a lookout to search for:
  - Diver on surface
  - Bubbles
- Question buddy:
  - When was buddy last seen?
  - Was the buddy comfortable at the time?
  - What was the depth?
  - How much air did the buddy have left?
  - What is the buddy's diving experience?
- **Reassess options**
- Wait–based on air; depth; time; and experience
- Recall divers
- Call for help:
  - Radio other dive boats
  - Call rescue organisation
  - Call police
- Organise search:
  - Use snorkellers where possible
  - Don't risk the health of searchers (ie. DCI, hypothermia, solo divers etc)

Local emergency contact number

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Recovery of an unconscious diver from depth

- Secure victim

Begin ascent

- Inflate buoyancy compensators to start
- Ditch victims weight belt if necessary

During ascent

- Try to keep control of ascent rate (don't endanger yourself)
- Extend victims neck to keep airway open
- **Do not hold your breath**

Upon reaching surface

- Remove both weight belts (victim's first)
- Inflate buoyancy compensators (victim's first)
- Call for help
- Secure patient for towing (eg. "doh-cee-doh" grip)
- Attempt in-water rescue breaths
- Begin tow, removing victim's scuba equipment

In-water rescue breaths

- Remove and keep masks
- Always keep patients head above water
- Pinch patients nostrils to seal nose
- Start with five full inflations in ten seconds

Tow to boat or shore

- Continue two rescue breaths every ten seconds
- Remove patients scuba gear then own between breaths
- Continue one rescue breath breath every five seconds

Remove patient from water

- A plan needs to be developed for the specific situation (shore, boat, pool, etc)
- Follow Basic Life Support (Module 11)

Basic life support

Danger

Response

Help

Airway

Breathing

Compressions

Defibrillate

Effect CPR

First Aid

Defibrillation requires special training

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1. Define:
   a) An incident
   b) An accident.

2. List five key elements of dive preparation.

3. List two aspects of diving that should never be exceeded.

4 List four reasons for continuing education.

5. a) List seven essential skills of scuba diving.

   b) What is the most important aspect of diving skills?

6. What is the minimum cylinder pressure you should have upon surfacing?

7. a) List eight items of equipment regarded as essential.

   b) List six important spares.

8. When planning your dive, what are six on-site considerations?

9. What does a hangover cause and why is it a problem with diving?

10 When should you have a diving medical?

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11. a) List six potential causes of stress.

    b) List six indicators of stress.

    c) In a stress situation what can help prevent panic?

12. What is the best way to avoid an incident becoming an accident?

13. How should an auto-inflating buoyancy compensator be managed?

14. What is the recommended lost buddy procedure?

15. What is the procedure for an out of air situation?

16. How should you approach a panicking diver?

17. What item of equipment is necessary if there is any risk of silting?

18. Name three uses for a safety regulator.

19. Why is it important to fill out and send in a Diving Incident Report?

20. List the six elements of accident management.

21. If a diver is reported missing, what should your immediate response be?

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Scuba Learning Module 10

The respiratory system

- Anatomy & function 26
- Mechanics of breathing 28
- Definitions 29
- Control of breathing 30

The circulatory system

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- Blood vessels 35

Tissue fluid & Lymph 37

Gas exchange

- Cellular respiration 38
- Oxygen 39
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Review questions

- Respiration & circulation 41



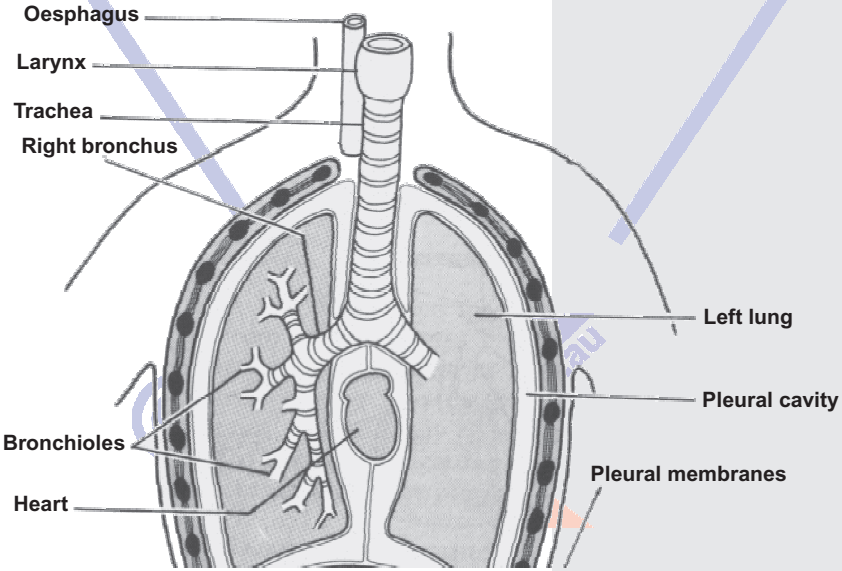
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Components

- Air passages through nasal cavity and mouth
- The trachea (windpipe)
- The lungs (in thoracic cavity within chest)



Function

- Breathing in (inspiration)
- Breathing out (expiration)
- Gas exchange

Mouth and nasal passages

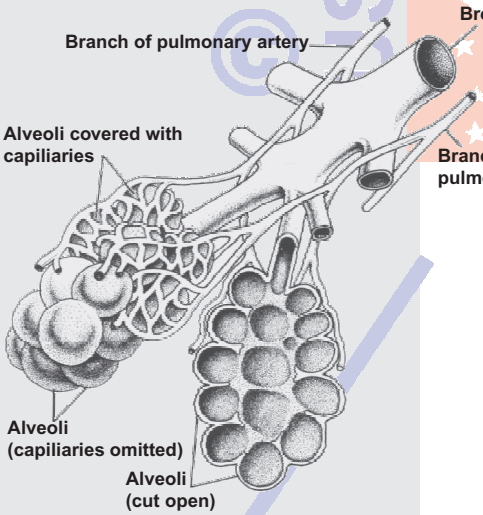
- Before reaching the lungs air is humidified, filtered and cooled or heated
- Food goes down the oesophagus and air goes up and down the trachea

Trachea (Windpipe)

- Round tube supported by cartilage bands
- Larynx (voice box) is located at the top of the trachea
- Divides into two bronchi–one to each lung

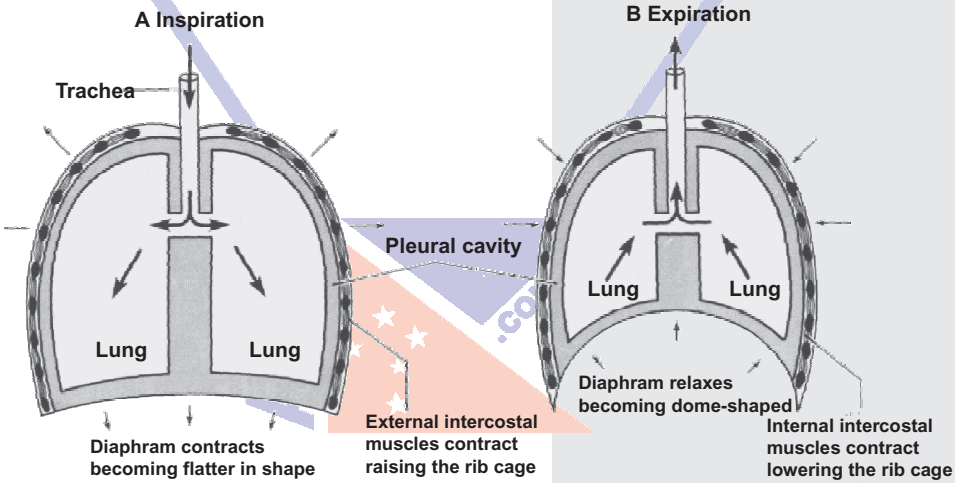
Lungs

- Contained in thoracic cavity
- Ribs and intercostal muscles form the wall of the thoracic cavity and the base is the diaphragm, a sheet of muscle which separates it from the abdomen
- Intercostal muscles join ribs together and are part of breathing mechanism
- Pleural membranes surround each lung and also line the inside of the thoracic cavity
- Pleural cavity is fluid filled space between pleural membranes—reduces friction during breathing
- Lungs consist of bronchi, bronchioles and alveoli
    - Bronchi divide into bronchioles, the smallest of which contain muscles which can alter diameter and therefore air flow
    - Bronchioles terminate into about 300 million tiny air sacs (alveoli) which give lungs their spongy texture
        - Gas exchange only occurs in the alveoli which are approximately 0.2 mm diameter and surrounded by a network of capillaries
        - Surfactant (a liquid) coats the inside of each alveolus and aids gas exchange and helps prevents collapse of alveolus
- The part of the respiratory system where gas exchange does not take place is referred to as "**dead space**"
- The regulator and snorkel add to the "**dead space**"



Breathing in (Inspiration)

- Diaphragm contracts becoming flatter
- External intercostal muscles contract raising rib cage
- Negative pressure is created via a volume increase
- Alveolar sacs expand to fill space drawing air down air passages



Breathing out (Expiration)

- Diaphragm relaxes becoming dome shaped
- Internal intercostal muscles contract lowering the rib cage
- Positive pressure is created by volume reduction
- Alveolar sacs contract pushing air back up air passages

FEV_1

Percentage of vital capacity that can be breathed out from maximum inspiration in one second (very important part of diving medical—must be at least 75% to be fit to dive)

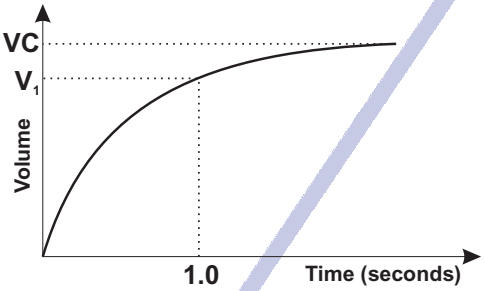
$$FEV_1 = \frac{V_1 \times 100}{\text{Vital Capacity (VC)}}$$

RMV

Respiratory minute volume (RMV) is amount of air consumed in one minute (Number of breaths x tidal volume).

Vital capacity

Volume of air from maximum inspiration to maximum expiration (average 4–5 litres).



Residual volume

Amount of air remaining in lungs after maximum expiration (average 1 to 1.5 litres).

Total lung volume

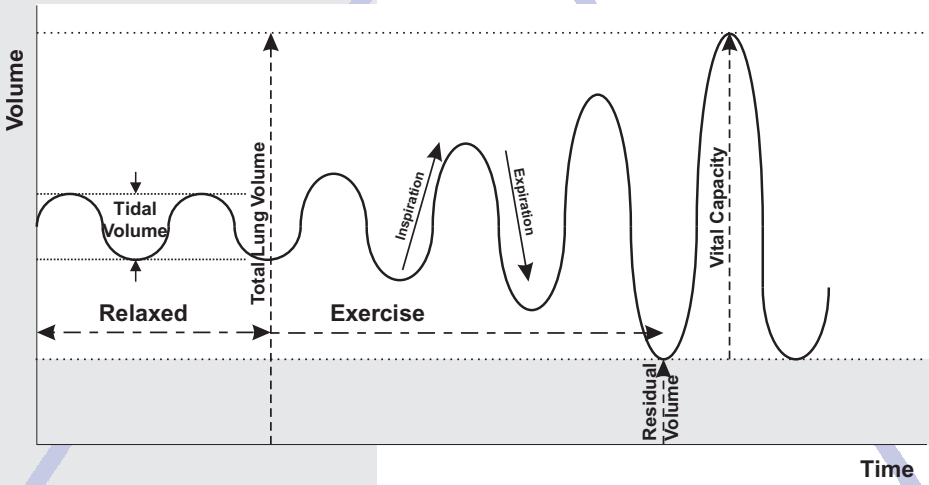
Total of vital capacity plus residual volume:

- Average adult female = 4.5 litres
- Average adult male = 5.5 litres

Tidal volume

Air moved in and out of lungs in one breath:

- Average resting adult = 0.5 litres



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Breathing

- The adult breathing rate at rest is 16–18 breaths/minute
- The respiratory center of the brain is called the medulla and is responsible for analysing information from the body and therefore setting breathing rates
- The most dominant factor controlling breathing is the level of carbon dioxide in arterial blood
- Carbon dioxide levels are detected by chemoreceptors located in the medulla, aorta and carotid arteries
- The response to an increased carbon dioxide level is:
  - Increased rate and depth of breathing
  - Increased heart rate
  - Increased diameter of blood vessels (vasodilation) which can lead to a headache
- Low oxygen has little influence on controlling breathing

Breathing rate and depth can be increased by:

- Increased carbon dioxide levels
- Exercise
- Anxiety
- Disease
- Pain/shock
- Sudden chill
- Voluntary override (eg hyperventilation)

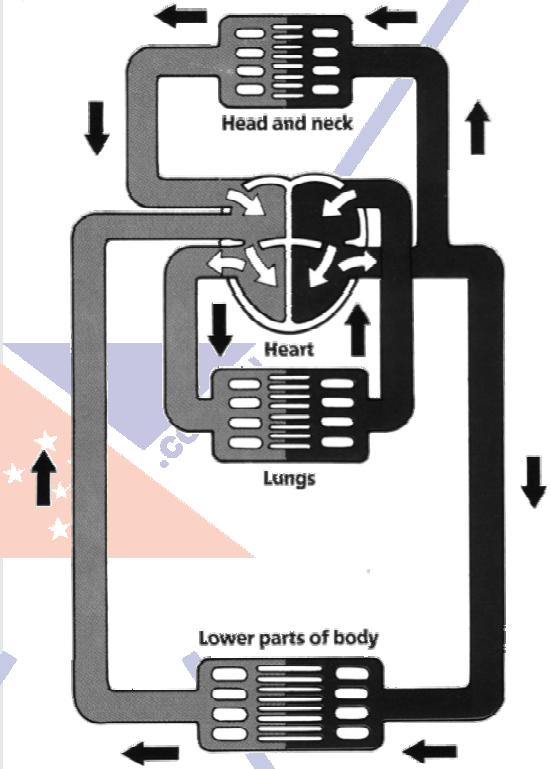
Breathing rate and depth can be decreased by:

- Voluntary override (eg skip breathing)
- Relaxation
- Rest

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Major components

- Blood
- Heart
- Blood vessels



Functions

- Transport of oxygen to cells from lungs
- Transport of carbon dioxide from cells to lungs
- Transport of other substances around the body (eg. nutrients, wastes, hormones etc)

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Description

Adults have on average 5.5 litres of blood transporting substances around the body.

Components of blood

Plasma

- 55% of blood
- Straw coloured liquid
- Contains protein used for clotting
- Transports:
  - Dissolved CO_2 from body to lungs
  - Dissolved oxygen from lungs to body
  - Dissolved food from intestines to body
  - Urea from liver to kidneys for excretion
  - Hormones from glands to tissues

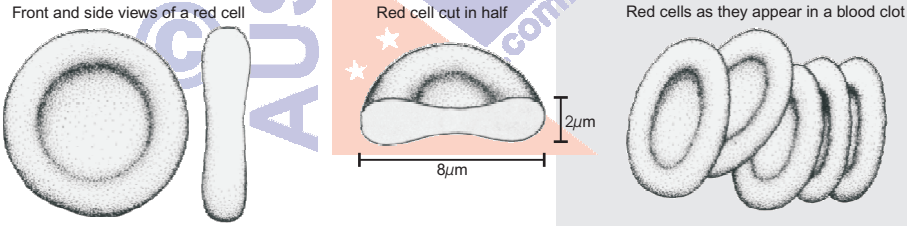
White blood cells (Leukocytes)

Fight infection by:

- Eating germs
- Producing antibodies

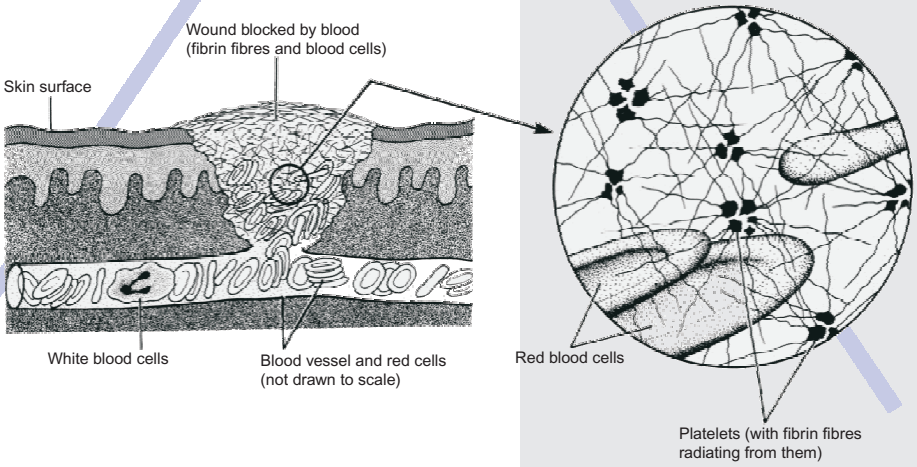
Red blood cells (Erythrocytes)

- Transport oxygen from lungs to cells of body
- Contain haemoglobin (iron based protein) for transport of oxygen (gives red colour to cell)
- Produced in the bone marrow
- Live for four months
- Destroyed in the spleen



Platelets

- Instrumental in stopping bleeding
- Convert clotting protein in plasma to a blood clot

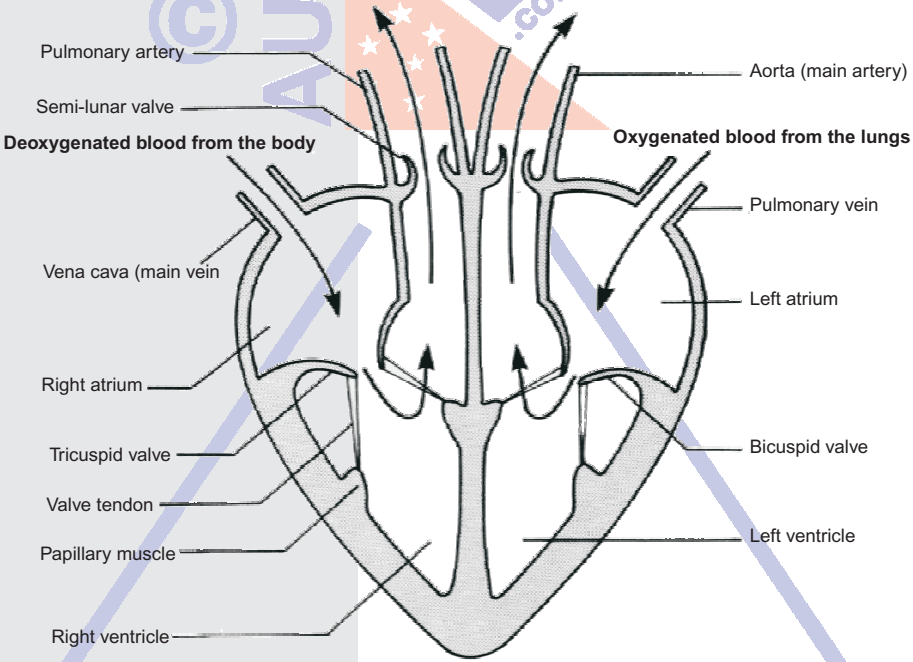


Description

- Pumps blood around the body
- At rest an adult heart beats 60-70 times per minute and up to 150 times per minute during exercise
- An adult heart pumps about 5 litres of blood per minute around the body at rest and increases to 20 litres per minute during exercise

Structure

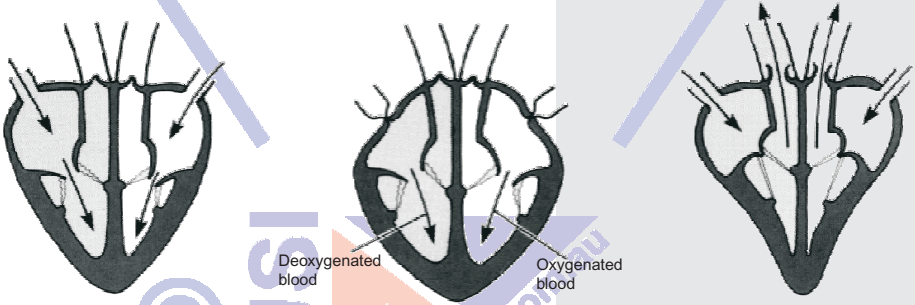
- The heart is a hollow bag with walls of cardiac muscle
- The heart is divided into four chambers
- The left and right atria are the two chambers positioned at the top of the heart
- The left and right ventricles are the two chambers positioned at the bottom of the heart
- Ventricles have thicker walls than atria
- Valves separate each of the chambers to prevent back flow of blood
- The heart has its own coronary arteries and veins to supply it with food and oxygen and remove wastes



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Mechanics

- A heartbeat (or cardiac cycle) is one contraction and relaxation of the heart
- On contraction (systole) first atria then ventricles contract pushing blood into arteries at high pressure
- When atria and ventricles relax (diastole) blood fills the heart from the veins



Between beats
The heart relaxes and fills with blood from the veins. Semi-lunar valves prevent blood entering through the arteries

Atria contract
Blood is forces from the atria into the ventricles

Ventricles contract
Blood is forced into the arteries. Bicuspid and tricuspid valves prevent blood flowing back into the atria. The atria start to fill with blood again.

Pulse & blood pressure

- A pulse is due to the sudden expansion of an artery due to increased blood pressure as the heart contracts
- Blood pressure is measured as systolic (heart contracted) over diastolic (heart relaxed)
- Average adult blood pressure is 120 over 80 mm Hg

Patent Foramen Ovale

- Incompletely sealed "hole in heart" (should seal at birth)
- Occurs in approximately 30% of the population
- Allows some mixing of venous and arterial blood
- May be a significant factor in Decompression Illness

Arteries

- Carry high pressure blood away from the heart
- Divide and sub-divide into arterioles
- Thick elastic walled
- Small arteries and arterioles are controlled by a muscle layer within the vessel wall causing:
  Vasodilation–larger diameter, more blood flow; or
  Vasoconstriction–smaller diameter, less blood flow

Capillaries

- Narrowest blood vessels–so small that red blood cells have to squeeze through out of shape
- Vessel wall is single layer of cells
- Amount of blood flowing into a capillary is controlled by arterioles

Veins

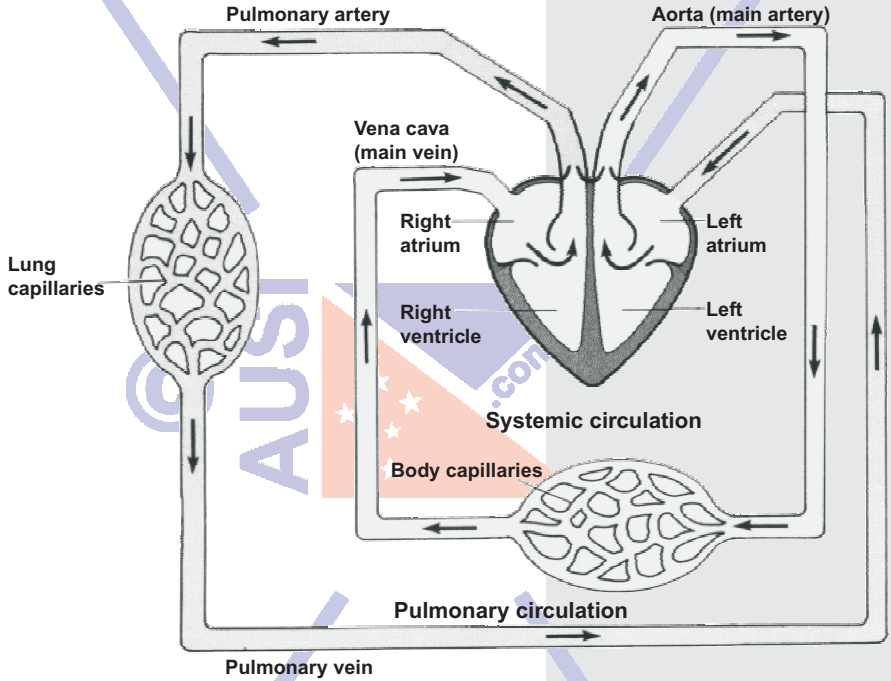
- Capillaries join up to form venules
- Venules join up to form veins
- Veins carry low pressure blood to the heart
- Veins are thin walled
- Blood flow through veins is assisted in three ways:
  - One-way valves only allow flow towards the heart
  - Many large veins are inside muscles (eg legs and arms) so that muscular contractions help to pump blood towards the heart
  - When the heart is relaxed (diastole) the pressure of blood in the heart is lower than in the veins

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Main blood vessels

All mammals including Man have a double circulation system joined only at the heart, consisting of:

- Pulmonary circulation–heart and lungs
- Systemic circulation–heart and body



Pulmonary circulation

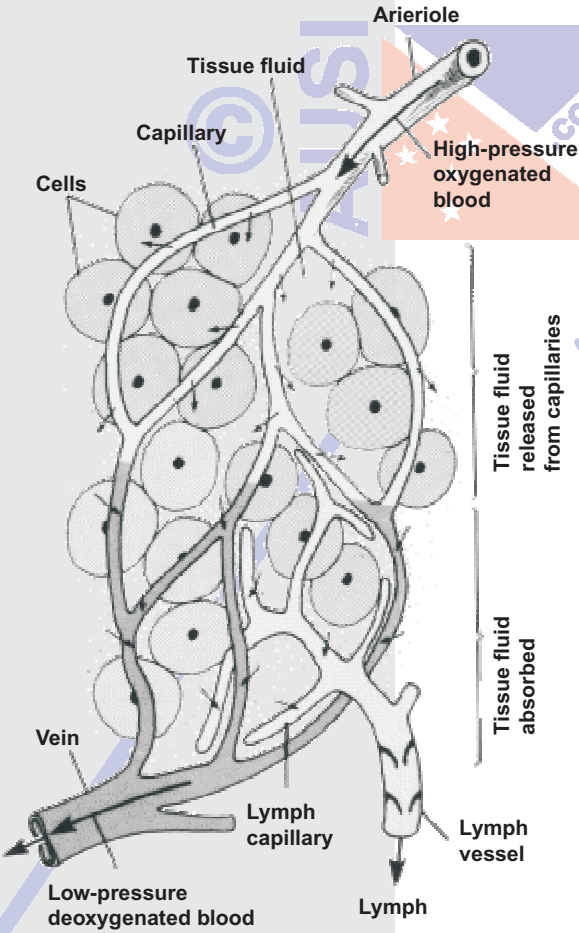
- Deoxygenated blood leaves the right ventricle at high pressure via the pulmonary artery to the lungs
- The pulmonary vein returns oxygenated blood to the left atrium at low pressure

Systemic circulation

- Oxygenated blood leaves the left ventricle at high pressure via the aorta (main artery) to the rest of the body (ie head, arms, legs and organs)
- Deoxygenated blood is returned via the vena cava (main vein) into the right atrium where it enters the pulmonary system

Tissue fluid

- A network of capillaries runs through all tissues
- Higher pressure at the arterial end of a capillary forces clear liquid carrying oxygen and nutrients (tissue fluid) through capillary walls into the tissue space
- Tissue fluid delivers oxygen and nutrients to cells and collects carbon dioxide and waste from cells
- Some tissue fluid is absorbed back into the capillary at the venous end
- Remaining tissue fluid is called lymph



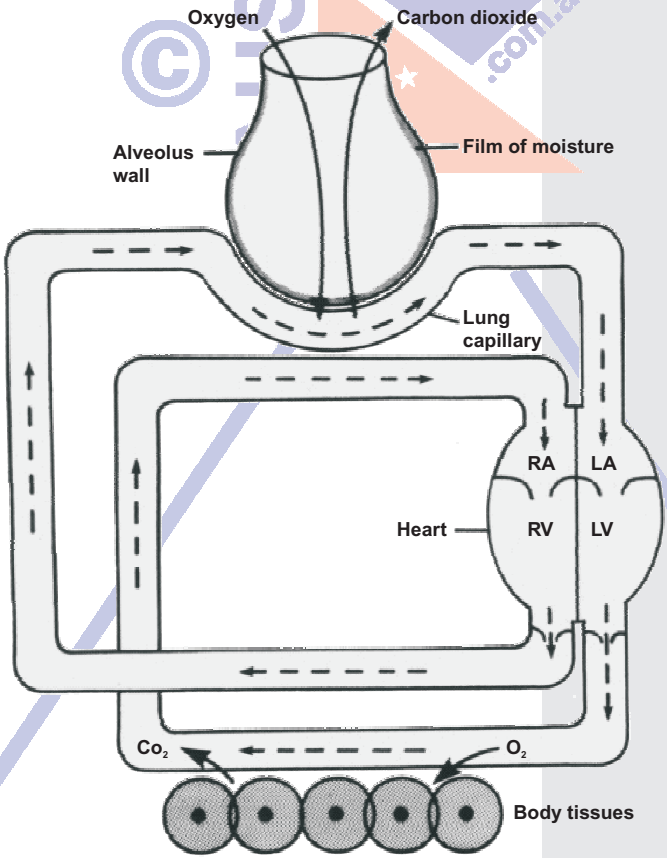
Lymph

- Lymph is absorbed into lymph capillaries which then drain into larger lymph vessels
- Lymph vessels contain valves to prevent back-flow and are situated between muscles where contractions help to pump lymph along the vessel
- Lymph then passes through lymph nodes for cleansing (removal of bacteria and solid matter) before draining into large veins in the neck and hence back into the circulatory system

Cellular respiration

- The aim is to produce energy for cellular processes
- Overall process involves some 50 bio-chemical reactions
- Oxygen and glucose (from food) is required for the process and carbon dioxide is released as a waste product
- Respiration is the opposite of photosynthesis in plants which produces energy and oxygen from carbon dioxide and food
- The simplified reaction is shown below:

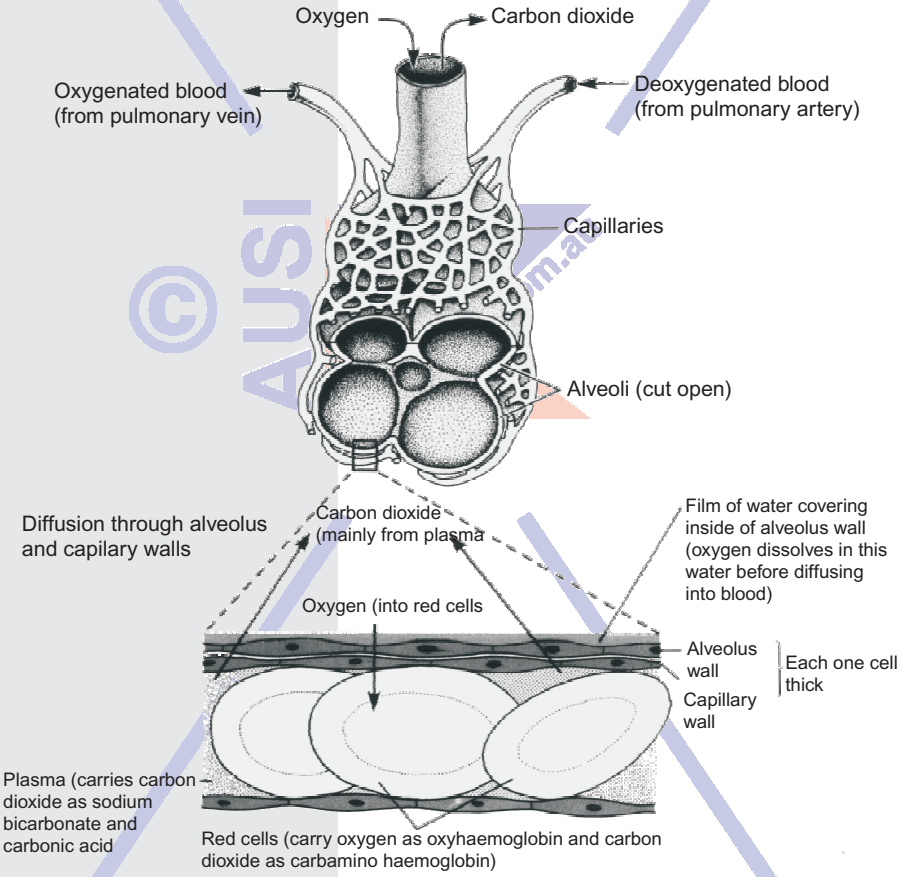
$$\text{Glucose} + \text{Oxygen} \xrightarrow{\text{Enzymes}} \text{Carbon Dioxide} + \text{Water} + \text{Energy}$$



Absorption of oxygen

- Oxygen enters the alveolus as a component of the air we breathe
- In the alveolus oxygen dissolves in the surfactant
- Oxygen then diffuses through alveoli and capillary walls and combines with haemoglobin in red blood cells forming oxyhaemoglobin

Air is approximately 21% oxygen



- Red blood cells are forced through narrow diameter capillaries by blood pressure which:
  - Increases surface area (easier gas absorption)
  - Slows flow (increased absorption time)

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Release of carbon dioxide

- Carbon dioxide is transported either:
  - Dissolved in the plasma in the form of sodium bicarbonate or carbonic acid, or
  - Attached to the Haemoglobin of the red blood cell (only a small amount) as carbamino-haemoglobin
- On reaching lungs an enzyme in the red blood cell causes breakdown of sodium bicarbonate and carbonic acid releasing carbon dioxide
- Carbon dioxide diffuses through capillary and alveoli walls into the surfactant
- Carbon dioxide gas is released from surfactant into the alveoli to be breathed out

How diving effects gas exchange

- At depth there is an increased partial pressure of oxygen and hence more oxygen is dissolved in the plasma
- Dissolved oxygen is easier to utilise than oxyhaemoglobin and therefore dissolved oxygen is used first
- Carbon dioxide levels can build-up at depth because oxyhaemoglobin inhibits the breakdown of carbon dioxide
- The build-up of carbon dioxide leads to vasodilation which may lead to a headache
- The effects of Carbon Monoxide Poisoning are lessened at depth due to the increased level of dissolved oxygen in the blood which can sustain consciousness
- Increased carbon dioxide causes vasodilation which can increase the risk of:
  - Anxiety and panic
  - Decompression Illness
  - Nitrogen Narcosis
  - Hypothermia
  - Oxygen Toxicity
  - Seasickness

1. List three functions of the respiratory system.

2. What is the function of the pleural cavity?

3. What is the function of surfactant?

4. Define "dead space".

5. a) Define FEV_1

   b) What is it used for?

6. a) What is the respiratory centre of the brain called?

   b) How are levels of carbon dioxide detected in the blood?

   c) What are the body's responses to high carbon dioxide levels?

7. What are the functions of the circulatory system?

8. List the four major components of blood.

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9. Draw and label a simple diagram of the heart.

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10. What is Patent Foramen Ovale and what is its significance to diving?

11. List three ways blood flow is assisted through the veins.

12. What are the fundamental differences between arteries and veins?

13. Name the two circulation systems in humans.

14. What is lymph?

15. List five effects of diving on gas exchange.

Scuba Learning Module 11

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DR H ABCDEF

Non-responsive adult victim

- Check for **Danger**—remove hazards
- Check for **Response**—gently shake and ask
- Control **severe bleeding** (pressure and elevation)
- Call for **Help**—call for ambulance—000
- Open **Airway**—head tilt and jaw lift
- Check **Breathing**—look, listen, feel
  - If breathing is not normal, give two rescue breaths (one second each)
  - Use pocket mask where possible
- Give 30 chest **Compressions**
  - Locate centre of chest
  - Compress one third (4–5cm, 1–1.5")
  - Rate of 100 per minute (nearly 2 per second)
- **Defibrillate**—use AED, if available and trained
- **Effect CPR**—two rescue breaths to 30 compressions
  - Continue until qualified help arrives, normal breathing resumes or exhaustion
- **First Aid**—upon recovery
  - Give 100% oxygen as soon as possible
  - Call for medical assistance
  - Manage shock
  - Administer specific first aid

Danger

Response

Help

Airway

Breathing

Compressions

Defibrillate

Effect CPR

First Aid

Any attempt at resuscitation is better than no attempt, an unconscious person with a blocked airway is unlikely to recover

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Do not expose yourself to the same danger as the patient you are trying to help

Action

Check for hazards

- Check environment for potential **Danger** to rescuer or victim (eg electricity, gas, chemicals, dangerous animals, currents etc)

Moving an injured person

Only move victim if necessary, as moving may worsen injuries

- To ensure safety (eg traffic, fire, falling debris, in water, toxic environment, electricity etc)
- To clear airway (ie turning victim on their side)
- When skilled help will not be available for a long time

If movement is necessary

- Avoid bending or twisting victim especially neck and back
- Drag rather than lift, if appropriate
- Use helpers
- Support injured limbs (splint fractures)
- Use a stretcher if available - if not use a flat object such as a door or bench seat



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Action

Apply pressure & elevation

- Press clean cloth onto wound
- Elevate wound if necessary and possible
- Add new dressings over the top of old ones

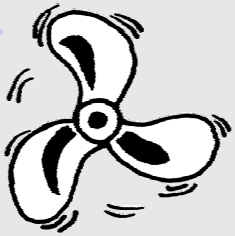
Arterial bleeding

- Arterial bleeding is severe bleeding and is identified by:
  - Bright red colour of the blood
  - Blood comes out in spurts
- Arterial bleeding must be controlled immediately
- If no dressing, bandages or pads immediately available use hand directly on wound
- **Never use a tourniquet**—a narrow constriction tightened around the limb above the wound (eg shoe lace, rope, belt etc). Tourniquets:
  - Cause total lack of blood flow to the rest of the limb
  - Cause serious tissue damage where they act
  - May result in a limb having to be amputated

Cross infection

- When dealing with bleeding victims take extreme care to avoid cross infection
- Hepatitis B and Aquired Immune Deficiency Syndrome (AIDS/HIV) are transmitted via blood
- Wearing rubber gloves when dealing with a bleeding person can reduce the risk of cross infection

Arterial bleeding is life threatening and takes immediate priority



Propellers can cause severe bleeding in divers

A person suffering from a seizure/fit needs to be protected from self-injury ie., remove dangers and place in lateral position

Action

Shake and shout

- Shake arm/shoulder and shout: "Hello, can you hear me?"
- If **Response** then assess, monitor and apply first aid
- If no response continue to airway check

Causes of unconsciousness

- Fainting
- Head injuries
- Medical conditions such as:
  - Seizure/fitting
  - Stroke
  - Cardiac arrest
  - Diabetes
  - Severe bleeding
- Lack of available oxygen from:
  - Near-drowning
  - Smoke or gas inhalation
  - Asthma
  - Choking
- Drugs
- Electric shock
- Hypothermia
- Heat stroke
- Diving conditions:
  - Cerebral Arterial Gas Embolism (CAGE)
  - Decompression Illness (DCI)
  - Latent Anoxia
- Carbon Monoxide Poisoning
- Animal injury (marine or terrestrial)



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Action

Raise alarm

- Call for **Help** as soon as you know that there is a real problem
- Yell loudly if alone
- Use bystanders, if available

No response to call

If alone and no response to call for help:

- Manage airway and breathing
- Control bleeding
- Make emergency call (000) for an ambulance, only if it can be done in a short time (less than two minutes)

Response to call

- Give location, problem and help required (eg "I have an unconscious person at 26 Barkley St, Richmond and need an ambulance")
- Have emergency information handy (eg phone numbers for Police, Doctor, Hospital, Ambulance etc)
- Before sending a bystander for help have them repeat the message and ask them to come back to confirm help is on the way

Bystanders

Apart from sending for help, bystanders can also be used for:

- Assisting with resuscitation
- Crowd control
- Guiding help to the site
- Securing blankets and other equipment
- Setting up Automated External Defibrillator (AED)
- Setting up oxygen equipment

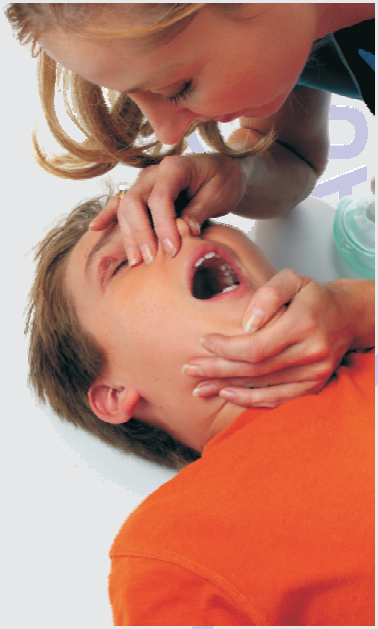


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Airway must be cleared quickly to allow assessment of breathing and circulation



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Action

Open, drain and clear airway

- Turn victim on side, avoid lateral (sideways) movement
- Turn face slightly downwards
- Open mouth and remove any foreign material (including dentures if dislodged)
- Do not probe for unseen material
- Tilt victims head back and lift jaw (pistol grip)

Airway obstruction

Cause

- Tongue
- Epiglottis
- Soft palate
- Semi-solid material eg vomit, seaweed
- Solid material in airway (ie choking)
- Laryngeal spasm caused by irritation (eg. water, vomit)
- Swelling/injury to airway (eg bee sting, strangulation)
- Medical condition (eg asthma)

Recognition

- Partial–laboured noisy breathing
- Complete–breathing effort but no sound of air escaping
- Loss of natural chest movement
- In-drawing of chest and out-pushing of abdomen
- Sucking in spaces in-between ribs and collar bones
- Nostril flaring
- May not be evident until rescue breaths are attempted

Action

Look, listen and feel for breathing

- Leave victim on side
- **Look** for movement of chest and abdomen
- **Listen** for sound of air escaping
- **Feel** for escape of air or chest movement
- **If not breathing normally**—commence rescue breaths

If breathing normally

- Place in lateral (recovery) position
- Avoids airway blockage and allows drainage
- Monitor **Airway** and **Breathing**
- Treat for shock
- Apply specific first aid as necessary

Lateral (recovery) position

- Place patients near arm across their chest
- Prop near leg up at right angles
- Roll away using hands at hip and shoulder—support head
- Extend neck and tilt face down

If not breathing normally

Give two rescue breaths to inflate lungs with oxygen and to check airway

- If airway is clear:
  - Commence **Compressions** (Page 54)
- If airway is blocked:
  - Commence compressions
  - Clear airway
- Check for vital signs (no more than ten seconds)—coughing, movement, normal breathing, pulse and level of consciousness

Compressions are vital, so do not waste time



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Action

Commence rescue breaths

Position patient

- Lay victim on their back
- Kneel alongside victim

Extend airway

- Place one hand on forehead and use thumb and index finger to seal soft part of nose
- Use other hand with pistol grip to maintain chin lift
- Avoid excessive force (use care)
- Avoid lateral movement

Give rescue breaths

- Take a normal breath and placed lips around victim's mouth making a good seal
- Blow steadily into victims mouth and watch the chest rise, which takes about one second; this is an effective rescue breath
- While maintaining head tilt and chin lift take mouth away and watch chest fall
- Give a second rescue breath by following the same procedure
- Give 30 compressions (see Page 54)
- Check signs of life



Mouth to nose ventilation can be used for in-water resuscitation or if the mouth is injured or cannot be opened or if a seal is difficult to achieve

Physiology

- Inspired air contains approximately 21% oxygen
- Expired air can contain up to 17% oxygen
- Can survive with as little as 10% inspired oxygen

The percentage make up of inspired and expired air for a person resting and a person exercising:

Gas	Inspired	Expired (at rest)	Expired (exercise)
Nitrogen	78%	78%	78%
Oxygen	21%	17%	12%
Carbon dioxide	–	4%	9%
Other gases	1%	1%	1%

Cross Infection

- The following have a risk of being transmitted during rescue breaths:
  - Tuberculosis
  - Meningitis
  - Cold sores
  - Hepatitis B
  - AIDS (HIV)
  - Some poisons (eg. insecticides)
- Take care
- If in any doubt use mouth to mask resuscitation

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Problems

- It is important not to delay compressions while looking for signs of life or if there are problems giving rescue breaths
- Commence compressions after no more than two attempted rescue breaths

Problem	Cause	Solution
Chest not rising	Airway obstruction	Check head tilt Check chin lift Check for foreign material and remove Try mouth to nose
	Not enough air supplied	Blow harder
	Inadequate seal	Check nose seal Reseal mouth Try mouth to nose
Air leakage	Inadequate seal	Check nose seal Reseal mouth
Distended stomach	Airway obstruction	Check airway
	Inadequate head tilt	Check head tilt
	Blowing too hard	Blow softer DO NOT press stomach
Regurgitation	Passive flow of stomach contents	Roll on side and clear
Vomiting	Active ejection of stomach contents–sign of recovery	Roll on side and clear Check for normal breathing

Ancillary devices

- Airways, oxygen resuscitators, resuscitation mask, AED etc.
- Only use if trained in their proper use



Don't delay—give rescue breaths while setting up ancillary devices

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Action

Commence compressions



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Adult victims

- Place victim on a hard flat surface
- Kneel by the victim's side
- Position heel of one hand on the centre of the chest with fingers (slightly raised) and running parallel to ribs:
  - Do not apply pressure over the upper abdomen or on the lower sternum
- Place other hand on top of first
- Interlock fingers to prevent pressure from being applied to the victim's ribs
- Keep compression arm (lower hand) locked straight and position yourself vertically over the victim's chest
- Compress chest one third, approximately 4–5cm (1"–1.5") and release pressure without losing contact with chest
- Give 30 compressions at the rate of 100 per minute
  - Compress rhythmically with equal time for compression and relaxation
  - Use upper body weight as compression force
  - Avoid rocking, thumping or quick jabs
- Follow compressions with two rescue breaths
- Continue CPR (two rescue breaths to 30 compressions) until victim starts breathing normally, trained help arrives or you are exhausted

Physiology

Compressions achieve 30-50% of normal blood flow to brain which is enough to prevent brain damage.

Problems

- Incorrect hand position
- Compressions too hard

Effect

- Can crack or break ribs
- Can break the Xyphoid Process
- May rupture internal organs

Solution

- Check position and depth of compressions

Check for pulse

- Maintain head tilt
- Place index finger and middle finger in soft curve between Adam's apple and large neck muscle of patient
- Use flat portion of fingers (tips are too sensitive)
- Don't press too hard
- Allow some time (at least five seconds)
- Only feel one artery at a time
- If pulse present continue rescue breaths



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Action

Apply AED, if trained to use

- Attach and use as soon as possible but only on a non-responsive patient
- Only use manufacturer's recommended and programmed energy levels and accessories

Automated External Defibrillators (AED) will:

- Analyse heart rhythms and displays prompts
- Correct Ventricular Fibrillation (VF) and Ventricular Tachycardia (VT)

Use

- Position and affix pads correctly:
  - Dry area and remove excess hair before affixing pads
  - One pad on right side of chest just under the collar bone and there other on the left side of chest below the breast
- Before use:
  - Ensure no one is touching patient
  - Ensure patient is dry and not in a wet area
  - Avoid metal fixtures
  - Take care around oxygen
- Give only a single shock then continue CPR for two minutes before checking rhythms and pulse

Defibrillation is regarded as an advanced life support technique and should only be done if properly trained.



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Operation

One person CPR

- 30 compressions (almost two per second) followed by two breaths

Two persons CPR

- One performs compressions and the other rescue breaths
- Minimise fatigue by exchanging roles approximately every two minutes
- Minimise delay when swapping roles

Recovery checks

Do not interrupt CPR

- Stop to recheck victim only if normal breathing resumes

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Compression only CPR

- If unable or unwilling to give rescue breaths then give continuous chest compressions at the rate of 100 per minute

Duration

Once started CPR must be continued until either:

CPR skills should be reassessed annually

- Return of normal breathing
- Patient recovers
- Trained help arrives
- Doctor pronounces dead
- Physically impossible to continue

CPR for infants and children

Infant Less than one year old.

Child One to eight years old (guideline only).

Adult Over eight years of age.

	Infant	Child	Adult
Rescue breaths			
Airway	Head tilt and jaw lift		
Inflation	Puff from cheeks Use mouth to nose	Puff gently from cheeks	Blow to inflate
Rate	Two breaths–one second in for each breath		
Compressions			
Compression Point	Centre of chest		
Use	Two fingers	One hand	Both hands
Depth	One third of chest–approximately 4–5 cm (1'–1.5") in adults		
Rate	30 compressions at 100 per minute (approximately two per second)		
CPR rates			
One & two rescuers	30 compressions to two breaths		



CPR using a pocket mask
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Description

Shock is a:

- Physiological response leading to failure of circulatory system (ie. failure to supply vital organs with oxygen via blood)
- Life threatening condition and must be identified and treated quickly
- Positive feedback system (ie the body's reaction increases rather than decreases the effects creating a vicious circle)

Causes

External fluid loss

- Severe bleeding
- Burns
- Excessive sweating
- Dehydration
- Diarrhoea
- Vomiting

Internal fluid loss

- Infections
- Internal haemorrhaging
- DCI–capillary leakage
- Allergic (anaphylactic) reaction to foods, toxins or antivenom

Psychological:

- Fright
- Anxiety
- Emotional distress

Recognition

- Pale, cold, clammy skin
  - Due to reduced peripheral circulation and stimulation of sweat glands
- Rapid, shallow breathing
  - Due to trying to increase oxygen level
- Weak, rapid pulse
  - Due to increased effort to circulate blood and hence oxygen to body
- Dizziness, confusion and reduced consciousness
- Due to lack of oxygen to brain

Other indicators of shock

- Weakness
- Thirst
- Nausea & vomiting
- Apprehension

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Management

- Lay patient down and elevate feet
- **Reassure**
- Keep patient still
- Protect from environment (out of sun if hot, blankets if cold)
- Observe Airway & Breathing
- Arrange medical assistance
- Give patient oxygen to breathe (100% if possible)
- Record all details of accident, condition of patient and first aid given
- Apply Basic Life Support, if necessary
- Apply specific first aid for injury/illness (covered in *Diving First Aid*, *Diving Ailments* & *General First Aid—Modules 12, 13, & 14*)

Moving the patient

- Only move if necessary (ie. out of immediate danger)
- Get help to come to the patient
- Wait 20–30 minutes after the accident (if no signs of shock) or 20–30 minutes after signs of shock have dissipated before transporting patient

Don't

- Give patient anything by mouth
- Move patient
- Give patient any alcohol
- Say anything negative about patient's condition

Always assume shock occurs in any accident situation

1. What does DR H ABCDEF stand for?

2. Why is using a tourniquet dangerous?

3. How can you avoid cross infection:
   a) When treating a bleeding patient?
   b) When giving rescue breaths?

4. What should be done for a person suffering a fit or seizure?

5. When sending a message for help what information must the message contain?

6. List four ways in which a bystander can assist.

7. a) What are the three signs of lack of breathing?
   b) List four signs of cardiac arrest.

8. a) What does AED stand for?
   b) Who can use an AED?

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9. What do you do about the following problem which may be encountered during CPR?
   a) Chest not rising
   b) Air Leakage
   c) Distended stomach
   d) Regurgitation
   e) Vomiting.

10. What three problems can incorrect position of the hands during compression cause?

11. What is the cycle for CPR.

12. List four signs of recovery during resuscitation.

13. List the differences between giving CPR to an infant rather than an adult.

14. List six signs of shock.

15. List the management of shock.

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Scuba Learning Module 12

Accident management

Review 64

Secondary assessment

Assessing a patient 65

Neurological function 66

Potential injuries 70

Oxygen

Delivery 71

Supply 72

Safety 73

DES

Diver Emergency Services 74

Other issues

Accident follow up 75

First aid kit 76

Review questions

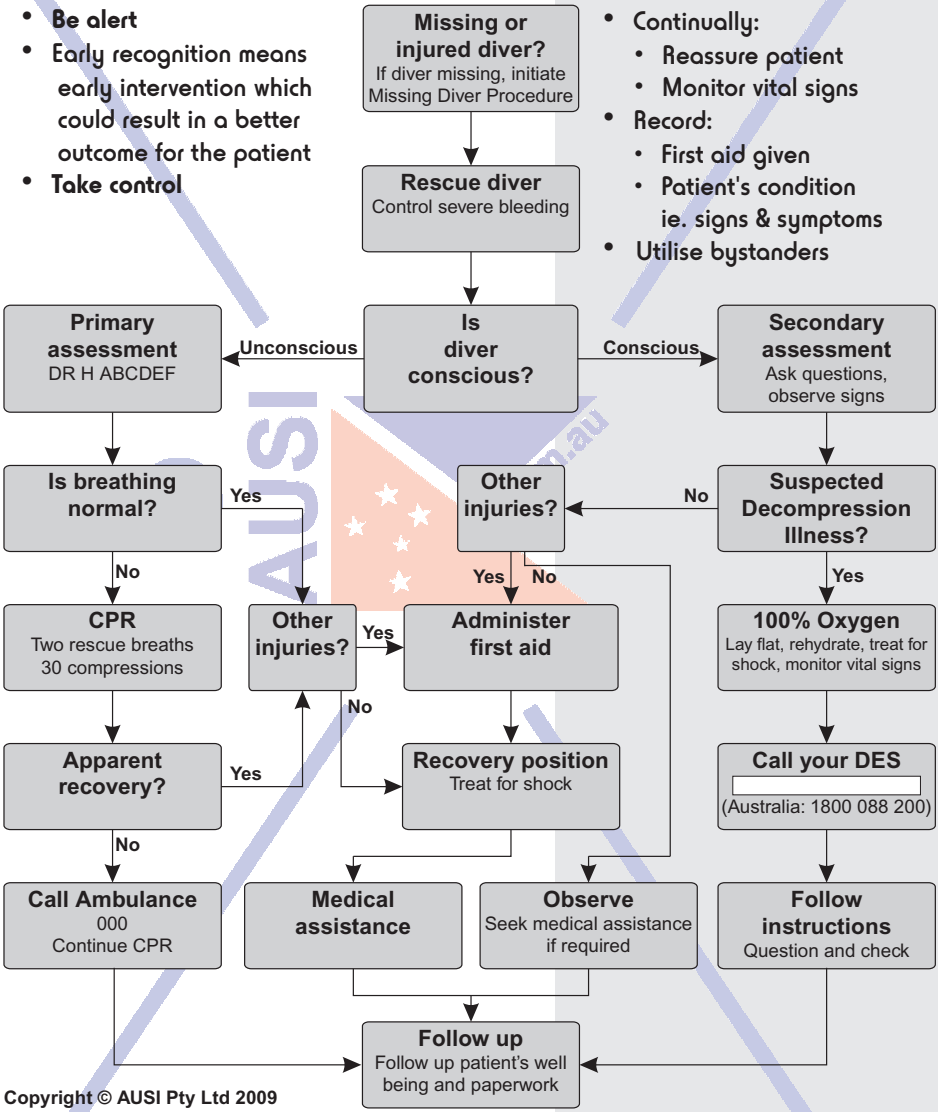
Diving first aid 77



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Scuba Accident Management Flow Chart

- Be alert
- Early recognition means early intervention which could result in a better outcome for the patient
- Take control



- Continually:
  - Reassure patient
  - Monitor vital signs
- Record:
  - First aid given
  - Patient's condition ie. signs & symptoms
- Utilise bystanders

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Purpose

Secondary assessment is an important skill for Rescue Divers and follows primary assessment (DR H ABCDEF), which was covered in detail in Module 11, to:

- Determine the presence of DCI (immediate or delayed)
- Determine signs and symptoms the patient is suffering from
- Identify other injuries or maladies that may require first aid

Personal details & history

- Record patient's personal details (eg. name, address etc)
- Record emergency contact details (eg next of kin)
- When did problem start (before or after dive)?
- Have signs and symptoms changed?
- Have you suffered from this problem before?
- Dive profiles
  - Depth and bottom times
  - Ascent rates
  - Safety stops
  - Incidents
- Any known allergic reactions?
- Any other medical problems?

Always double check details with buddy and assess buddy too

Questioning & recording

- Signs are determined from observation and symptoms are determined by asking the patient questions
- Make questions precise and if possible use yes/no questions:
  - Have you got a headache?
  - Is the headache at the front, back, on top or the side of your head?
- All answers and other assessments must be recorded

Symptom checks

Check patient for the following symptoms where appropriate:

- Dizziness–distinguish between light headness and vertigo (rotational or gidiness)
- Headache–where?
- Ear problems–clearing, pain, ringing, fullness (water), hearing loss?

Vital signs

Check and record patients vital signs continuously

- Conscious state–fully, semi or unconscious
- Breathing–normal or abnormal: depth and rate
- Pulse–present; strength and rate

Examination

The first aider must recognise and report any abnormalities by comparing the patient's normal (baseline) responses (obtained during diving medical–consult log book) with responses to the following tests:

- Mental alertness
- Motor strength
- Cranial nerves
- Sensation
- Balance/Coordination

Mental alertness

Ask the diver

- Who are you?
- Where are you?
- What time of day is it?
- What is your mother's maiden name?
- What is your address and phone number?
- Some simple arithmetic problems

Motor strength

Upper Extremities

- Test grip by diver squeezing rescuers middle and index finger as hard as possible
- Push and pull hand against rescuers grip
- Have diver press palms together and rescuer attempts to pull apart
- Hold elbows out and resist downward pressure

Trunk

- Any problem sitting standing or remaining upright
- Sit up and leg lift

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Cranial nerves

Eyes

- Do eyes track together? (up and down & sidto side)
- Are both pupils approximately same size?
- Do both pupils react equally to light?
- Do both pupils constrict when gaze shifted from far away to finger held 10–15 cm in front of nose?

Face

- Ask diver to:
  - Raise eyebrows
  - Frown
  - Close eyes tightly
  - Smile
  - Show teeth
- Do both sides move equally?

Mouth

- Say "aaah"–uvula and soft palate should rise
- Stick tongue out–shouldn't deviate
- Wiggle tongue from side to side

Hearing

- Is hearing normal (any roaring, humming or ringing)?
- Can you hear rubbing fingers with eyes closed (check with self first for background noise)?

Neck muscles

- Can diver turn chin sideways against rescuers hand (feel face and observe contraction of neck muscles)?
- Pull down on divers wrists and have diver shrug each shoulder upwards against this resistance

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Sensation

- Ask "Does this feel normal?" not "Can you feel this?"
- Look for pain, numbness, hot-cold sensations or woolly/heavy feeling in extremities
- Compare left side to right

Light touch

- Lightly drag finger over front and back of the arms, trunk and legs including fingers, toes, palms and soles
- Touch hairs on arms and legs

Sharp & dull

- Using pin or sharp pencil have diver identify "sharp" or "dull" end
- Drag point vertically across body surface looking for strips of dullness or areas with different feeling

Position

- Diver closes eyes while rescuer moves various joints
- Have diver identify which direction joint was moved

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Balance/coordination

Gait

- Diver walks to and from rescuer - heel to toe (both forwards and backwards)

Rhomberg Test

- Diver stands with feet together, arms away from sides, eyes closed (some swaying is normal)

"Sharpened" Rhomberg test

- Diver stands heel to toe, arms crossed over chest and eyes closed
- Rescuer times up to 60 seconds, record time if diver topples

Alternating movements

- Tapping toes or clapping hands should be smooth without clumsiness

Orientation in space

- Have diver touch own index fingers together overhead without looking
- With eyes closed put heel on knee and run down leg to toes, repeat on other side
- Diver to touch index finger to rescuers palm in different positions (alternate left and right)

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Injuries to look for

The following are some of the potential injuries that can occur in a diving situation and are discussed in detail in the Diving ailments (Modules 13) or General first aid (Module 14).

- Burns
- Carbon dioxide toxicity
- Carbon monoxide poisoning
- Cardiac arrest
- Carotid sinus syndrome
- Cuts and abrasions
- Decompression illness
- Ear barotrauma
- Ear infections
- Envenomation
- Exposure
- Fractures
- Impalement
- Near-drowning
- Pulmonary barotrauma
- Respiratory arrest
- Salt water aspiration syndrome
- Seasickness
- Severe bleeding
- Shallow water blackout
- Shock
- Spinal injuries
- Sprains/dislocations
- Stings
- Unconsciousness

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General

The method of oxygen delivery depends on the patient's condition, of which there are three broad categories:

- Breathing and fully conscious
- Breathing and either semi-conscious or unconscious
- Not breathing and unconscious

100% Oxygen should be used immediately for any diving accident

Breathing and fully conscious

Use demand valve:

- Delivers 100% oxygen
- Can see and hear breathing
- Maximises duration of oxygen supply

Breathing and either semi-conscious or unconscious



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Use non-breather bag mask:

- Delivers 30–70% oxygen
- Can see breathing
- Start at 15 litres per minute
- To maximise oxygen duration, decrease flow rate to suit patient's rate of breathing

Not breathing and unconscious

Give rescue breaths use non-return valve pocket mask supplemented with oxygen:

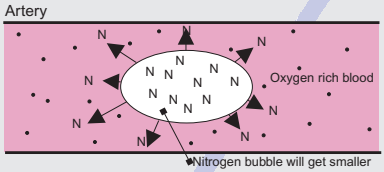
- Delivers 55% oxygen
- Start at 15 litres per minute

Oxygen kit

- Adequate supply of O_2
- Adaptor for scuba regulator
- Dedicated scuba regulator
- Nasal cannula
- Tubing
- Various size therapy masks

Benefits

- Reduces bubble size
- Increased dissolved oxygen in the blood
- Helps to get oxygen to previously oxygen starved tissues
- Helps with respiratory distress
- Reduces the effects of shock



Oxygen cylinders

- Two types of oxygen cylinder
  - Black with white top (Medical)
  - All black (Industrial)

Note: Industrial oxygen can be used in emergencies



- Two types of oxygen valve:
  - Bullnose
  - Pin index

Note: Ensure oxygen regulator is compatible with valve type

Size	Capacity (l)	Duration	Valve Type
C	440	20-40 min	Pin Index
D	1500	1.5-3 hrs	Bull Nose
E	3800	3.5-7hrs	Bull Nose

Delivery systems

Constant flow (not 100% delivery)

- Therapy masks
- Nasal cannula

Demand (100% delivery)

- Tight sealing oronasal mask with oxygen demand regulator
- Dedicated scuba regulator with an adaptor (eg BENDEEZ)

Sources of emergency oxygen

- Hospital
- Dentist
- Surf Life Saving Club
- Veterinary surgery
- Aquarium shops
- Ambulance
- Workshops
- Swimming pools

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Setting up oxygen equipment

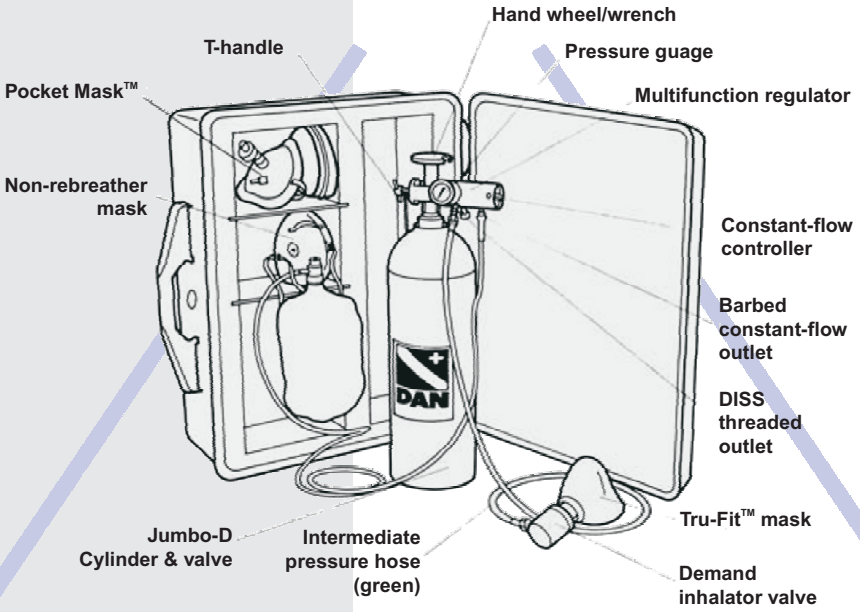
- Be familiar with equipment
- No flames, sparks or cigarettes
- Avoid flammable substances (eg petrol)
- Use in a well ventilated area
- Don't use home made adaptors
- Avoid normal lubricants (consult experts for safe ones)
- If using a scuba regulator, when first turning oxygen on:
  - Depress the purge button
  - Do not have regulator in mouth or near face

Delivery

- Five minutes off for every 25 minutes oxygen
- Record time on and off oxygen and the effects

Adverse effects

- Patient may have a transient worsening of symptoms which should not last more than a few minutes (leave on oxygen)
- Check equipment if adverse reaction continues
- A patient who is hyperventilating (over-breathing) may have difficulty using a demand system (put on constant flow until breathing is comfortable)
- Sufferers of chronic lung diseases (chronic bronchitis or emphysema) may react adversely to oxygen but are highly unlikely to be associated with diving activities



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Function

To provide emergency advice over the phone for diving and pressure related accidents:

- When call is received, "on-call" hyperbaric doctor is paged and calls back
- Response is normally a matter of minutes
- Advice will be given on management, likely diagnosis, first aid and appropriate transport

24 hour diving emergency hotlines

Australia

• Within Australia	1800 088 200
• Outside Australia	+61 8 8212 9242

New Zealand

• DES New Zealand	0800 4DESIII

Korea

• DAN AP Korean Hotline	010 4500 9113

China

• DAN AP Chinese Hotline	+852 3611 7326

South Africa

• Within South Africa	0800 020 111
• Outside South Africa	+27 10 209 8112

America

• DAN America	+1 919 684 8111
• DAN America-Mexico	+52 5 629 9800 Code 9912935

Europe

• Hotline	+39 06 4211 8685

Japan

• Hotline	+81 3 3812 4999

DES (within Australia):
Free call 1800 088 200

DES (outside Australia):
+61 8 8212 9242

Australian DES statistics

Over 500 calls per year are received where:

- 10% are very serious
- 10% are serious
- 60% are divers with symptoms
- 19% are doctors about diving medicals

1% are nonsense calls

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Medical treatment

If victim is transported to a medical treatment facility the following should be done:

- Someone should accompany victim
- Victims clothes and wallet should be sent with them
- Victims next of kin should be informed
- First aid records should go with victim and a copy should be kept by first aider
- Follow up on victims condition by:
  - Ringing medical facility
  - Visiting victim

Advise a follow-up visit to a diving doctor if victim has been given first aid and treatment.

General

- Do not admit liability or blame anyone else
- Put diving equipment aside
- Seek trauma counselling if appropriate
- Keep first aid records for six years (Statute of Limitations)—seven years in Western Australia
- Record names and addresses of witnesses
- Have first aid records confirmed by witnesses
- Fill in relevant accident report forms (eg Project Stick Beak, Diving Incident Report)
- Follow through with victim until satisfactorily resolved

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General

- A diving first aid kit should be available at all times where diving activities are taking place
- Keep a list of the kit contents and any time the kit is used
- Immediately replace any supplies that are used



Contents

- Anaesthetic
  - Spray
  - Ointment
- Antiseptic
  - Cream
  - Spray
  - Ointment
- Bandages
  - Elastic
  - Crepe
  - Triangular
- Cotton buds and wool
- DES Emergency Handbook
- Disinfectant
- Dressings
  - Adhesive plaster
  - Gauze pads
  - Non-adhesive for burns
  - Butterfly strips
- Ear drops and drying agent
- Eye wash
- Fasteners
  - Safety pins
  - Waterproof tape
- Fluids (water)–two litres
- Implements
  - Forceps
  - Knife
  - Needle
  - Scissors
  - Tweezers
- Medication
  - Aspirin
  - Decongestants
  - Motion sickness
  - Paracetamol
- Oxygen kit
- Pencil and note pad
- Resuscitation mask
- Space blanket
- Sun block
- Vinegar

Other useful items

- Boat hook, oars, fins or rolled-up newspaper can be used for splinting
- Outboard motor or car radiator for hot water
- Blankets, towels or clothes as pads or bandages

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1. What is a potential benefit of ear;ly recognition of an accident?

2. What four things must be continually done throughout the first aid process?

3. List six key elements of assessing a patient.

4. a) When must assessment of neurological function be done?

   b) List the areas to be examined.

5. Describe the Sharpened Rhomberg test.

6. a) List four benefits of oxygen for diving first aid.

   b) List six sources of oxygen.

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7. a) How do you achieve 100% delivery of oxygen?

   b) When should 100% oxygen be used?

   c) During delivery of oxygen what should be done?

8. List six safety considerations when using oxygen.

9. a) What service does DES provide?

   b) What is your local number for DES?

   c) What is your international number for DES?

10. List your follow through steps if a diver has to be transported for medical treatment.

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Scuba Learning Module 14

Bleeding	96
Cuts and abrasions	97
Envenomation	98
Spines & impalement	99
Stings	100
Exposure	101
Near-drowning	102
Ineffective breathing (choking)	103
Burns	104
Skeletal injuries	108
Review questions	
General first aid	109



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Physiology

- Adult male has approximately six litres of blood
- A small amount of liquid on flat surface can be deceiving (eg a spilt cup of coffee on a floor covers a large area although it only contains about 200 ml)
- Arterial blood is bright red
- Arterial bleeding comes in spurts

Management

Stop bleeding by

- Press clean cloth onto wound
- If wound is on a limb - elevate the limb
- Keep patient still and quiet - prevents shock
- **Reassure** patient
- Treat for shock

Call a doctor if

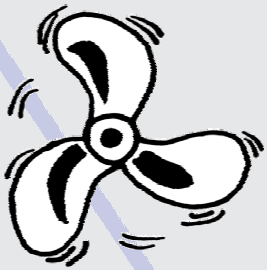
- Bleeding doesn't stop
- Bleeding was severe
- Suspected internal injuries
- Embedded object
- Injury is caused by an animal

Dress the wound

See Cuts & Abrasions (page 97)

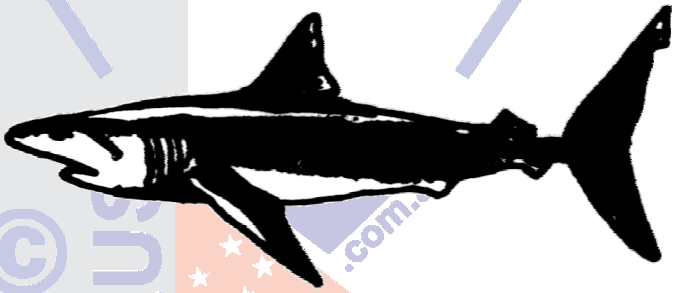
Arterial bleeding is life threatening and takes immediate priority the key to control of bleeding is pressure and elevation

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Cuts

- Clean wound thoroughly with disinfectant and water (wash away from wound)
- Remove any remaining foreign material
- Apply antiseptic
- Control bleeding by direct pressure
- Firmly apply appropriate dressing (do not use cotton wool)
- Seek medical advice if severe or for coral cuts



Abrasions

- If small and minor leave it exposed to dry
- Clean wound as for a cut (see above)
- Cover area with a sterile non-sticking gauze and
- Secure with bandages
- If a wound is serious further cleaning will be necessary in hospital

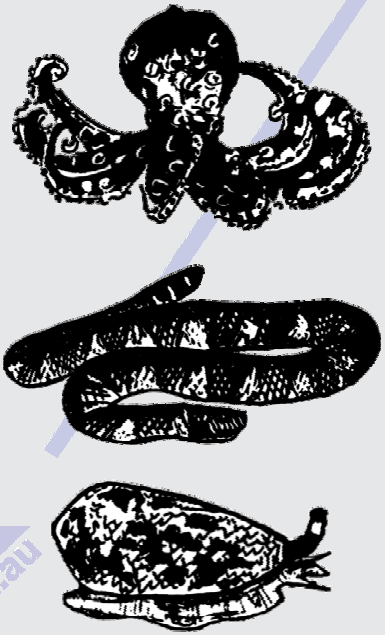
Severe cuts and uncontrolled bleeding require medical attention

General

- Tetanus injections will be required if victim is not already immunised otherwise a booster may be required
- Wear rubber gloves whenever dealing with bleeding, cuts or abrasions to help prevent cross infections

Cause

- Injection of toxin from an animal's defensive or hunting system
  - Snake (including sea snakes)
  - Blue ringed octopus
  - Cone shell
  - Spider (except red back & white tail)



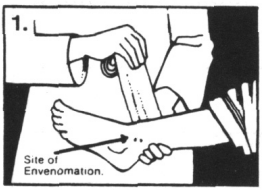
Effect

- Toxin is generally deposited into general circulation via the lymphatic system (see Respiration and Circulation–Module 10)
- Paralysis
- Respiratory and cardiac failure

Management

- The key is pressure and immobilisation, see diagram
- Treat for shock
- Monitor vital signs
- CPR as necessary

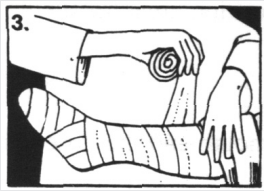
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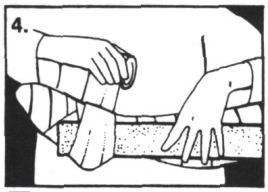
1. Apply a broad pressure bandage over the bite as soon as possible. Keep the bitten area still. Do not wash wound.



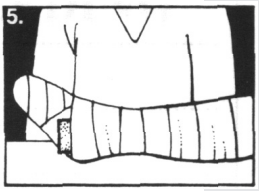
2. The bandage should be as tight as you would apply to a sprained ankle. Fingers or toes should remain pink, with normal sensation.



3. Extend the bandage as high as possible.



4. Apply a splint to the limb.



5. Bind it firmly to as much of the limb as possible. Do not remove until proper medical support is available.



6. Bites on hand or forearm. 1. Bind to elbow with bandages. 2. Use splint to elbow. 3. Use sling. 4. Do not remove bandage.

Drawings courtesy of Dr Straun Sutherland



Old wife
found in temperate waters



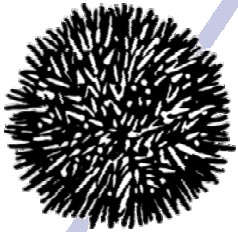
Stonefish
found in tropical waters

Stingray
found in most waters



Causes

- Fish spines
- Stingray barb
- Sea urchin
- Sharp and blunt objects



Sea urchin
found in most waters

Recognition

- Severe pain
- Shock
- Respiratory and/or cardiac distress
- Object/spine projecting from body or visible under skin
- Swelling
- Bleeding

Delayed infection

- Swollen and red around wound
- Tender to touch
- Discharge from wound

Management

- Remove spines carefully
- If wound on limb, immerse in hot water (57 degrees Celsius–check with a normal hand first!)
- **Do not** try to remove large objects, especially in vital areas
- Stabilise object relative to patient and get medical help
- Treat for shock
- Monitor vital signs
- Go to hospital for X-ray to make sure all fragments of spines or objects have been removed

Causes

- Bee
- Wasp
- Jellyfish (including Box Jelly & Irukandji)
- Corals
- Anemones

Recognition

- Severe pain
- Swelling (can be extreme if victim has an allergic reaction)
- Red spot or welts
- Itchiness
- Nausea/vomiting
- Shock
- Respiratory and/or cardiac distress

Management

- If stinging mechanism is still active then neutralise first (for marine stings use vinegar–30 seconds)
- Carefully remove stinging mechanism
- Treat for shock
- Use ice (cold compress) or spray-on local anaesthetic
- Monitor vital signs
- Resuscitate if necessary
- If allergic reaction has occurred check for SOS bracelet and possible medication carried by victim



Anemone
found in most waters



Jellyfish
found in most waters



Hydroid
found in most waters

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Beware of hypothermia even in tropical water—heat is drawn away from the body 25 times faster in water than in air of the same temperature

Hot & cold

Normal temperature

- Body core is maintained at 37°C (98°F)

Too hot

- Sweating–evaporative cooling
- Skin becomes flushed–radiates heat

Too cold

- Shivering–generates heat
- Goose bumps–raise hairs for insulation
- Skin becomes pale–reduces radiation

Energy production exceeds energy loss

°C	Condition	Skin	Colour	Alertness	Muscles	Action
+ 37°C 98°F	**HEAT STROKE**	dry	red	unconcious		apply ice patches cool by fanning URGENT medical help lie victim down
+ 37°C 98°F	**HEAT EXHAUSTION**	excessive sweating	pale	faint	cramps	**sponge down** **cool in shade** **drink cool fluids**
⇧	**HOT**	sweating	flushed			cool shower cool in shade drink fluids
37°C	**NORMAL TEMPERATURE RANGE**					
⇩	**COLD**	shivering	pale		numbness	dry warm shower warm drink
- 37°C 98°F	**MILD HYPOTHERMIA**	uncontrolled spasmodic shivering	blotchy skin and blue extremities	vague	cramps	dry body contact medical help car heater
- 37°C 98°F	**SEVERE HYPOTHERMIA**	shivering stops	blue	unconcious	muscle rigidity	dry body contact urgent medical help wrap in plastic

Energy loss exceeds energy production

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Prevention of hyperthermia

- Stay hydrated, drink plenty of non-alcoholic fluids
- Avoid direct sunlight–stay in shade
- Remove exposure suit on hot days
- Avoid over exertion

Prevention of hypothermia

- Remove wet exposure suits & avoid wind-chill
- Wear appropriate exposure suit
- Abort dive when feeling cold
- Avoid alcohol, before and after diving
- Adequate diet

Definitions

Drowning—death resulting from immersion underwater.

Near-drowning—severe non-fatal aspiration of water.

Salt Water Aspiration Syndrome—minor aspiration of a fine mist of salt water (see Diving ailments—Module 13).

Mechanism

Submergence without air source

- Victim over-weighted
- Equipment failure
- Victim can't swim
- Victim has blackout or heart attack
- Shallow water blackout from hyperventilation

Loss of air source whilst submerged

- Extreme narcosis
- Equipment failure
- Panic
- Out of air
- Victim has blackout or heart attack

Effect

Either may result in an involuntary breath whilst submerged, causing:

- Large amounts of water to be swallowed
- Involuntary laryngeal spasm
- Small amounts of water entering lungs

Recognition

- Coughing
- Chest pain
- Laboured breathing
- Cyanosis
- Foam around mouth (often blood flecked or stained)
- Unconsciousness
- No breathing, no pulse

Physiology

Lungs

- Surfactant can be damaged leading to:
  - Collapse of alveoli
  - Leakage of blood and protein into lungs from the capillaries (Pulmonary Oedema)

Stomach

- Leakage of blood, protein and electrolytes into the stomach

Blood

- Can cause major changes to blood chemistry

Management

- Observe vital signs
- Resuscitate if necessary
- Give 100% oxygen
- Hospital for at least 24 hours

Recovered near-drowned victims must be hospitalised for observation as a fatal relapse may occur

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Cause

- Airway obstruction (eg. tongue, epiglottis, foreign material etc)
- Paralysis (eg. spinal cord damage, cardiac arrest, stroke, electric shock, poison, envenomation
- Chest injury (eg pneumothorax)
- Lack of oxygen (eg fluid or blood in lungs, near-drowning, smoke or gas inhalation, strangulation, suffocation etc)
- Head injury
- Drugs

Recognition

- Laboured noisy breathing
- Nostril flaring
- Rapid breathing and heart rate
- Sweating
- Cyanosis (bluish colour–extreme lack of oxygen)

First aid

- Back blows may help
- 100% oxygen
- Don't use abdominal thrust techniques due to danger of:
  - Damage to internal organs
  - Vomiting or regurgitation
  - Damage to foetus if pregnant
- Monitor condition
- If deterioration (especially cyanosis) then commence rescue breaths

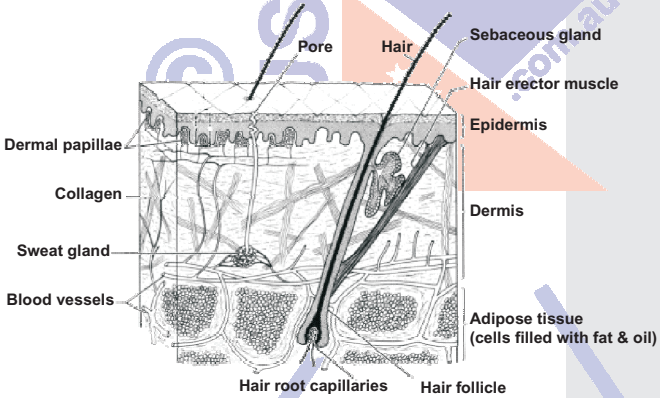
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Causes

- Sunburn
- Flame
- Electrical
- Chemical
- Scalds
- Heat and friction (ropes)

Types of burns

Type	Definition	Recognition
First degree—Surface	Outer skin layer (epidermis) only	Painful, sensitive, red, dry skin. No blisters
Second degree—Partial thickness	Down to inner skin (dermis) layer	Moist, mottled, painful sensitive skin & blisters
Third degree—Full thickness	All skin and subcutaneous layer	Dry white or charred skin Little pain, insensitive



Management

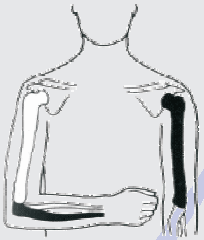
- Remove from source and remove any contaminated clothes
- **Cold** running water for minimum of ten minutes (no lotions)
- Treat for shock
- Medical help for second and third degree

Sprains

- When joint ligaments are over stretched and torn
- Characterised by swelling, bruising and pain
- Pack joint in ice as soon as possible (reduces swelling)
- Bandage firmly to prevent too much movement
- Will heal in approximately 10 days if properly supported with pads and bandages

Dislocations

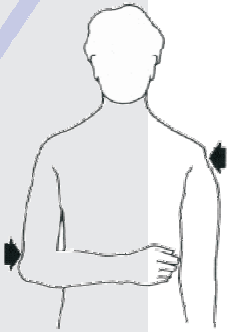
- When bones are separated at a joint (eg shoulder, elbow, hip, knee, thumb or finger)
- Joint can no longer be moved, very painful, and looks deformed
- Support the injured area in a comfortable position so that the two bones can't move relative to each other (eg. sling or splint)
- Take to hospital where they can manipulate joint back into place
- Do not attempt to relocate joint as can cut off circulation or nerves causing permanent damage



Normal joints



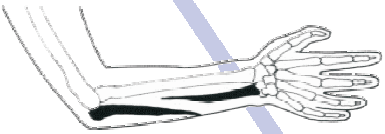
Dislocated joints



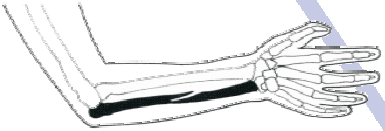
Signs of dislocation



Closed fracture—The skin is not broken



Open fracture—TBone protudes or there is a deep wound over it



Greenstick fracture—The bone is bent or not completely broken

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Fractures (broken bones)

Types

- Closed–internal injury
- Open–bone protruding from flesh
- Hairline–bone is cracked but not separated
- Green-stick–bone is broken and separated

Recognition

- Pain
- Swelling
- Bruising
- Odd shape or orientation of limb
- Limb won't support weight
- Can't move limb

First aid

- Avoid movement of limb
- Get into comfortable position and immobilise limb (support both side of break so no relative movement)
- Cover any protruding bones with sterile dressing
- Do not attempt to retract bones into wound as can cause damage to blood vessels and nerves
- Treat for shock

Treatment

- X-ray to determine extent of damage
- Fracture 'reduced' (bone put back in normal position)
- Limb probably 'set' in plaster cast
- If break is severe may require surgery and supporting pins, plates etc

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Jaw fracture

- May be life threatening if victim is unconscious or jaw is broken on both sides
- Do not bandage

If conscious

- Assume position of greatest comfort (usually sitting up and leaning forward)
- Patient may wish to support own jaw

If unconscious

- Monitor and maintain vital signs

Spinal injuries

If conscious

- Do not move
- Treat for shock
- Call for medical assistance

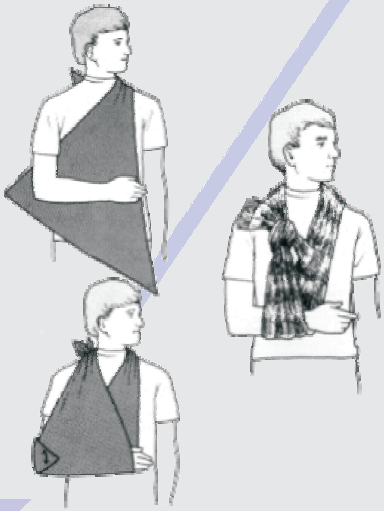
If unconscious

- Carefully place in 'stable side position'
- Ensure neck support at all times
- Avoid lateral movement
- Monitor and maintain vital signs

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Bandaging

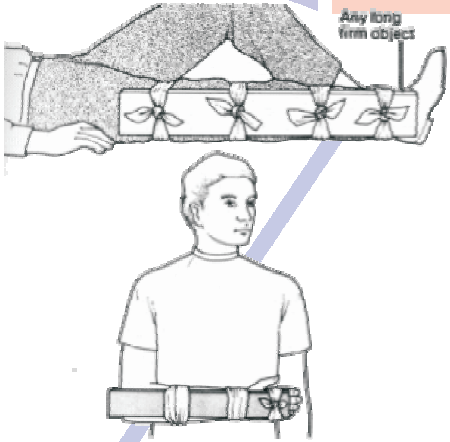
- Bandaging should be firm but should not cut off circulation
- A few minutes after bandaging, check extremity of limb (ie toes or fingers) for temperature, colour and feeling

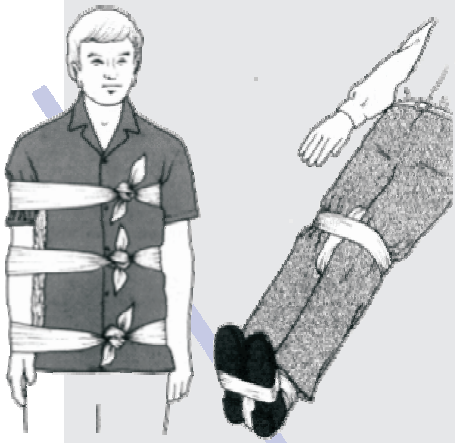


Applying a triangular bandage

Splinting

- Used to immobilise limb above and below a fracture or injured joint
- Material used must be long, wide and firm
- Material can be improvised from rolled up newspaper, boat oar, boat hook, flag pole etc
- Use padding to prevent discomfort, further injury and to accommodate any deformity
- Splint must fit snugly





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1. What is the key to controlling bleeding?

2. a) What should not be used when treating cuts?

   b) List two general precautions when dealing with cuts.

3. Describe the Pressure Immobilisation Technique.

4. List the management for a stingray barb?

5. List the management for a jellyfish sting.

6. a) What are the distinguishing differences between cold, mild hypothermia and severe hypothermia?

   b) List four factors which help to prevent hypothermia.

   c) What is the first aid for heat exhaustion and heat stroke?

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7. Why is it important to have a recovered near-drowned victim hospitalised?

8. List five signs of choking.

9. List the management for burns.

10. a) Define:
(i) a sprain

(ii) a dislocation

(iii) a fracture.

b) List the management for a suspected spinal injury if:
(i) conscious

(ii) unconscious.

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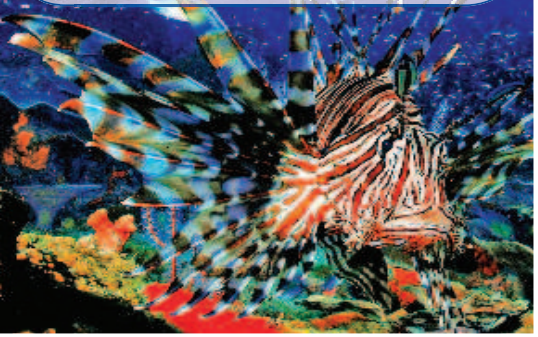
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