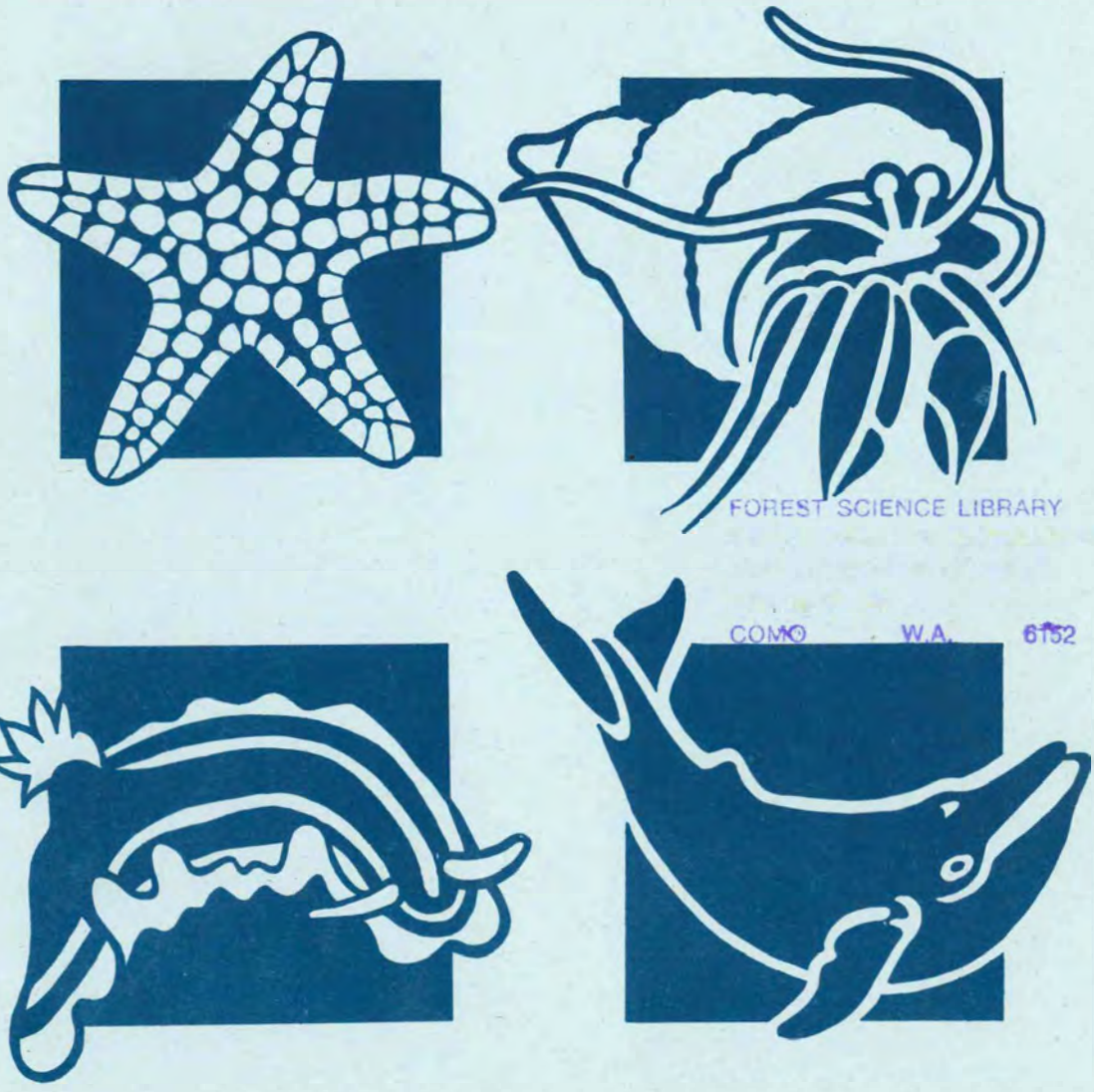
Exploring Coastal Waters



Department of Conservation and Land Management

OCEAN RESCUE 2000

4096-0695-1M

CONTENTS

PREFACE

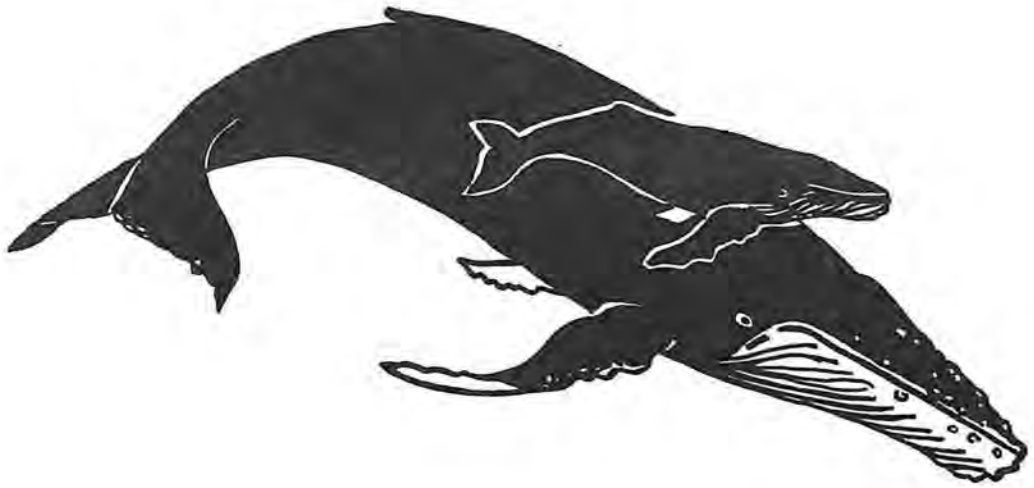
This kit is the first in a series of packages on the marine environment to be produced for primary and secondary schools. The activities contained in the kit are designed to be carried out in the temperate waters and coastal areas of Australia.

This package was developed with the assistance of the Ocean Rescue 2000 National Marine Education Program. Ocean Rescue 2000 is a ten year conservation and management program which aims to ensure the wise and sustainable use of Australia's marine and coastal environments. It is administered by the Department of the Environment, Sport and Territories in partnership with its agencies, the Great Barrier Reef Marine Park Authority and the Australian Nature Conservation Agency.

The project was co-ordinated by the Department of Conservation and Land Management (CALM), Western Australia, as a part of its commitment to marine management. CALM is responsible for the management of marine reserves and for the conservation of marine plants and animals. No management of natural areas can be successful without the assistance and support of the people who live near and/or use these environments.

This kit is designed to help increase the awareness and understanding of the marine environment so that our unique temperate waters areas can be appreciated, conserved and protected for future generations.

The writers of the activities are primary school teachers chosen for their skills and experience in developing resource materials. All activities have been trialed in the classroom or with students at the beach.



ACKNOWLEDGEMENTS

The people involved in this project were:

Rae Burrows (Project Co-ordinator)

Rae is the Interpretation/Education Officer for CALM's Swan Region in the greater metropolitan area around Perth. She is responsible for the planning and development of interpretation and education facilities and resources in the Region's three marine parks. She guided the development of this package.

Janette Huston (Team Co-ordinator)

Janette is a primary school teacher at St Anthony's School at Greenmount, WA. She also works part time at Greening Western Australia as the Landcare Education Officer. She was the team leader of CALM's Exploring Wheatbelt Woodlands kit for upper primary schools. Janette wrote the section entitled 'Seagrass Meadows'.

Sue Doncon (Writer)

Sue has been teaching for 13 years. She is an active member of the Primary Science Committee and is committed to improving and developing the role of science in primary schools. Sue was responsible for writing the 'Sandy Beaches' section.

Bob Huston (Writer)

Bob is a primary school teacher at St Francis Xavier in Armadale, WA. He has been teaching for 10 years and enjoys incorporating environmental studies into his education program. Bob has a keen interest in the marine environment. His role in this package was to write of the section entitled, 'Limestone Reefs'.

Kerry Langley (Writer)

Kerry has taught for 18 years in Western Australian schools. She has always had a keen interest in marine science, spending 18 months as an Education Officer for the former Atlantis Marine Park at Two Rocks, W.A. Kerry is committed to helping people become aware of the importance of conservation of the marine environment. She is responsible for 'The Deep' section in this package.

All members of the writing team contributed to the development of the 'Reef Walker' game. David Burton, of CALM's Marine Operations Group prepared the information for the touch pool activity.

Word processing was done (again and again) by Julie Davies of CALM's Swan Region. Her patience and persistence is greatly appreciated.

The accuracy of the technical information within the package was checked by CALM's wildlife and marine experts.

Text was edited by David Gough of CALM's Corporate Relations Division. The package was designed and illustrated by Kellee Merritt.

Financial assistance from Ocean Rescue 2000, CALM's Corporate Relations Division, and the Swan Region Nature Conservation Program is gratefully acknowledged.

All contributors are acknowledged for their enthusiasm and commitment.

MARINE RESERVES AND MANAGEMENT

Australia is blessed with a long and varied coastline and an abundance of marine life, which has had a long history of use and appreciation, dating back to the earliest Aborigines. There is an increasing awareness that the marine environment has a number of values, from recreational and commercial fishing, to tourism and conservation. Management is essential to protect and use the resources wisely for future generations.

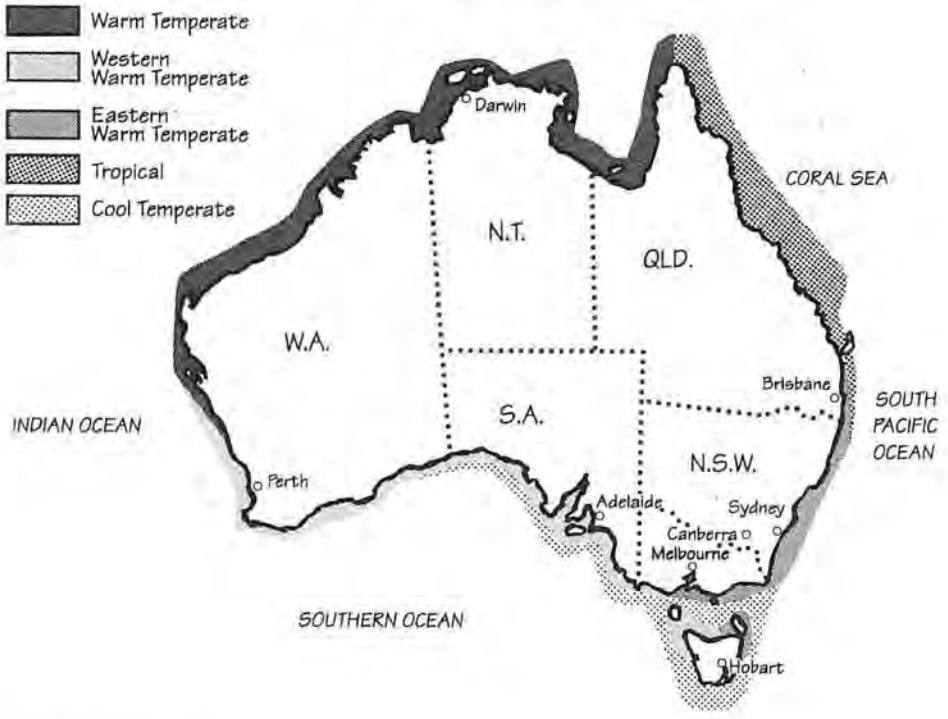
Marine ecosystems are inter-connected to a greater degree than terrestrial systems. In the sea, the water itself is the habitat of a large number of marine living things for all or parts of their life cycles. Planktonic and nektonic plants and animals spend their entire lives drifting or swimming in the water. Even most bottom dwelling organisms have larval stages that are planktonic and may be widely dispersed by water currents.

The water mass is the site of most of the ocean's primary production. The resulting energy may be carried by currents from its place of origin over long distances to support other ecosystems. Water currents may also quickly spread pollutants from site of origin to nearby habitats.

The openness of marine ecosystems means they can be influenced by events beyond their own boundaries. They also can be quickly recolonised from other areas by means of planktonic larvae, if they become degraded. Management of the marine environment must take these aspects into account..

There are two major marine plant and animal provinces in WA, a tropical province in the north, and a temperate province in the south.

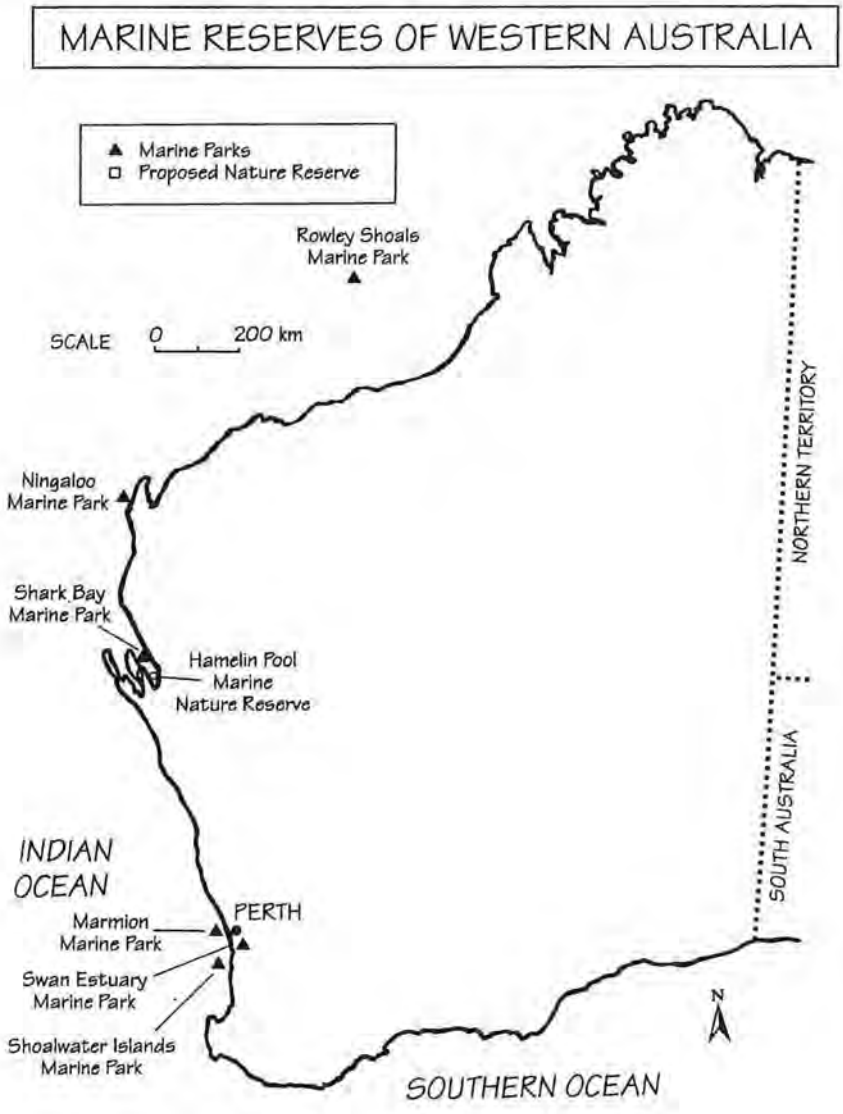
THE BIOGEOGRAPHICAL PROVINCES OF THE AUSTRALIAN COAST



The northern plants and animals belong to the vast Indo-West Pacific Region which stretches from the east coasts of Africa to French Polynesia, and from the Ryuku Islands of Japan to the northern coasts of Australia. The temperate plants and animals belong to the Southern Australian Region, which extends across the entire south coast of the continent. Most species in this region are endemic. There is also some local endemism along the south-western and south-eastern coasts. There is some overlap of the regions off the central west coast.

WESTERN AUSTRALIAN MARINE RESERVES

In Western Australia, there are currently eight marine reserves set aside for their representative wildlife and for their conservation and recreation values. Seven of the reserves were established under the Conservation and Land Management Act 1984, and one was established under the Rottnest Island Authority Act 1987. More areas with representative habitat types and wildlife, are being investigated for inclusion in the State's marine reserve system.



Marine reserves established under the CALM Act are currently of two types:

1. Marine Nature Reserves - set aside for conservation, restoration and study of the natural, archaeological and historic environment. Marine plants and animals may not be killed or interfered with except for scientific purposes under licence. One currently exists at Hamelin Pool, at Shark Bay.

2. Marine Parks - where recreation is allowed as long as the natural and cultural environment is conserved and restored. Recreational and commercial fishing is permitted. Zoning within the park may separate incompatible activities. In the metropolitan area, there are presently three marine parks—Marmion, Shoalwater Islands, and Swan Estuary marine parks.

A new category of reserve, Marine Management Area, is to be created under the CALM Act. This will be a multiple-use reserve.

OVERVIEW

Exploring the Coast: Teaching Activities for Upper Primary School comprises a wide range of teaching activities and supporting information written and trialed by practising teachers. The kit is closely linked to the primary school curriculum and supports the aims of the Student Outcome Statements. 'First Step' concepts have been used throughout the package.

Subjects addressed in this package include:

- social studies
- science
- language
- art and craft
- mathematics

The goal of the kit is to empower children and teachers with the knowledge to actively assist in the conservation of marine and coastal environments.

Specific objectives are to:

- increase appreciation and awareness of the marine and coastal environments
- increase knowledge of marine wildlife, landscapes, values and management issues
- improve understanding of marine management issues
- enhance personal commitment to the oceans and its wildlife
- encourage positive community action to protect and conserve marine communities.

The kit is divided according to four main habitats:


limestone reefs


seagrass meadows


sandy beaches


the deep

The activities in each of these habitats are designed to:

- be hands-on (action-based)
- integrate both the school and beach environments
- be environmentally sound

A glossary of key words, and lists of relevant references and videos are included at the back of the kit. A pledge sheet and certificate prototype is also included to assist teachers reward students who at the end of the year have tried to change their behaviour to help conserve the marine world.

KEY OUTCOMES

Knowledge

Students will understand:

- the adaptations of wildlife to their marine environment
- the diversity of life beneath the waves
- that marine ecosystems are inter-connected and contain interdependent organisms
- that people have a significant impact on the marine communities
- that making decisions about the marine environment involves choices between a range of options, and that individuals have an important effect on these choices and on the management of marine and coastal environments.

Skills

Students will:

- develop skills in basic scientific research and monitoring techniques
- develop skills in describing the environment through art, mathematics and writing.

Values

Students will:

- learn to value marine environments highly and act in ways that protect their conservation values.

SUMMARY OF ACTIVITIES

This program consists of 22 teaching activities developed for the temperate areas of coastal Australia. Although initiated in Western Australia, most of these activities would be applicable in the temperate waters areas Australia-wide.

Each activity includes objectives, curriculum links, background information, resource sheets, supplementary activities, and a wealth of other information.

While each activity may be used for a 'one-off' lesson, a more coherent program should include a number of school - and excursion-based activities. The activities are aimed at Years Five, Six and Seven. Most may be readily adapted for older and younger children.

The activities are arranged into the four habitat themes and one general marine theme. Following are outlines of each theme, its activities, and the major curriculum links. Excursion-based activities are identified with {E} and school-based activities are denoted {S}.

Limestone Reefs

This zone covers intertidal and submerged limestone reef systems, and introduces some of their inhabitants.

Secrets in Stone {E} examines the formation and erosion of limestone. The ecological concept of change is illustrated by the activity. Some school pre- and post-visit activities are outlined to help students understand the lengths of time involved in these natural processes. (Science)

Hopping Rock Pools {E} introduces marine plants and animals of the limestone reefs and investigates some of the links between them in food webs and food chains. (Science)

Rocky Shore Safari {E} investigates some of the adaptations that the creatures of the limestone reefs have developed in order to survive and thrive in their environment. (Science, Maths)

Creature Feature {S} uses the concept of adaptation to create a creature that would best feed and survive in a rock pool. (Art, Science)

Conservation Code {S} brings all the activities together and amalgamates the value statements into a pledge to assist in the conservation of the marine environment. (Language)

Sandy Beaches

Sandy beaches - the place where everyone likes to stroll, but where there are hundreds of treasures, if you know how to look.

What's that Shell? {E} is discovering the amazing world of shells. The ecological concepts of diversity and adaptation are investigated. (Maths, Science, Language)

Beach Litter Survey {E, S} Where's all the rubbish coming from? What effects does it have on the marine ecosystem? We can help by reducing, recycling and reusing. (Maths, Science, Social Studies)

Making Waves {E} Watch the waves totally decimate a coastal development! (Science, Language)

Role Coasting {S} Pretend to be someone else and fight for your views. (Social Studies, Language)

See Birds {E} is a quiet activity which highlights the differences and adaptations of the various fascinating seabirds.(Science, Maths, Language)

Seagrass Meadows

The nursery and the lungs, the sand stabilisers, and the source of food - seagrass meadows are one of the most important ecosystems.

The Ocean's Garden {E} classifies and develops an herbarium of seaweeds and seagrasses. The differences between the two are investigated. (Language)

What am I? {E} enables students to take the first step towards being marine biologists by identifying marine algae and animals. (Language, Science)

Seagrass Forests {S} shows the importance of the seagrass meadows as a life support system. The impact of people is explored. (Language)

Sound Seagrass {S} investigates the seagrass meadows of Cockburn Sound and our past and present effects on them. (Language, Health, Social Studies, Maths)

A Happy Family {S} is a role play of a sheltered shore food web, concentrating on the importance of seagrass meadows to the system. (Science, Language)

The Deep

This habitat is 'the deep' - a place of wonders, some of which are still undiscovered or poorly understood.

Shipwrecked {S} looks at the myths and legends that have developed over the years about the oceans and their inhabitants. Students are asked to create their own 'monster' based on a real animal. (Social Studies, Language, Art)

A Whale of a Time {S} introduces students to the wonders of the great whales and shows their immense size when compared with people. The dependence of all marine animals on the oceans as a whole is also investigated. (Language, Health, Maths)

Find my Home {E} shows students that the constant movement of the ocean delivers exciting objects from the ocean depths to the shore. (Maths, Science)

Depths of the Ocean {S} examines the deep and the various animals and plants that live in the photic (light) zones. (Science, Art)

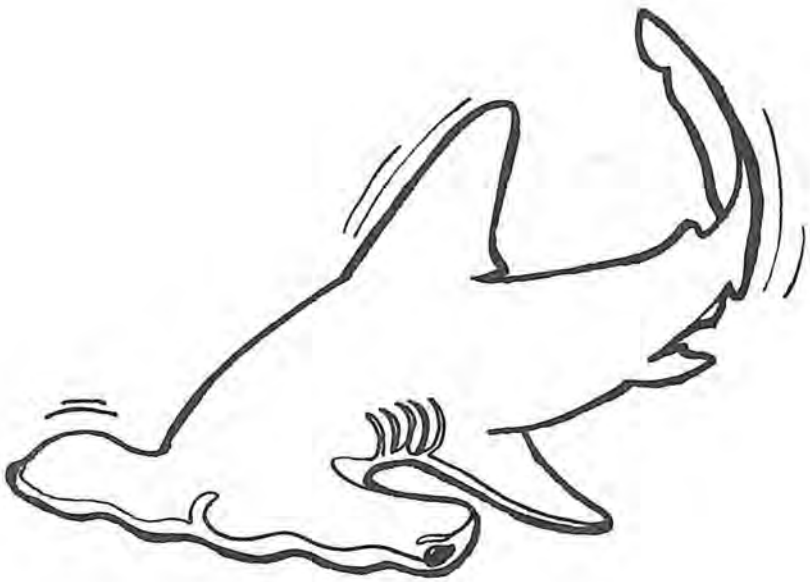
Why is the Sea Salty? {S} investigates just why the ocean is salty and where the salt all comes from. (Science)

Exploring Coastal Waters

Two activities which brings all the concepts together.

Touching Wonders (E) brings the wonders of the ocean to the students — without even getting their feet wet! The touch pool is a great activity to introduce the students to marine life before they go snorkelling. (Science)

Reef Walker (S) is a board game which leads the players through all four of the habitats and discovers how much they have learnt from the previous activities. (Science, Maths)



TABLES OF THEMES AND ACTIVITIES

Theme	Activities (E = Excursion S = School)		Main Curriculum Area					
			Science	Art	Language	Maths	Social Studies	Health
LIMESTONE REEFS 	Secrets in Stone	E	✓					
	Hopping Rock Pools	E	✓			✓		
	Rocky Shore Safari	E S	✓					
	Creature Feature	S	✓	✓				
	Conservation Code	S			✓			
SANDY BEACHES 	What's that Shell?	E	✓		✓	✓		
	Beach Litter Survey	E	✓			✓	✓	
	Making Waves	E	✓		✓			
	Role Coasting	S			✓		✓	
	See Birds	E	✓		✓	✓		
SEAGRASS MEADOWS 	The Ocean's Garden	E			✓			
	What am I?	E	✓		✓			
	Seagrass Forests	S			✓			
	Sound Seagrass	S			✓	✓	✓	✓
	A Happy Family	S	✓		✓			
THE DEEP 	Shipwrecked	S		✓	✓		✓	
	A Whale of a Time	S			✓	✓		✓
	Find my home	E	✓			✓		
	Depths of the Ocean	S	✓	✓				
	Why is the Sea Salty?	S	✓					
EXPLORING COASTAL WATERS	Touching Wonders	E	✓					
	Reef Walker	S	✓			✓		

The "C" Code

Visiting the beach requires you to take care - both of yourself and of the environment.

Come prepared: Always bring sunscreen, hat, T shirts, sandshoes and drinking water. Help conserve the wildlife by causing as little disturbance as possible particularly near nesting seabirds and on the vegetated dunes.

Be Cautious: This is a different environment to that which humans are adapted. A few rules must be adhered to:

- Never stand with your back to the ocean
- Watch out for limestone overhangs and ledges. They may collapse without warning.
- Don't run on the rocks.

Be Cool: Remember the 'slip, slop, slap, wrap' slogan and make sure your students are well prepared. Take extra drinking water and ensure sandshoes are worn when reef walking.

Be Careful: Explore with a friend. Always display the dive flag when snorkelling or diving.

Be Courteous: Make sure your activities do not spoil someone else's enjoyment of the area.

Be Conservative: Keep to the paths and beaches. Always return things to the places you found them. Observe in place rather than take.

Be Clean: Please do not feed the wildlife. Take your rubbish home with you when you leave. Gloves should be worn when doing litter surveys-needles should be left alone and ranger or teacher informed. Use a stick when looking through seaweed.

Come Back: Return and discover more about this magnificent environment.

REMEMBER
Take only photographs,
and leave only footprints.

Limestone Reefs

Secrets in Stone

This is an excursion-based activity where students collect and examine mineral samples to obtain a greater understanding of the structure and formation of limestone reefs.

CONCEPTS

- The limestone foundation of the reef has developed over tens of thousands of years and is still an ongoing process.
- The limestone of the reef encourages the life of many different marine plants and animals.
- Conservation of the limestone reef system includes not only the living marine creatures, but also includes the non-living elements such as limestone.

OBJECTIVES

- Students will understand the formation of limestone reefs.
- Students will make a record of mineral samples collected.
- Students will construct a map detailing the relief structure of the limestone reef, location of mineral samples, and fossil deposits.

VALUES

- Students will understand that limestone takes a long time to form and needs to be protected from harmful human activity.

CURRICULUM LINKS

CURRICULUM AREA	STAGE / YEARS	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Language	5,6,7	3.2.13 Maps	A. Interpret and draw a variety of maps for different purposes.
Science	5 6	Matter/Energy Matter	Investigating ways of changing substances. Investigating rocks and crystals.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Life and Living	4.15 Explains how living things have changed over geological time, using evidence from various sources
	Natural and Processed Materials	4.18 Recognises and describes conditions that influence reactions and change in materials

BACKGROUND INFORMATION

Limestone reef formations have developed over many thousands of years.

In that time, the sea level hasn't always been the same, but has risen and fallen many times. For example, approximately 18,000 years ago, the coastal plain extended a further 20 kilometres west, beyond Rottnest Island. Rottnest itself then stood as a hill rising on the coastal plain. Five to seven thousand years ago the sea level rose to cut off Rottnest Island from the mainland.

The coastline then was not the one we have today. Around 3,000 years ago, the sea level dropped again by about 2.5 metres to the sea level we see today.

Limestone has been formed from the continuous deposit of sedimentary layers of calcium carbonate. Typical of these calcium carbonate rich materials has been organic matter of marine life, such as shells, corals and skeletal materials.

Over the millennia, chemical and physical processes have lead the calcium carbonate rich solutions to leach out of the sedimentary deposits and cement the layers into limestone formations. The limestone formations which were more resistant to erosion by the sea formed reef features like Carnac Island. The many familiar features seen on coastal reef systems, such as rock pools, cliffs, overhangs and caves, illustrate limestone's susceptibility to the forces of erosion.

KEY WORDS

calcium carbonate, limestone, millinium, mineral, sedimentary, leach, erosion

REFERENCES

Mackness, B. (1990) *Mastering Sea Shores.* Dellasta, Melbourne.
Gould League of Victoria (1988) *Coastal Wildlife.* Gould League of Victoria Inc. Victoria.

TEACHER DIRECTIONS

Materials

Glue
Magnifying glass / student
Clipboard / student
Witches hats (3 of)
Limestone rock samples
Hammer
Vinegar
Hacksaw blades
Ice-cream containers

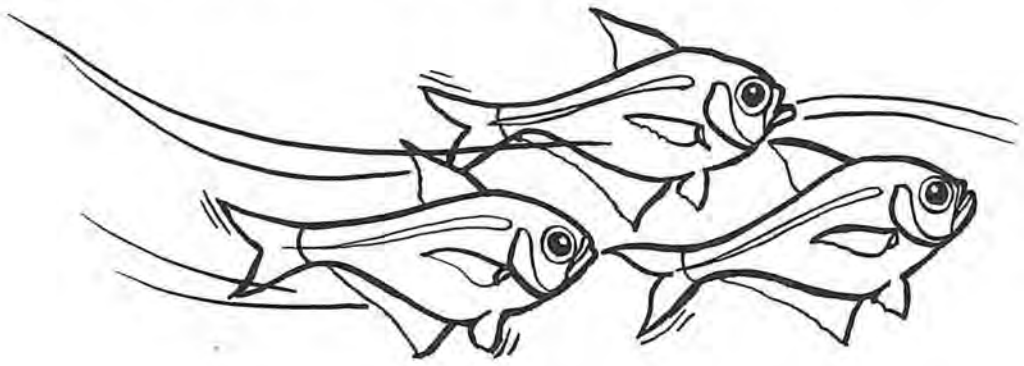
LESSON OUTLINE

Pre-excursion Activity (Worksheet 1)

While at school, students will be involved in an activity discovering some of the characteristics of limestone. The students working in groups will explore and compare the qualities of limestone with one or more other minerals (eg. granite or sandstone) by:

- SANDPAPER TEST: Testing for hardness by rubbing a sample with coarse sandpaper. The students comment on how resistant limestone was to the sandpaper.
- CRUSHING TEST: Testing for hardness by examining how easy it is to crush limestone rock into a powder-like form by pounding it. The students comment on how easy or difficult it is to crush limestone using a hammer.
- WATER TEST: Testing to see what effect water has on the durability of limestone by soaking a sample in water for 5 -10 minutes. After soaking, students check to see if this has weakened the rock's hardness by rubbing it with sandpaper, as before and comparing the result with the previous Sandpaper Test.
- CHEMICAL TEST: Testing how resistant limestone is to the effects of chemical erosion by immersing a limestone sample into acetic acid (or vinegar). The students comment on what effect vinegar has on the limestone.
- HACKSAW TEST: Students test how resistant limestone is to being sawn by a hacksaw blade. The students comment on how easy or difficult it was to saw through limestone.

Using the information they have gained from the above tests, the students briefly describe the qualities of limestone.



Excursion Activity (Worksheet 2)

Lead students through their excursion activity sheet. Ensure that before they start the activity, the students understand the tasks set before them. Of special note is their response to the final question.

Ask the students to draw a map of the excursion area from a suitable vantage point. Identify the boundaries for the students. Mark these with two of the witch's hats and use the third hat to mark the vantage point. Discuss the physical characteristics of the area. The students complete the map and use a legend and symbols to mark the features of the area. Fossil locations and soil sample locations will be marked later.

Once the map has been completed and initial discussion concluded, the students should be familiar with the excursion site and their thinking tuned in to the tasks ahead. Lead the students on through their follow-up tasks.

The students are to collect four rock or sand samples from four different locations, beginning at the reef as near as possible to the water line, and ending at the base of the dune system or at the high tide mark. The samples are to be glued in order in the boxes on Worksheet. The students then compare the samples under magnifying glasses and note the major differences.

Explain the term 'fossil' and send the students on a search over the reef for fossil deposits. Each fossil discovery to be marked on students' excursion site maps.

Discuss the characteristics of limestone. Complete Worksheet 2.

EVALUATION

- Were the students able to compare and contrast the samples effectively?
- Were the students able to describe the composition of limestone rock?
- Were the students able to produce a map of the excursion site?

COMPLEMENTARY ACTIVITIES

Excursion to the E. De Clarke Geological Museum, The University of Western Australia (Nedlands), Mineral House (Department of Mines and Energy in Perth).

Establishing a geology display table in the classroom.

WORKSHEET 1

Name:________________________

Date:________________________

LIMESTONE DISCOVERY TESTS

MINERAL	SANDPAPER TEST	CRUSHING TEST	CRUSHING TEST SAMPLE	HACKSAW TEST	WATER TEST	CHEMICAL TEST
	Hard Soft	Comment	Glue	Very Resistant Not very Resistant	Comment	Comment
	Hard Soft	Comment	Glue	Very Resistant Not very Resistant	Comment	Comment
	Hard Soft	Comment	Glue	Very Resistant Not very Resistant	Comment	Comment
	Hard Soft	Comment	Glue	Very Resistant Not very Resistant	Comment	Comment
	Hard Soft	Comment	Glue	Very Resistant Not very Resistant	Comment	Comment

Using the information you have gained from the five tests describe the qualities of limestone you have discovered:

WORKSHEET 2

Name:_____
Date:_____

SECRETS IN THE STONE

LOCATION	SCALE

LEGEND

- Mark in the position of your view - (observer)
- Calculate a scale
- Complete the legend and mark in your map the location of the major features eg. reef line, rock pools, cliffs, points, sand beach, boulders, etc.
- Collect four mineral samples from the area
- Begin by collecting from the water line and work back ending at the base of the dunes
- Mark the location where each sample was taken on the map using an appropriate symbol
- Glue your samples in the corresponding squares below

SAMPLE 1 | SAMPLE 2 | SAMPLE 3 | SAMPLE 4

MINERAL SAMPLES

- How do the mineral samples compare to each other in grain size, texture, composition and colour?

- Describe limestone rock (How does it feel, what is its texture, colour, what materials can be found in it, etc.)

Rocky Shore Safari

Students complete transect type study of a coastal limestone reef shelf for marine animals. Students identify what adaptations each animal has developed that enable it to survive in areas where it is found.

CONCEPTS

- Plants and animals develop the right adaptations to meet the prevailing conditions of their environment.
- Plants and animals are found in places where they are best adapted to survive.

OBJECTIVES

- To complete a transect type study.
- To identify adaptations an organism has developed to meet its prevailing environmental conditions.
- To understand that for living things to survive they must adapt to their environment.

VALUES

- Students will understand the need to put marine organisms back in exactly the same places they were found.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Mathematics	5/6/7	N:P4.2	Record and interpret data using standard tally.
Science	6	A Small Animal	Investigating responses to animals and their environment.

STUDENT OUTCOME STATEMENT LINKS

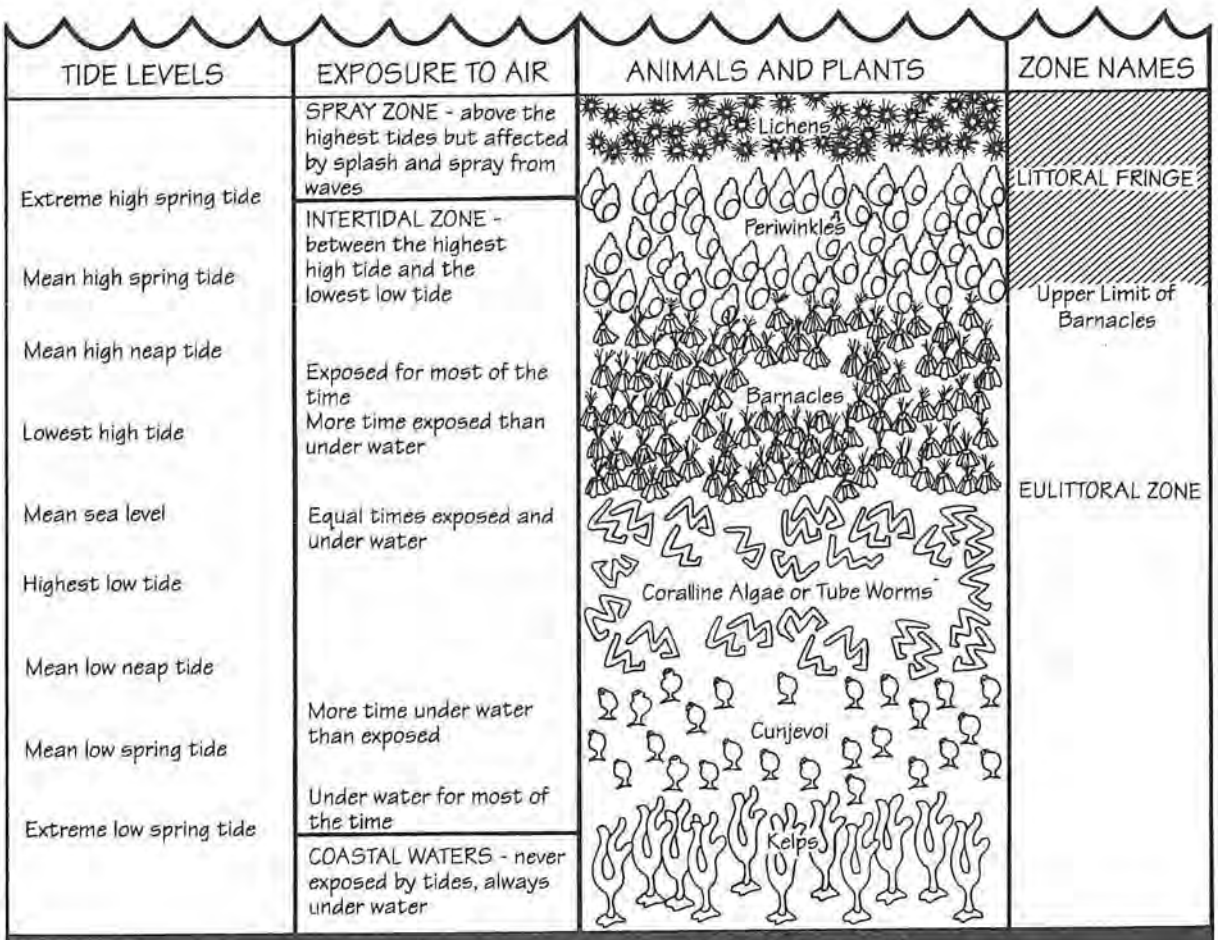
PROFILE	STRAND	LEVEL
Mathematics	Chance and Data	3.18 Clarifies, sequences and tabulates data to help answer particular questions and varies the classification to answer different questions.
Science	Life and Living	5.15 Identifies features of groups of living that enable them to compete successfully in their environments.

BACKGROUND INFORMATION

The intertidal zone can be a difficult place for marine plants and animals to live. To survive they must be well adapted to resist the pounding of waves and exposure to the drying rays of the sun, and withstand considerable periods out of the water.

Some of the animals have adapted a strong muscular foot to hold them fast to the rocks when they are stationary or on the move, (e.g. periwinkles, chitons, limpets). Some animals also have a hard shell for the dual-purpose of protection against the forces of waves and also to resist moisture loss when exposed to the sun. Still other animals form a hard outer body to provide the same protection as shells.

On the intertidal rocky shore zone, marine life can be found in distinct areas on the rock. Species present are directly related to their level of adaptation to the slope of the rock and the exposure to waves and the sun.



A general diagram of zonation on a typical rocky shore (not to scale)

KEY WORDS

adaptations, environment, transect

REFERENCES

Mackness, B. (1990) *Mastering Seashores.* Dellasta, Melbourne.
Gould League of Victoria (1988) *Coastal Wildlife.* Gould League of Victoria Inc. Victoria.
Haddon, F. (1986) *The Australian Environment: Seashores.* Hodder and Stoughton, NSW.
Gunzi, C. (1992) *Rock Pool.* Angus and Robertson, NSW.
Pope, J. (1985) *The Seashore.* Franklin Watts Ltd., London.

TEACHER DIRECTIONS

Materials

Clipboards
Witch's hats (one per group)
Coat hangers (2 of), (stretch the coat hangers out to a diamond shape)
Resource Sheets 1and 2, Worksheet 3

LESSON OUTLINE

Pre-excursion Activity (Resource Sheet 1and 2)

Introduce to the students the creatures they are likely to see in the Rocky Reef Safari survey using Resource Sheet 1. Describe the physical features of the reef platforms using the Resource Sheet 2. Have the students predict where certain marine creatures are likely to be found on the reef.

Excursion Activity (Worksheet 3)

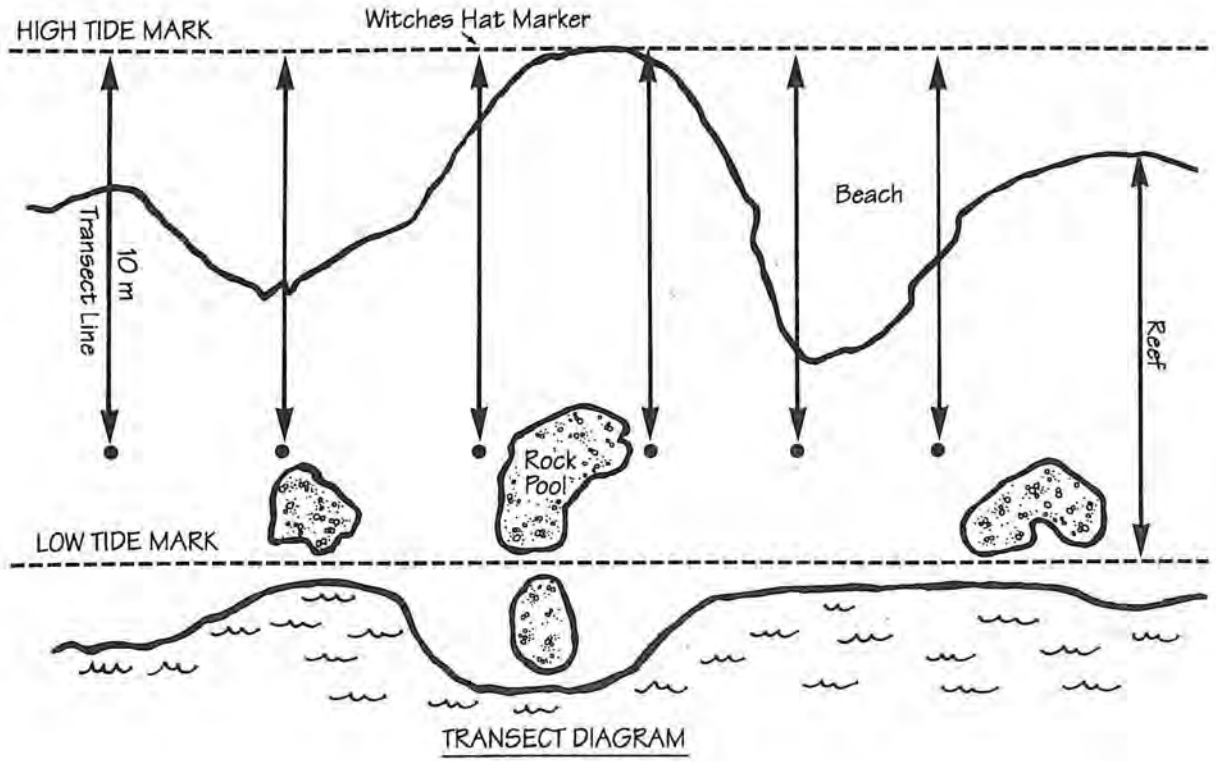
A suitable excursion site needs to have a wide rocky reef platform of about 20 metres or more in width and have a frontage of about 30—50 metres. It is best if the reef structure has small cliff faces or outcrops which would be covered at high tide or against which waves crash.

The students to work in groups with each person being assigned a specific task (i.e. recorder, pacer, counter).

At the excursion site place six witch's hats about five metres apart along the high tide water mark. Start at the marker and work along a straight line for about ten metres towards the sea.

At each witch's hat, put the two stretched coat hangers side by side. Count the number of different marine animals and record on Worksheet 3.

TAKE CARE: HAVE AT LEAST ONE OF THE GROUP WATCHING THE SEA AND WAVES AT ALL TIMES



TRANSECT DIAGRAM

Progress towards the sea, stopping to carry out the survey at each paced interval. The figure of ten metres is only a suggestion. If shorter, allow for more surveys by shortening the pace interval (e.g.: each half).

Complete the transect and answer the focus questions on Worksheet 3.

EVALUATION

- Were the students able to complete a transect study?
- Were the students able to recognise how each animal had adapted to suit its environment?
- Did the students understand that an animal evolves adaptations to suit its environment?

COMPLEMENTARY ACTIVITIES

Students could keep a running record of marine animals found on the reef platform over a 12 month period.

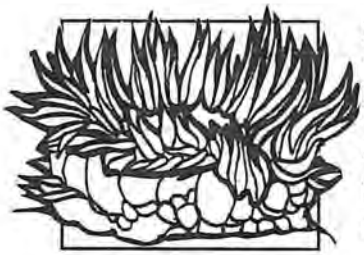
Students could make models of a reef platform, showing the reef's physical features and the distribution of marine life.

RESOURCE SHEET 1

ANIMALS ON THE LIMESTONE REEF

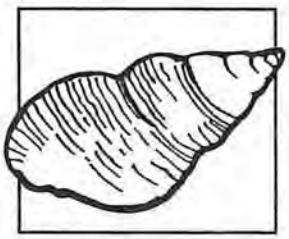
Limpets: Limpets are cone-shaped snails, which anchor themselves to the reef by a large yellow muscular foot. Under the shell, they have antennae and a mouth that contains thousands of abrasive teeth. At high tide, limpets move slowly over the reef, grazing on tiny algae. At low tide, they tend to return to exactly the same spot that they left, each fitting its shell back into the tiny groove it made in the rock.

Mussels: Mussels attach themselves to the rocks by a net of anchor threads called a 'byssus'. They feed at high tide by opening up and filtering the water for microscopic plants and animals. At low tide, they protect themselves by closing their two shells.



Sea Anemones: Most sea anemones are fixed to the reef by the base of the column of their bodies. They look like flowers, but are really animals. A sea anemone's mouth is surrounded by a ring of stinging tentacles which are used to catch and paralyse small sea creatures. Jelly fish are relations of anemones.

Dog Whelks: Dog whelks are carnivorous molluscs that feed on mussels, barnacles and limpets. They have thick heavy shells to protect them from damage when tossed about by the waves. Their shells change colour depending on what they eat. They have a file-like tongue that can drill holes through shells with the aid of a special chemical, which helps to soften the shell as they drill. The drilling process can take up to three days.

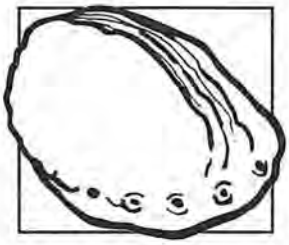


Periwinkles: Periwinkles are molluscs that look similar to snails. They have a lid over the entrance to their shells which is moved back underwater to allow movement. Periwinkles live on breakwaters, pieces of seaweed (on which they also feed) and wet rocks.

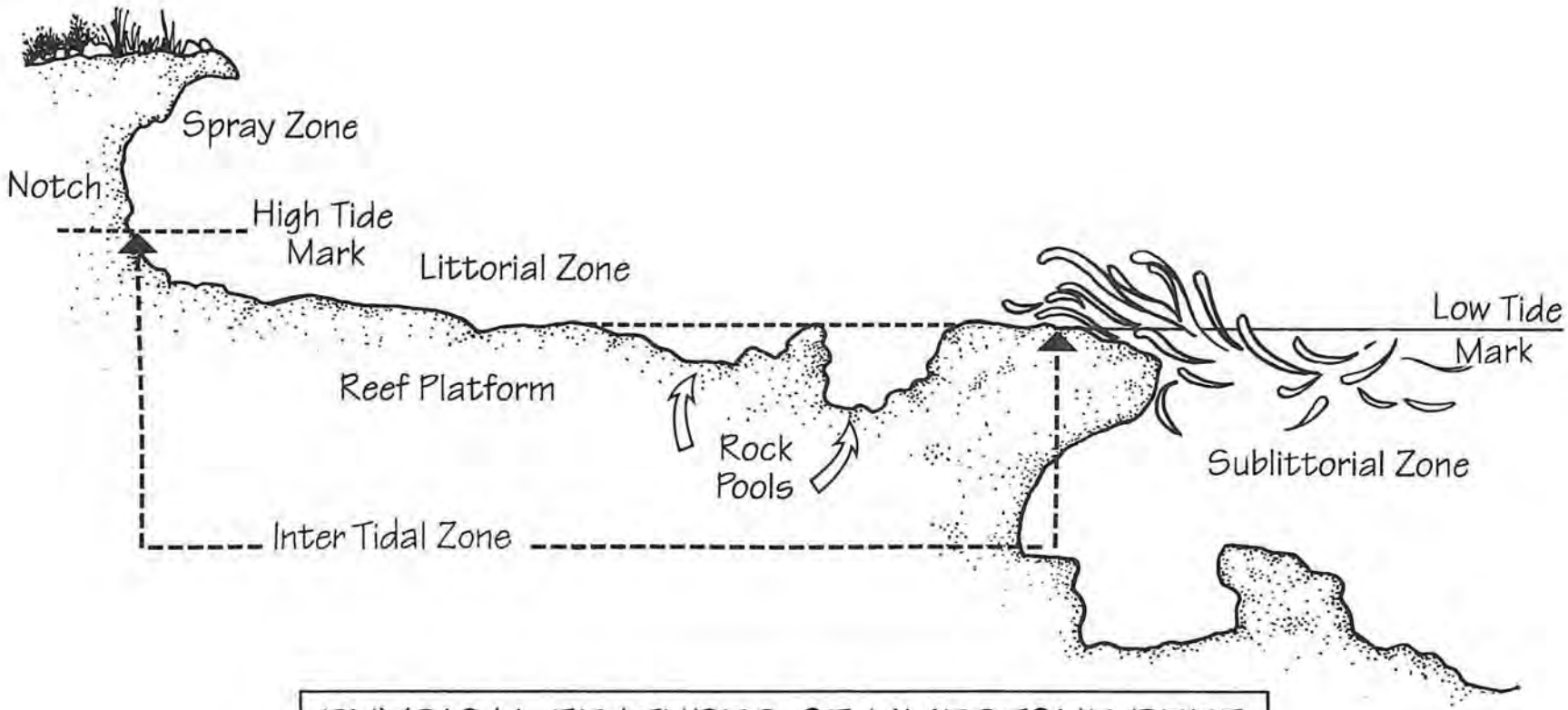
Chitons: Chitons cling to rocks tightly by means of a single muscular foot, similar to that of a limpet. Unlike limpets, chitons have divided shells that fir together like armour. They move over rocks with a tiny wave-like movement of their muscular feet, feeding on algae as they go.

Barnacles: Barnacles are often found in large colonies on the rocks. When the tide is in, their feathery tentacles filter out plankton from the water.

Starfish: When the tide is out, starfish hide under rocks. When the tide is in, they leave the shelter of the rocks and search for food. They have hundreds of tiny tube feet on the underside of each arm that enable them to move. If an arm is broken off, a whole new animal can grow from the severed arm. Most starfish are predators, prising open the shells of different creatures with their arms. They then expel their stomachs onto the shellfish, digest the flesh, then return their stomachs through their mouths.



Abalone: The large muscular foot with which abalone move and cling to the rocks, is also highly prized as food. They feed on drifting algae and seagrass.



PHYSICAL FEATURES OF LIMESTONE REEF

WORKSHEET 3

Name: _____
Date: _____

ROCKY REEF SAFARI

LOCATION _____

SURVEY TIME Start _____
Finish _____

SECTION	PERIWINKLES	LIMPETS	CHITONS	DOG WHELKS	BARNACLES	ABALONE	MUSSELS	CRABS	SEA ANEMONES		
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

1. What marine creature was found the <u>most</u>? _____
2. Where was it mostly found on the reef? _____
3. What animal was found the <u>least</u>? _____
4. Where was it seen the most? _____
5. In which <u>sections</u> were the number of <u>different</u> creatures found the most?

_____

6. Why was this so? _____

_____

_____

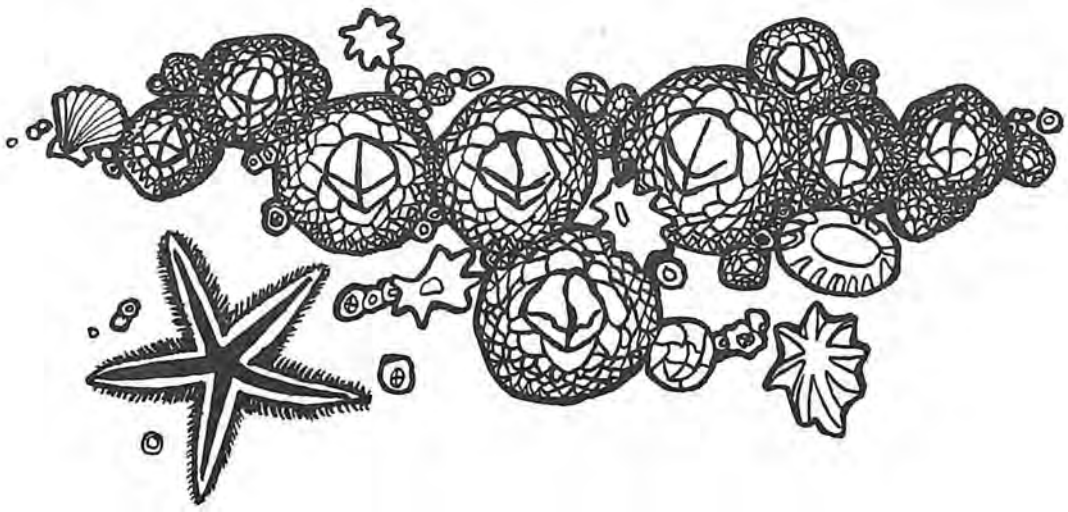
7. What marine creature was found in the greatest abundance in the high tide region?

8. What adaptations did this creature need to have to survive so well in the high tide region?

9. What marine animals were found in nearly every sector of the survey?

10. List the special features these creatures have in common with each other?

11. What special features do marine creatures need to have to survive on the rocky reef shelf environment?



Hopping Rock Pools

This is an excursion-based activity, studying the marine plants and animals of the rock pool ecosystem, and focusing on constructing food chains and food webs.

CONCEPTS

- Ecology is the study of organisms in relation to the living and non-living parts of their environment.
- Food chains and food webs are diagrammatical representations of the feeding relationships between living organisms within an ecosystem.
- Conserving the marine ecosystem involves preserving the relationships between the organisms that nature has established.

OBJECTIVES

- To construct food chains of organisms found in a rock pool ecosystem.
- To construct a food web of organisms found in rock pool ecosystem.
- To recognise that changes will occur within an ecosystem if the food web relationship between organisms is altered.

VALUES

- Students will recognise the importance of preserving feeding relationships between marine animals.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	6 7	A Small Animal Living Together	Investigating responses to animals and their environment. Investigating animal / plant interdependence.
Mathematics	5/6/7	NP: 4.3	Record data in, and interpret organised lists and tables.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Life and Living	3.13 Maps relationships between living things in a habitat.
Studies of Society and Environment	Natural and Social Systems	5.16 Explains common and diverse features of various natural systems. 3.16 Describes an example of a cycle within natural systems and the place of people in it.

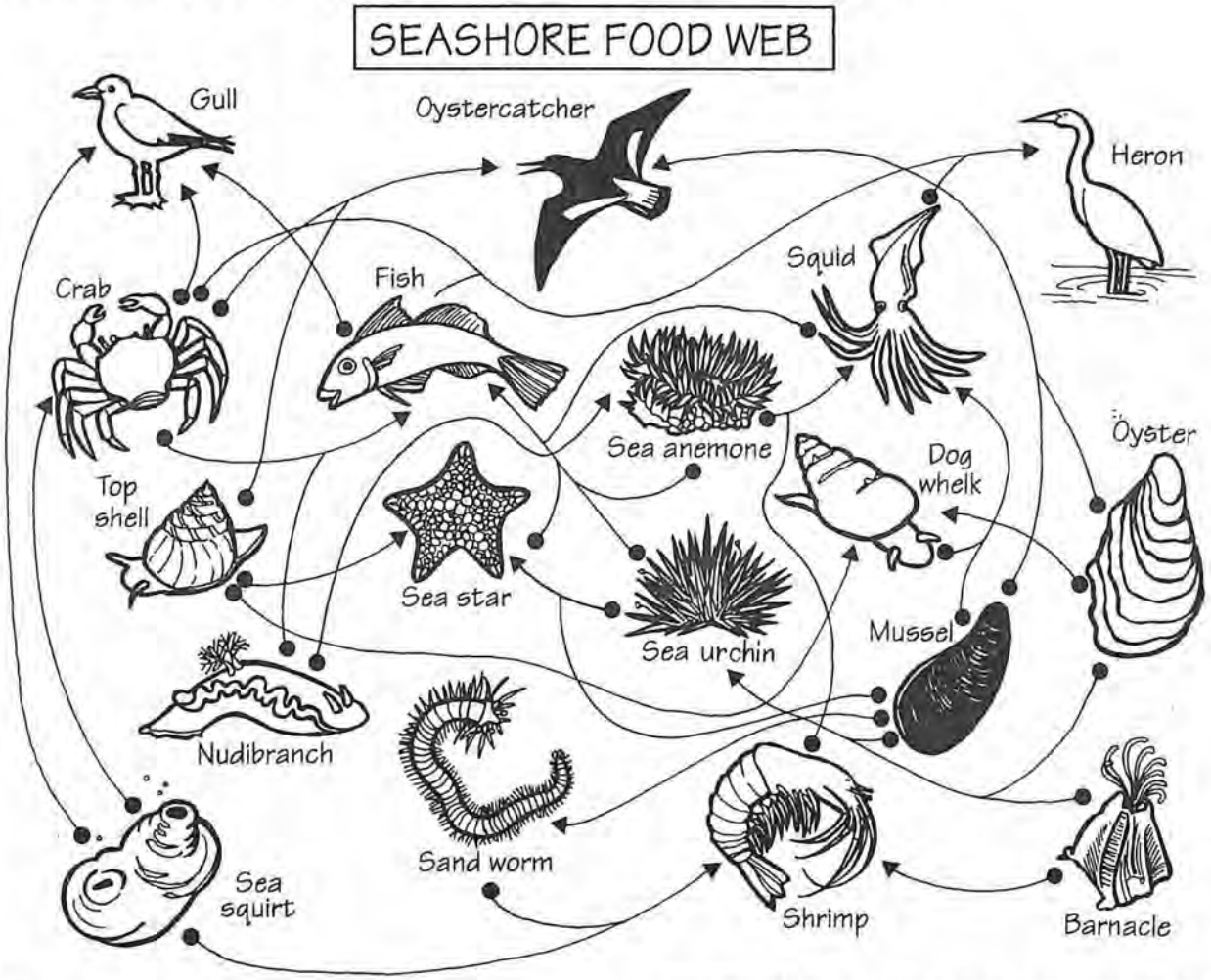
BACKGROUND INFORMATION

An ecosystem can be defined as a community of living organisms (different species of living plants and animals) interacting with each other and with their non-living surroundings (air, water, soil, waves, currents, sunlight) in a defined space (e.g. rock pool, rainforest, wetland).

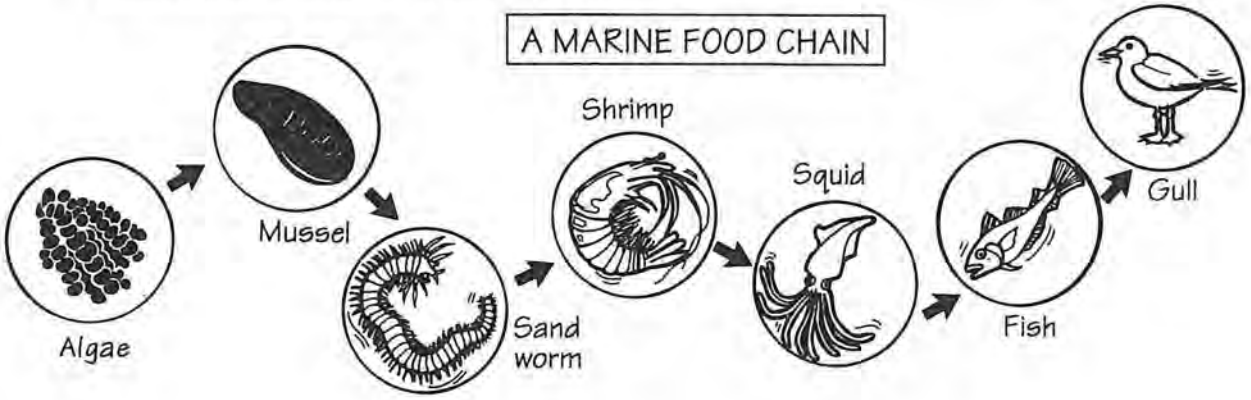
Permanent rock pools are essentially self-contained ecosystems. They provide excellent opportunities to discover, appreciate and understand the ecology of marine life.

The interaction that exists between different organisms within a community of different plants and animals is quite varied. One of the most obvious examples of this interaction is the feeding relationship.

In the rock pool there are the plant organisms that produce their own food through photosynthesis. These organisms are called 'producers' or 'autotrophs'. Other living organisms feed on plants and are called 'herbivores', while those that feed on other animals are called 'carnivores'. There are also animals that feed on both plants and animals. They are called 'omnivores'. Finally, there are a whole range of other organisms, both plant and animal, which break down dead organic matter. These are known as 'detritivores'. Herbivores, carnivores, omnivores and detritivores are collectively known as 'consumer organisms' or 'hetrotrophs'.



A single array of organisms feeding on each other is called a 'food chain'. In many cases, consumer organisms feed on several different food sources. A network diagram showing the complex feeding relationships within an ecosystem is called a food web.



The relationships between organisms extends beyond important feeding relationships. For example: marine plants (producers) provide food for herbivores and contribute significantly to the oxygen content of the water. They also help maintain temperature levels and provide places of refuge.

The removal of a plant or an animal due to pollution fall out or over fishing, for example, can have a wider destabilising effect that extends right through the food web of an ecosystem.

KEY WORDS

ecosystem, ecology, herbivore, carnivore, omnivore, detritivore, organism, hetrotrophs, autotrophs

REFERENCES

Mackness, B. (1990) *Mastering Sea Shores.* Dellasta, Melbourne.
Gould League of Victoria (1988) *Coastal Wildlife.* Gould League of Victoria Inc. Victoria.
Pope, J. (1985) *The Seashore.* Franklin Watts Ltd., London.

TEACHER DIRECTIONS

Materials

Scoop net
Clip board
Resource Sheets (seaweeds, sea animals)
Thermometer attached to a string and weight
Ice-cream containers
Plastic cling wrap
Cutting knives
Box of good quality elastic bands

LESSON OUTLINE

Pre-excursion Activity

Viewing containers will be used on this excursion. They may be made by:
(i) cutting out the bottom of an ice-cream container, and
(ii) covering the opening and the sides of the ice-cream container with plastic wrap and securing it with elastic bands.

Develop a food chain and food web for an animal with which the students are familiar (e.g. mouse, skink, frog, magpie). What will happen when one or more members are removed from the food chain and food web? Explain the term 'ecosystem' using a rock pool as an example.

Excursion Activity (Worksheets 4 and 5)

Divide students into small groups and assign each a rock pool.

Measure the depth of the rock pool using the weighted string and rule. Attach a thermometer to the string and measure the surface (top 15 cm) and bottom temperatures of the rock pool. The students estimate the dimensions of the rock pool. Record the measurements on Worksheet 4.

Complete a survey of all the living organisms (plants and animals) in the rock pool and complete Worksheet 4.

Move back to shore and using Worksheet 5, construct a food chain diagram of one of the consumer organisms, deciding whether it is an omnivore, herbivore, detritivore, or carnivore by its features.

Construct a food web of the rock pool, including as many of the organisms as possible that were recorded.

Study and/or discuss the food chain and food web diagrams in light of the focus questions on the Worksheet 5.

EVALUATION

- Were the students able to complete the survey accurately?
- Are the students able to construct accurate and clear food chain and food web diagrams?
- Do the students understand the significance of preserving established feeding relationships in marine ecosystems?

COMPLEMENTARY ACTIVITIES

Construct food web models.

'Connection Inspection' activity from Steve van Matre's *Conceptual Encounters*, Institute for Earth Education 1987.

WORKSHEET 4

Name: _____
Date: _____

ROCK HOPPING

ROCK POOL

Dimensions (Estimate) _____

Maximum depth _____

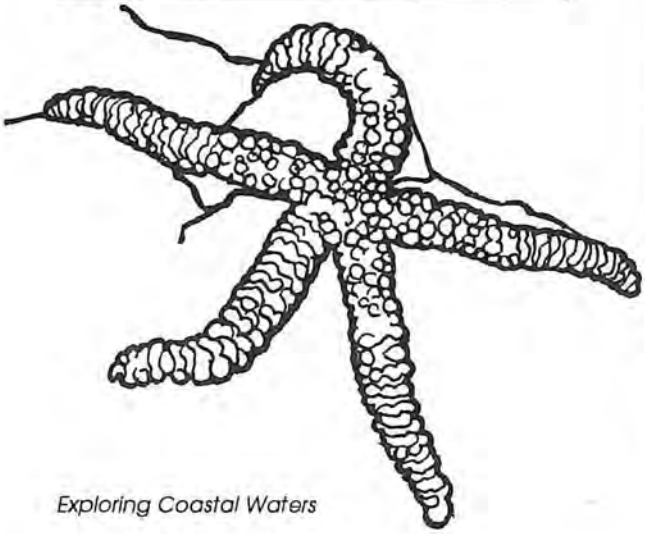
Temperature - bottom _____

- surface _____

PLANTS - NAME	COLOUR

ANIMAL - NAME	H	C	O	D

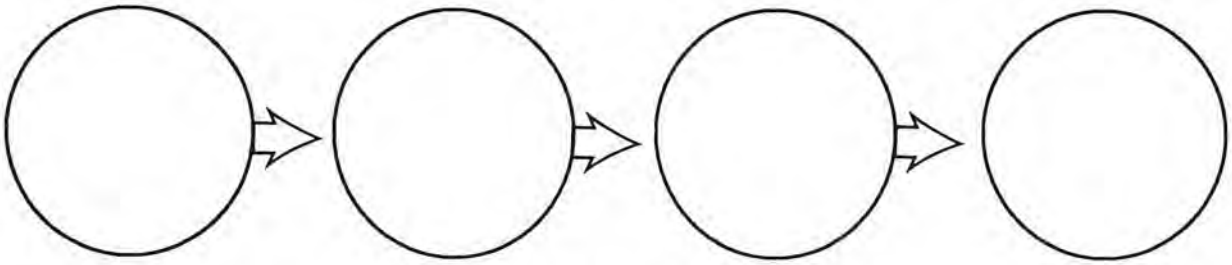
H = Herbivore C = Carnivore
O = Omnivore D = Detritivore



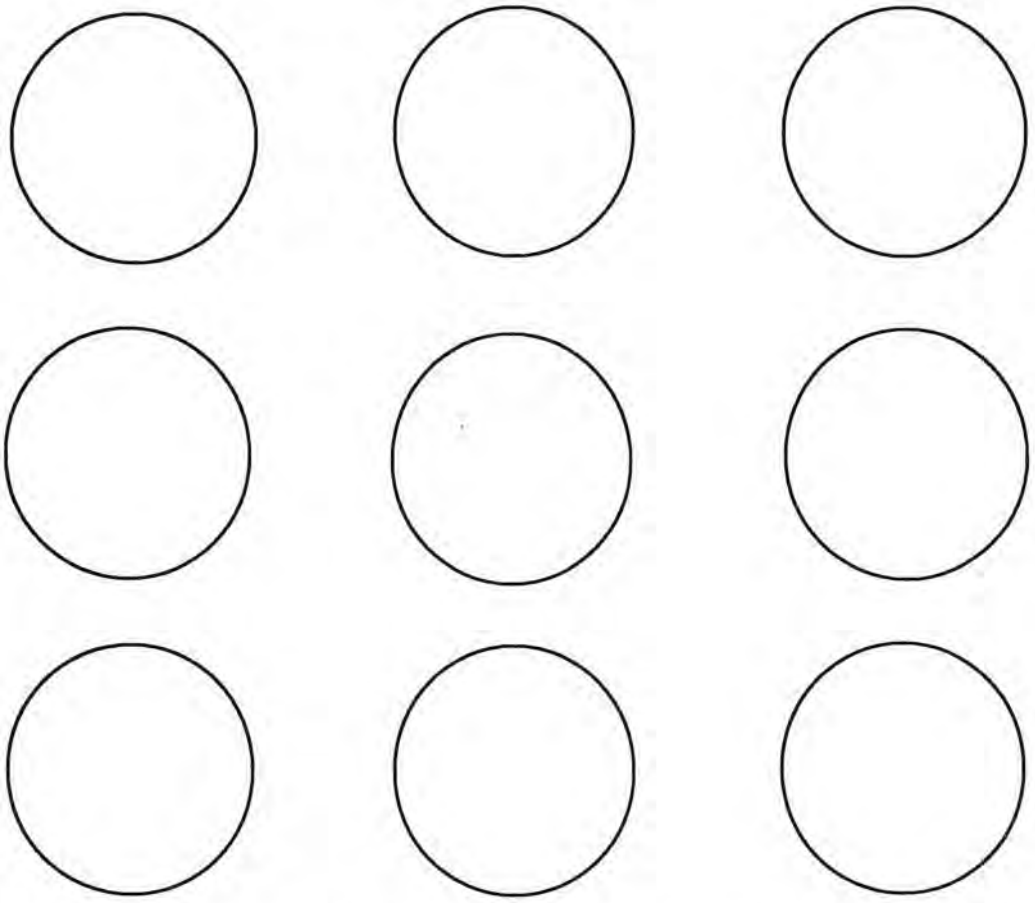
WORKSHEET 5

Name: _____
Date: _____

ROCK HOPPING



- Construct a food chain for one of the marine animals.



- Construct a food web diagram of the rock pool. (Mark in the arrows).
- What animals would be likely to die in the rock pool if all the algae in the rock pool were destroyed by chemical pollution?

_____

_____

- What would be the effect on the other animals in the food web of the rock pool if all the meat eating animals were destroyed by chemical pollution?

_____

_____

Creature Feature

Students construct a 3D diorama of a rock pool environment and create and describe their own rock pool marine creature.

CONCEPTS

- Marine plants and animals have evolved and adapted to suit the conditions of their environment.

OBJECTIVES

- To construct a 3D diorama of a rock pool environment .
- To create a marine animal creature that inhabits the rock pool.
- To understand how marine creature adapt to a rock pool environment.

VALUES

- The diversity of marine life needs to be preserved.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / STRAND	NUMBER / YEAR	UNDERSTANDINGS / TOPICS
Language	5/6/7	3.2.2 Descriptions	B. present descriptions in oral and written form.
Arts and Craft	5/6/7	Shape and Form	
Science	6	Animals	Investigating responses of animals to their environment.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
The Arts	Creating, Making Presenting	3.3 Plans and presents art works for a particular audience or purpose.
Science	Life and Living	3.13 Maps relationships between living things in a habitat.

BACKGROUND INFORMATION

Rock pools are essentially self-contained ecosystems that are isolated on the limestone reef platform for periods of time between tidal shifts. Rock pools can range in size and depth from minor puddles to large, deep pools.

On average, rock pools are recharged with sea water, nutrients and sea life twice a day with tidal movements.

The marine life that inhabit these rock pools have evolved characteristics that help them to survive and reproduce in their rock pool environment.

KEY WORDS

environment, adaptations, marine, ecosystem, diorama, three dimensional

REFERENCES

Gunzi, C. (1992) *Rock Pool.* Angus and Robertson, NSW.

TEACHER DIRECTIONS

Materials

Cardboard boxes of various sizes
Art and craft material (paint, paper, egg cartons, string, sponges, etc.)

Lesson Outline **(Worksheet 6)**

Discuss the rock pool ecosystems of coastal reefs. Include the range of creatures that live there, the conditions which make life difficult, the characteristics or adaptations made by various organisms to survive and thrive in such an environment.

In small groups, students construct 3D diorama models of a rock pool ecosystem, using various art and craft material resources. Encourage creativity by folding and shaping paper and using a range of materials to create marine life and 3D effect.

Each group should create a rock pool marine animal and place a model of it in the diorama. The creature may be based on a known marine animal and modified to make it unique, but still suitable for the rock pool ecosystem.

Complete Worksheet 6, describing how the creature is well adapted to surviving in the rock pool environment. The description should extend to what it eats and what eats it. Include a diagram of the creature's food chain and where it fits into the rock pool's food web.

The students present their creatures and dioramas to the class.

EVALUATION

- Were the students able to construct a quality 3D diorama of the rock pool ecosystem?
- Were the students able to create a imaginative rock pool marine creature?
- Were the students able to describe their creature, detailing clearly how the creature had adapted to living in the rock pool environment?

COMPLEMENTARY ACTIVITIES

Present diorama as a mini marine park by producing an accompanying information pamphlet.

Make large model marine creature mobiles.

WORKSHEET 6

Name: _____
Date: _____

CREATURE FEATURE

IDENTIFICATION PROFILE

Size: _____

Colour Patterns: _____

_____

_____

How does it move? _____

_____

_____

NAME OF CREATURE

_____

What does it eat? _____

_____

Who are its predators? _____

_____

Active at night or day? _____

_____

What are its special features?
(e.g. sting, poisons, sonar, suckers, claws, tentacles, shell,...)

_____

_____

_____

_____

Conservation Code

Students write their own pledge to conserve the marine environment.

CONCEPTS

- Conservation of the natural environment is everyone's responsibility.
- Limestone reefs have unique conservation value.
- Conservation codes are necessary to define the behaviour required to protect and preserve the marine environment.

OBJECTIVES

- Students will produce a pledge and conservation code for the coast.
- Students will list human activities that are having a harmful effect on the limestone coastal reef environment.
- Students will put their conservation code into practise whenever they are visiting the coast.

VALUES

- The community needs to be active in helping to conserve marine environment.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Social Studies	6	2.1	Differing demands on the natural environment may lead to conflict.
Language	5/6/7	2.1.1 P	Whole text.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
English	Reading and Viewing	4.4 Uses writing to develop familiar ideas, events and information.
Studies of Society and Environment	Place and Spaces	3.9 Identifies issues about care of places arising from different ways in which they are valued.

BACKGROUND INFORMATION

More than 80 per cent of Western Australia's population is concentrated along our extended coast. The advent of four-wheel-drive pleasure vehicles and small pleasure craft has opened up our massive coastline to recreational pursuits as never before. This has placed enormous pressure on our coastal environment and on conservation management practices.

The level of human impact on the coastal marine environment can be so severe that government management bodies have found the need to implement special laws and regulations to ensure the preservation of our marine environment. For instance, in Western Australia there are specific catching limits, or bag limits, for recreational species of fish, (e.g. a daily bag limit of 20 'table fish' applies) molluscs (e.g. abalone) and crustaceans (e.g. crayfish).

The community can help by adopting appropriate codes of behaviour that aim to conserve our marine environment in practical and important ways. The special value of conservation codes is that they are motivated and imposed by the community itself wanting to protect and preserve the coastal marine environment.

KEY WORDS

conservation, ecosystem, environment, pledge, code

REFERENCES

Reid, A. (1992) *Coasting*. Gould League Of Victoria Inc., Victoria.
Jennings, T. (1981) *Sea and Seashore*. Oxford University Press. Oxford.
CALM 'C' Code (see p.17 this document).

TEACHER DIRECTIONS

Materials

Worksheet 7

LESSON OUTLINE

Discuss conservation of the marine environment, and ask students to discuss examples of conservation in action.

List the human activities that are having destructive impacts on our marine environment. Identify which human activities have a harmful effect on coastal limestone reef systems. Refer to newspaper articles and magazines to highlight current issues.

Discuss CALM's 'C' Code (page 17). What is the value of this type of action in promoting conservation.

List the issues a pledge and conservation code would need to address to promote behaviour that aims to protect coastal limestone reef systems.

Develop a pledge and conservation code that would help protect your local limestone reef environment. (Worksheet 7).

The pledge should be used as the basis for the code of behaviour of the class on all excursions. The whole school should be encouraged to adopt the pledge.

EVALUATION

- Do the students understand the meaning of the term conservation?
- Were the students able to produce an effective pledge and conservation code for limestone reef environment?
- Were the students able to identify and list human activities that threaten the quality of limestone reefs?

COMPLEMENTARY ACTIVITIES

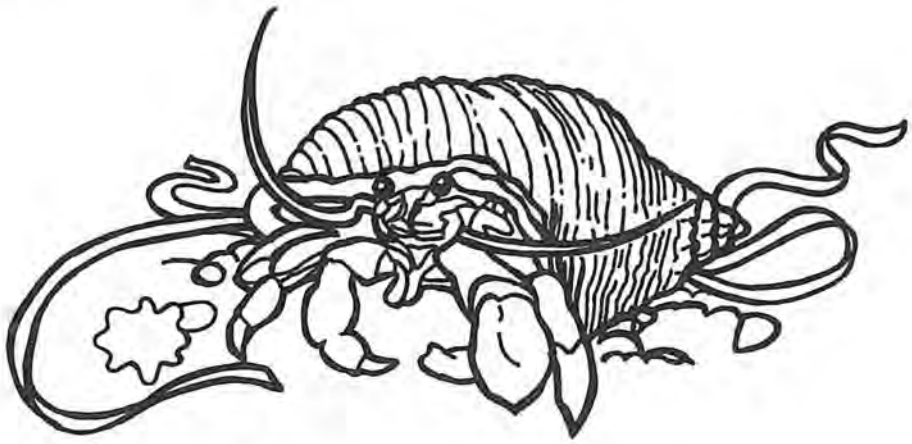
The Conservation Code could complement the 'Creature Feature' activity.

Visit a marine reserve (Marine Park or Marine Nature Reserve - see map in Preface, page 6.)

Invite a Department of Fisheries officer to speak to the class about fish size and bag limits.

Make badges with the conservation pledge printed on it.

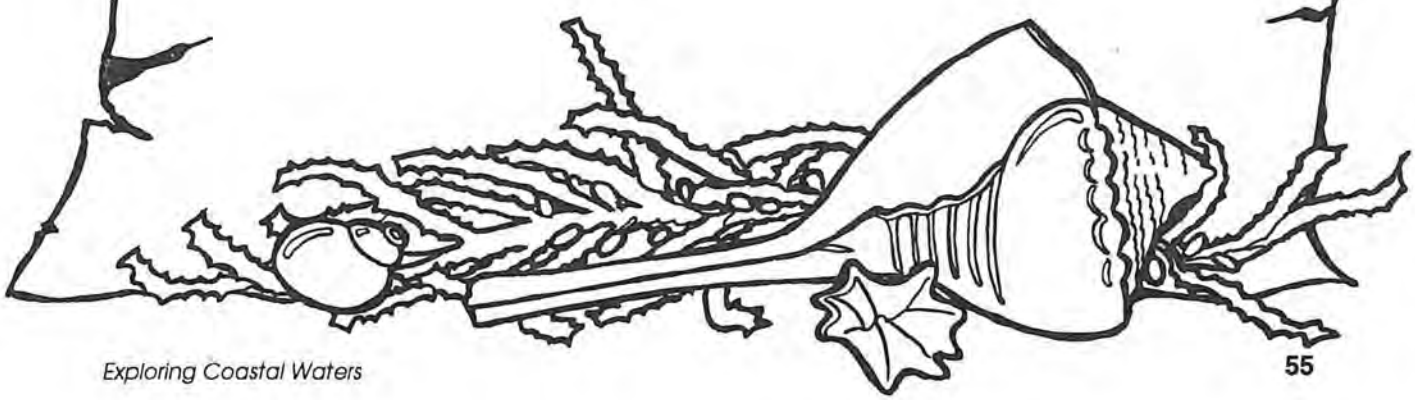
Find out the bag limits for particular species of commercial fish, molluscs and crustaceans.



WORKSHEET 7

Name: _____
Date: _____

I pledge that I will do the following to protect the marine environment...



Sandy Beaches

See Birds

The students will complete a survey of the local birds found on the beach, observing and recording their varied behaviour.

CONCEPTS

- A variety of birds are commonly found in a coastal environment.
- Birds display specific behaviours when in a flock.
- Large numbers of silver gulls are indicative of rubbish management problems.

OBJECTIVES

Students will be able to:

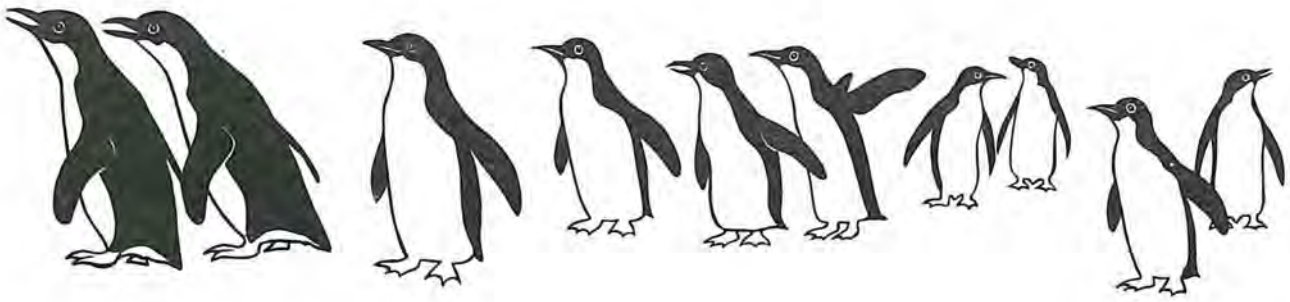
- observe and record the types and number of birds found at the beach,
- observe and record the behaviour of silver gulls in a flock,
- understand that providing unnatural sources of food for silver gulls can cause a population explosion of the species.

VALUES

- Wild animals, like silver gulls, are in balance in nature. Human interference may upset this delicate balance.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	6	Animals	Investigating the responses of animals to their environment.
Mathematics	5/6/7	N:P4:1	Construct and read graphs, and interpret graphical information.
Language	5/6/7	3.2.12 Figures	A: use, retrieve and interpret information from simple figures. B: arrange pictures and objects in graph form - use appropriate labels on graph axes.



STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Mathematics	Chance and Data	3.20 Reads and describes information in simple tables, diagrams, pictographs and bar graphs.
Science	Working Scientifically	3.3 Argues conclusions on the basis of collected information and personal experience.
Studies of Society and Environment	Place and Spaces	3.9 Identifies issues about care of places arising from the different ways in which they are valued.

BACKGROUND INFORMATION

Almost three-quarters of the Earth is covered by the oceans which provide a habitat for around 260 species of birds.

Adaptations

When birdwatching, it is important to observe not only the size and colouring of the birds, but also their beak and feet formations.

The shape of a bird's beak will give an accurate guide to what it eats. There are five main sources of food for birds: seeds, fruit, insects, and meat.

Seed-eaters have short beaks which end in a point and are strong enough to crack the husks and shells of seeds.

Fruit-eaters are referred to as soft-billed birds, as their beaks are reasonably long, but not very strong. Nectar feeding birds would fit into this category, as they need the long bill to get into flowers.

Insect-eaters, which feed from the ground, usually have long, fairly thin beaks.

Meat-eaters, which catch their prey live, have short, hooked beaks. Those birds that eat the flesh of dead animals have longer hooked beaks. In both cases the beak is used to tear up the flesh. Fish-eaters have similar beaks to meat-eaters, being slightly hooked at the end to hold the fish.

The feet of a bird will tell you something of the habitat in which it lives. If it has webbed feet, it will feed in a watery habitat, as it needs the webbing to swim or wade in the water. Land- dwelling birds have four distinct toes. These are used to scratch around on the ground when looking for food or to grip onto a perch in the branches of trees.

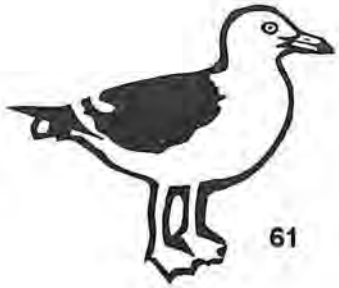
Common Seabirds

The **silver gull** can be found around the entire coast of Australia, as well as inland along major river systems. These birds are omnivorous, feeding on fish, plankton, crustaceans, insects, carrion, and almost all types of food scraps. The adult bird has white eyes with a red eye ring, red bill and feet. The young birds have dark eyes, bill and feet. They also have light brownish feathers in among the grey and white, giving them a mottled look. Silver gulls generally nest in large colonies on islands off the coast. If eggs are left unattended, or if young chicks wander out of their parent's territory, other gulls will attack and kill them. These birds always establish a hierarchy of dominance in the flock. Older birds rule over the younger ones and this is often seen when the birds are feeding. It is common to see birds hunch or arch themselves and run forward aggressively or adopt a more submissive, begging posture. The silver gull can live for up to ten years.

The **pacific gull** is an Australian gull found around the coast of Tasmania and along the southern and south-eastern coasts of the mainland. The pacific gull is larger than the silver gull, with a much thicker bill and black back and wing feathers. These birds feed on fish, squid, shell fish, crustaceans, sea urchins and carrion. Pacific gulls tend to nest alone or in small loose groups. They are known to feed on the eggs and fledglings of other seabirds.

The **crested tern** is found around the entire coast of Australia, as well as around the fringes of the Indian and part of the Pacific Oceans. The crested tern has colouring similar to that of the gull, except for the distinctive black feathers on the top of the head which are tufted at the back. They have long, tapering, pointed wings, a forked tail and a long, pointed, yellow bill. Terns feed predominantly on small surface fish, as they do not swim under water. Fish are only taken within plunging depth of the surface. Crested terns are also known to eat squid, crustaceans, and sometimes eggs and baby turtles. They can live for up to seventeen years.

The **pied oystercatcher** is mainly found on beaches and estuaries around the coast of Australia. It is a chicken-sized bird with black plumage on its head, back and wings, and white underparts. The pink legs, long scarlet bill and eyes stand out in contrast. Pied oystercatchers are wading birds that feed mainly on molluscs. Their chisel-shaped bill, which is flattened side on, makes feeding easier. They move along wet sandy flats and bars at low tide, probing beneath the sand for molluscs. Pairs mate for life. They will defend their territories throughout they year, but may also temporarily join flocks when not breeding.



The **pied cormorant** is found mainly in coastal and salt water areas, but is also found in freshwater environments on inland rivers and lakes. Coastal pied cormorants breed in colonies all year, while those found inland are more solitary. The pied cormorant has a distinct plumage with black above, white below and an orange-yellow face patch in front of its eye. Its bill is grey and feet black. Pied cormorants feed mainly on fish and on some crustaceans and molluscs. They dive headlong into the water to grasp their prey in their hooked beak before rising to the surface. Cormorants are often seen perched on rocks, poles and boats, holding their wings outstretched to dry. unlike most waterbirds, the cormorant doesn't have waterproof wings. This helps it to fish; as its wings and body become heavy with water it can dive more easily and stay underwater for more than half a minute. The pied cormorant must preen its feathers, oiling them with a special oil gland in its body to help it shed water after diving.

KEY PHRASES

at rest, upright alarm posture, hunched threat, oblique threat posture, forward posture, grass stabbing, grass pulling, gesture, wing span.

RESOURCES / REFERENCES

Bourke, S., Hanson, S. and Moroney, D. *Caring for the Coast - Coastal Activities for Primary Schools.* Henley Grange Council, South Australia.
Gould League of Victoria, *Common Seabirds* (Poster).Gould League of Victoria Inc. Victoria.
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CALM (1993) *Silver Gull Action Plan for the Perth Metropolitan Area.* Department of Conservation and Land Management, Western Australia.

TEACHER DIRECTION

Materials:

Clipboard file
Worksheets 8 & 9

LESSON OUTLINES

Pre-excursion Activities

Discuss Worksheets 8 and 9 with the students.

The students will need to become familiar with the features of the selected birds to be identified on the 'Birds On The Beach' survey sheet, along with any other common seabirds found on the coast. This will help with identification on the day.

Excursion Activities

At the beach, discuss the following code of behaviour:

Move about as little as possible.
Sit still and quietly when observing the birds.
Don't look into the sun, have it behind you.
The feet and beaks of the birds will tell you a lot about them.
Observe the colour of their feathers, eyes, legs and facial skin, and any colour patterns, as those are usually more important for identification than colour alone.

REMEMBER TO ALWAYS WEAR SUNSCREEN, A HAT AND SHIRT WHEN AT THE BEACH.

- Students should spread out along the beach and find a place to sit to observe the birds in the area. Complete Worksheet 8.
- Spend about 20 minutes on the survey, observing important features of the birds to try to determine what they may feed on, whether they perch on branches or swim, etc. Much of this information can be gained by observing the birds' feet, beaks, necks and general behaviour.
- Discuss Worksheet 9.
- Each student to resume old position or find new one and complete Worksheet 9 over a 20 minute period.

Post-excursion Activities

- Graph the class results of Worksheet 8.

- Read the media article on the problems associated with escalating silver gull populations (Resource Sheet 3). Do numbers of silver gulls counted, compared with the number of other seabirds counted, seem to validate the findings in the media article? Discuss.

- Design a sign that would be suitable for erection at beaches. The message should ensure that people understand why silver gulls must not be fed. Include a slogan and an appropriate symbol in the sign design.

- Discuss the results of Worksheet 8 and the various adaptations the students have observed. Different shaped beaks and feet determine their uses. Compare the shape of the feet in waterbirds, tree-perching birds and ground-dwelling birds. Compare the shapes of beaks for meat-eating, seed-eating, nectar-feeding, and waterbirds.

- Gulls' behaviour (Worksheet 9) can also be graphed to see what, if any, behavioural trends occur in a community of silver gulls. Discuss the roles that were observed in the bird community; dominance, territory claims, etc., and how this would impact on weak, injured or sick birds. Can the students suggest reasons why the birds act in this way?

EVALUATION

- Did the students fill in the survey forms correctly?
- Did the students graph the class results accurately?
- Did the students understand the reasons for the increase in numbers of birds like silver gulls?

COMPLEMENTARY ACTIVITIES

Send the designs for silver gull signs to the Department of Conservation and Land Management's Regional Interpretation Officer -

Swan Region
3044 Albany Highway
KELMSCOTT W.A. 6111

They will be considered in the development of such signs at appropriate locations.

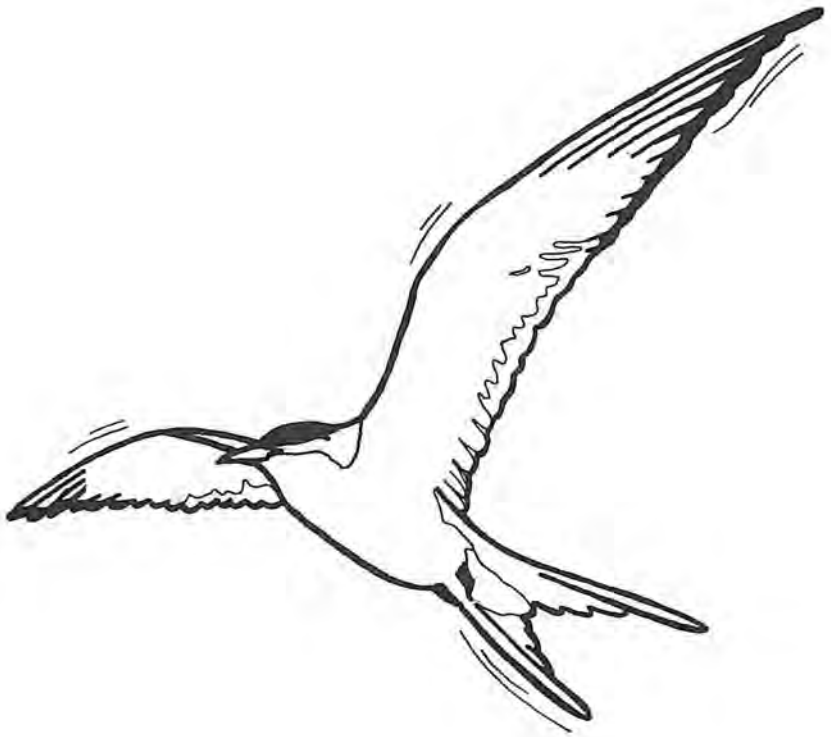
This activity can be linked with the 'Rocky Shore Safari' activity included in this package. It looks at the special adaptations birds have developed to allow them to survive in their specific environments just like the creatures of the rocky shore. Both activities can be completed while on the same outing.

Students conduct a survey of birds in and around the school grounds. Look for similarities and differences between the two surveys.

Visit Herdsman Lake, Lake Monger, Yanchep National Park or the Perth Zoological Gardens to observe the bird populations in these areas.

Students research bird colonies which have pecking orders and specific behaviours. Compare and contrast to the silver gulls.

Invite a guest speaker to the class from an ornithological society, or the Gould League Association.



Please don't feed the seagulls!

LOCAL residents are being asked not to feed the seagulls which congregate in public areas in an effort to reduce their numbers.

Rockingham Town Clerk Gary Holland said council had been concerned for some time over the growing number of scavenging seagulls around the area.

Mr Holland said gulls congregated at feeding sites for a free handout. Consequently the gull population would only decline if the amount of food available from human sources was reduced decreasing the capacity of the area.

He said the silver gull was a protected species, however the Department of Conservation and Land Management recognised the need for some control methods.

"Not only do they cause a nuisance by gathering in large numbers looking for food, the silver gull has been recognised as a carrier of salmonella a bacteria which causes food poisoning.

"Research has indicated that direct culling of a colony with no other control efforts increases both recruitment to the colony and reproductive success. As a result, population reductions are undetectable," he said.

"Itis therefore important that residents are alerted to the dangers of feeding seagulls and leaving scraps exposed in parks and beaches."

Mr Holland said action would be taken to deter the congregation of seagulls at the new landfill site in Millar Road an action endorsed by CALM.

Council will meet representativess of CALM to discuss future action to control this problem.

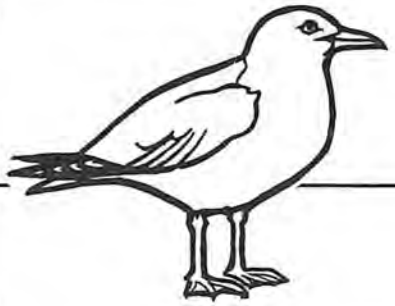
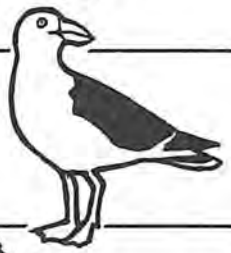
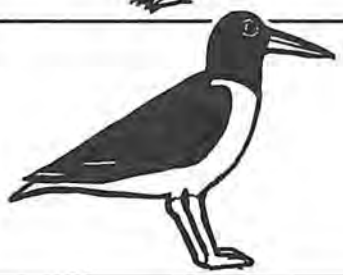
WORKSHEET 8

Name: _____

Date: _____

BIRDS ON THE BEACH

List and describe any other bird you may see. Make up its name if you like.

BIRD TYPE		TALLY
Silver gull (Adult) - white eyes with red ring, scarlet to red feet and bill, clean white to grey feathers with black outer primaries on wing.		
Silver gull (Young) - dark eyes, brown feet and bill, grey and white feathers interspersed with brown tail feathers.		
Pacific gull - bigger than the silver gull, has a much thicker bill and black back and wing feathers.		
Crested tern - similar colour to seagull with black feathers tufted at the back of head, long pointed long wings, forked tail.		
Pied oystercatcher - black head, breast and back except for white rump patch and upper tail coverts, belly and underwings white, bill bright orange, red legs.		
Pied cormorant - general plumage black above and white below, conspicuous orange-yellow face patch in front of eyes, bill dark grey, legs and feet black, eyes green with blue eye ring.		
Others (describe):		

WORKSHEET 9

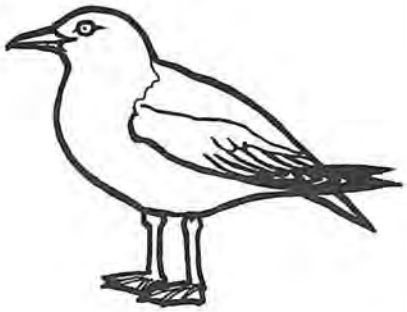
Name: _____

Date: _____

STRIKE A POSE

- BEHAVIOURS OF THE SILVER GULL

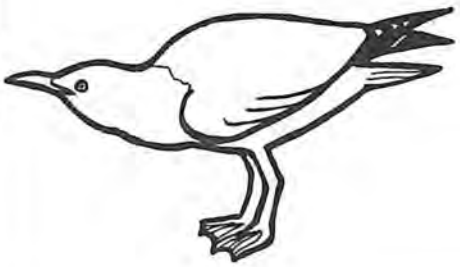
At Rest



TOTAL

Forward Posture

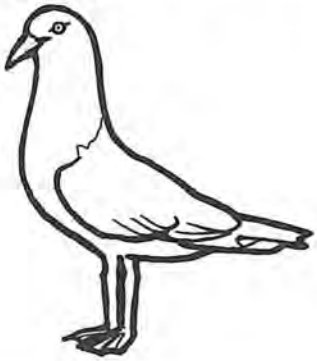
Head is dropped until it is lower than the tail with bill pointed upward - a sign of submission.



TOTAL

Oblique Threat

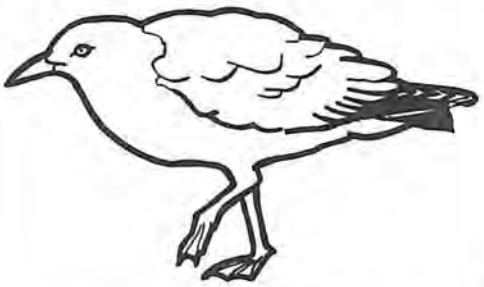
Neck is stretched up and head tilted down, wings may be lifted a little.



TOTAL

Hunched Threat

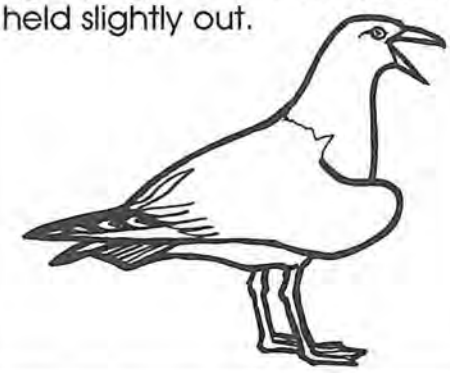
Threatening behaviour, body is hunched, feathers ruffled. Bird makes quick walking movements at other birds.



TOTAL

Upright Alarm Posture

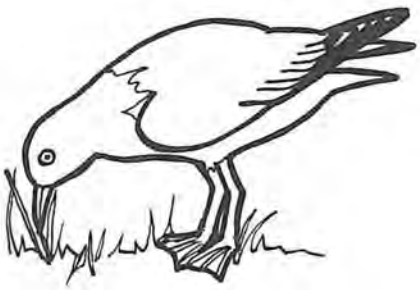
Eyes wide open, neck stretched, feathers pressed tightly against the body, wings held slightly out.



TOTAL

Grass Stabbing/Grass Pulling

Possibly signalling territory



TOTAL

Role Coasting

This activity simulates a situation in which conflict arises between individuals and groups with differing viewpoints. The students have to discover ways to resolve the conflict.

CONCEPTS

- People have differing values, interests and goals, which can all lead to conflict.
- Resolution of conflict can be achieved by several forms of cooperation.

OBJECTIVES

Students will be able to:

- explore the various attitudes people have about our coastline
- understand that management has to take account of all viewpoints and values.

VALUES

- Any area/environment has many different values to plants, and people and other animals.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Social Studies	5 6 7	Decision making Environment Society and Culture	Community Decisions. Sharing the Environment. Cooperation and Conflict.
Language	5/6/7	2.2.5 Drama	A: utilise drama for language acquisition and development. B: integrate both spontaneous and prepared improvisation to develop student approaches to, and interpretation of text.
		5.2 Speaking	A: need to 'read' the attentiveness and responses of the audience and adjust content, pace and volume accordingly. B: adopt gesture, stance and general mannerisms that signal composure and confidence E: talk to small and large groups about something of personal significance. G: use palm cards with written cues.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Social Studies	Place and Spaces	4.9 Describes different views of individuals and groups about issues related to the care of places.
Social Studies	Natural and Social Systems	3.17 Illustrates the linkages between rights and responsibilities for members of a community.
English	Speaking and Listening	3.7a Interacts for specific purposes in the classroom.

BACKGROUND INFORMATION

In 1990, it was calculated that seventy-five per cent of Australians lived within 30 km of the sea. It has been estimated that this figure will increase to more than eighty-five per cent within the next thirty years. The distribution of people along the coast is uneven, with some local foreshores becoming overloaded. This situation will only become worse as the population increases in these areas and spreads to other areas, which are, at present, relatively inaccessible and unused.

Not only are numbers increasing, but people's mobility is on the increase. Some areas that were previously used seasonally are now receiving more regular use.This concentration means that many beaches have become so overcrowded in summer, and in some areas all year long, that protective dune vegetation is being destroyed and wind erosion is increasing.

It is necessary for community groups, conservationists and government bodies to work together to develop and implement strategies to help conserve the coastline, while still allowing the public to use it.

KEY WORDS

cooperation, conflict, resolution, community group, net fishing, mineral sands, chairperson.

REFERENCES / RESOURCES

Marr, F. (ed) (1993) *Discovering The Hills Forest*. Department of Conservation and Land Management, Perth.
—*Mineral Sands - Building A Brighter Future* WA Mineral Sands Industry.
Reid, A. (1992) Coasting Activities for coastal excursions and beach holidays. Gould League of Victoria Inc. Victoria.
—*Technical Data - Geology, Mining, Processing* Westralian Sands Limited. Capel, Western Australia.
Van Vliet, J. (1990) *The Beach: A Great Place To Be.* Investigating APSJ 6(3), 6-7.

TEACHER DIRECTIONS

Materials

Role cards for the students
Map of the coastline and surrounding areas
Large sheet of paper attached to the wall (optional)
Felt pens
Overhead transparency of map and pens (optional)

Roles:

Coastal Caretakers Committee
Chairperson
Secretary
Marine Biologist
Local Council Members

Community Groups
Professional Fishers
Sand Mining Company
Resort Developer
Local Residents
Park Rangers
Naturalist Society
Recreational Fun Company

LESSON OUTLINE

- A proposal has been made to the Coastal Caretakers Committee suggesting that the area of Beachfront Bay and adjacent land become part of the Capeview National Park. Before the committee makes its final recommendations to the appropriate government bodies, a community meeting will be held to allow interested groups and individuals to present their views.

- The teacher decides how many students are to be in each group and prepares the appropriate number of role-play cards (from Resource Sheet 4). Distribute cards.

- Each group decides on a suitable strategy to use in putting forward their points of view as to why their group should have access to the beach area. The role-play cards are used as a guide. To add atmosphere to the meeting, students may wish to dress according to their roles.

- The Coastal Caretakers Committee Chairperson will ask each group to choose a representative to present their ideas. Each group will be given an equal amount of time to present their arguments.

- Each group's speaker needs to refer to the map of the area, using either the overhead transparency or the paper copy, during their presentation.

- The committee secretary will record each group's point of view on the large sheet of paper or on the blackboard.

- The Coastal Caretakers Committee will listen to the presentations, discuss them and come to a decision as to which groups should have access to the area. Their decision will be announced at the end of the meeting, after the committee has had sufficient time to make its decision. Reasons need to be given as to how the committee reached its decision.

- After the role-play is over, discuss aspects of the activity and the processes the students undertook:

  * Students' views on the decisions made by the committee,
  * Ways in which speaker presentations could have affected the final decision,
  * Ways presentations could have been improved,
  * Other influences that could have affected the committee's decision,
  * How accurately the activity reflected real life situations.

EVALUATION

- Were students able to form and present a logical argument as to why their role-play group should have access to the Beachfront Bay?

- Were students able to discuss how community decisions can be affected by a variety of factors, including values, and the interests and goals of individuals and groups?

COMPLEMENTARY ACTIVITIES

This activity has relevance to all parts of the package, especially the 'Seagrass Meadows' section. It is a good way to tie all sections together in a relevant and thought-provoking activity.

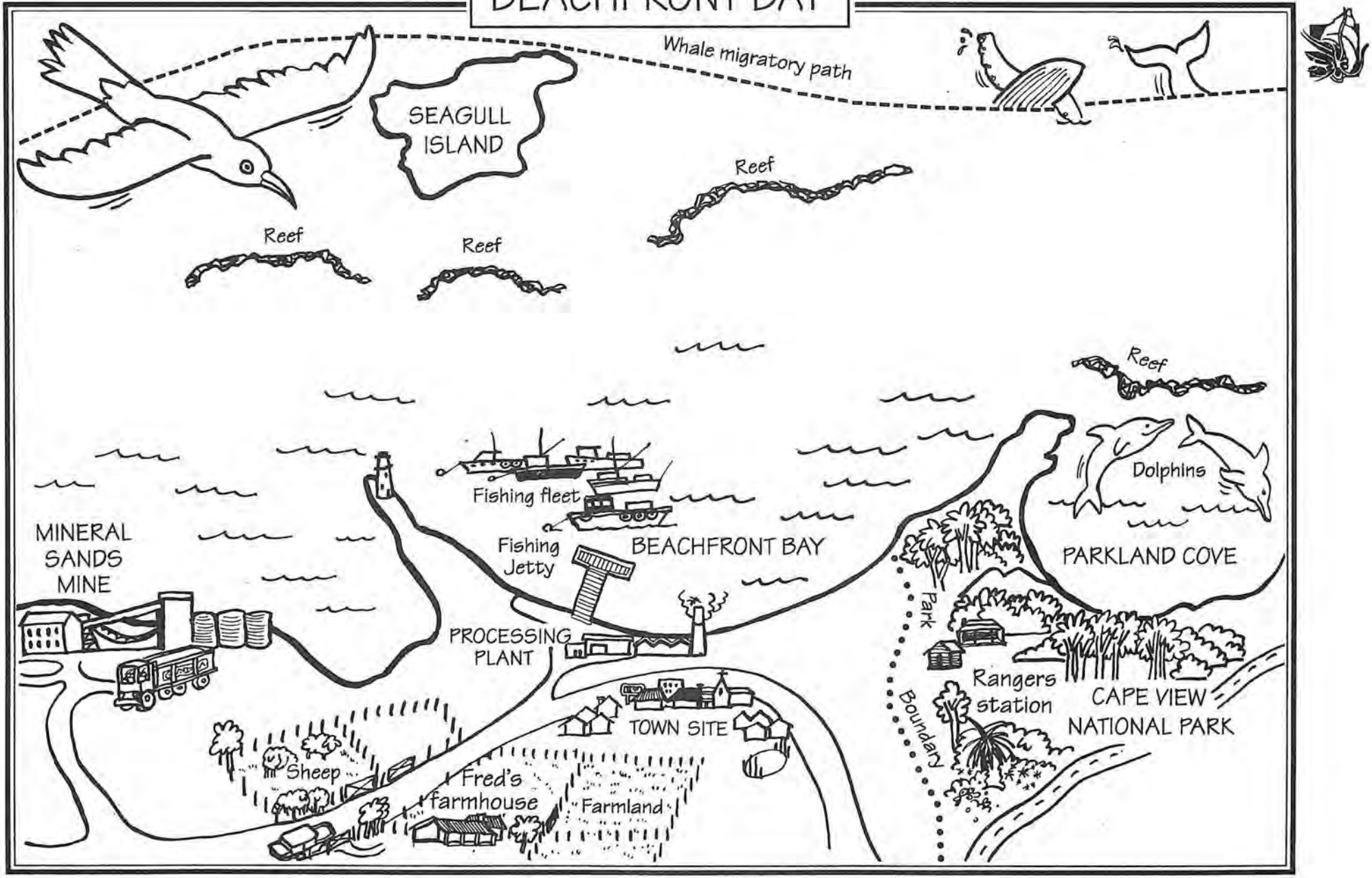
Students could write letters to the editor of the local paper voicing concerns they have on issues similar to the ones in the role-play.

Create a pin-up board in the classroom of 'Environmental Hot Spots' or 'Conservation Concerns'. Students bring in newspaper clippings that are current and relevant to the topic, and discuss and display them.

Hold class or group debates on topics such as

- Four-Wheel-Drive vehicles should be banned from beaches, or
- Licences should be compulsory for all fishing.

BEACHFRONT BAY



RESOURCE SHEET 4

COASTAL COMMUNITY PROFILE CARDS

COASTAL CARETAKERS COMMITTEE

The committee is responsible for running the community meeting, taking notes on the main points made by each group, keeping the proceedings in order and arriving at a final decision.

When making its decision, the committee needs to remember:

- Certain groups may use the area at specific times of the year, but not all year round.
- Because this is public land, as many users as possible should be accommodated.
- Not all users will be able to be accommodated.
- Environmental constraints, such as protecting wildlife (including endangered species), and pollution to the environment, need to be considered.
- The area needs to be managed for future generations of people, plants and animals, and not just the present community.
- The area's upkeep is to be met by the various groups as there is no public funding available.

PROFESSIONAL FISHERS

There has been a commercial fishing industry in the local waters of the bay for many years. The fishing industry would not be profitable if there was a ban placed on net fishing. You insist that the only species of fish affected are those you fish for commercially. Many of the fishers live and have families in the coastal town on the bay.

SAND MINING COMPANY

You have been successfully mining mineral sands further along the beach. Your company, in its search for further mineral sands to mine, have tested the bay and found rich deposits on its edge. The company claims to have an extensive re-vegetation programme. Mining the area would bring in a lot of money for the local town businesses and provide jobs for some of the people in the town. Mineral sands are used in the production of paper, plastics, refrigerators, cosmetics, anti-perspirants, rubber, textiles, sports equipment, colour television sets, and other items.

RESOURCE SHEET 4

RECREATIONAL FUN COMPANY

Your company specialises in recreational activities on the beach. Included in these are parasailing, hire of windsurfers, surfcats, canoes, paddle boats and jet skis. The majority of business is carried out over the summer months. The company could be affected if the bay became part of the national park as some activities may be restricted on the beach.

RESORT DEVELOPER

Your company prides itself on its ability to build modern resort complexes that are in keeping with the natural environment, while still offering all the luxuries a person could want. The resort would offer many local people a variety of job opportunities and bring in tourists to the area who are ready to spend their money. The proposed park would deprive you of a perfect site. You want no restrictions placed on the type of recreational activities that can be developed in the bay.

LOCAL RESIDENTS

If the proposed changes go ahead, your houses in the coastal town will be surrounded by the national park. All pets would be confined to the town site, and recreational activities on the park grounds, including the bay area, may be restricted. You feel that a ban should be placed on the commercial fishing industry as it interferes with recreational fishing.

PARK RANGERS

Your role is to protect the environment for future generations. Duties include: maintenance of facilities, monitoring the nature ecosystems, surveying and educating the public. You want to include the bay area into a marine park adjoining the existing national park. You would rehabilitate the area, then leave it undisturbed except for surveys for research and activities which do not impact adversely on the area. You are trying to ensure a 'fair go' for all park users, provided the park is not damaged for future generations.

NATURALISTS SOCIETY

Your society comprises bushwalkers, birdwatchers and conservationists. Your members make regular visits to the area to view the native animals and natural landscapes. Your society would like access all year to the area, with the freedom to walk where they wish, and to see as few people and unnatural structures as possible. Your society is opposed to commercial fishing in the bay, mining of the beach and motorised recreational pursuits.

Beach Litter Survey

An activity where students examine beach litter and discuss the problems arising from littering.

CONCEPTS

- Rubbish is not only unsightly but has a serious physical impact on the coastal and marine environments.

OBJECTIVES

Students will be able to:

- collect, tabulate, graph and analyse rubbish collected at the beach
- describe the possible sources of the rubbish collected on the beach
- describe the effects that rubbish have on the marine environment, in terms of injury and destruction of marine life.

VALUES

- People, both individually and as a society, need to take responsibility for the care and protection of the marine and coastal environments.
- We all need to minimise the impact we make on these environments (Reduce, Reuse, and Recycle).

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Mathematics	5/6/7	N:P4:1 N:P4:2	Construct and read graphs, and interpret graphical information. Record and interpret data.
Language	5/6/7	3.2.12	Figure A: Use, retrieve and interpret information from simple figures. Figure B: Arrange pictures and objects in graph form—use appropriate labels on graph axes.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Mathematics	Chance and Data	3.20 Reads and describes information in simple tables, diagrams, pictographs and bar graphs.
Science	Working Scientifically	3.3 Argues conclusions on the basis of collected information and personal experience.
Social Studies	Place and Spaces	3.9 Identifies issues about care of places arising from the different ways in which they are valued.

BACKGROUND INFORMATION

People have impacted on the coastal environment in many ways. One of the most noticeable of these is the presence of rubbish. Rubbish is not only an eye-sore, it has a serious effect on the plant and animal life on the coastline.

Rubbish can be found in three forms: BIODEGRADABLE, PHOTODEGRADABLE and PERSISTENT. Materials such as wood, paper, cloth and food are all forms of biodegradable rubbish. This means they will break down in a relatively short period of time. Material that can be broken down into small pieces when exposed to light over a period of time are said to be photodegradable. Rubber and most plastics are neither biodegradable nor photodegradable. This means that it takes years, maybe hundreds of years, for them to break down or disintegrate.

Plastics, fast food containers, wrappers and similar items can cover vegetation, blocking off water and sunlight, and cause the plants to die. The plants are a necessary link in the coastal chain of survival. Without them to bind the sand dunes, rapid wind and water erosion will occur and will ultimately lead to the degradation of the coast.

The majority of the rubbish that washes up onto beaches is plastic. Waste such as plastic bags, six-pack ring holders, bait straps and fishing nets or lines are responsible for the death of many marine animals. Sea lions, fish, dolphins and birds often become entangled in plastic waste and die of strangulation, starvation, drowning or exhaustion. Turtles and birds often feed on plastic bags, thinking they are jellyfish. This results in the turtles and birds starving to death as the plastic clogs their digestive systems.

However, the news is not all bad. People are working towards solving these problems. Regulations to control pollution near the coast and to protect marine animals are already in place, and are constantly being monitored and upgraded. New laws are being developed to regulate dumping plastic at sea, for example. Recycling is becoming an important issue and will make a growing impact on the environment as the trend increases. Scientists are also contributing by developing biodegradable and photodegradable plastics, as well as working in other areas of research.

KEY WORDS

biodegradable, photodegradable, pollution.

REFERENCES / RESOURCES

Bourke, S., Hanson, S. and Moroney, D. *Caring for the Coast - Coastal Activities for Primary Schools.* Henley Grange Council, South Australia.
Braus, J. (ed) (1992) *Ranger Rick's Nature Scope - Diving Into Oceans.* National Wildlife Federation, Washington DC .
MESA. (1993) *Adopt A Beach - A Coastal Monitoring Project.* Marine Education Society of Australasia, Western Australia.
Moffat, B. (1990) *Beaches Worksheets.* Wet Paper Publications, Brisbane.
Reid, A. (1992) *Coasting - Activities for coastal excursions and beach holidays.* Gould League of Victoria Inc. Victoria

TEACHER DIRECTIONS

Materials

Gloves to protect hands
A collecting bag per group (plastic or mesh bags)
Rubbish Record Sheets (Worksheet 10)
Pencils and clipboards

LESSON OUTLINES

Pre-excursion Activities

- Brainstorm the many ways that rubbish can affect the marine and coastal environment. Students recount occasions when they have observed marine creatures that have been affected by rubbish, either on beaches or in the water (seagulls with hooks in their beaks, fishing line wrapped around them or caught up in plastic are common sights).

- Discover what it would be like caught up in a plastic six-pack holder. Students place their hands through the rings of a six-pack holder and try to break the plastic. Imagine they are an animal, such as a young sea lion, with plastic caught around them. Describe what it would be like to live like that. What would be the eventual outcome?

- Discuss the special safety issues in collecting rubbish on the beach:
  * always wear protective gloves,
  * handle glass, jagged metal and sharp objects with extreme care,
  * never pick up a syringe found on the beach, inform the teacher who will dispose of it
  * remember to always wear sunscreen, a shirt and a hat when at the beach.

- While still at school, the students are organised into small groups. Establish the rules under which they will be operating at the beach. Reinforce the safety precautions that are to be observed during the activity.

Excursion Activity

- Each group collects 100 (or as many as possible) pieces of rubbish in their collection bags.

- When the task is completed, return to the gathering point.

- Students sort the rubbish into separate piles, as Worksheet 10 indicates.

- Count all the items in each pile and record the results on the worksheet.

- When recording has been completed, sort according to non-recyclable or recyclable. Dispose of all rubbish in a suitable fashion.

Post-excursion Activity

- Graph the results of the survey. Select five of the most common rubbish items and record where each comes from.

- Discuss ways to combat the rubbish problem on our beaches.

EVALUATION

- Did the student fill in the Rubbish Record Sheet correctly?
- Did the student graph the class results accurately?
- Did the student make reasonable suggestions as to possible sources of the rubbish?
- Did the class suggest possible consequences of rubbish remaining in the marine environment?
- Did the class suggest ways to improve the rubbish problem on our beaches?

COMPLEMENTARY ACTIVITIES

Design a poster with the theme 'Beautify Our Beaches', 'Killer Plastics', or your own slogan. Contact local community centres about the possibility of displaying the work.

Write a letter to the local council or Member of Parliament of a coastal area to ask for information on what steps are being taken to care for the coastal area and the marine inhabitants.

Hold a Recycle Week at school. Students recycle articles such as paper, aluminium and steel cans, food scraps, and soft and hard plastics. Find out what organisations are available to take these items.

Students complete a litter survey of their home, recording what is thrown out or discarded that could have been recycled (eg. food scraps, plastics, paper, aluminium and steel cans, chemicals/detergents and other items washed down the sink).

Contact and arrange a visit from a member of a community group involved in Marine Conservation.

WORKSHEET 10

Name: _____

Date: _____

RUBBISH RECORD SHEET

TYPES OF RUBBISH	NUMBER OF ITEMS	TOTAL
From Boat and Beach Users:		
Glass bottles		
Plastic bottles		
Cans		
Plastic Bags / containers		
Food Wrappers		
Wood		
Paper / Cardboard		
Rubber		
Cloth		
Bottle Tops		
Polystyrene		
Other Glass		
Other Metal		
Other:		
From Fishing Sources:		
Rope		
Plastic Bait Wrapping		
Plastic Bait Strips		
Bait Buckets		
Floats (or parts of floats)		
Fishing line		
Other:		
From ships at sea:		

Making Waves

Students work together in small groups to simulate the action of waves on a coastline, while controlling the variables of wave size and coastal formations.

CONCEPTS

- A coastline can be altered in a variety of ways by the wave action of the oceans.
- Seasons can affect how wave action impacts on coastlines.
- Cultural and natural coastal formation can affect how wave action impacts on coastlines.

OBJECTIVES

Students will be able to:

- understand the effects of wave action on a coastline, and the coastline on waves,
- suggest ways of maintaining and/or improving coastal beach fronts which are unstable.

VALUES

- People need to act responsibly when making changes to the structure of a coastline as it will affect the associated marine habitats.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	6 7	Matter Matter and Energy	Investigating rocks and crystals Investigating the effects of heat, air and water on weather.
Language	5/6/7	3.2.1 Recounts, Procedures & Explanations	A: recount - provides a, chronological account of events. B: elaborate on procedures - method, evaluation. C: elaborate on explanations - operation, cause and effect, applications, evaluation comments.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Earth and Beyond	3.8 Relates changes in their physical environment to physical processes.
Study of Society and Environment	Time, Continuity and Change	3.5 Constructs a sequence from a set of events.

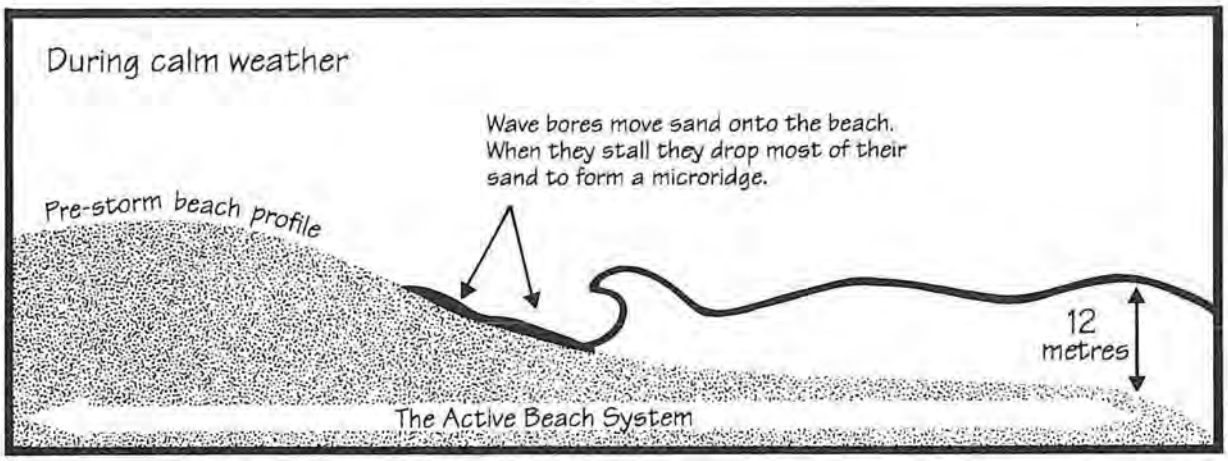
BACKGROUND INFORMATION

Most waves are formed by the movement of the wind over the sea's surface. The sun heats the oceans and the air above it is warmed and rises. A partial vacuum above the ocean's surface is created, and nearby, cooler air moves in to take its place, thereby creating wind. As the wind moves over the sea, surface ripples are formed. The more the wind blows, the bigger the ripples grow until finally, a wave is formed. Larger waves can also be caused by movements on the Earth's surface in the form of volcanoes and earthquakes beneath the sea.

In deep water, waves consist of a circular movement of water that travels across the ocean's surface. When a wave reaches shallow water, the circular motion is disrupted by the sea floor. The wave crest slows down, then lifts up and falls forward to make a breaker.

How the waves impact on the shore often depends on the time of year as well as what the wave hits—whether the formation is natural or built. Waves that reach the shore in calm weather are usually in a regular pattern of smooth, rounded waves. This gentle wave action deposits sand on to the beach. Waves that reach the shore in stormy weather are more random. These steep, high, storm waves erode the beach sand. The action of waves on a shoreline is a continual, ever changing process.

A



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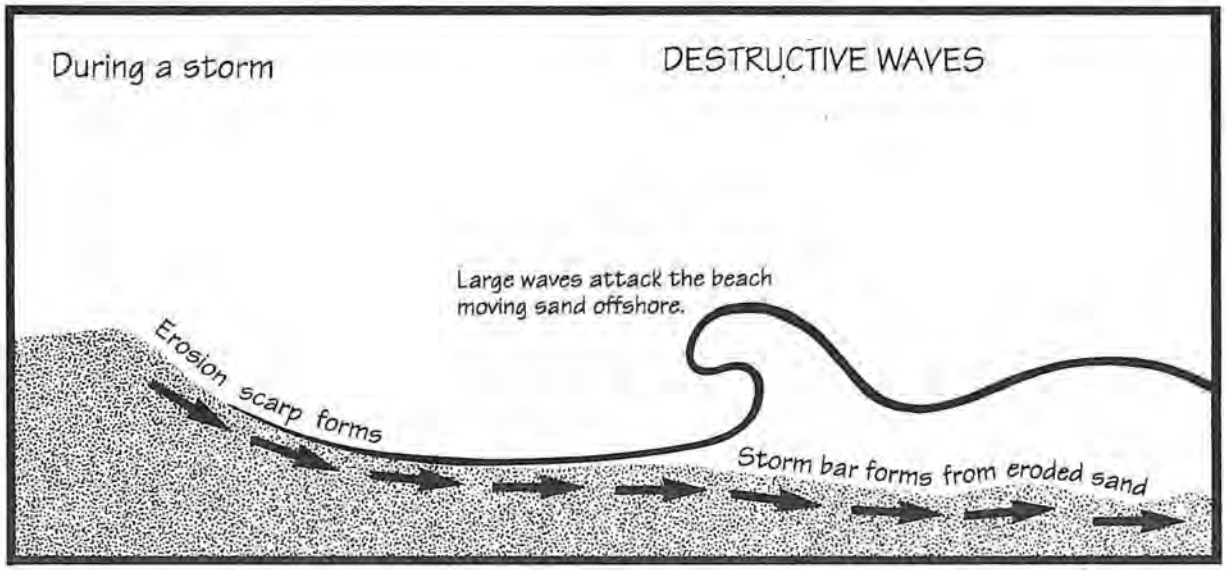

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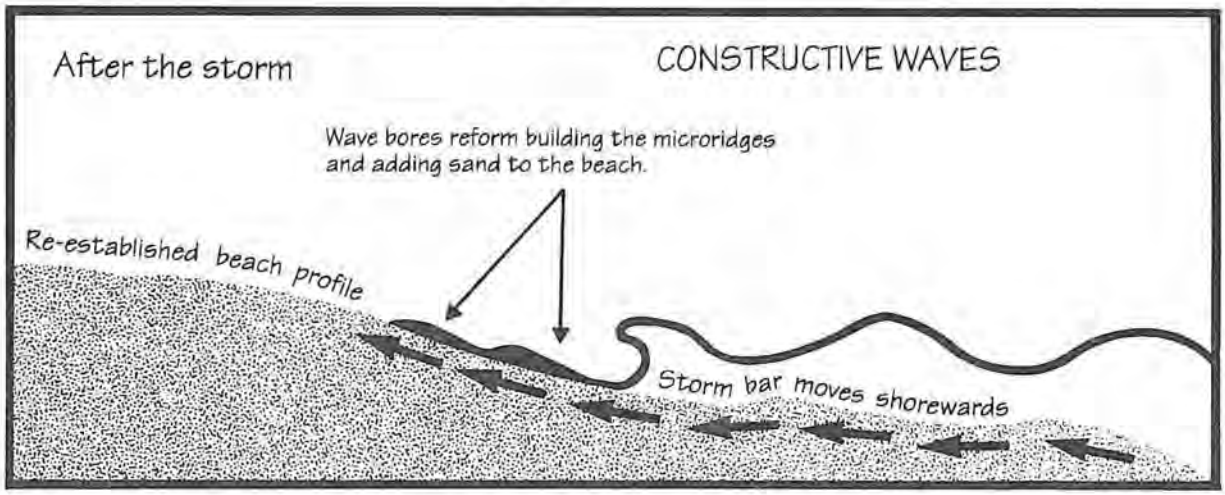

KEY WORDS

coastal erosion, groyne, headland, point, constructive waves, destructive waves.

REFERENCES

Bourke, S., Hanson, S. and Moroney, D. *Caring for the Coast - Coastal Activities for Primary Schools.* Henley Grange Council, South Australia.
Moffat, B. (1991) *Coastal Studies.* Wet Paper Publications, Brisbane.
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CSIRO (1993) *All At Sea - A Month of Environment Activities.* CSIRO Science Education Centre and Scitech Discovery Centre, Perth, Western Australia.

TEACHER DIRECTIONS

Materials

Bathers
Trowels
Buckets
Hats
Sunscreen
Shirts

LESSON OUTLINE

Excursion Activities

- Record whether the tide is going in or out by placing a stick in the sand at the water's edge when you first arrive at the beach. Record where the water is after one hour.
- Students work in pairs and station themselves at the end of the wave wash on the beach.
- Students to construct barriers, islands and groynes using a range of materials according to Worksheet 11. Dune plants can be simulated by seaweed.
- Complete Worksheet 11 and discuss.
- Record how many waves crash against the built barrier in one minute. What happens to the barrier? How long does it take for the waves to effect the barrier? How long before each is destroyed? Rebuild each barrier five times to get an average picture.
- Build the barriers at different distances from the wave wash to simulate destructive and constructive waves. Those closer to the wave wash should have stronger and more frequent waves acting upon them.
- Observe the waves over a short period of time. Which way are they breaking? Are they all of the same force? Do they come in sets and, if so, how many waves in each set? When would be the best time to take out a small boat through the waves?

EVALUATION

Students accurately recorded the effects that:

- small gentle wave action has on coastlines,
  rough wave action has on a coastline,
- different coastal formations makes on wave action and its impact on the coast.

Students suggest ways to maintain or assist in stabilising unstable beaches.

COMPLEMENTARY ACTIVITIES

This activity can be linked to the 'Secret In The Stone' activity included in this package. It can be used before the beach activity as an introduction to how sandy beaches and reefs are formed. It can also be used as a follow-up activity to show the effect wave action can have on reefs as well as sandy shores.

Video *Waves In The Ocean*. Classroom Video, NSW.

Talk to surfers about left and right breaks. Observe surfers. Go surfing.

Read the book, *Pinquo* by Colin Thiele.

Construct a wave tank with a large trough, a ruler for the paddle, and sand for the coastline. Observe the changes in the coastline with waves of different forces, and with groynes and 'vegetated' sand dunes.

WORKSHEET 11

Name: _____
Date: _____

MAKING WAVES

Record what happened to the barriers when the waves contact. Is the tide coming in or going out? How many waves in each set?

SAND BARRIER

Destructive waves (barrier built close to the wave wash)

Constructive waves (barrier impacted infrequently by gentle waves)

SAND AND PLANT BARRIER eg. seaweed, seagrass.
Collect items washed up on the shore.

Destructive waves:

Constructive waves:

SAND AND ANIMAL BARRIER eg. rock, shells.
Collect items washed up on the shore.

Destructive waves:

Constructive waves:

Look out to sea. Tick which way are the waves breaking?

RIGHT ☐ LEFT ☐

What's that Shell?

Students fossick on the beach looking for as many different shells as they can find, then classify them in as many ways as possible. This is an enjoyable way to become familiar with the shells on the beach and their many characteristics.

CONCEPTS

- There is a large diversity of shell types found on the coastline.
- The numbers and kinds of shells found on the beach habitat being explored will be affected by the adjacent marine habitats.

OBJECTIVES

Students will be able to:

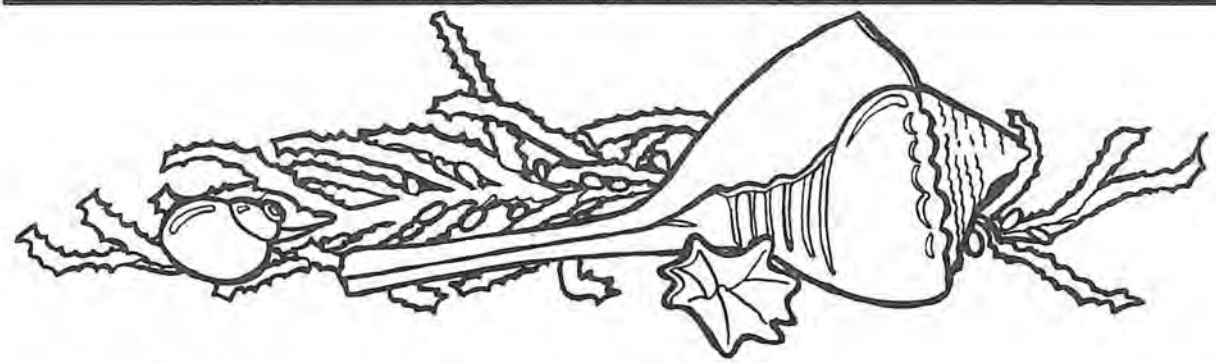
- collect and record the types of shells found on a sandy beach
- classify the shells according to the selected criteria
- name the shells collected and identify them as either gastropods of bivalves.

VALUES

- Shells are a habitat for many sea creatures and must not be removed from the environment.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Mathematics	5/6/7	S:P3:2 S:P3:5 S:P4:2	Carry out activities involving the classification of shapes. Investigate the features and functions of shapes in the environment. Carry out activities to investigate reflectional and rotational symmetry.
Language	5/6/7	3.2.2 B 5.2 A,B,C	Descriptions. Present descriptions in oral and written forms. Speaking.



STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Mathematics	Space	4.9 Selects, describes and compares figures and objects on the basis of spatial features, using conventional geometrical criteria.
Science	Life and Living	3.13 Maps relationships between living things in a habitat.
English	Speaking and listening	3.7a Interacts for specific purposes in the classroom.

BACKGROUND INFORMATION

Shells belong to a group of animals called Molluscs. Mollusca, meaning 'soft body', is one of the largest divisions of the animal world and can be found in marine and freshwater environments. The sheels that we commonly find on the beach are from one of two groups, Gastropods or Bivalves.

Bivalves are made up of two parts, joined by a hinge of interlocking teeth, with a tough ligament holding the two parts together. Some of the common bivalves are clams, scallops, oysters, cockles and mussels. You may see two siphon tubes of a bivalve protruding just above the sand. These tubes are used for breathing and feeding.

Gastropoda, meaning'stomach foot', include abalone, tritons, periwinkles, limpets, cowries, whelks, turbans, the common garden snail, and a range of animals without shells, including the common garden slug and a range of sea slugs. Most gastropods have a single spiralled shell, which is why they are sometimes referred to as Univalves. They have a head which includes a pair of tentacles and a pair of eyes on or at the base of the tentacles.

Shell shapes are adapted to help the animals live in specific environments. The wedge-shape of some shells allows the animal to burrow in the sand easily. Some shells, which are streamlined and quite flat in shape, help the animal to stay attached to rocks that are subject to turbulent conditions. Many shells are spiral-shaped, which allows for the growth of the animal without it needing to a find a new home. These are just a few of the variations in shells.

KEY WORDS

molluscs, gastropods (univalves), bivalves, muscular foot, hinge, hermaphrodite.

REFERENCES

Bourke, S., Hanson, S. and Moroney, D. *Caring for the Coast - Coastal ctivities Activities for Primary Schools.* Henley Grange Council, South Australia.
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Reid, A. (1992) *Coasting - Activities for coastal excursions and beach holidays.* Gould League of Victoria Inc. Victoria.

TEACHER DIRECTIONS

Materials

Shell Identifier (Resource Sheet 5, Worksheets 12 & 13)
Bags or buckets for collecting shells

LESSON OUTLINE

Pre-excursion Activities

- Using the shell identification key (Resource Sheet 5) students become familiar with the various types of shells common to the coast.

- Use Worksheet 12 (6 different cards provided) to play 'shell bingo'. This will help familiarise the students with the various features of the shells. Each group is supplies with a bingo card. Cockle or other bivalve shells can be used for counters. Pull a picture out of a hat and call out the name as well as some information about the animals (where it lives, what it eats, etc.). Students to match them on their cards then cover with shell. The first student to have five in a row wins.

Excursion Activity

- Students divide into small groups and collect 100 shells per group. Whole, undamaged specimens are best as they are easier to classify and study.

REMEMBER:

Shell collecting is a fascinating activity, but always follow these simple steps:

- only collect shells that do not have an animal living in or on them
- limit the number of shells you take as a variety of marine creatures use empty shells for their homes.
- return shells to the beach when you have finished with them.

- Students use Worksheet 13 to sort the shells and put five in each category according to:
  size (smallest to largest)
  colour (lightest to darkest)
  shape (circular, spiral, elongated, symmetrical)
  texture (rough, smooth)
  patterning
  type (gastropod, bivalve)
  student's own choice.

Discuss which form of classification would be the most useful for the average shell collector to use. Give reasons for the choice.

- Students use Resource Sheet 5 to identify their shells and classify them as either Bivalves or Gastropods.

- Look at the variety of shell shapes. Suggest reasons why the shapes are different and what advantages the shapes have for the molluscs such as protection from predators or camouflage.

- Discuss ways the various molluscs may obtain their food. Would they move around or are they stationary? Do they bury themselves in sand or are they found on the reef? How could these factors affect the shell shapes?

- Create a beach display of the shells collected complete with identification and classification.

EVALUATION

- Did the students classify shells into two groups using a variety of criteria?
- Did the students identify their shells by name?
- Did the students classify the shells as either Bivalves or Gastropods?

COMPLEMENTARY ACTIVITIES

This activity can also be done in conjunction with the 'Rocky Shore Safari' activity in the Limestone Reef section of this package.

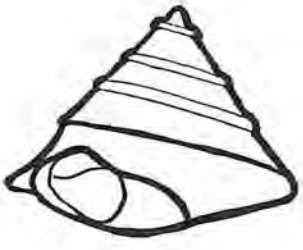
After completing this activity, students can use what they have learnt to include various shell shapes into the diorama created in the 'Creature Feature' activity in the Limestone Reef section of this package.

Students look for growth lines on a variety of shells. Separate the shells according to those which you think are very old and those that are very young.

Design a shell. Imagine you are a creature living in the sea. Design an original shell which will give you protection, ease of movement and room in which to grow.

Make a shell fossil. You will need modelling clay or Plasticine, paper cups and plaster of paris. Half fill the cup with the modelling clay and press a selected shell into the clay to make a impression. Remove the shell and add the plaster of paris. When dry, remove the paper and separate the clay from the plaster.

Using the shell shapes found on the beach, create a design that can be made into a lino print, string print or silk screen print, and which can then be put onto either paper or material in Art class. This can be extended to printing T-shirts or other articles of clothing.

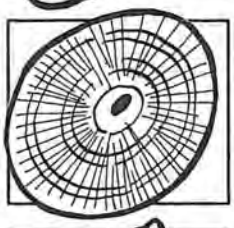


RESOURCE SHEET 5

What's that Shell?

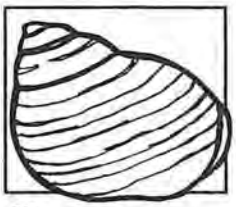
GASTROPODS

Abalone: Quite a flat shell with a low, off-centre spire and a large body whirl. A row of respiratory holes are found on the side of the shell.

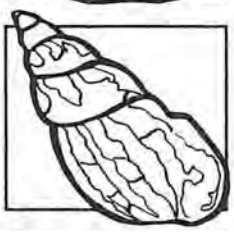


Keyhole limpet: Usually has a hole in the middle of the shell. They are common on rocky shores.

Top shells: A small, conical shell which is circular to the bottom. Mostly found in shallow water.

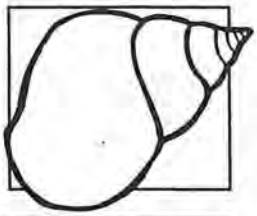


Turban shells: Medium to large in size, generally heavy and globose. Found in shallow water.

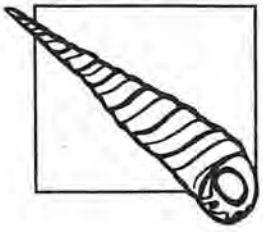


Pheasant shells: Rounded with few whorls, a moderate spire and a smooth outer surface.

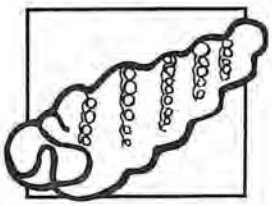
Nerites: Globose, fairly heavy shell with low spire. Lives mainly on rocky shores.



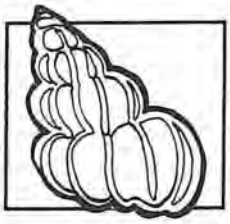
Periwinkles: Small shells with a high spire.



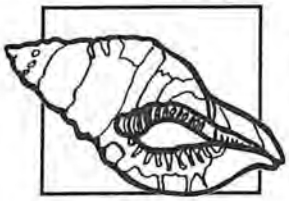
Screw shells: Long, tapering shell with up to 25 whorls and a small rounded opening.



Creepers: Shell size can vary. A large spire and a long, often curved, anterior siphon and small opening.

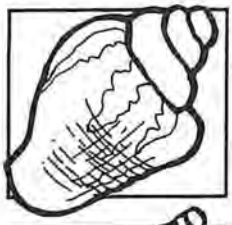


Wentletraps: Small, generally white, high spired, with numerous whorls and strong ribs. They are found in shallow, sandy areas along with sea anemones, on which they feed.

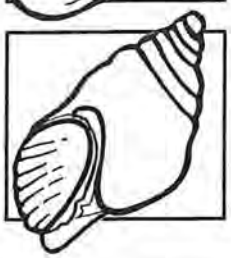


Triton shells: Range from small to large in size with solid shells and pronounced varices, which are never spiny. The operculum is brown and horny with the opening either rounded or oval in shape.

Murex shells: Range in size from large to small, have a prominent spire, a small, round aperture and a horny operculum. The most prominent feature is the many varices which often have long spine projections.



Dove shells: Small, heavy shells that are smooth or with a spiral rib, and a very narrow aperture. They live among seaweeds and seagrasses.

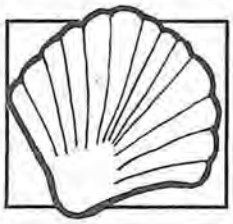


Dog whelks: Small and ovate with a medium to high spire, often with a pronounced sculpture. They are common on intertidal and subtidal sand and mud.

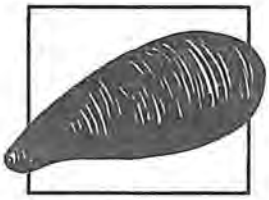
RESOURCE SHEET 5

BIVALVES

Ark shells: Small to large in size and elongated. Valves are equal and often almost rectangular in shape. They are commonly found in intertidal and subtidal rocks and sand.

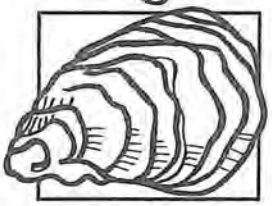


Dog cockles: Usually medium to large in size. Valves are equal and almost circular, fitting tightly together. Usually found in fairly shallow, sandy areas.



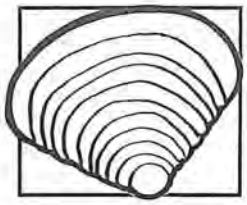
Mussels: A typical mussel shell is equivalve, inequilateral with the anterior side short. They are generally found in shallow water, forming dense beds on rocky shores, jetty pilings and hulls of ships.

Scallops: Oval or orbicular in shape. Inequivalve and inequilateral with a straight hinge. They are usually found lying on the sandy bottom in shallow water.



Oysters: Medium to large in size with a heavy shell, which can vary its shape to fit the area in which they live. They are commonly found in large numbers on intertidal rocks.

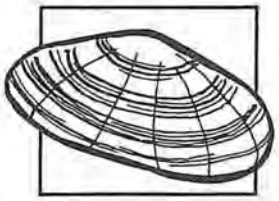
Cockles: Sizes range from small to large. Valves are almost circular and equal. Found burrowed in shallow sand and mud.



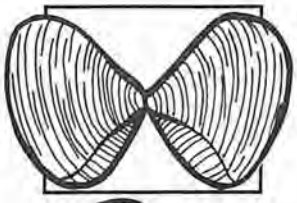
Trough clams: Medium to large in size, almost triangular or oval in shape, with equal valves and a smooth or ribbed outer surface.

Wedge shells: Medium size, triangularly ovate, flattened, with a smooth, solid external surface. These shells live in the surf zone of sandy beaches.

RESOURCE SHEET 5



Tellins: Size ranges from small to large. Ovate or oblong in shape, with thin flattened, brightly coloured valves. They live in shallow, sandy areas, lying just below the sand surface with only their siphons showing.

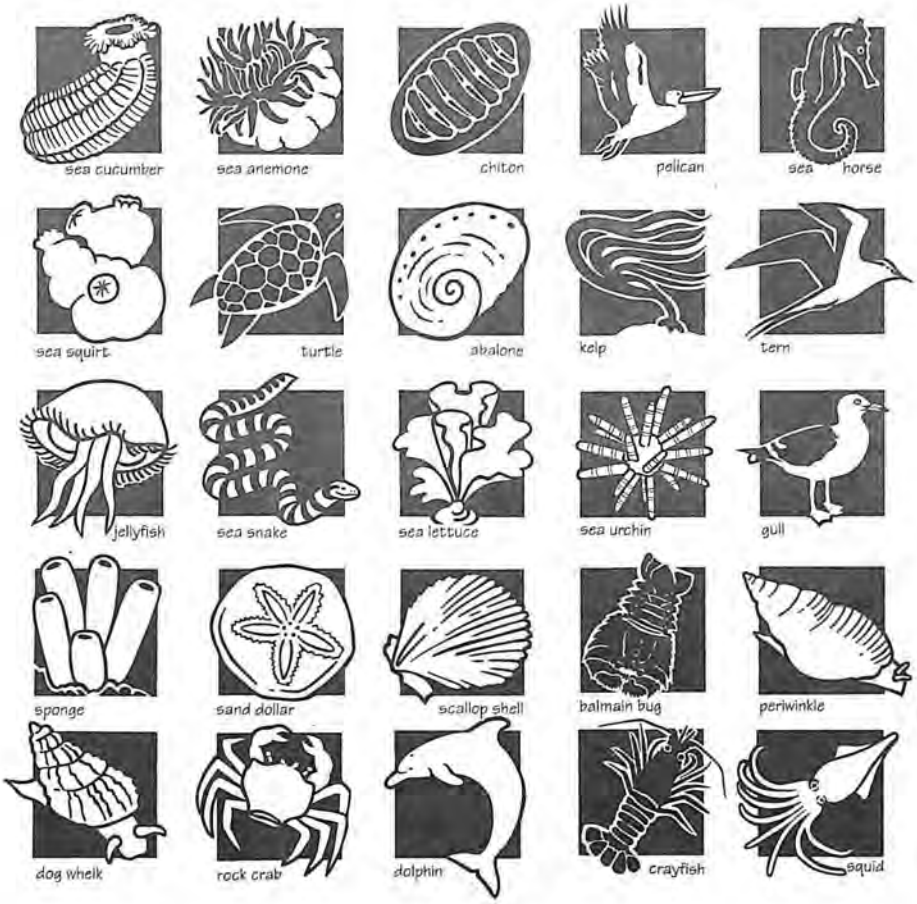


Pipis: Small to medium in size, wedge-shaped flattened, with equal valves. They are found in abundance in the surf zone of sandy beaches, lying just below the sand surface.

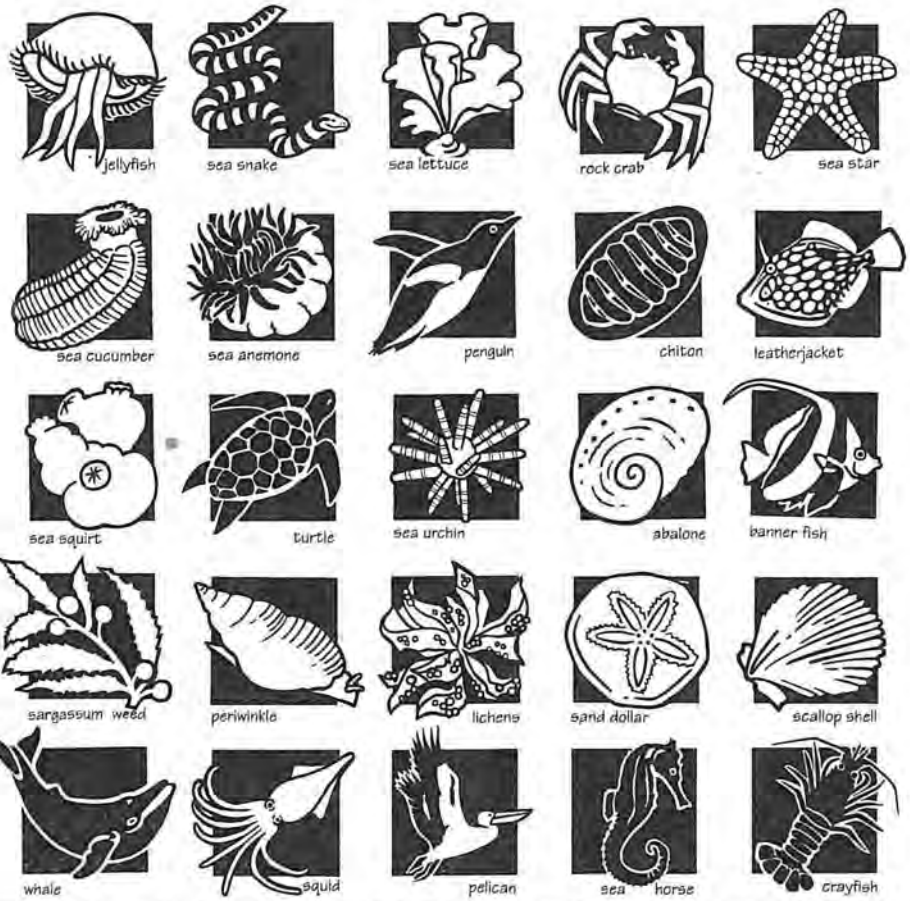
Venus shells: Shells are usually oval or circular in shape. The valves are equal and can be found in a variety of colours and sizes. They are commonly found in shallow, sandy or muddy areas of protected bays, and at the mouth of estuaries.

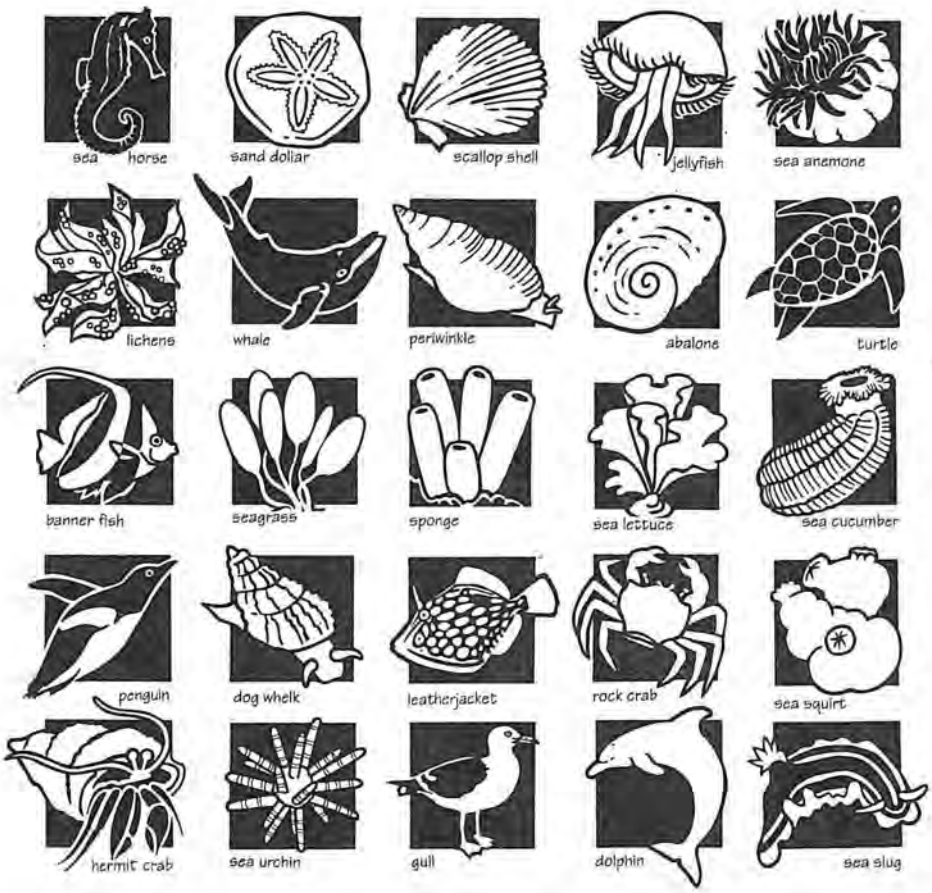
WORKSHEET 12

SHELL BINGO



WORKSHEET 12

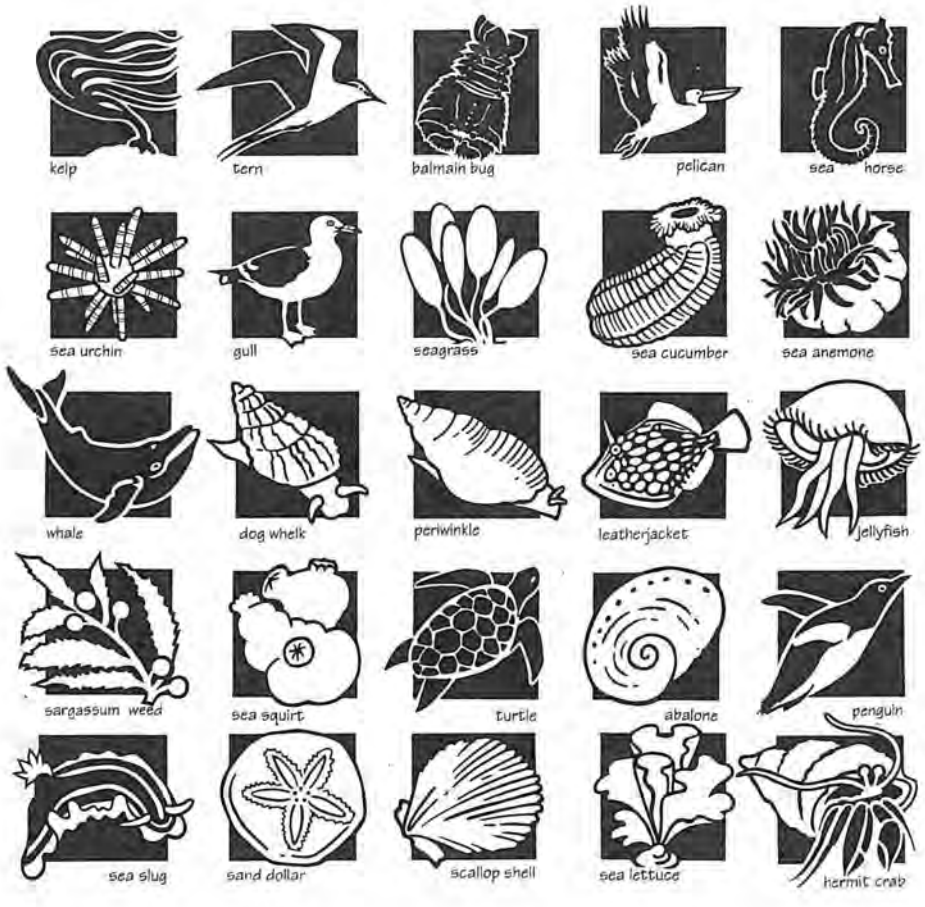




WORKSHEET 12

WORKSHEET 12

WORKSHEET 12



WORKSHEET 12

WORKSHEET 12

SHELL BINGO

CALLERS CARD

SHELL SORTING

Select five shells to go into each category

SIZE
(small to large)

SHAPE

COLOUR
(lightest to darkest)

TEXTURE
(rough, smooth)

PATTERNS

TYPE
(butterfly, single)

OWN CHOICE

Seagrass Meadows

The Ocean's Garden

Classify seaweeds and seagrasses, and construct a herbarium.

CONCEPTS

- Seagrass and seaweed (algae) are different types of plants.
- Living seagrasses are more commonly found subtidally.

OBJECTIVES

- To classify seaweed and seagrass, and to recognise the characteristics of each.
- To establish a herbarium using the seaweed and seagrass collected.

VALUES

- To treat seaweed and seagrass with care so as not to damage the delicate balance of the marine environment in which they both play an important part.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Language	6/7	5.3 Writing	E. children to decide whether own knowledge is sufficient or whether further information should be sought
	5/6/7	4.2 Listening and Reading	H. regroup events, information and ideas into categories.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Processing Data	4.3 Draws conclusions linked to the information gathered and the purposes of the investigation.
English	Speaking and Listening	3.7a Interacts for specific purposes in the classroom. 5.7a Interacts with peers in structured situations to discuss familiar or accessible subjects involving challenging ideas and issues.
Studies of Society and Environment	Natural and Social Systems	3.16 Describes an example of a cycle within natural systems and the place of people in it.

BACKGROUND INFORMATION

SEAWEED (Marine algae)

Seaweeds may be brown, green or red. They do not have roots, stems, leaves, flowers or fruit. Roots are unnecessary because they are anchored to rocks by holdfasts (which look like fingers) and their minerals and nutrients are provided by the constant movement of sea water over them.

Seaweeds reproduce by spores which are released directly into the water.

Seaweeds provide food and shelter for a range of marine animals.

SEAGRASS

Seagrasses are not related to the seaweeds. They are angiosperms. They have roots, stems, leaves and inconspicuous flowers. They produce fruits and set seeds like flowering plants on land.

Some seagrasses form large underwater meadows. They grow in sheltered parts of the sea, bays and estuaries.

Seagrass meadows form important breeding grounds and nurseries for fish and invertebrates.

KEY WORDS

seagrass, seaweed, algae, holdfast

REFERENCES

Pope, J. (1985) *The Seashore.* Franklin Watts Ltd. London.
Haddon, F. (1986) *The Australian Environment - Seashores.* Hodder and Stoughton. NSW.
Dakin, W.J. and Bennett, I. (1992) *Australian Seashores.* Collins, Angus & Robertson Pty Ltd. NSW.

TEACHER DIRECTIONS

Materials

Paper or plastic bags
Scissors
Trays
Stiff paper (white and coloured)
Salt water
Newspaper
Nylon stocking
Telephone books or similar weighty objects

LESSON OUTLINE

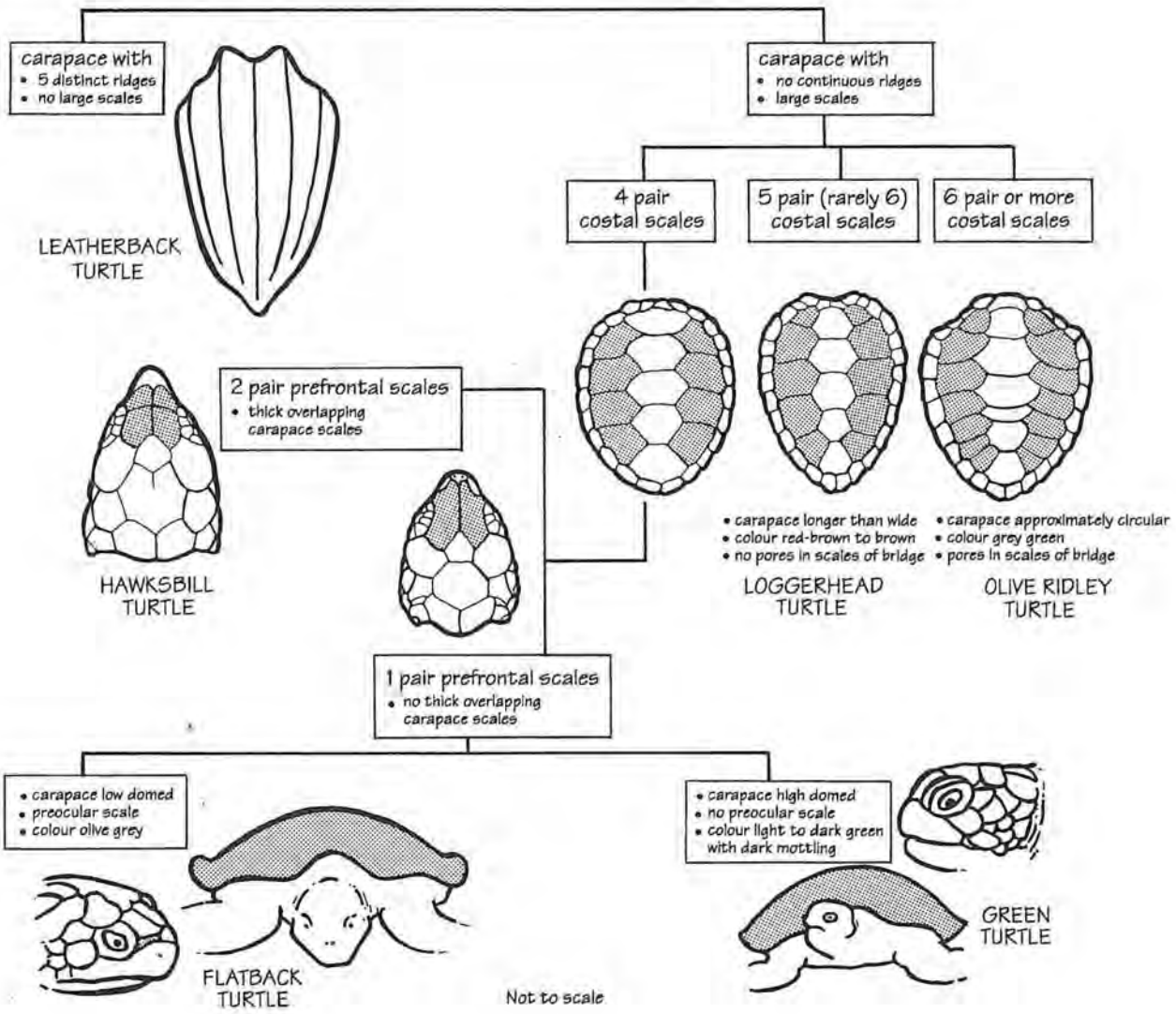
Pre-excursion Activity

Explain to students the differences between seaweeds and seagrasses. Provide them with Resource Sheet 6 and draw a dichotymous key. An example is below.

NOTE :

Before commencing any seaplant exploration activities, be sure to stress the need for care at all times when picking up or going through the plants. There could be dangerous items of rubbish hidden amongst them. A gardening fork makes the job much safer.

GUIDE TO ALL MARINE TURTLES FOUND IN WATERS OFF THE WESTERN AUSTRALIAN COAST



Excursion Activities

- Collect a variety of fresh seaplants from the beach, not from the water.
- Separate them into two groups—seagrass and seaweed—using Resource Sheet 6 to help with the classification.
- Label the bags.
- Take a cutting (to fit A4 page) from each plant and place it into the correct bag.

Post-excursion Activity

(Complete the following activity as soon as possible, as seaweed tends to stink after a while)

- Follow the directions for presenting the plants on Resource Sheet 7.
- Place seagrasses on different coloured cards.
- Using Resource Sheet 8 as a reference guide, identify the plant you have pressed. Use reference books to find out more information about the plant.
- Complete a plant identity sheet (Worksheet 14) for each plant and attach it to the page.
- To protect and preserve, laminate the worksheet with clear adhesive plastic.
- Collate all the sheets into a book and keep in the library as a resource titled *Marine Herbarium*.

* If a beach visit is not possible for this activity, collect the plants yourself from the beach and complete the activity at school.

EVALUATION

- Were students able to classify the plants into the correct categories using the information provided?
- Were students able to identify the seagrass and seaweeds from the diagrams?

COMPLEMENTARY ACTIVITIES

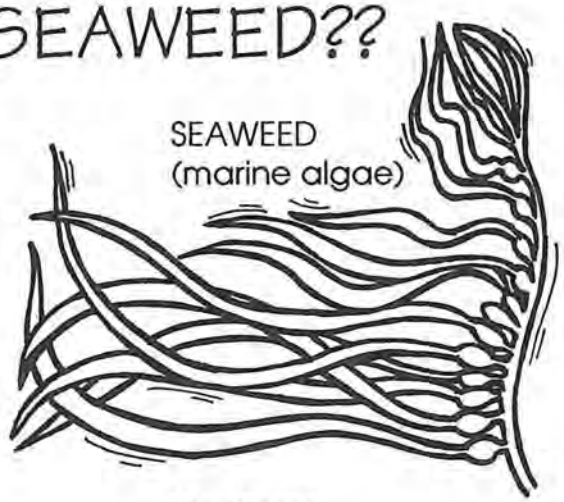
Paint a mural of all the seagrass and seaweeds seen at the beach, or collected and pressed.

Design a public noticeboard that could be erected at the beach to inform people about seagrasses and seaweeds. Include a safety and conservation message.

RESOURCE SHEET 6

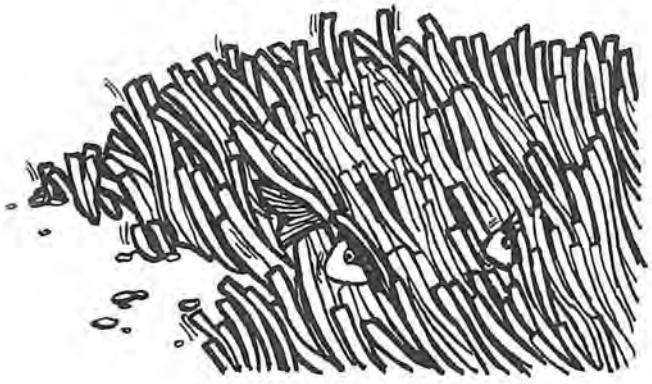
SEAGRASS OR SEAWEED??

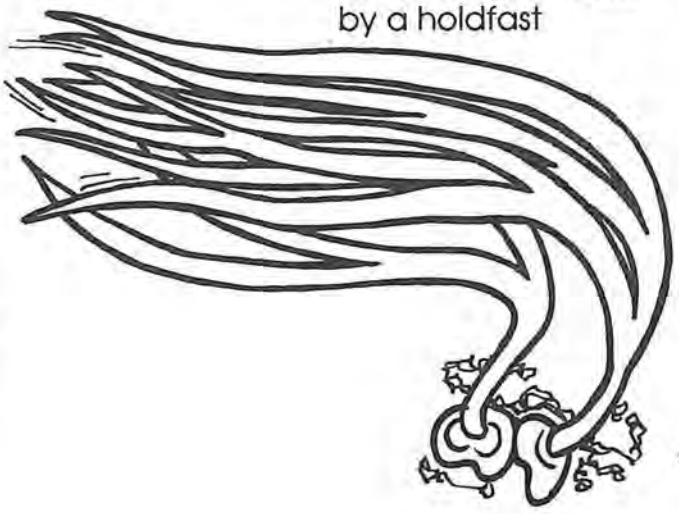
SEAGRASS



SEAWEED
(marine algae)

Stems	No Stems
Leaves	No Leaves
Flowers (though difficult to see)	No Flowers
Fruit	No Fruit
Sets Seeds	No Seed
Roots	No Roots
Forms large underwater meadows	Some cling to rocks by a holdfast





RESOURCE SHEET 7

PLANT PRESS

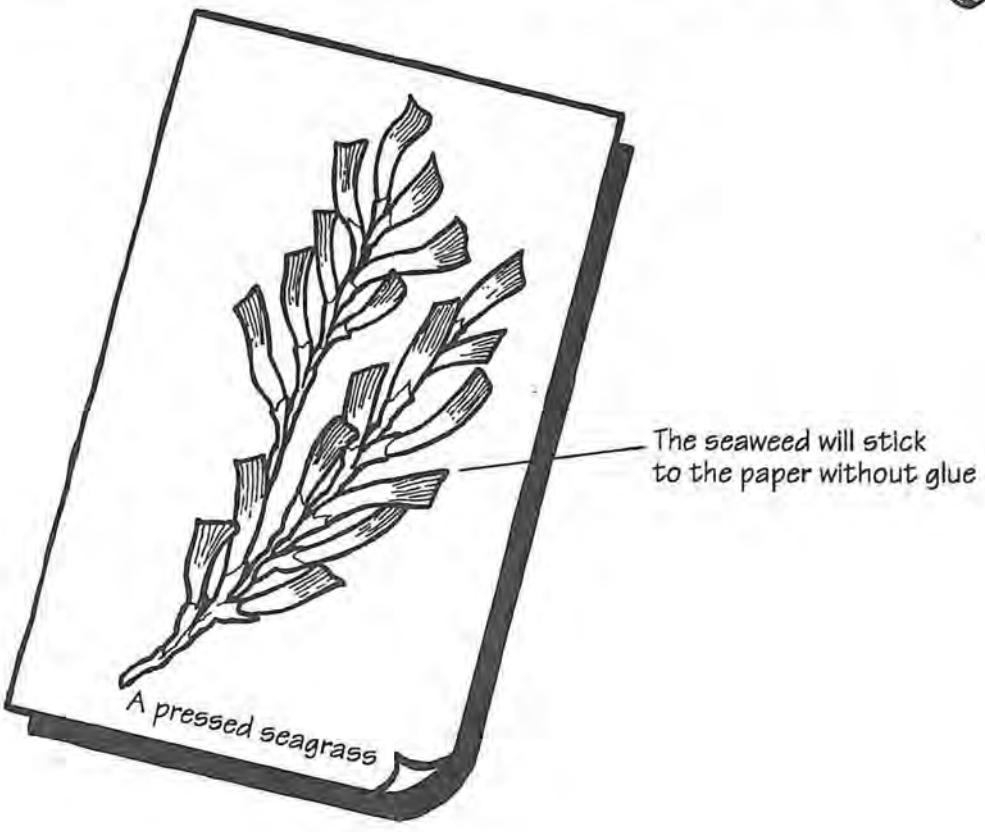
1. In a dish of salty water, spread out a piece of seagrass or seaweed.

2. Slide a piece of stiff paper under it and arrange it so that it looks well layed out.

3. Lift the paper and plant out of the tray and place both of them on a thick layer of newspaper. Place a nylon stocking over the plant and place more newspapers on top.

4. Place a heavy weight on top and press everything flat. The seaweed or seagrass will then stick to the paper.

5. Leave to dry for a week before removing. You may need to change the newspaper after the first few days.



RESOURCE SHEET 8

PLANT IDENTIFICATION CHART

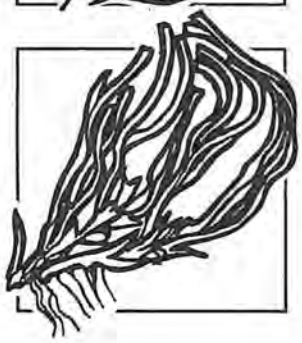
SEAGRASSES

Zostera - Eelgrass

Sheds some leaves in the Autumn.
Much is washed to the shore, often in the form of round leaf fibre.

Amphibolus antarctica - Sea Nymph/Wireweed

Long stems may support growths of hanging on plants and animals.

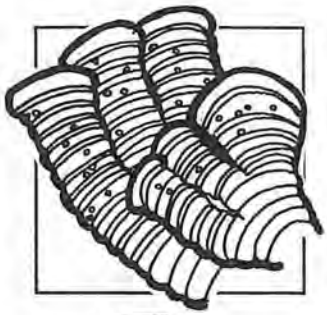


Posidonia - Fibre-ball weed

Natural balls of leaf fibres, rolled by wave action, are often washed ashore on beaches.

SEAWEEDS

Green Algae



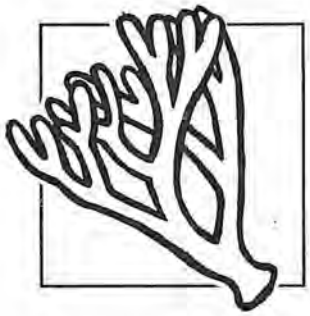
Padina

Each frond has a little fan.

Ulva lactuca - Sea Lettuce

Almost transparent, bright green in colour.

RESOURCE SHEET 8



Codium

Colours range from rich green to almost black.

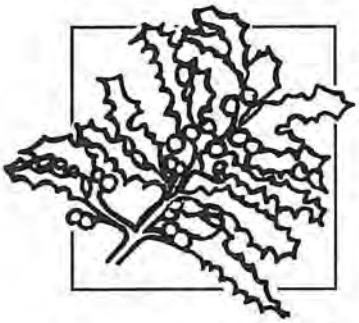
Caulerpa

Brilliant green, strap like.

Brown Algae

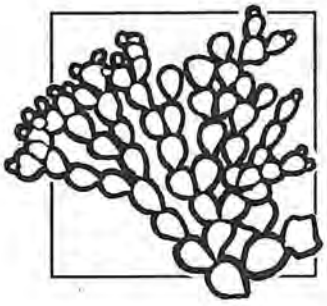
Durvillea potatorum - Bull Kelp

Long, thick, leathery like straps.



Sargassum

Little round floats about the size of a sultana.



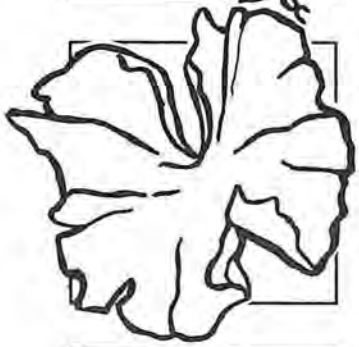
Hormosira banksii - Neptune's Necklace/ Seagrapes

Brown-yellow coloured. Made up of bubble shaped chambers.

Red Algae

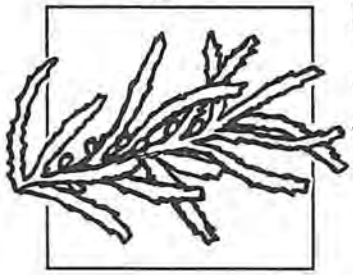
Corralines

Small, very neatly branched. White colour when washed up.



Porphyra

Looks like a dying sea lettuce.



Phyllospora comosa - Bubble weed

1—1.5 metres in length. Flattened stem and long leaf like fronds. Attached are bubble like air sacks.

WORKSHEET 14

Name:

Date:

HERBARIUM

Number: Date:
Collected by:
Common or own name:
Scientific name:
Where found:
Colour:
Plant form:
Other Notes:

Number: Date:
Collected by:
Common or own name:
Scientific name:
Where found:
Colour:
Plant form:
Other Notes:

Number: Date:
Collected by:
Common or own name:
Scientific name:
Where found:
Colour:
Plant form:
Other Notes:

Number: Date:
Collected by:
Common or own name:
Scientific name:
Where found:
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Plant form:
Other Notes:

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Common or own name:
Scientific name:
Where found:
Colour:
Plant form:
Other Notes:

Number: Date:
Collected by:
Common or own name:
Scientific name:
Where found:
Colour:
Plant form:
Other Notes:

What am I?

Using 'What Am I ?' hints, students identify the correct sea plant or animal, and later explore the beach to discover if they were correct.

CONCEPTS

- Different plants and animals can be found on the coastline.

OBJECTIVES

- To identify marine plants and sea creatures found on the beach, using hints and picture clues.

VALUES

- To treat plants and sea creatures on the beach with the same care and respect that all living creatures should be shown.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Language	5/6/7	4.1 Comprehending	B. inferential - supporting detail, comparisons, predicting outcomes.
		2.1 Spoken and Written	G. get information from and use a variety of diagrams in texts.
		1.0 Language Concepts	C. written messages are subject to as much interpretation as spoken messages.
Science	7	Living Together	Investigating animal and plant interdependence.

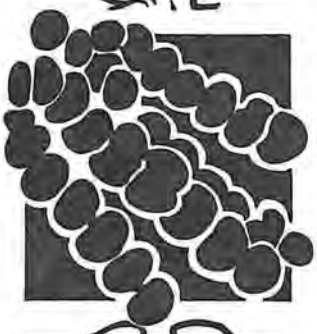
STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Natural and Processed Materials	3.17 Makes connections between the structure of common materials and their properties.
Studies of Society and Environment	Investigation, Communication and Participation	4.2 Translates information from one form to another.

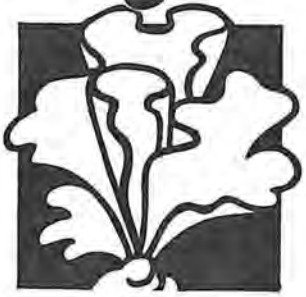
BACKGROUND INFORMATION
(Answers to Worksheet 14)

crab: Active at high tide or at night. Survives in the day time by sheltering in crevices, under rocks and seaweed, and by keeping its gills wet. Crabs have five pairs of legs, one pair having pincers at the end. They are scavengers eating the remains of dead creatures. Every few weeks crabs moult their old shell.

seagrass: Has stems, leaves, inconspicuous flowers, forms fruits and sets seeds like flowering plants on land. Grows in sheltered parts of the sea. Forms large underwater meadows. Breeding grounds for fish other sea creatures. Not related to algae.

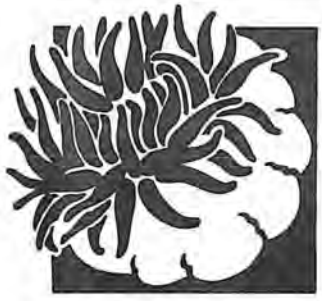


seaweed (macro algae): Do not have roots, stems, leaves, flowers or fruit. They cling to rocks by 'holdfasts', which look like fingers. Sea water provides them with the necessary minerals, so that they do not need stems or leaves. They provide food and shelter for seashore animals. Their colours are green, brown and red.

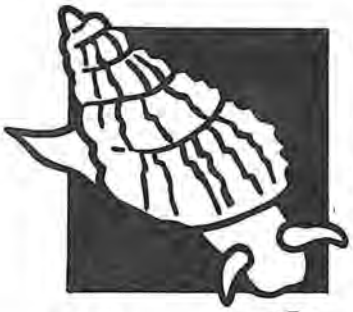


sea lettuce (*Ulva lactuca*): Bright green, flat-leaved algae. Bright green fronds found on exposed rock platforms and shallow pools that are only covered at high tide. Called a sea lettuce because of its shape and colour. Aborigines used to prepare and eat this plant.

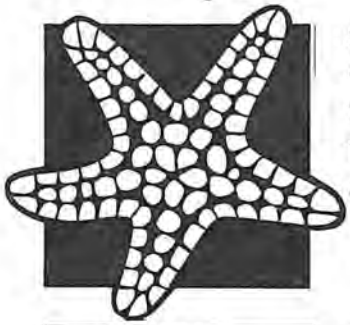
sea urchins: Round, slightly flattened body covered with spines that are made of chalky substance. Animals related to sea-stars. Move around using special tube feet. To disguise themselves, they drape seaweed over their sharp spines, using their tube feet to do this. Sea urchins can feed as they move along as their mouths are at the base of their bodies.



sea anemone: Soft bodied relatives of coral and jellyfish. Can be found under rocks and in cracks or pools where they are protected from the sun. They move very little and are fixed to the reef by the base of the column of their body. They look like flowers, but are really animals.



dog whelk: Active, carnivorous animal that readily bores through the shells of other molluscs to feed on the soft flesh inside. This process can take up to five days. They have thick, heavy shells so they are not harmed if they are tossed about by the waves. Their shell colour changes depending on what they eat.



sea-star, star fish: Has five or more hollow arms. Along the arms are two rows of little legs with terminal discs called tube feet. These enable the animal to move slowly over the reef. If an arm is broken off, a whole new animal can grow from the missing arm.

sea slugs, nudibranchs: Snails without shells. Often seen in summer months. Sea slugs disguise themselves well by blending in with the pebbles and sand as they do not have outer shells. The gills form a frilly ring on their backs but these are withdrawn inside the body when in danger. It is both male and female in the same animal (hermaphrodite). They move with the use of soft muscular feet under their bodies.

periwinkles (*gastropods*): Small blue snail-like molluscs which huddle together to protect themselves from dry and exposed conditions. They have a lid over the entrance to the shell and when underwater they move the lid from the mouth of the shell and crawl along like a snail.

lichens: Plant-like organisms that are actually made up of two organisms—an alga and a fungus living together. They form crusty or leafy growths on rocks in the spray zone, or on trees.

sea cucumber: Belong to a group of marine animals called echinoderms, meaning 'spikey skin'. Their body is soft and sausage-like. They might even be mistaken for large worms. Instead of teeth, they have a group of branched tentacles which help them feed. They can part with a considerable portion of their body and grow a new portion to replace it. Other members of this group are sea stars and sea urchins.

sponge: Colourful, porous organism that is a very simple animal. Obtains food by filtering plankton from water passing through the holes in its body. It grows on or under rocks in sheltered parts of rock pools.

KEY WORDS
rock crab, seagrass, seaweed, sea lettuce, sea urchin, sea anemone, dog whelk, sea star, sea slug, periwinkle, lichens, sea cucumber, sponge, mollusc, carnivorous.

REFERENCES
Gould League of Victoria (1988) *Coastal Wildlife*. Gould League of Victoria Inc. Victoria.

TEACHER DIRECTIONS
Materials

Worksheet 15

LESSON OUTLINE

Pre-excursion Activity

- Using the background information and the diagrams on Worksheet 15, discuss the types of marine plants and creatures to be found on the beach. Read through the descriptions if the students have little knowledge of marine creatures and plants.

- Go through the activity sheet and then let the students try to work out the answers.

Excursion Activity

- The students should explore the beach in groups using Worksheet 15 as a basis for a 'Treasure Hunt'-type activity. As each item on the list is found, it should be examined in more detail, then ticked off the list.

Don't forget to return all items to the beach when you have finished using them.

Answers to the clues are in found in the 'Background Information'.

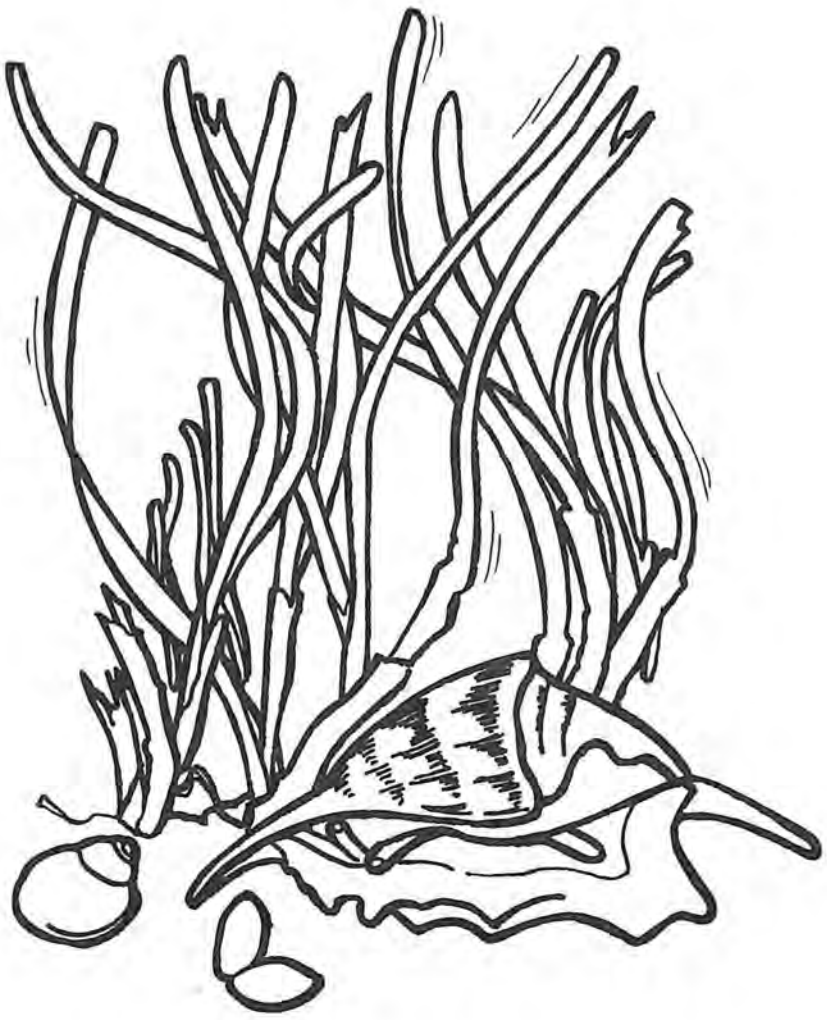
EVALUATION

- Were the students able to complete the activity successfully?
- Were the students able to find the correct items?

COMPLEMENTARY ACTIVITIES

Students make up their own "What Am I?" questions on items, plants or animals found at the beach.

Students design wanted posters, which give written descriptions and a picture of the plant and animal in question.



WORKSHEET 15

Name: _____

Date: _____

1. I am usually found on rock platforms. I like hiding under stones and in crevices. My colours usually blend in with my surroundings. I eat the remains of dead creatures. I moult my outer layer every few weeks and replace it with a new one.

I am a .....

2. I live in a large colony of my own kind. I often can be found washed up on the beach. My skin is usually slimy, and I need light to keep me alive. I am similar to something that lives on land. My species is constantly under threat because of human activities.

I am a .....

3. My colours range from brown, green and red. I cling to rocks with my 'holdfast'. I am also known as algae. You see me everywhere when you walk along the beach in a variety of forms. Some people actually like eating me!

I am a .....

4. I am green and look somewhat transparent. People would like to eat me, but I taste quite salty! I am quite easy to find out on the reef.

I am a.....

5. I have a hard body and can be quite painful if touched. I often can be found in pretty colours like purple, red etc. My mouth is underneath my body, and as I move I feed. A very prominent part of me is made of chalk.

I am a .....

6. I am carnivorous (meat-eater). I am related to the jellyfish. I attach myself to rocks or bury myself in sand. My soft arms wave around in the water. I look like a flower, but am really an animal.

I am a .....

7. I am carnivorous. I creep slowly over rocks. I am a mollusc (shell creature). My body is soft. I bore through the shells of other molluscs to feed on the soft flesh inside. I don't look anything like my name suggests.

I am a .....

8. I have a skeleton inside my body that is made of chalk. If part of me is broken off, a whole new animal can grow from the lost part. I have hundreds of tiny suckers under my arms. I turn my stomach inside out on top of my victim, then I eat them.

I am a .....

9. I creep around rock pools searching for food using my soft muscular foot. I scrape food off rocks with my file-like tongue. I am neither male nor female, I am both at the same time.

I am a .....

10. I am small, blue-black in colour and huddle together with my friends to protect ourselves from dry and exposed conditions at and above the high tide mark. I eat algae and snails eat me. I am a mollusc.

I am a.....

WORKSHEET 15

Name: _____
Date: _____

11. I am black and yellow and grow on rocks in the spray zone. You can often find me where there are strong waves. I consist of an alga and a fungus. You often see the likes of me on the bark of dead trees.

I am a .....

12. I am a sausage shape and my body is soft. To defend myself, I squirt out most of my internal organs, but luckily I can regrow these organs. I live in sand and gravel under rocks.

I am a .....

13. I am an animal with a strange shape. I look like a plant. If you look closely, you will see many holes or 'pores' which are used to pass water in and out of my body. Sea slugs and fish love eating me. In some countries, I'm allowed to be collected and people use me to clean themselves.

I am a .....

A Happy Family

Role-play a sheltered-shore food web and focus on the importance of seagrass meadows.

CONCEPTS

- Seagrasses provide food for sheltered-shore ecosystems.
- Seagrasses are an important part of the marine food-web.

OBJECTIVES

- To show the dynamics of a food web by role-play.
- To state the importance of seagrasses in the marine environment.

VALUES

- To care for seagrass meadows as they are a vital link in the sheltered-shore food web.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	7	Living Together	Investigating animal and plant interdependence.
Language	5/6/7	5.2 Speaking	G. Provide opportunities for spontaneous play and role play

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Energy and Change	3.12 Identifies the chain of sources and receivers of energy within systems.
	Working Scientifically	4.2 Collects and records information as accurately as equipment permits and investigation purposes require.
	Life and Living	5.13 Describes the role of living things in cycling energy and matter.

BACKGROUND INFORMATION

As with all food webs, the whole story of what eats what can get very complicated. A simple example of a sheltered-shore food web is shown below.

Organisms can be divided into three groups; **Producers, Consumers and Decomposers.**

Producers: Organisms that make their own food. 'Green' plants, algae, zoanthallae and phytoplankton are the most common producers, using sunlight for energy.

Consumers: Organisms that rely on other organisms for food, because they cannot make their own.

Decomposers: Rely on other organisms for their food but differ from consumers in that they break down complex organic compounds to form simple inorganic substances. Examples include bacteria and fungi.

The following definitions may help you understand the linking up of the food-web:

Plankton: Microscopic living things (phytoplankton - plants, zooplankton - animals).

Detritus: A mixture of fine particles of decaying plant, animal and bacteria. It looks like scummy ooze that is deposited from floating (suspension) in the sea, to rocks and sand. It is eaten by crabs, bivalves and worms and needs sunlight to survive.

Deposit feeders: Generally, burrowing animals like small crabs. They feed on detritus that has been mixed with sandy or muddy sediment.

Suspension feeders: Feed on floating materials, usually plankton and detritus. Examples include mussels, barnacles, sponges and tube worms. They are eaten by snails, pebble crabs, small fish etc.

Carnivores: Usually larger animals that eat dead meat or live prey of smaller animals. Examples of carnivores are molluscs (soft bodied/hard shelled sea creature eg. snail), sea-stars, sea anemones, fish, worms, bivalves (having a hinged double shell eg. oyster) octopus and birds. Some of these are eaten by large fish and active fish eaters.

Active Fish Eaters: Are larger fish like bream that are constantly active in their search for smaller fish, they often may also eat invertebrates (animals without a backbone). These fish are often caught by humans.

Omnivores: Feed on plants and animals. They may be active hunters but are commonly scavengers. Examples include large crabs.

Almost all food-webs and chains begin with plants. Through the chlorophyll (green colouring) in their leaves and other tissues, plants can capture heat and light energy from the Sun and store it as energy in their various tissues. This is where seagrasses play their important role.

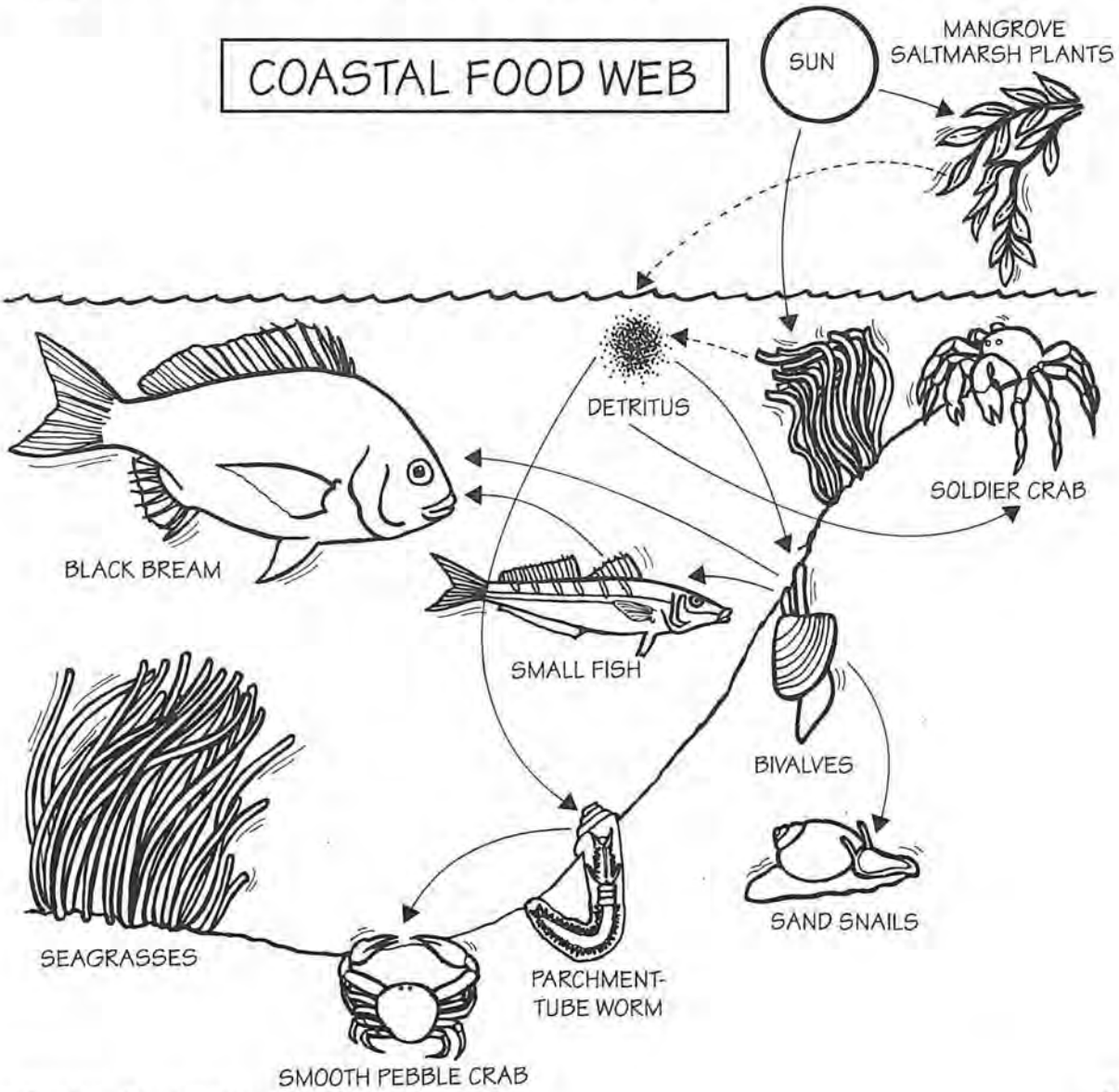
In most ecosystems, the major producer is also the major source of food.

Seagrasses are not a major food source for consumers, even though they rely on the Sun's energy and are this system's major producers.

The major food source is detritus, which is mainly a product of decayed land plants and seagrasses.

Suspension feeders, which include numerous bivalves, tube worms, and deposit feeders, like crabs, feed on detritus and are eaten by carnivores such as sand snails, crabs and small fish.

Bigger fish like bream are active fish eaters, but will also eat invertebrates.



KEY WORDS

ecosystem, food web, detritus, decay, suspension feeders, deposit feeders, active fish eaters, bivalves, carnivores, omnivores, invertebrates, chlorophyll, producers, consumers, decomposers.

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TEACHER DIRECTIONS

Materials

Two metres of stiff nylon tape, recycled fishing line, cord or bait box strapping
Cardboard cut out of Sun taped onto a stake
Coloured card bibs (attach with safety pins) (Resource Sheet 9)

LESSON OUTLINE

- Provide each student with a bib (from Resource Sheet 9) and a cord.
- Stake the Sun into the ground and explain to the students the concept of food chains and the importance of seagrass meadows in this chain.
- Students wearing their bibs and holding their cords, await teacher's instructions to connect themselves.
- Each student connects to a **need** (by both parties holding the cord at each end)
- Call out *"Detritus needs the sun, deposit feeders get their energy from detritus, suspension feeders to connect to detritus, carnivores to connect to suspension or deposit feeders, active fish eaters to connect to carnivores"*. The class now represents a food chain.
- The students to reinforce the concept by saying what they are, what they need to survive and what uses them for survival. For example, *"I am the seagrass. I get my energy from the sun and need clean water. I provide shelter for young marine animals"*.
- Discuss the complex food web.

- Introduce a calamity. *"Some pollutants have been dumped down a drain and have poured into the bay where the food chain operates. Unfortunately, the seagrass has been killed"*. Remove the seagrass from the food web and show how the whole system is effected. The scenario could also be the introduction of a lot of moorings in the area and the seagrass be affected by physical damage.

- Show video *A Problem in Albany's Harbour* (refer to details under the video section). Discuss the problems exposed in the video in relation to the students' knowledge of the sheltered-shore food web.

- Students to write a mock letter to the Albany or Rockingham Council expressing their views and explaining the importance of seagrass meadows in the marine food web. Resource Sheet 10 will provide guidelines for setting out the letter.

EVALUATION

- Were students able to comprehend the importance of seagrass meadows in the sheltered shore food web by describing what might happen if the meadows were to become polluted, depleted or disappear entirely?

- Were students able to explain in their letter the importance of seagrass meadows and their need for protection? Was letter well-structured?

COMPLEMENTARY ACTIVITIES

Compare the sheltered-shore food web to the food web of others. For example, the Australian bush, a farm environment, or a backyard garden.

What would happen if any section of these webs were missing (especially the vegetation)?

ROLE PLAY BIBS

1. DETRITUS

decayed seagrass

Eaten by - crabs
- bivalves
- worms

NEEDS - SUN

Green

ROLE PLAY BIBS

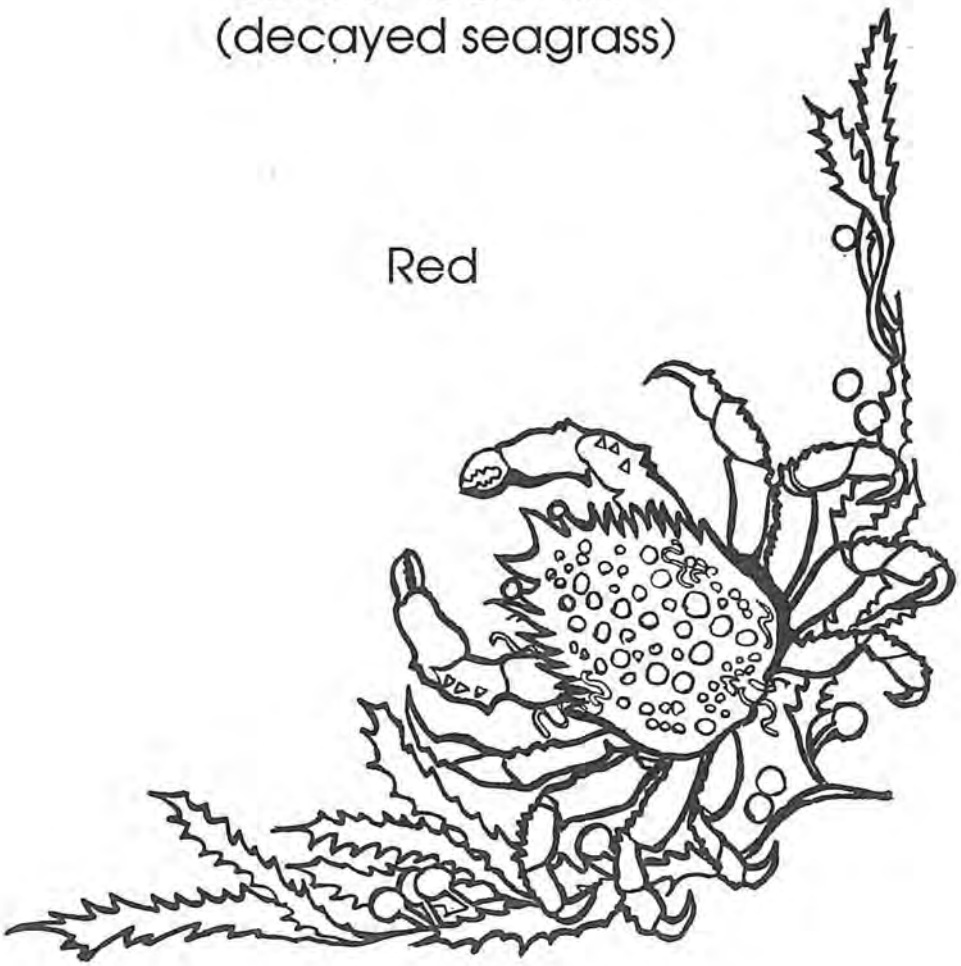
2. DEPOSIT FEEDERS

e.g. small crab

Eaten by carnivores

NEEDS - DETRITUS
(decayed seagrass)

Red



ROLE PLAY BIBS

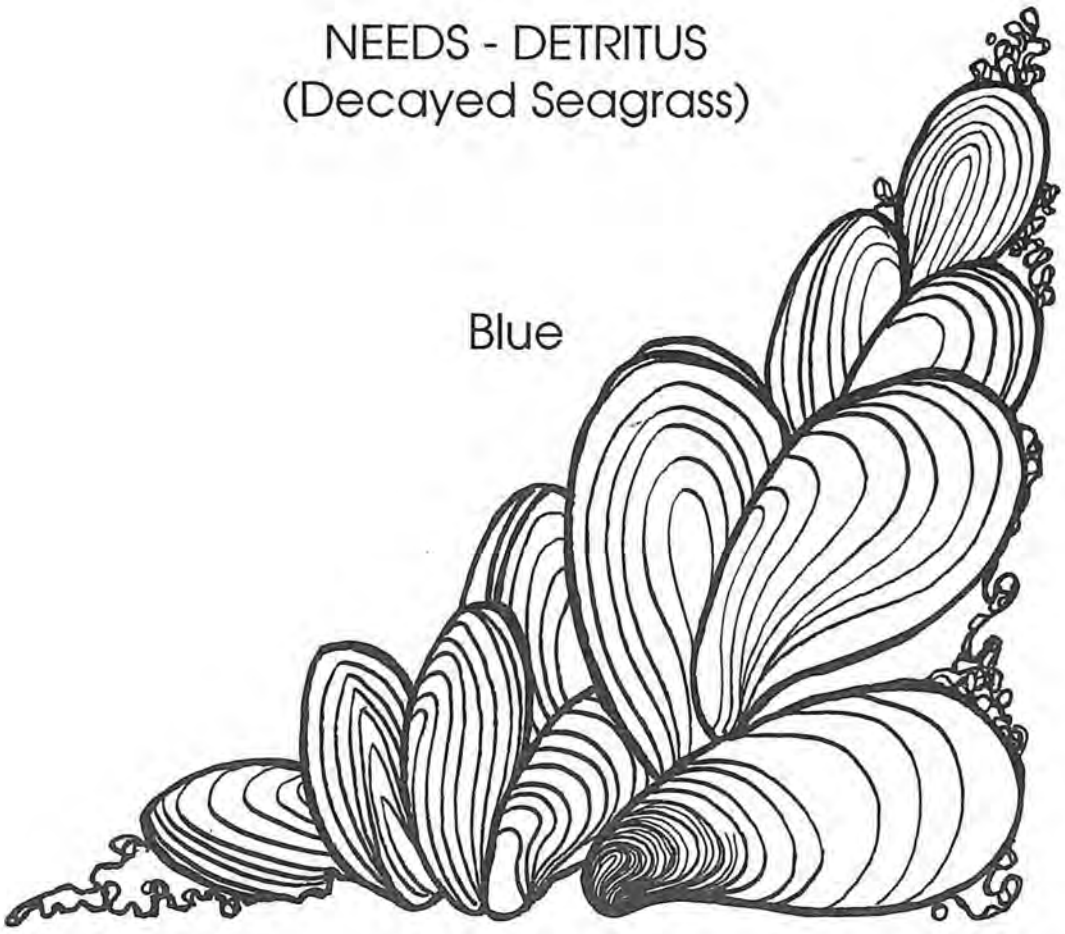
3. SUSPENSION FEEDERS

e.g. bivalves, worms, mussels, barnacles, sponges

Eaten by - snails
- smooth pebble crab
- small fish

NEEDS - DETRITUS
(Decayed Seagrass)

Blue



ROLE PLAY BIBS

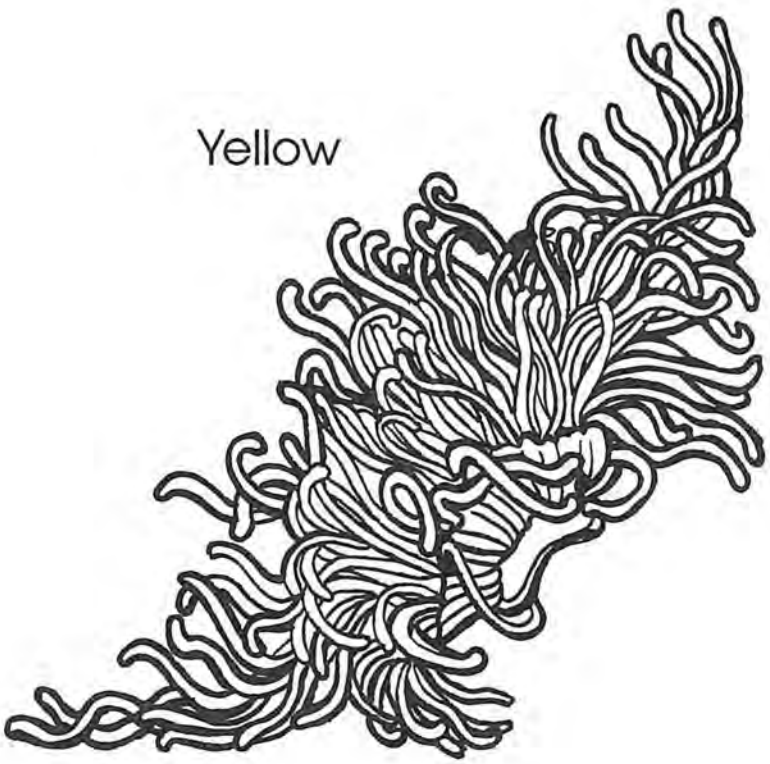
4. CARNIVORES

e.g. sand snail, pebble crab,
sea star, sea anemone, small fish

Eaten by - large fish

NEEDS - suspension feeders
- deposit feeders

Yellow



ROLE PLAY BIBS

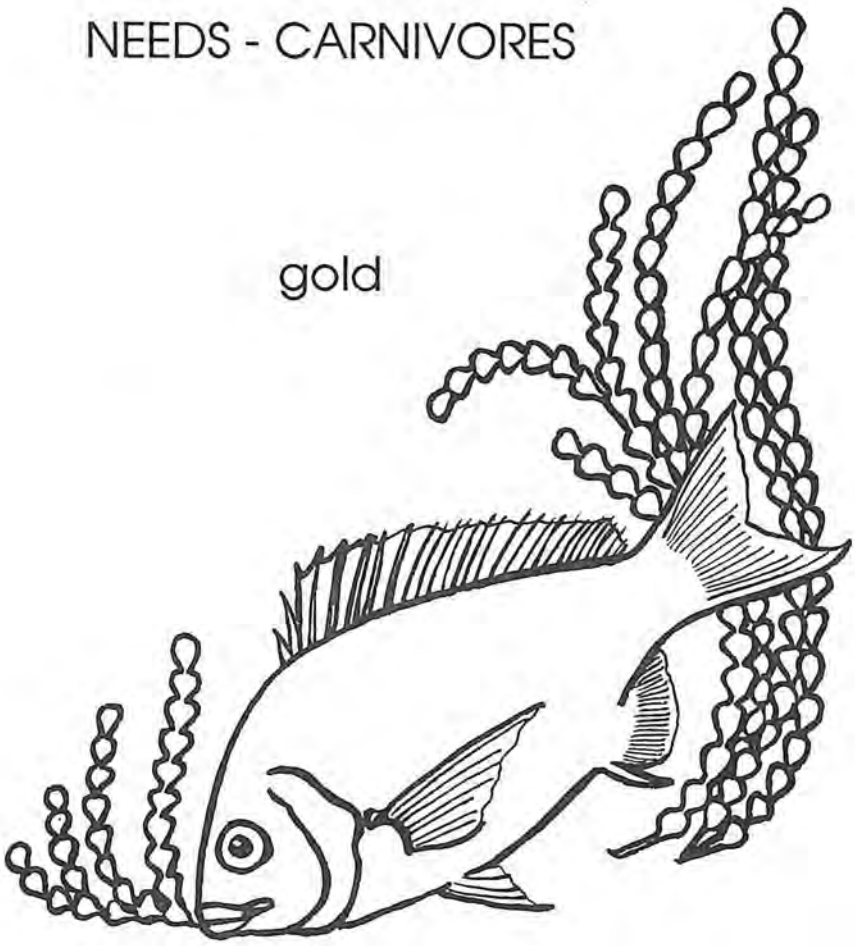
5. ACTIVE FISH EATERS

e.g. Black Bream

Eaten by humans

NEEDS - CARNIVORES

gold



LETTER FORMAT

NAME (SELF)
ADDRESS
DATE

NAME (to whom writing)
ADDRESS

Salutation,

PARA. 1. *Introduce self and state reasons for interest in issue, and why it should be of concern to everyone.*

PARA. 2 and 3. *State what you want the Council to do about the issue.*

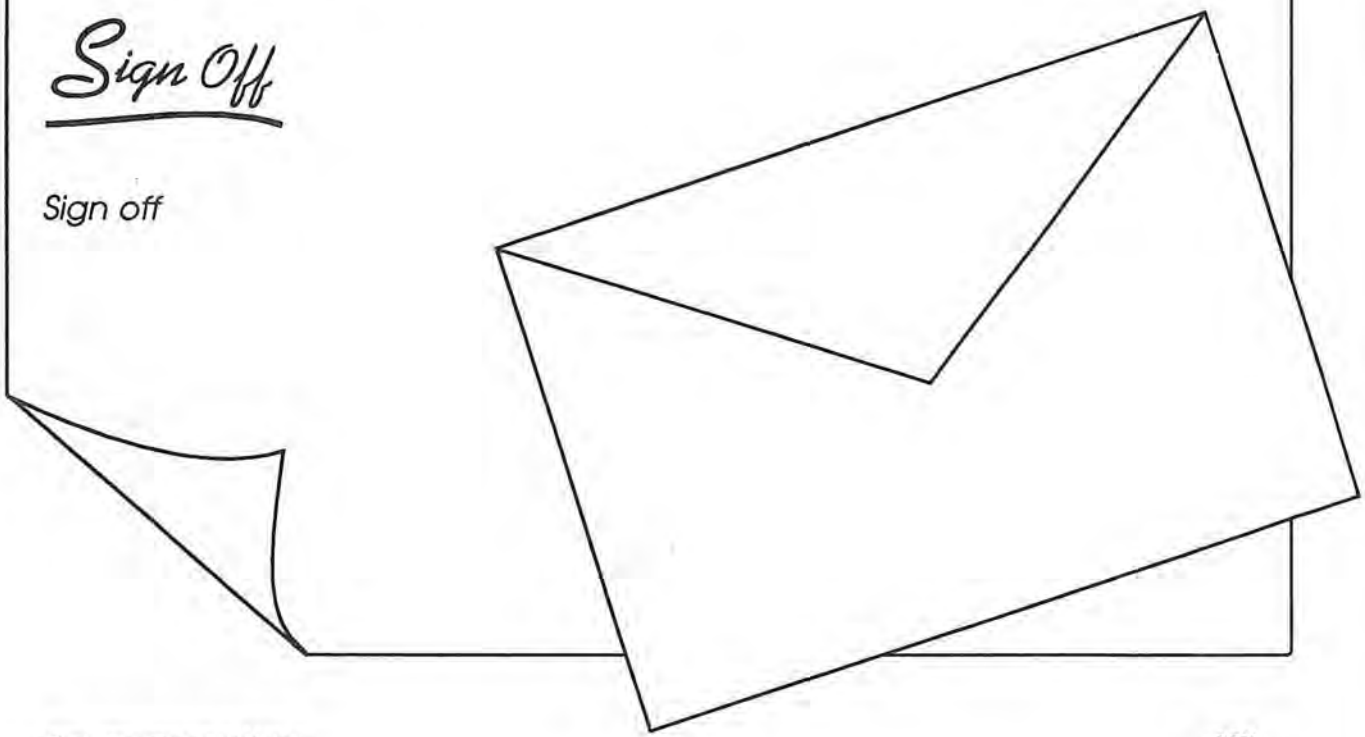
PARA. 4. *Suggest ways that the community may be able to help the Council in its endeavours and show their commitment.*

PARA. 5. *State what you are going to do now and in the near future to address the problem-for example write media articles, conduct public meetings, distribute fliers to all households, etc.*

PARA. 6. *Offer self as contact .*

Sign Off

Sign off



Sound Seagrass

Students study the graphs, tables and diagrams, and answer questions relating to each.

CONCEPTS

- Seagrass meadows are declining.
- Industrial and sewage effluent, superphosphate and moorings are the major causes of seagrass decline.
- Increased awareness of the risks, and a better understanding of seagrass systems leads to better management practices.

OBJECTIVES

- To recognise that the decline of seagrass meadows is due to a number of factors.
- To analyse data and form conclusions.

VALUES

- To treat seagrass meadows with care and consideration so as not to damage this fragile habitat.

CURRICULUM LINKS

CURRICULUM	STAGE / AREAS	NUMBER / YEAR	UNDERSTANDINGS / STRAND TOPICS
Language	5/6/7	3.2.12 Figures	A. use, retrieve and interpret information from simple figures.
Health	5	Community, Environmental	Effect of pollution on health and the environment.
Social Studies	6	Environment	Sharing the Environment.
Mathematics	5/6/7	M:P4.1	Construct and read graphs and interpret graphical information.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Working Scientifically	4.4 Reviews the extent to which their conclusions are reasonable answers to the questions asked.
Mathematics	Chance and Data	3.20, 4.20, 5.20 Reads and describes information, tables, diagrams, line graphs, histograms, plots and summary statistics.
Science	Life and living	4.13 Identifies events that affect balance in the ecosystem.

BACKGROUND INFORMATION

Australia has the largest seagrass beds in the world, which do very well in clean, relatively low nutrient, coastal waters. However, over recent years, seagrass losses have been extensive (more than 45 000 ha). In Cockburn Sound, 97 per cent of the seagrass meadows have been lost since 1969.

Problems arising include loss of habitat and productivity, and increased sediment mobility. Recovery and recolonisation from such losses are rare, creating long-term consequences. Seagrasses provide habitats for sea animals, including the western rock lobster, an industry worth about $275 million annually.

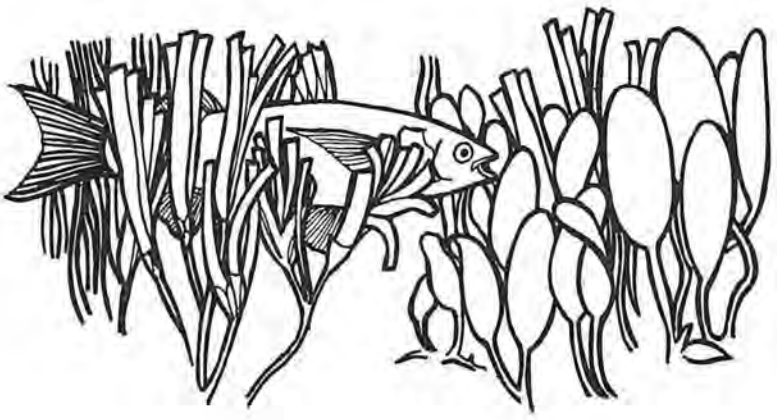
Seagrass meadows also reduce water movement, prevent erosion and provide suitable 'nurseries' for a range of plants and animals. They also trap and bind sediment, contribute greatly to the food chain and support high production rates (e.g. lobster).

Seagrass decline may result from natural events such as 'wasting disease' or high energy storms. However, most seagrass loss has resulted from human activity, including land reclamation, changes in land use, and pollution (including over-enrichment).

Seagrass restoration (planting seedlings) has been attempted, but such attempts are expensive, time-consuming and, so far, have not been successful.

KEY WORDS

pollution, phosphate, nitrogen, dredging, profile, emissions, industrialisation, histogram, productivity, erosion, photosynthesis, epiphytes, sediment, mobility, recolonisation, algae, decline, toxic, effluent, density, reclamation, phytoplankton.



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TEACHER DIRECTIONS

Materials

Worksheets 16-20

LESSON OUTLINE

- View the video 'A Problem in Albany's Harbour' with the class as a background to seagrasses.
- Select any of the Worksheets on Cockburn Sound.
- Discuss each figure before students begin the activity. All these activities are probably best done as an overhead in the classroom.
- Answers are on Resource Sheet 11.

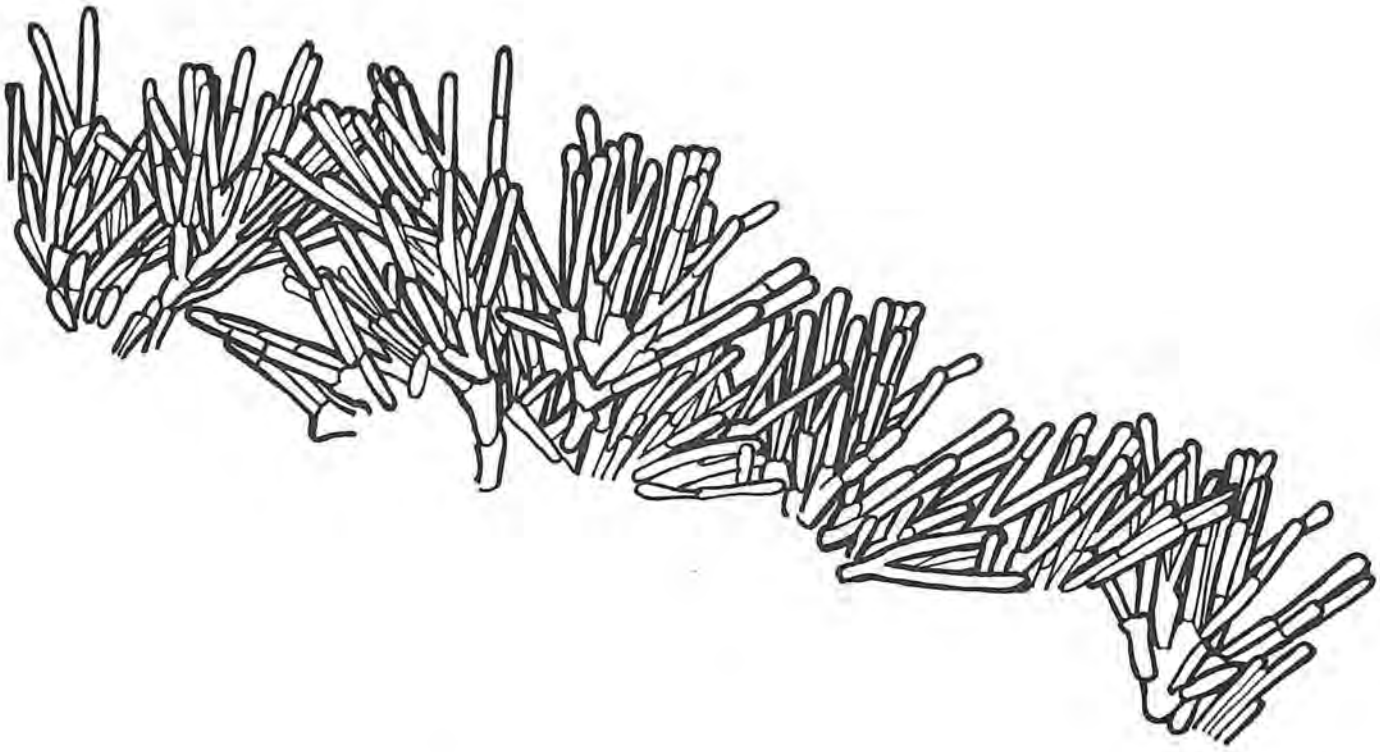
EVALUATION

- Were students able to complete the questions based on the figures?

COMPLEMENTARY ACTIVITIES

Organise an excursion to Cockburn Sound.

Activities from Ocean Rescue 2000 Teachers' Kit on 'Seagrass'.



RESOURCE SHEET 11

ANSWERS TO SEAGRASS WORKSHEETS

Worksheet 15

1. Highlighted
   - Sewage Outfall
   - Lime sand mining (Parmelia & Success Banks)
   - Oil Refinery Outfall
   - Fertilizer Works Outfall
2. Cockburn Sound is just below Fremantle.
3. Garden Island
4. Destroyed them in building the Causeway.

Worksheet 16

1. When the total nitrogen (N) discharge reached 1500 kg/day
2. 1,095,000 kg/year
3. - Too much N triggers algal blooms
   - clouding water cuts light to seagrass
   - decaying algae use up oxygen in water
   - fish and bottom life suffocates
   - poisonous to sea creatures
   - algae covers seagrass
   - water no good to swim in, etc
   - poisonous to sea creatures
   - unnatural
   - algae covers seagrass
4. siteworks, dredging, pollutants, machinery, pollution from vehicles.

Worksheet 17

1. 150m
2. It needs light
3. Too much wave action on beach - also exposure to sun at low tide
4. 2 m — 6 m
5. Erosion

Worksheet 18

1. Answers will vary but the general hypothesis for seagrass decline is that a decrease in light reaching the seagrass reduces effective seagrass photosynthesis.
   - Nutrient enrichment can lead not only to increased phytoplankton growth, but also to enhanced growth in algae on leaf surfaces.
   - Sedim1ent imbalances may be caused by activities such as harbour and groyne construction.
   - Increased pressure of grazing by sea urchins as the canopy thinned.
   - Toxic effluent (eg. hydrocarbons, phenols)
2. siteworks, dredging, pollutants, machinery, pollution from vehicles.

Worksheet 19

1. 1,3,4,5,7,8,9,10,11,12,13,14,15,17.
2. a. Posidonia sinuosa
   b. Amphibolis griffithii
   c: Posidonia australis
   d. Amphibolis antarctica
   e. Posidonia coriacea
3. 20
4. 4
5. 7

WORKSHEET 16

Name: _____

Date: _____

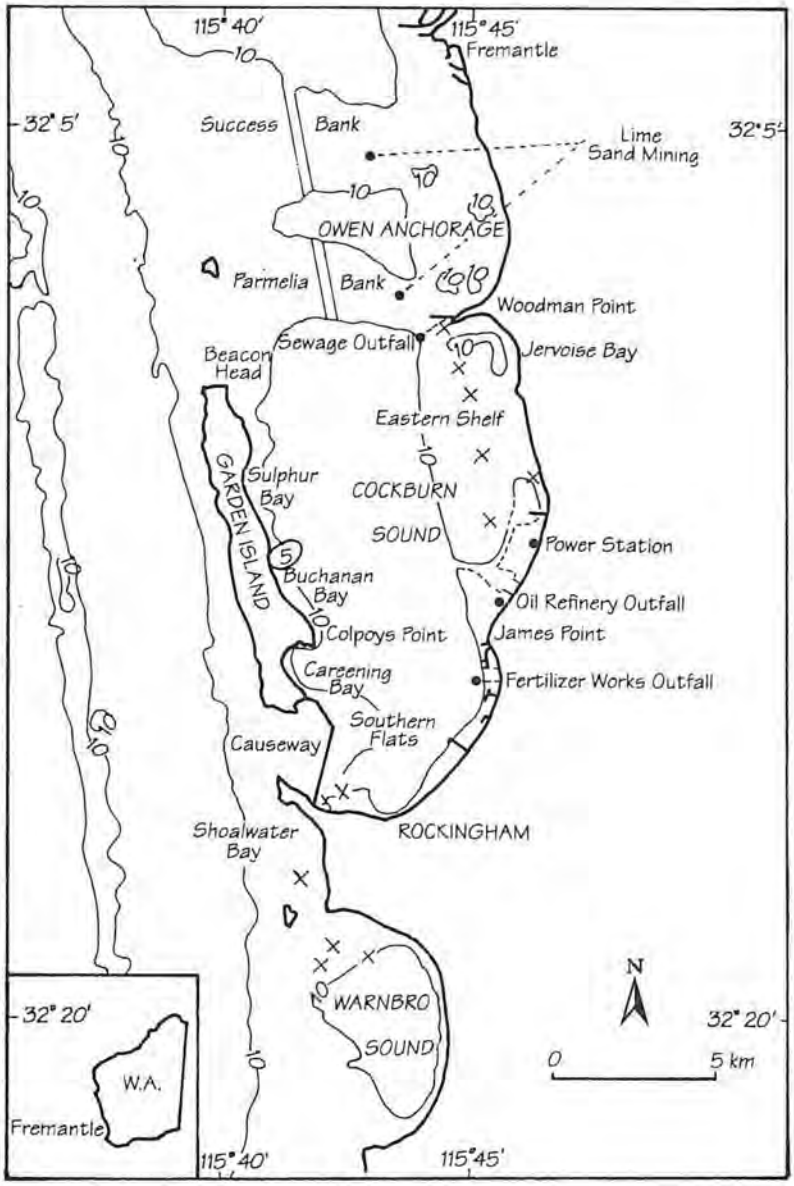


Fig 1. Cockburn Sound W.A. The crosses mark the sites where seagrass productivity was measured.

1. Using a highlighter mark the four industries that may be causing problems.

2. Using an atlas, mark Cockburn Sound on the map in the left hand corner.

3. What is the name of the island off the coast? _____

_____

4. A causeway was built to the island. What effect do you think this would have on the seagrass meadows below? _____

_____

Name: _____
Date: _____

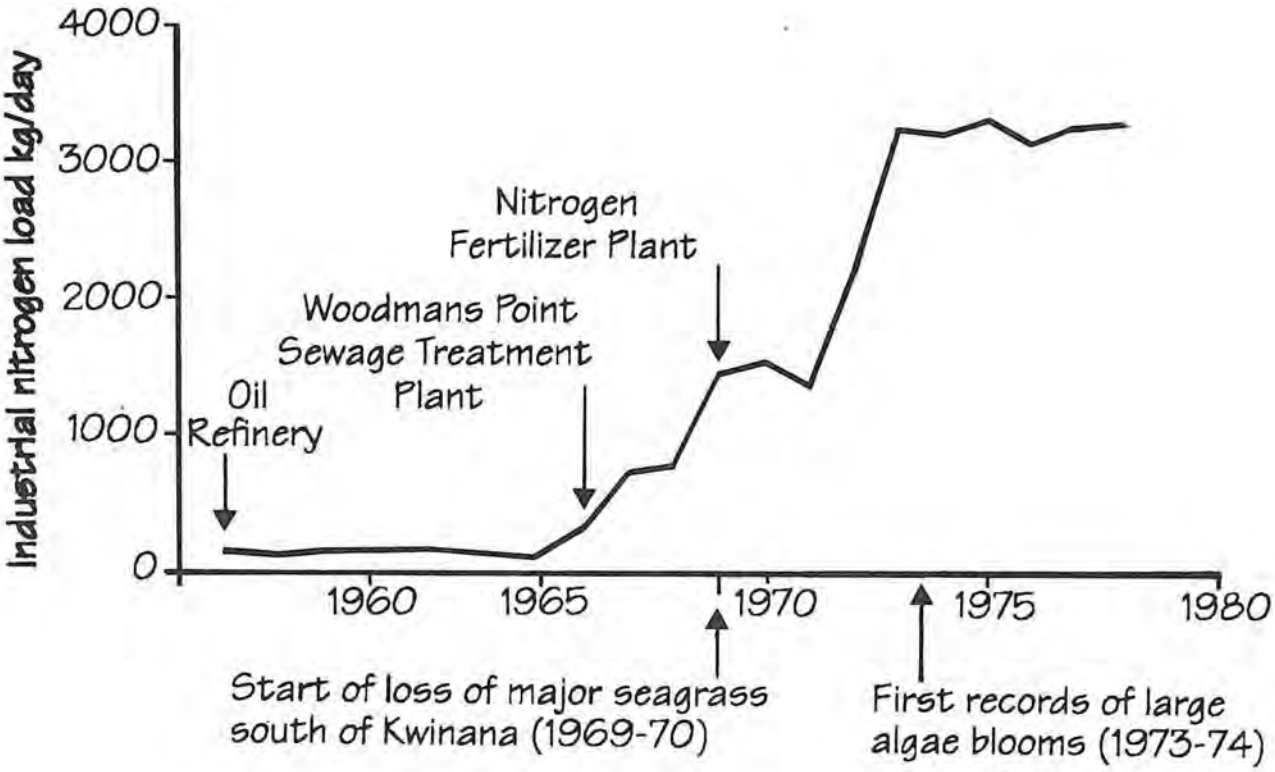


Fig. 2 Estimated nitrogen levels entering Cockburn Sound showing the beginning of discharge from the oil refinery, sewage treatment plant and fertilizer works, together with the major time of seagrass loss and the first record of algae blooms.

1. The loss of major seagrass areas took place when what event happened?

_____

_____

2. In 1975 approximately 3000 kg/day of nitrogen was being discharged. How much would that be per year? (You may need to use your calculator)

_____

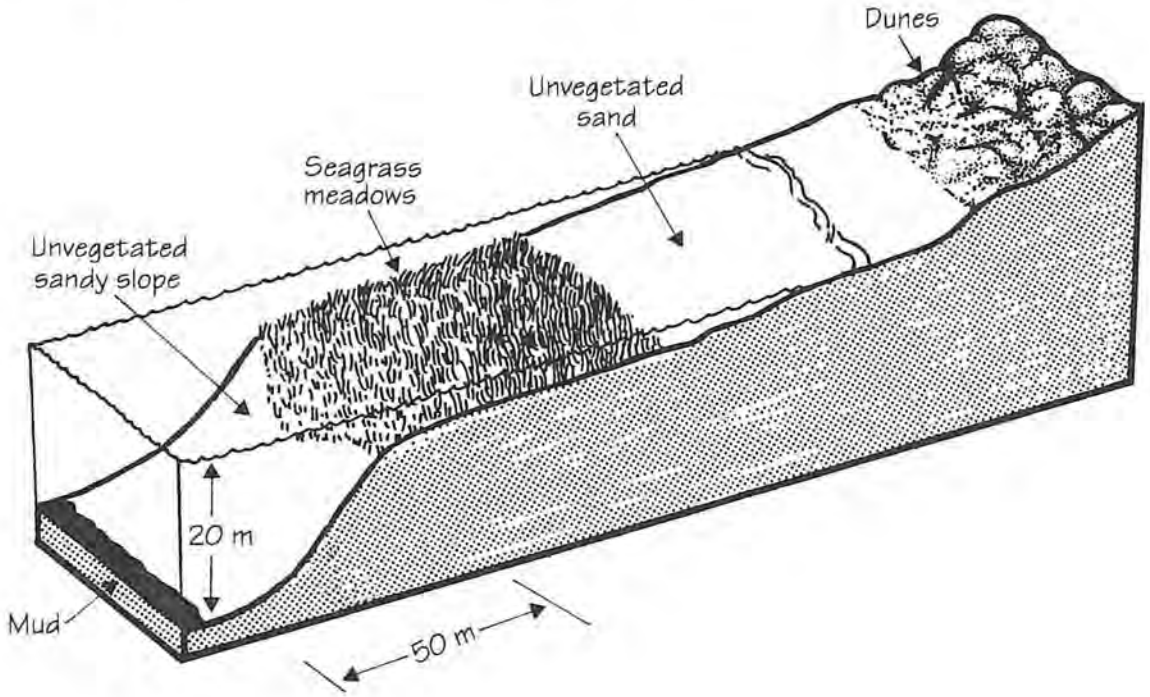
3. Why was this a problem? _____

_____

_____

WORKSHEET 18

Name: _____
Date: _____



NB.1: In protected areas, seagrass will grow in $^1/_2$ m of water, but leaf tips may be burnt in summer
NB.2: In clear waters, seagrass will grow to 10 m

Fig. 3 Profile of the shore of Cockburn sound showing the belt of seagrass meadows on the sandy platform, and the steep slope to the mud floor.

1. How many metres of seagrass meadows run along the profile?

_____

2. Try to imagine a 150 m running race and you will picture quite a distance of seagrass meadows. Why do you think the seagrass doesn't grow down the slope and in the mud?

_____

_____

3. There is about 150 m of unvegetated sand between the dunes and the seagrass meadows. Why do you think nothing is growing there?

_____

_____

4. Seagrasses can grow in certain depths of water. Looking at the profile, what is the range of these depths?

_____

5. If the seagrass meadows weren't there, what do you think would happen to the sand? Consider the water depth.

_____

_____

WORKSHEET 19

Name: _____

Date: _____

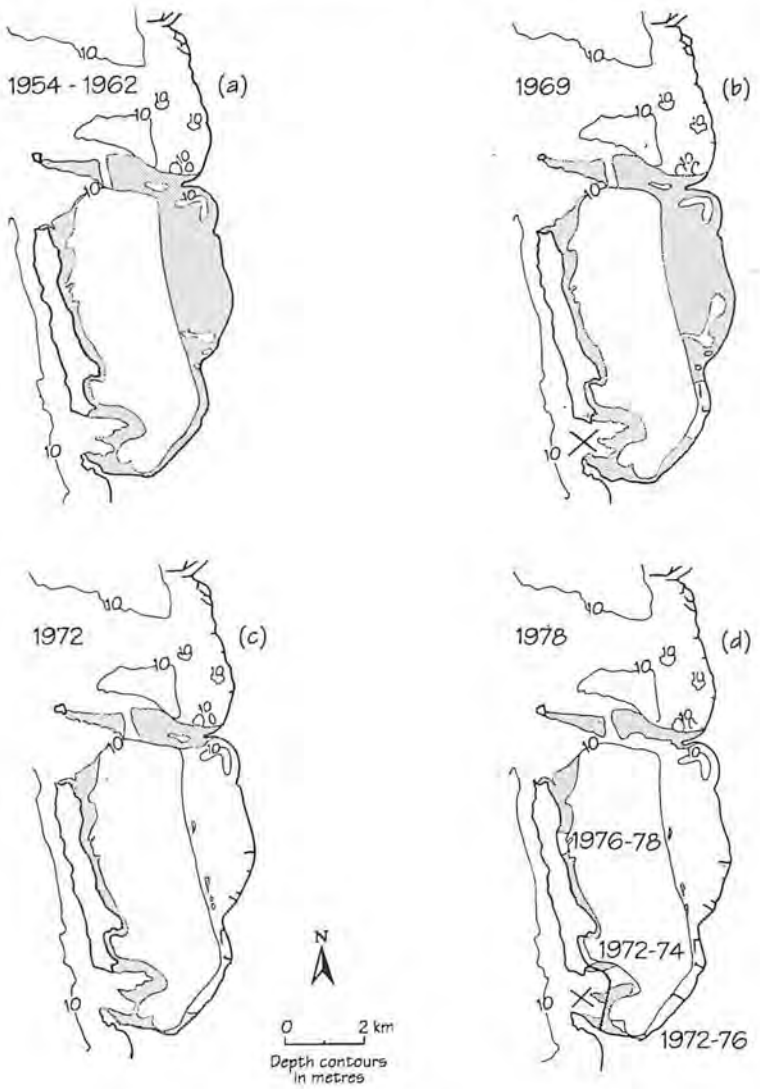


Fig. 5 Progressive changes in seagrass distribution in Cockburn Sound

1. In one paragraph explain what would have been the cause of this decline.

_____

_____

_____

_____

_____

_____

2. X marks the spot where the causeway between the mainland and Garden Island now stand. In the building and use of the bridge, what do you think caused the seagrass to decline?

_____

_____

_____

Name: _____
Date: _____

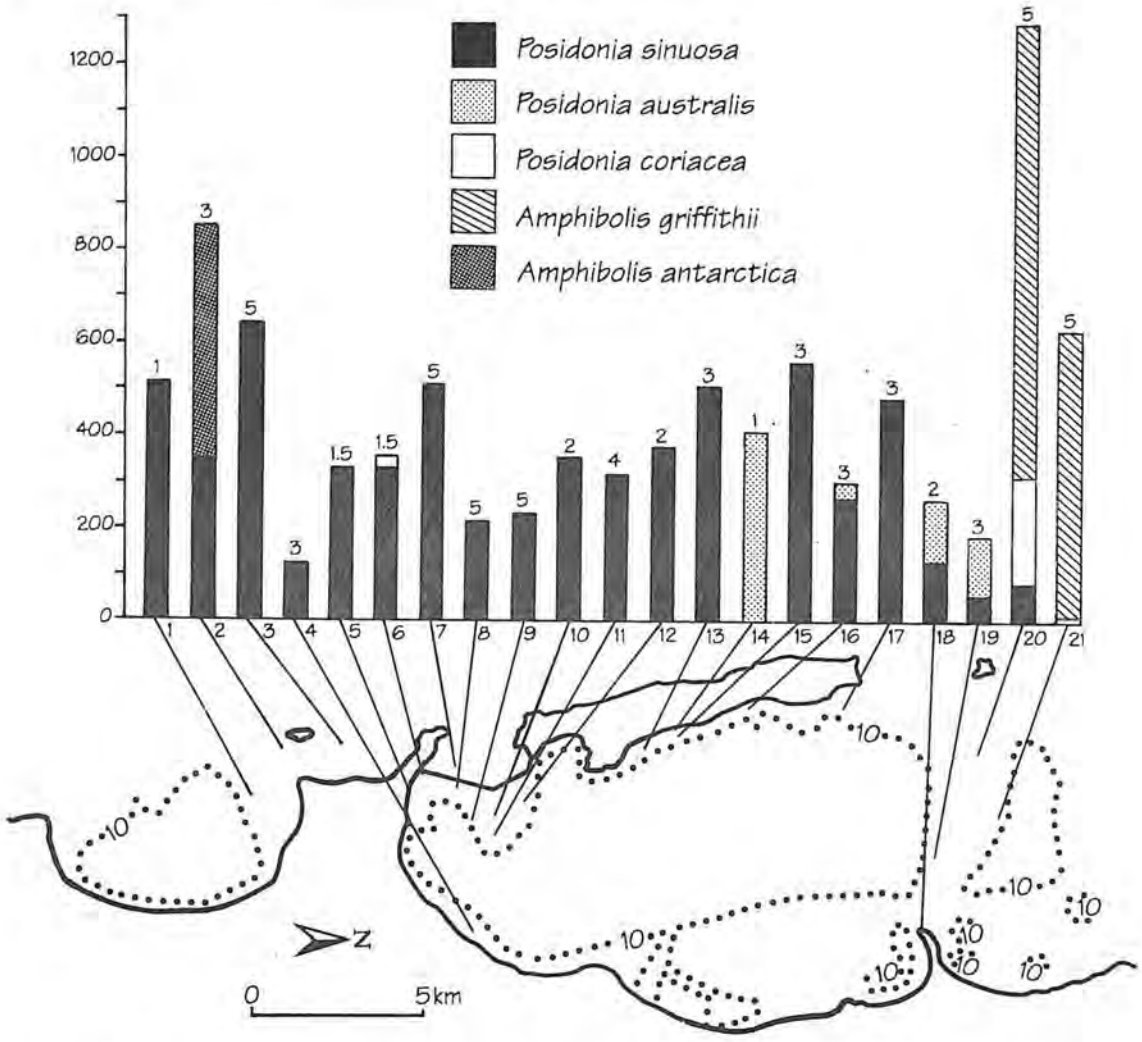


Fig 6. Seagrass crops in 1977. Each histogram shows the dry weight of seagrass. Shading indicates how much of each species there is in that area. Each histogram is accompanied by water depths (above in metres).

1. Which areas have only single species? _____

_____

2. List the species in order of most dominant to least dominant.

   a. _____

   b. _____

   c. _____

   d. _____

3. Which area has the highest amount of seagrasses? _____

4. Which area has the least amount of seagrasses? _____

5. How many areas have seagrass growing in 1 - 2 metre depths? _____

Seagrass Forests

A story about the life support system that seagrass meadows provide, and their human destruction.

CONCEPTS

- There is a general correlation between the main process of seagrass loss and the discharge of effluent that is rich in plant nutrients.
- The Earth is an organism with seagrass being one of its lungs.
- Healthy seagrass means a healthy ocean.

OBJECTIVES

- To create an understanding of the necessity of seagrasses and the causes of their decline.
- To ensure responsible behaviour from people using boats. (Damage from anchors, propellers etc.)

VALUES

- Preventing pollutants and reducing human impact will prolong the life of seagrass meadows.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Language	5/6/7	3.2 Informational	C. some factual texts are characterised by technical vocabulary. It is necessary to understand that vocabulary before fully comprehending the text.
		4.1 Comprehending	A. literal - identify and recall; details, main idea, cause and effect, factual & non-factual. C. evaluative - making judgements regarding; fact or opinion, validity, reality or fantasy. D. appreciative - demonstrate appreciation by; emotional response, reaction to authors' use of language.
		4.2 Listening and Reading	

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
English	Reading and Viewing	3.1 Interprets and discusses some relationships between ideas, information and events.
Science	Life and Living	4.13 Identifies events that affect balance in an ecosystem.

BACKGROUND INFORMATION

Australia has the largest seagrass beds in the world and the largest number of seagrass species.

Geographe Bay and Frenchman's Bay, in Western Australia, provide foraging grounds for the largest single species fishery in Australia—the western rock lobster. Its value is around $275 million per year. An integral part of this industry's survival is the seagrass meadows in which the lobster makes its home.

Seagrass meadows are the basis of complex ecosystems, providing homes and feeding areas for a variety of marine creatures, including the dugong in Shark Bay. There are about forty times the number of animals in seagrass than in the adjacent bare sand.

The living leaves of seagrass plants provide space for minute plants and animals (epiphytes) to live. When the leaves die, they become food for microbes. Many species of fish, crabs, shrimp, and snails feed on the tiny organisms on both the living and decomposing seagrass leaves. While few animals actually feed on the seagrass leaves themselves, the complex canopy formed by the leaves provides valuable shelter from predators for a variety of animals.

The effects of the destruction of this fragile ecosystem are likely to be far-reaching and long-lived. Recovery is known to be slow. For example, in Jervis Bay, large circular clearings were created in the Posidonia meadows during the 1950s and 1960s. Nearly 40 years later, these holes are still evident in an otherwise healthy meadow.

In Australia more than 45,000 ha of seagrasses have been lost, mostly because of reduced light intensity due to human activities. In Princess Royal Harbour in Albany, WA, 80 per cent of seagrasses have been lost since 1960, and 97 per cent lost in Cockburn Sound since 1969. Boat users should try to minimise damage by anchoring in bare sand and by not using outboard motors in very shallow water over seagrasses.

Improper industrial and sewage disposal can cause nutrient enrichment, leading to stimulation of algal growth, which may smother seagrasses and cause their death. It has been suggested that recolonisation of some areas takes place over a 80—200 year period.

KEY WORDS

epiphytes, algae, recolonisation, ecosystem, microbe, organism, decomposing, current, erosion, camouflage, predator, pollution.

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Walker, D.I. and McComb A.J. (1992) *Seagrass Degradation in Australian Coastal Waters.* Marine Pollution Bulletin, Vol:25 5-8, pp 191-195 Great Britain.
Ocean Rescue 2000 (1994) *Seagrass. A Lawn too Important to Mow* Sea Notes Department of Environment, Sport and Territories, Brisbane.

TEACHER DIRECTIONS

Materials

Worksheets 21,22

LESSON OUTLINE

Read out the story (Resource Sheet 12) to the class or get a couple of children to read the parts of Timothy and Linda.

Discuss the story, focusing on points such as:

- Why are seagrasses important?
- What causes damage to seagrasses?

Further discussions may include:

- superphosphates from farms washing into creeks and thus down to the oceans,
- the fact that industrial discharges contain nutrients on which algae thrive, but seagrasses cannot handle.

How can seagrass meadows be restored?

Further discussions may include:

- a new superphosphate is being developed as a 'coastal super'
- sewage treatment plants can take their sewage further out or the plant can be relocated,
- drastic reduction in the amount of sewage going out to sea, relocation of industry to a less important area, more modern methods being used,
- changes take time.

Distribute Worksheet 21. Ask the students to choose a 'Death Notice' and write a dramatic news report.

Have the students complete Worksheet 22, 'Seagrasses Save Lives'. Distribute Resource Sheet 13 for supplementary information.

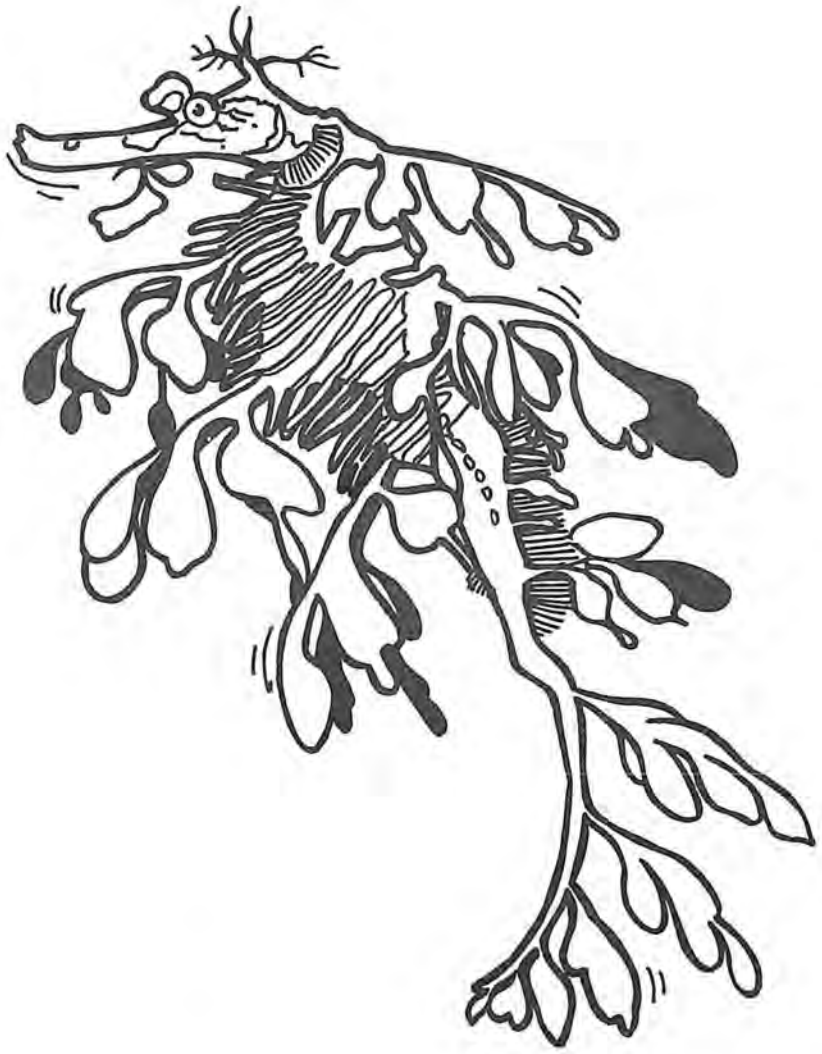
EVALUATION

- Did students complete the Worksheets accurately?

COMPLEMENTARY ACTIVITIES

Make a class mural, showing industry, pipes into the water and seagrasses covered with algae.

Create a 3D model of Worksheet 22, using milk cartons and boxes as factories, cardboard rolls as pipes, plastic with coloured felt pen markings as effluent, and crepe paper as seagrass meadows.



RESOURCE SHEET 12

The Seagrass Story

Uncle Alan sat down into the rocking chair and, pulling the rug over his knees, began to tell his nine year old nephew, Tim, and his eleven-year old niece, Linda, a story.

"Once upon a time", began Uncle Alan," on the coast of Western Australia, there was a beautiful forest. Now this was no ordinary forest. It was special because it lived under the sea."

"But Uncle Al, that can't be true. Trees don't grow under the water!" exclaimed Linda.

"Yes and how do the echidnas and kangaroos live under there?" enquired Tim.

"You see, as I said, this was no ordinary forest. It was called a seagrass meadow and it grew special plants that held the sea bed down so that the waves and water currents would not cause erosion," Uncle Alan replied.

"What's erosion?" asked Tim.

"I know," answered Linda, "it's where there are no plants to hold the soil down, so when there is rain or wind, the soil blows or washes away." Linda had learnt about Landcare at school in an Environmental Studies class.

"That's right Linda," said Uncle Alan, "and in the ocean, the waves and water currents can do the same kind of damage if there are no plant roots to hold down the sand. Now these seagrass meadows look like seaweed but are different, because unlike seaweed, they, like ordinary plants, have roots, seeds and flowers."

"OK," said Tim impatiently, not wanting to hear a lecture about plants, which he knew was one of Uncle Alan's favourite topics, "tell us about the animals that live down under."

"The seagrass beds along our coast are the home for many animals," said Uncle Alan. "The largest living snail in the world is found half buried in the sand, camouflaged by the rough material covering its outer shell. Octopuses slink through the seagrass leaves and feed on razor shells. Sometimes small squid, cuttlefish and large stingrays glide over the top. Inside the leafy cover, small sea urchins and starfish may be found, while on the sandy, cleared areas large starfish lie hidden under the sand. A sea cucumber moves slowly across the sand patches, while small fish abound, some well camouflaged while others brightly coloured relying on speed to escape their predators."

"Wow, you mean that many creatures live in the underwater forest!" exclaimed Linda.

"And hundreds more, many whose names I can't pronounce!" answered Uncle Alan.

"So what's so special about the seagrass meadows?" queried Tim.

"Tim," said Uncle Alan, "not only do the sea creatures live amongst the leaves, but they are also a nursery for young fish, crayfish and prawns. How can I put it? Well, I guess it's something like a day care centre. When the seagrass starts rotting it provides food for many more animals. Seagrasses also slow down water currents so that organic and mineral particles drop out and become food for tiny sea creatures."

"So, they're pretty important I guess," said Tim, "and without them many of the creatures that live amongst them would die."

"That's right. Now can I go on with my story?" asked Uncle Alan.

"Oooh yes!" exclaimed Linda, "We got right off track didn't we?"

"Now where was I? Oh yes, I was telling you about the special forest under the sea. Well now that you know why this forest is so important, I can continue my story," Uncle Alan said.

"Many years went by. All the creatures in the forest were happy and contented. One day they noticed the creatures on the land putting hollow tubes into the water. Nothing happened for quite a few days. Then they noticed dirty looking water coming out of one of them. Over the next few months different coloured dirty water came out of the other hollow tubes. It was only then that the creatures noticed a greeny-brown algae growing on the seagrass. You see, the stuff that was coming out of the pipes was full of nutrients and algae loved nutrients! Algae has no roots so it just drifts in the water - wherever it lands it clings to and in the seagrass forest all there was to cling to was the seagrass!"

"Uncle Al, the seagrass started to die didn't it?" interrupted Tim.

"How did you know that Tim. You haven't heard this story before?" questioned Uncle Alan.

"Well, the seagrass would suffocate in the end because the algae would strangle it!" exclaimed Tim feeling quite clever.

"You're pretty close," said Uncle Alan. "The algae sort of suffocated the seagrass by covering up all the leaves so much that they couldn't get any light, and plants need light to survive."

"What happened then, Uncle Al? Did Michael Jordan come to the rescue?" laughed Linda.

"I'm afraid not Linda, if only Michael Jordan could..." Uncle Alan's voice trailed off. "I'm sorry to say that this story does not have a happy ending. You see, the seagrass forests are still dying."

"But, Uncle Al, there must be something we can do!" cried Tim in disappointment.

"Well yes, I guess there is," Uncle Alan replied. "You see, when your Mum and Dad go boating around Rottnest Island or down in Albany's harbour during the holidays, tell them to be careful where they drop their anchor. Drop it on the sand, not the seagrass. If the water is shallow, driving their boat over seagrass meadows can be annoying for them when it gets caught in their propeller, but it also does a huge amount of damage to the forest under the water. It's something like pulling all the trees out of the ground. Did you know seagrass meadows take somewhere between 80-200 years to recover again? That is why we must look after them, just like our jarrah and karri forests."

"Well, at least we can do something to help," said Tim cheerfully.

"Now on that happy note, you two gremlins, it is way past your bed time and you've managed to keep me talking for quite some time!" laughed Uncle Alan, "Now it is time you were both in the land of dreams."

"I'm going to be dreaming of octopuses climbing trees in a huge underwater forest!" laughed Linda.

"And I'm going to be dreaming of hugging the back of a stingray and gliding over the seagrass meadows," sighed Tim sleepily. "Uncle Al, what will you be dreaming of?"

Uncle Alan replied as he folded up the blanket and started walking towards the door, "Tonight I will be dreaming of an ocean full of animals, forests and beautiful blue water...just like it used to be."

WORKSHEET 21

Name:_____
Date:_____

'DEATH NOTICES FOR SEAGRASSES'

Choose one of the death notices to write a dramatic news report.
You may need to do some research about the issue in each particular notice;

1. military depth charges
2. sewage outfalls
3. sand mining, and stormwater runout
4. sediment and herbicide
5. industrial development and sewage outfall
6. development around lakes

Include in your news report:

* headline eg. HOUSEHOLD WASTE POLLUTING FRAGILE OCEAN
* town and state eg. Scarborough, Western Australia
* sentence to grab the reader's attention eg. There is a link - the sea and your sink
* the report eg. They said it would never happen.....

JERVIS BAY, NSW

Dead: Seagrass plants in large holes in beds.
Cause of death: Dropping of depth charges by the military in the 1960s.

GULF ST. VINCENT, SA

Killed: More than 5,000 hectares of seagrass.
Cause of death: Sewage from the main Adelaide outfalls at Glenelg, Bolivar and Semaphore caused algae to overgrow and smother seagrass.

NSW COASTAL LAKES

Dead: 700 hectares of seagrass at Lake Macquarie and 1,300 hectares of seagrass at Tuggerah Lakes.
Cause of death: Development of farms and towns around lakes leading to increased nutrient levels particularly from stormwater runout. Increased plankton and algal growth resulted, blocking off sunlight to seagrass beds.

COCKBURN SOUND, WA

Dead: 97% of seagrass beds (3,300 hectares) by 1978.
Cause of death: Increasing urban and industrial development and sewage outfall from Perth in the 1960s, caused algae to overgrow and block sunlight to seagrass plants.
Prognosis: Decline of seagrass halted by relocation of sewage outfall outside the Sound in 1984, and better quality industrial discharges. Poor recovery and regrowth of beds.

ROTTNEST ISLAND, WA

Dead: Areas of seagrass adjacent to popular holiday destination.
Cause: Mooring of pleasure boats.

MORETON BAY, QLD

Dead: Seagrass beds.
Cause of death: Sand mining spoil from North Stradbroke Island and stormwater runout from Brisbane and Gold Coast area.

WORKSHEET 22

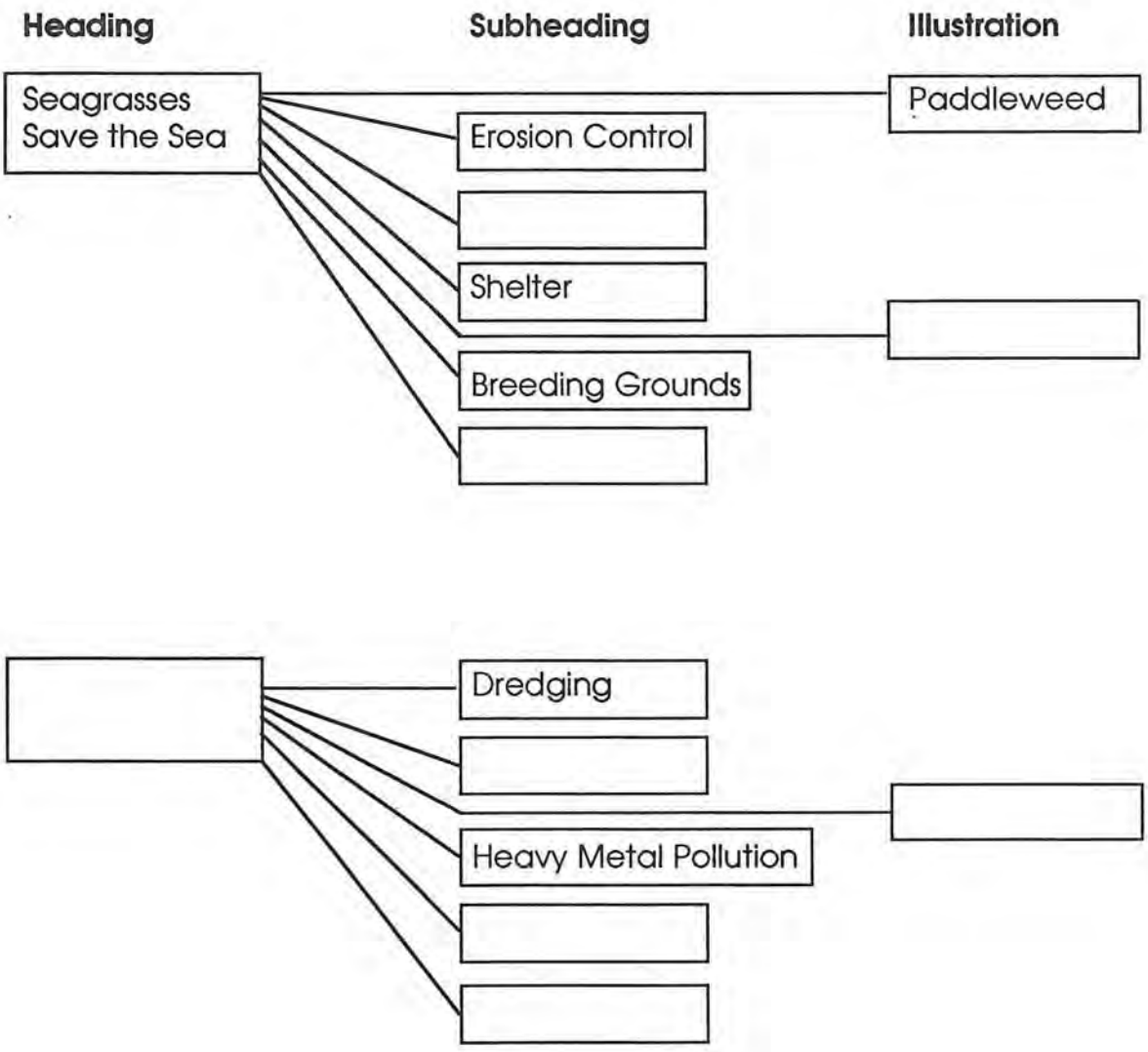
Name:_____
Date:_____

GRAPHIC OUTLINE

STUDENT COPY

This diagram will help you to understand the text you are about to read in Resource sheet 13. Fill in the missing sections.

SEAGRASSES SAVE LIVES



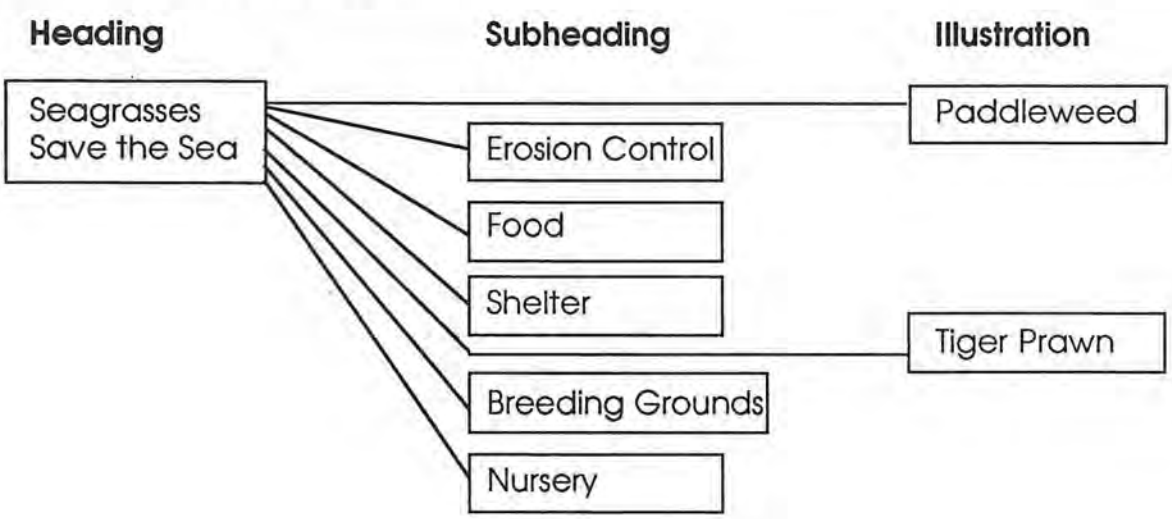
Worksheet Answers

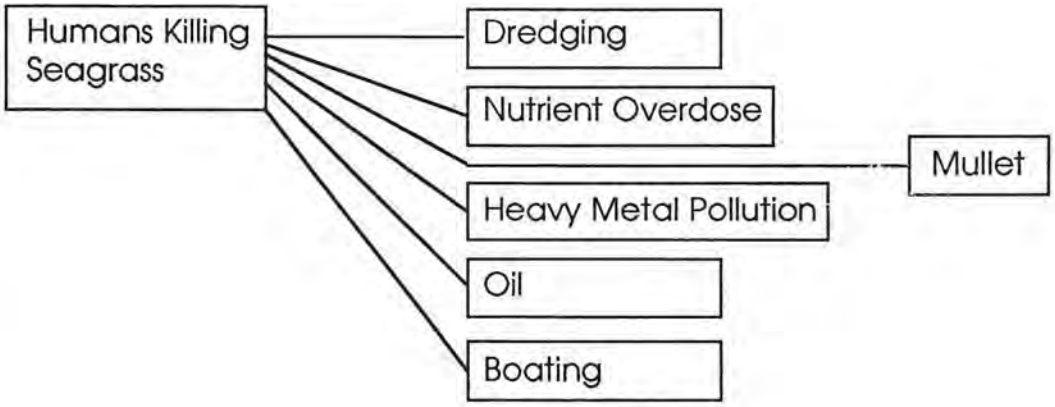
GRAPHIC OUTLINE

TEACHER'S COPY

This graphic outline will provide a purpose for reading and help students to recognise the scaffolding of text as an aid to confirming the content.

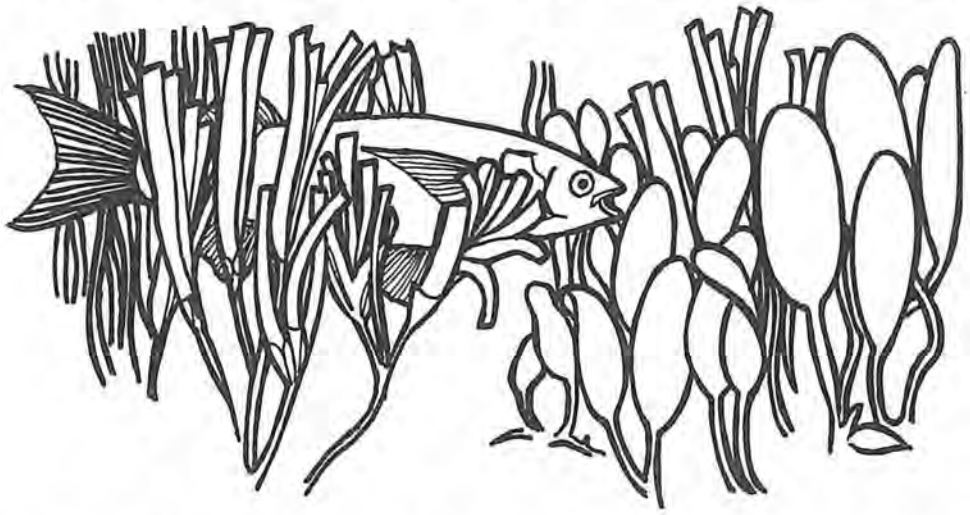
SEAGRASSES SAVE LIVES





RESOURCE SHEET 13

SEAGRASSES SAVE THE SEA



Seagrasses are vital for the ongoing health of our coastal waters and fisheries. They stabilise the sand and mud in which they grow, and provide food, shelter, breeding grounds and nursery areas for many marine organisms, such as fish and prawns.

Erosion Control

Seagrasses stabilise the sea bed with their roots. This prevents fragile coastal sea bottoms eroding and therefore helps to create permanent communities for algae and marine animals.

Food

Green turtles, swans, many invertebrates (animals without backbones), and some vegetarian fish feed directly on seagrass. It is also the only food of dugongs (sea cows).

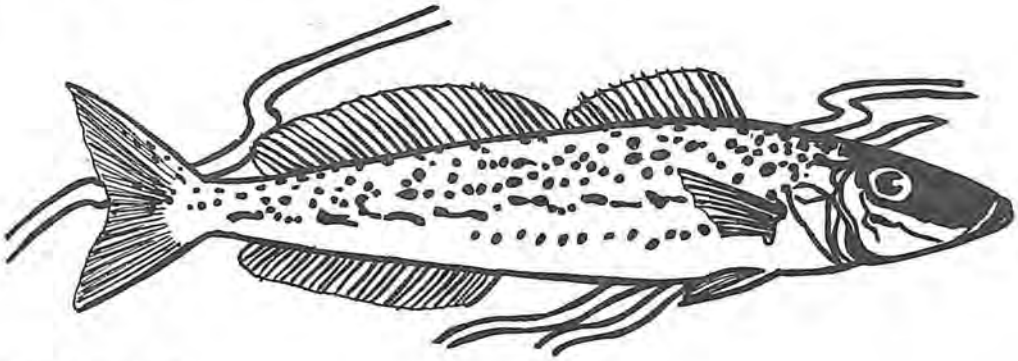
Decaying seagrass leaves also provide a bountiful supply for small animals, such as bacteria, worms and crabs; which in turn are eaten by juvenile fish, prawns and seabirds. In Port Hacking, NSW, 65% of the food eaten by leatherjackets are the tiny animals and plants living on the seagrass.

Seagrasses actively produce small amounts of nutrients required by other coastal plants and animals.

Shelter

Small animals and plants shelter in the seagrass leaves, receiving protection from predators, and too much sunlight, or temporary changes in salinity and temperature.

Fast water movement is also reduced considerably inside seagrass beds, creating a well protected home for its inhabitants.



Breeding Grounds

Seagrass beds provide breeding areas for many fish, including commercially important species such as King George Whiting in Western Port, Victoria.

Nursery

As a nursery for juvenile fish, crabs and prawns, seagrass meadows are worth hundreds of millions of dollars every year to our commercial fisheries. The value of the northern Australian prawn trawl fishery, for example, is $100 million per year, and important commercial prawn species are dependant on seagrasses for the early part of their life.

Young prawns hatch in the open ocean and rapidly make their way to coastal waters where they settle in seagrass beds. Here, they receive food, and protection from tidal currents and larger predatory fish. When they become large juveniles, they move back out to sea.

Juvenile fish dependant on seagrass include mullet, tailor, bream and flathead.

Humans Killing Seagrasses

Natural processes, such as storms, can damage seagrass beds. However, because seagrass beds are usually found in shallow coastal waters close to human habitation, they are particularly vulnerable to the impact of human activities.

Dredging

The dredging of shipping channels, ports and canal estates can kill seagrass.

Dredging not only physically removes seagrass plants, but creates muddied water that reduces the amount of sunlight penetrating to the seagrass. Therefore photosynthesis cannot take place and the plants cannot grow. Silt particles can also smother and suffocate animals and plants living in the seagrass beds.

Although regrowth of seagrass beds after dredging may be possible, land reclamation is a very final way of destroying seagrass beds and other marine communities forever.

Nutrient Overdose

MYTH: Seagrasses are plants and therefore need lots of nutrients, so sewage outfalls in coastal waters should help seagrasses grow.

FACT: Wrong! The nutrients in sewage certainly make some things grow, but it is not the seagrass. It is algae, and too much algae can kill seagrass.

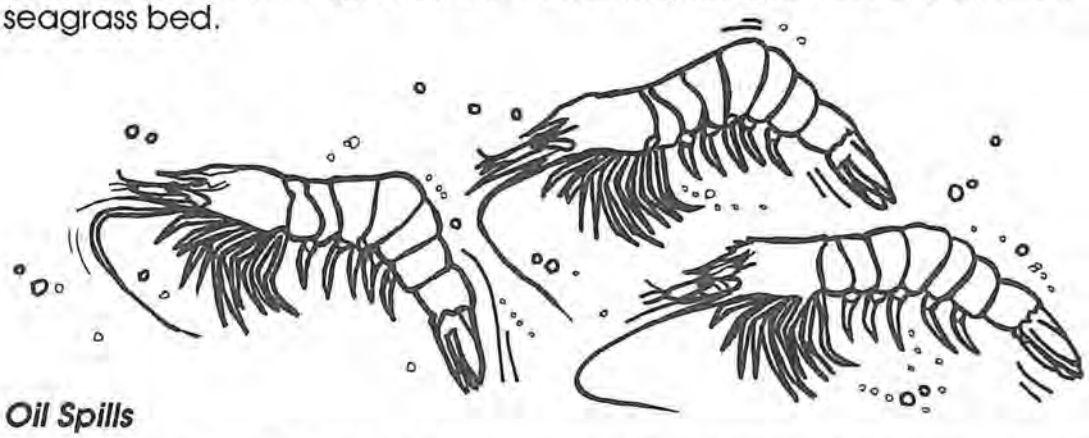
Sewage often contains an overabundance of nutrients such as nitrogen and phosphorus. These nutrients encourage the excessive growth of microscopic algae suspended in the water above the plants, or the overgrowth of algal plants on the seagrass leaves. If enough algae grows, the sunlight needed for photosynthesis cannot penetrate to the seagrass, and it cannot grow, eventually dying.

Excess nutrients also come from fertilisers in the water runoff from cleared coastal land, cities, towns and farms.

Heavy Metal Pollution

Seagrass roots can concentrate heavy metals then pass them up the food chain, poisoning many animals.

Seagrass level in an area 1.5 square kilometres in Spencer Gulf, S.A. were found to contain 73 tonnes of cadmium, 51 tonnes of lead and 571 tonnes of zinc, probably from the nearby lead smelter. The variety of animals, including commercially fished species, was drastically reduced in this poisoned seagrass bed.



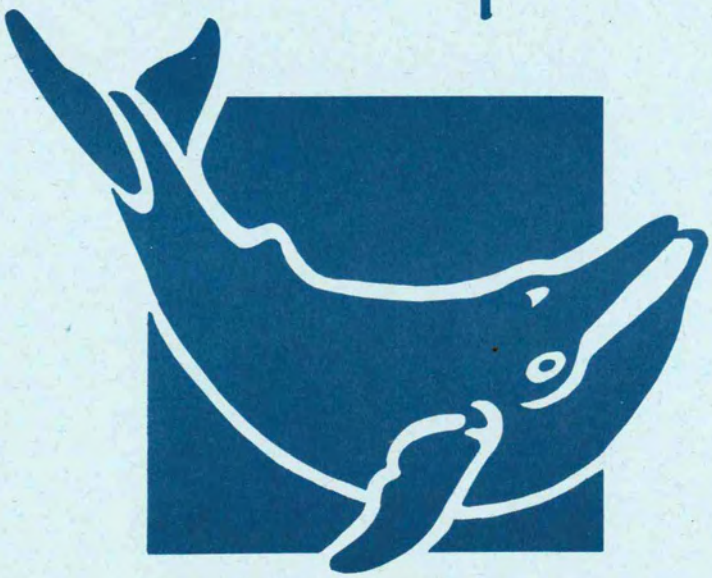
Oil Spills

Oil spills can also poison seagrasses. Another is that oil droplets can attach themselves to sediments, making them buoyant. This leads to erosion of seagrass beds and eventually seagrass death. A northern hemisphere beach lost 3,000 cubic metres of sand in one week due to this.

Boating

Damage to seagrass meadows by boat propellers, anchors and anchor chains is also common.

The Deep



Shipwrecked

Students are to design their own mythical creature based on a real marine animal.

CONCEPTS

- Marine animals have been base for the design of objects e.g. submarines; and stories for e.g. about mermaids; throughout history.
- The unknown and unexplained can be a basis for creating myths and legends.
- Many marine creatures were killed as a result of sailors' stories which created fear in the audiences. As knowledge and technology grew about the marine environment so did the conservation of these creatures.

OBJECTIVES

Students will be able to:

- create a mythical marine creature which they encounter on an imaginary voyage.
- recreate the life of early sailors and the hardships they endured.
- understand the importance of diaries in piecing together events in history.

VALUES

- To understand the need for protection of marine animals today because there is still insufficient known about these creatures and their role in the web of life.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Language	5,6,7	3.34 Myths and Legends	A: legends are often explanations of natural phenomena, and have religious and cultural origins. : myths are characterised by supernatural characters interacting with people.
		3.25 Notes	C: provide opportunities for children to make simple notes.
Arts and craft	5,6,7		Shape and Form.
Social studies	5	Change	Heritage of the Past.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Studies of Society& Environment	Time, Continuity and Change	5.5 Analyses how categories of time are used to describe ideas and the events.
English	Writing	4.5 Adjusts writing to take account of aspects of context, purpose and audience.
The Arts	Creating, Making and Presenting	5.1 Uses different starting points such as observation, experience and research to express ideas and feelings.

BACKGROUND INFORMATION

The unknown and unexplained throughout history has led people to create myths in order to provide some form of explanation for various happenings.

In the early sailing years of the 16th and 17th centuries, many sailors, with the combination of fear and excitement of their adventures, would encounter mermaids, Krakens, sea monsters and even Moby Dick.

These young sailors would spend months at sea, away from home, weary, hungry and anticipating adventure. After spending long hours watching the sea, their eyes would play tricks on them and they would imagine seeing a creature or part of a creature which had never been seen before and was huge and ferocious. Each time the story was told, the details would be exaggerated until the a sea creature became something that was to be feared.

Mermaids were believed to have been 'created' from the sea cow, which sunned itself on rocky outcrops and made unusual calls that were alluring to tired sailors.

These stories, and the lack of knowledge about deep sea animals, have led to the slaughter of many marine animals through fear. It is necessary for greater research to be carried out to help people develop a respect for the ocean depths.

The invention of the aqualung by Jacques Cousteau allowed divers to swim underwater for longer periods, and to explore and examine the ocean depths. Even though there is a great deal still unknown, divers have discovered that most of these terrible monsters are myths - just animals with unusual adaptations to their environment.

Modern examples of created monsters and mysteries appear in the 'Jaws' and 'Orca' series of films and in writings and films about the so-called 'Bermuda Triangle'.

Early sailors had great courage, inventiveness, curiosity and a sense of adventure to discover what lies beyond the horizon. They were also very superstitious and knew little about the sea. They experienced great difficulties and hardships with no modern conveniences. Disease was common, food scarce, sanitary conditions poor, rough weather such as storms and fogs, and often cruel overseers. This encouraged their imagination to create illusions to help with their personal survival.

KEY WORDS

sirens, mythical, kraken, dugong

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Video - 'The Little Mermaid'.

TEACHER DIRECTIONS

Materials

- Books on marine animals and marine stories such as the *Batavia* story in *Islands of Angry Ghosts*; *Daedalus* ; and *Mary Celeste.*
- A variety of pictures of marine animals with unusual features (e.g., narwhals, eels, rays, dugongs, walruses, squid, cuttlefish and gulper eels).
- Pictures of olden day ships and conditions.

LESSON OUTLINE

Brainstorm what the students imagine a sea monster to be like. Students then sketch their image of a sea monster (or mythical creature).

Discuss the features they created. What are they based on? Do they resemble any marine creatures?

Examine the pictures of unusual marine animals and their adaptations. Discuss the features which could be seen as frightening or mistaken as a mythical creature. (e.g., sea cow as a mermaid).

Read the stories of sea creatures such as the Kraken (Resource Sheet 14).

Visit the Maritime Museum in Fremantle and examine the early sailing ships.

View pictures of olden day sailors and ships. Discuss their courage, adventurous nature and the fear they would experience, as well as the hardships on-board ship. Discuss stories such as *The Batavia Story* and the disasters that occurred.

Discuss the type of monster the students would create from the ocean using parts of real marine animals if they had been an early sailor.

Establish the following scenario:

The class has been invited to travel on a three day voyage on the latest replica of an olden day ship, The *Mary Celeste*, or the *Endeavour*. They are to keep a diary of events during the journey. Due to an unusual and mysterious change in the weather pattern, an eerie storm occurs and the ship is wrecked.

They are able to escape on lifeboats and they experience encounters with a sea monster. (This can be an individual or group activity).

The students complete their diary of events (Worksheet 23), giving a full description of the mythical creature they have created.

They explain how it rescues or attacks them, and how they survive.

Using large sheets of paper or papier-mâché the students can create models of the mythical creature they have invented, with any modifications from the original. They then introduce it to the class, stating its special features, such as its habitat, diet, and any unusual features or habits it may have.

EVALUATION

- Were the students able to create a creature using (combining) real marine animal parts to help explain mythical creatures?
- Were the diaries comprehensive in their descriptions, and did they relay the hardships and details of the times?

COMPLEMENTARY ACTIVITIES

Working in groups, the students can produce a script for a play related to their adventure. They then perform the play.

Groups or the whole class can produce a newspaper report or picture book on the myth of this new creature in the form of:

(i) a picture dictionary of sea creatures,
(ii) a slit book, which enables them to mix and match their creatures

The class can have a sea creature day to dress up and role-play their creature.

Create a hoax of a newly discovered sea creature that can be written up as a newspaper article.

Find out more about the unusual sea animals (e.g. lantern eels, angler fish, megamouth) and the adaptations of the creatures from the depths. Why do you think we are just discovering some of these creatures?

Design a ship icon with a marine theme.

Study marine explorations of the early French and Dutch explorations.

RESOURCE SHEET 14

The Loch Ness Monster

Loch Ness is a beautiful lake in Scotland connected to the Atlantic Ocean and North Sea by a system of canals and lochs. It has steep rocky banks and ranges in depth from 100 m to more than 250 m.

During the last Ice Age, Loch Ness was an inlet of the ocean. When the sea level receded it is believed by some, that a family of sea monsters was stranded in the lake and still live there to this day.

The first sighting of one of these monsters was in the year 565 by St Columba. He reported seeing a man attacked by a monstrous sea serpent.

There were more frequent sightings just after the area became accessible with the building of a paved road in 1933.

'Nessie' or 'the Loch Ness Monster' has a small head on a long neck. It seems to splash a lot as it rapidly moves across the lake. It is most often reported as having a number of humps down its back, varying from 1—9. The animal has been variously described as being black, dark brown or grey and ranging in length from 3—12 m.

Numerous investigations have not unearthed any solid evidence of Nessie's existence.

Kraken

A kraken is a giant squid described as 'having a torpedo-shaped body, a slender tail, two goggle-shaped eyes, and a parrot-like beak used for tearing apart its prey. It has ten long, slender tentacles, two of which are longer than the rest. On each tentacle are three rows of sucker-like disks.' (Monsters, Mysteries, UFOs).

The monster made its first recorded appearance in 1555. Since then there have been a number of sightings, firstly around Norwegian waters, then later extending out to North American waters.

One story tells of a boatload of fishermen going ashore on an uncharted island. After they lit a fire, to their horror, the island began to sink. As they scrambled to safety they realised that they had actually been making camp on a floating kraken.

In 1877, a 'small' kraken was sent to a New York aquarium. It was about 3 m long and had a 2 metre circumference. Its eyes were 20 cm in diameter and its longest tentacles (or 'whips') measured 10 m in length

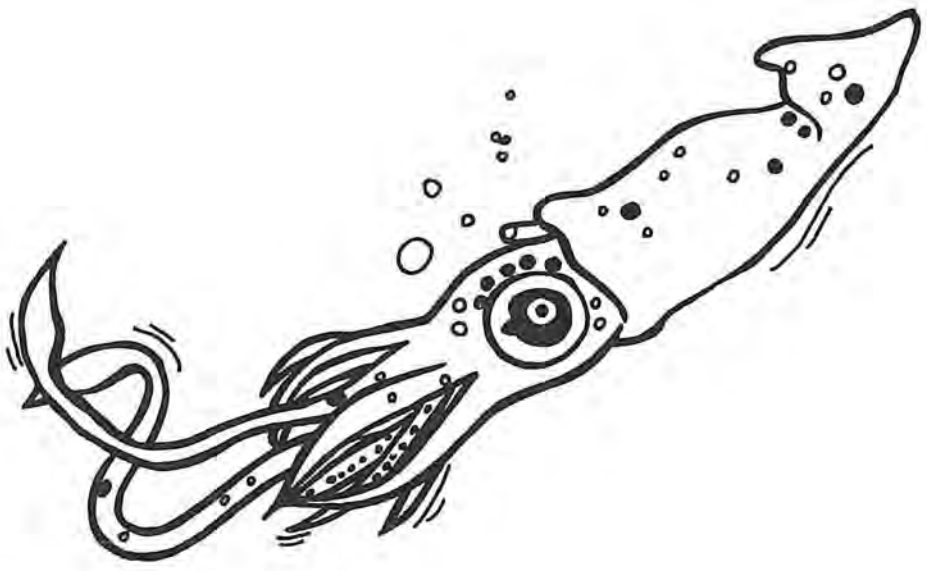
Mermaids

Mermaids - and mermen - have been part of marine folklore for thousands of years. They are creatures which live in the sea and are human from the waist up and fish from the waist down.

Mermaids are have been seen sitting on the rocks near the shore combing their long blond or green hair. They are very beautiful, but dangerous, having power over the sea itself. If they became angry, they may send great waves to destroy coastal villages.

Sometimes mermaids could apparently take on the full human form and come ashore to dance—a past time of which they were particularly fond. During this time if a young man stole a comb or similar possession of the mermaid, she would have to become his wife and stay with him. However, if she ever regained the object he had stolen, she would return to the sea and again become a young and beautiful mermaid.

Sometimes mermaids were thought to drag sailors down to them in the water to become their husbands.



WORKSHEET 23

Name: _____
Date: _____

The Diary of

_____

On their maiden voyage aboard the

_____

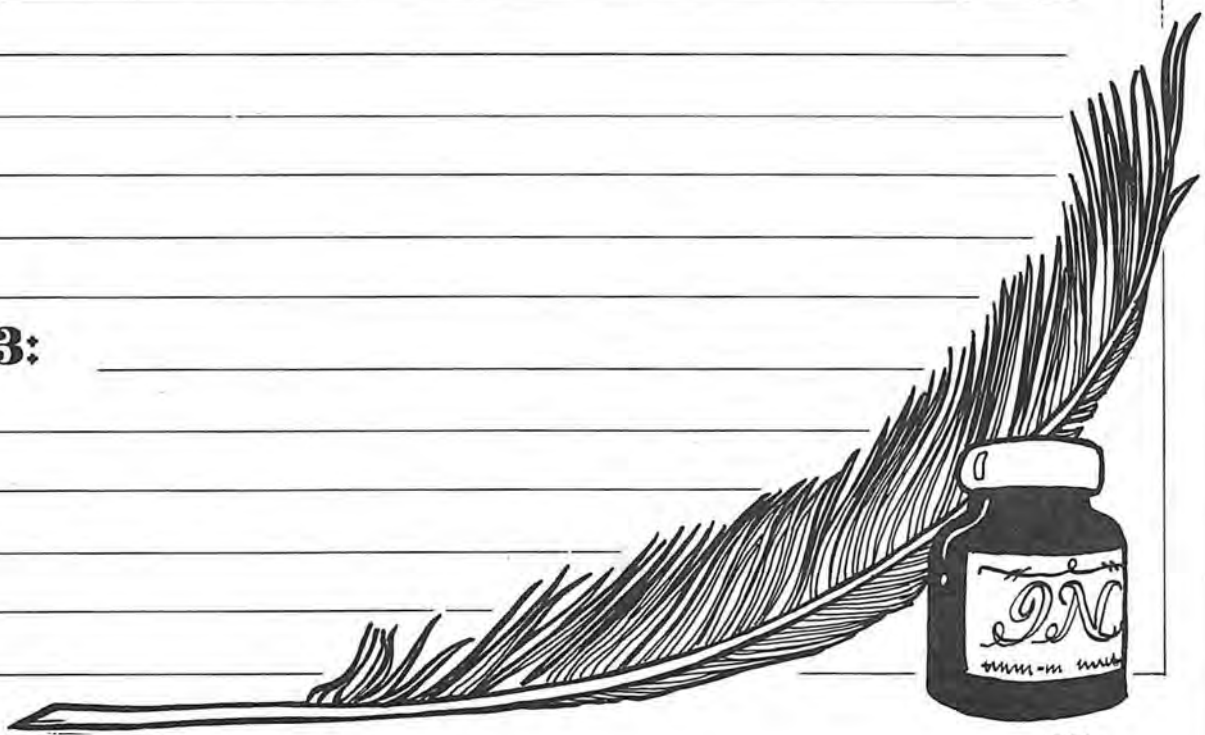
Date

_____

Day 1: _____

Day 2: _____

Day 3: _____



A Whale of a Time

Students will study a whale of their choice and then produce life-size shapes to compare the whales with their own body size. They will also become aware of marine animals' dependence on the ocean.

CONCEPTS

- Whales include the largest known animals on the earth.
- Marine life, unlike terrestrial life, depends on huge expanses of ocean for their survival.
- Whales and all marine life need to be conserved.

OBJECTIVES

Students will be able:

- to recognise the characteristics specific to each whale group,
- to reproduce a life-size outline of a whale,
- to understand the importance of the ocean for the survival of marine life.

VALUES

- To recognise the importance of whales in the marine ecology, and thus, the need for their protection on a worldwide basis

CURRICULUM LINKS

CURRICULUM YEAR	STAGE / STRAND	NUMBER / TOPICS	UNDERSTANDINGS / AREAS
Language	5,6,7	3.2.12 Figures	A: use, retrieve and interpret information from simple figures. B: teach children to use appropriate labels on graph axes
Mathematics	5,6,7 5,6,7	M:P 2.6 S:P 1.4 S:P 4.4	Relate measurement of area to other measures. Make scale models and drawings of familiar structures & areas. Reduce and enlarge.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
English	Writing	3.5 Recognises that certain text types and features are associated with particular purposes and audience.
Health & Physical Education	Human Movement	5.9 Understand the importance of and display effective personal skills in goal oriented group activities.
Mathematics	Measurement	4.12 Measures and makes things, using conventional units and measuring equipment for length, mass, capacity and angle and reading scale to the nearest marked graduation.

BACKGROUND INFORMATION

Whales, dolphins and porpoises belong to the order known as CETACEANS. They are classed as the most advanced marine mammals. They live entirely in the sea and breathe air. They communicate by sounds, which are also used as a form of echo-location navigation (i.e. a sound is emitted and an echo received). There are 75—80 different species of whale, dolphin and porpoise known, with these being classed into two groups:

1. ODONTOCETES, which have teeth
2. MYSTICETES, which have a baleen (a series of horny plates arising from the mucous membrane of the palate, which sifts out the plankton from the water)

Whales are found in various types of waters situated around the world with most baleen or larger whales undertaking extensive migration from cold waters to tropical areas and back - the journey often as long as 20,000 km. The humpback whale is the most common whale along our coastline during annual migrations. The abundance of food and their breeding cycle is related to this pattern. In both hemispheres, they meet in warmer areas to breed, then travel north or south toward the poles. They then return the following year to give birth after a gestation period of 11—12 months.

Whales are not the only marine animals to migrate. Many animals, some no bigger than a pinhead, make journeys of hundreds of kilometres. The sea is full of marine life migrating. Some are on their way to shore (turtles to lay eggs), others are heading for different waters (whales) and others are on their way to inland rivers (lampreys in the south west). The animals migrate in different ways. Some, like the tuna fish, travel in groups but others, like the turtle, travel alone. Smaller marine animals often use the tides and ocean currents to assist them in their migration, whereas larger marine animals are more independent.

For the larger migrating marine animals, dangers come mostly from humans. They are prime targets for food. It is necessary for people to be made aware of the importance of migration patterns.

Whales have been hunted since 1500BC for food, clothing, weapons and oil for lighting. Approximately 330,000 blue whales were killed over the past 60 years. By 1966 they became protected in many parts of the world. However, there is still a strong emphasis required for the conservation of all species. Whales are the largest animals known, and the heaviest, so without the buoyancy of the ocean waters, their internal organs would be crushed from their weight.

KEY WORDS

buoyancy, migration, cetacean, echolocation, species, larval stages, life cycle, ecology.

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Tapes of whales' songs.

TEACHER DIRECTIONS:

Materials

Video (whales)
Art paper
Graph paper
Library resources
Tape measure
Chalk
Pictures of whales
Map of the world
Large bitumen area

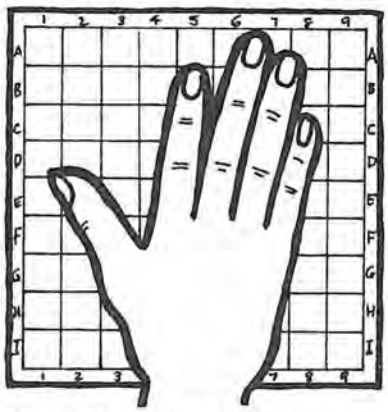
LESSON OUTLINE

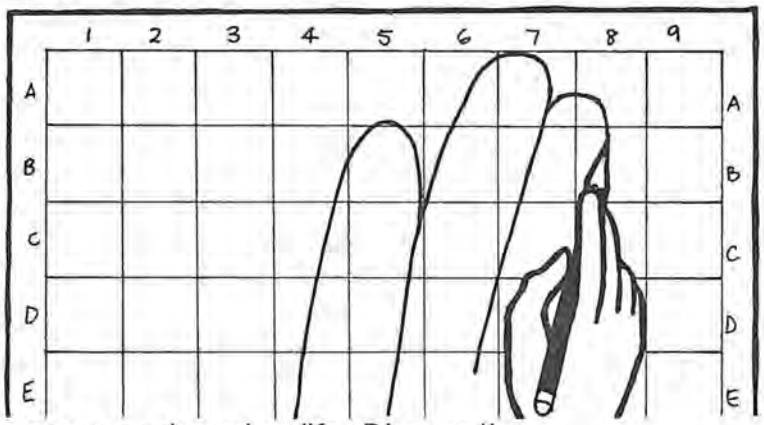
Preliminary Activity:

Scale will need to be taught so the students can transfer their whale to a life size model. Explain scale and its use in maps to demonstrate distance on a smaller level, such as 1 cm = 100 km.

Using normal graph paper, have the students trace around their hand. Then using larger grid paper have the children transfer their hand onto the larger grid.

The squares on the grid paper can be numbered to make it easier for the students experiencing difficulty.





Brainstorm features of the ocean and marine life. Discuss the interdependence of the plants and animals, and the importance of migration for their survival.

View the video on whales and discuss:

types of whales,
their size,
migration,
feeding,
breeding, and
their link in the marine food web.

Also discuss the effects of whaling.

In groups of two, select a whale using Resource Sheet 15. Complete Worksheet 24.

From their review, and using the information provided, each pair writes a letter to the leaders of countries that still allow whaling (such as Japan, Norway and Iceland), asking them to stop.

Each group will produce, to scale (e.g. 1 cm = 2 m), a paper cut-out of their whale and place it on the map of the world. Discuss the whale's habitat, habits and migratory patterns.

After comparing sizes of paper cut-outs of whales in class, the students move outside to measure and draw the real life replicas of their whales on the oval or school court.

A grid of one metre squares can be established, by using markers and string, with each square being numbered. The groups then transfer their smaller models to the larger grid, using chalk.[1]

On completion, the class can compare sizes of whales and see how many students can fit inside each outline.

EVALUATION

- Were the groups able successfully to produce a scale model of their whale?
- Were the students able to transfer their research into letter form?
- Were the students able to explain migratory patterns and their importance to the species' survival?

COMPLEMENTARY ACTIVITIES

Design posters stating the need for protection and the 'Rights of the Whales' to survive.

Draw the actual size of the largest dinosaur in comparison to the largest whale.

Write a poem or song about the need to protect the whales.

Undertake a class debate on tuna fishing and the effects this may have on dolphins.

Choose another marine animal and research its migratory habits. Why are migratory habits so important?

Visit the marine room at the W.A. Museum and examine the full size whale skeleton.

1. Activity reproduced with permission from 'Aquatic Project Wild'

RESOURCE SHEET 15

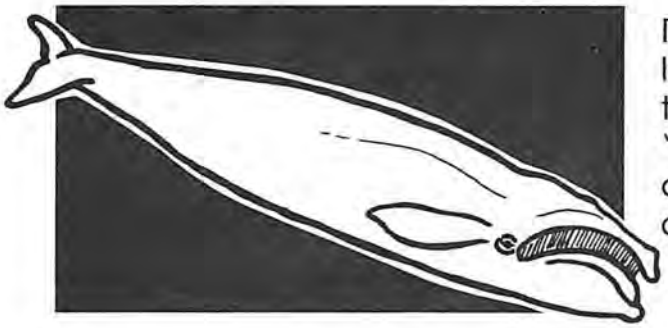
KEY FACTS ABOUT WHALES

The oceans house about 80 different species of whales. There are two groups of whales being:

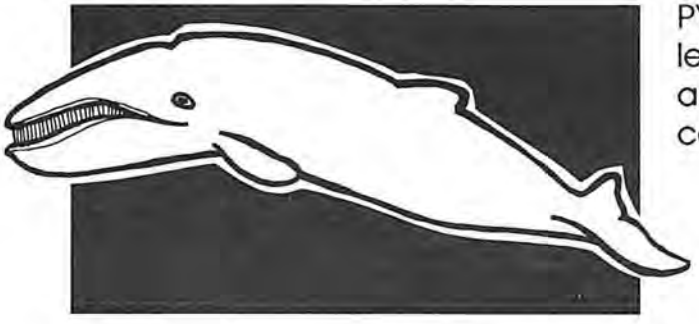
(i) Baleen - which feed by allowing water to pass through their mouths as they move through the ocean. Food is strained from the water by thin plates made of a horny substance called baleen.

(ii) Toothed - these whales have teeth to help them chew larger pieces of food like squid and fish.

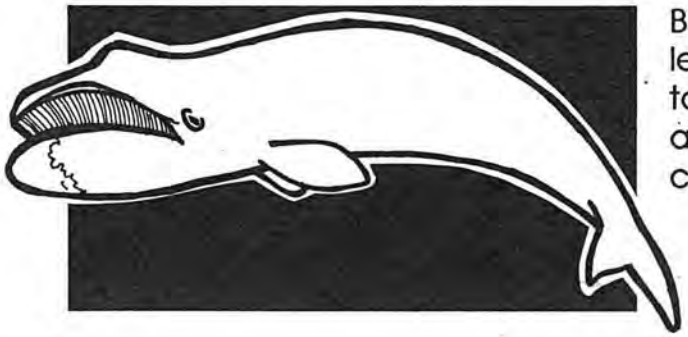
BLUE WHALES
length 26 metres, weight 150 tonnes. They are the largest of all whales.



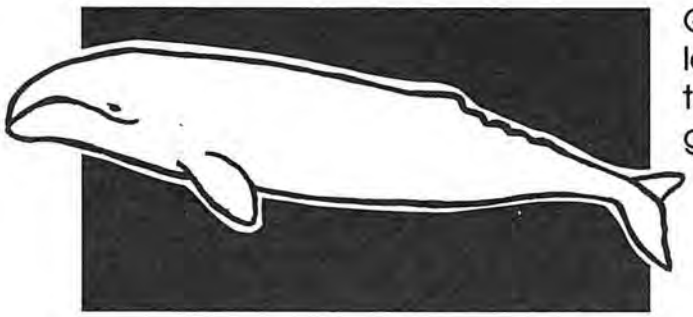
RIGHT WHALES
length 15 metres, weight 50—55 tonnes. Have upside down smiles with "callosities" or rough areas on the top of their heads which are usually covered with parasites.



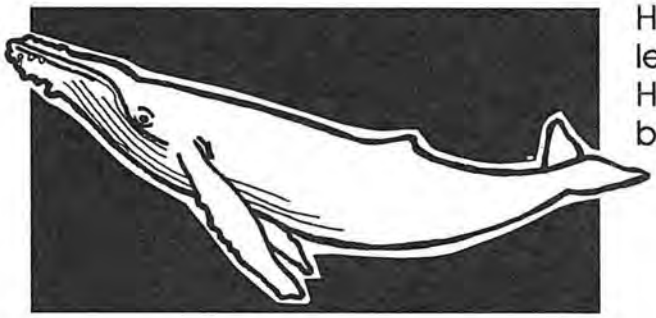
PYGMY RIGHT WHALES
length 5 metres, weight 3—3.5 tonnes are the most streamlined with no callosities.



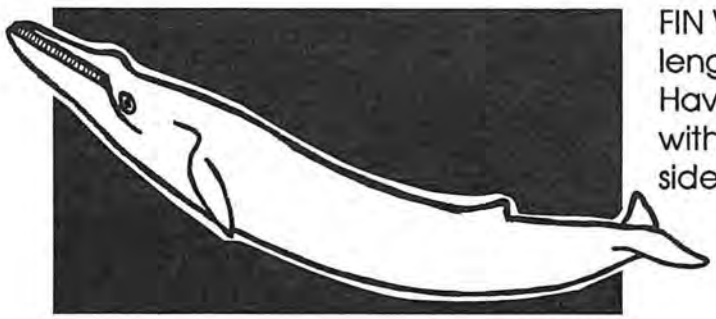
BOWHEAD WHALE
length 17 metres, weight 60—80 tonnes. Have an arched upper jaw and similar to right whales but without callosities.



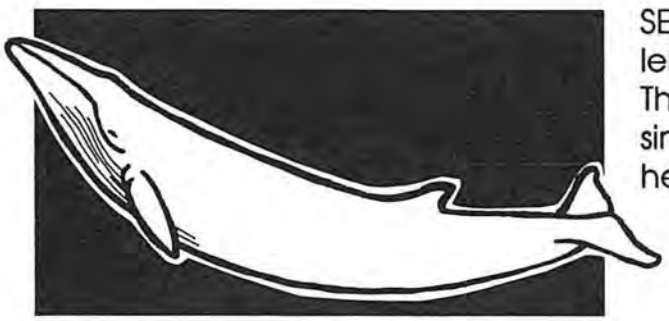
GREY WHALE
length 12—15 metres, weight 16 tonnes no dorsal fin, 2 short throat grooves and distinctive colour.



HUMPBACK WHALE
length 16 metres, weight 65 tonnes. Have the longest flippers and many bumps on the top of their heads.

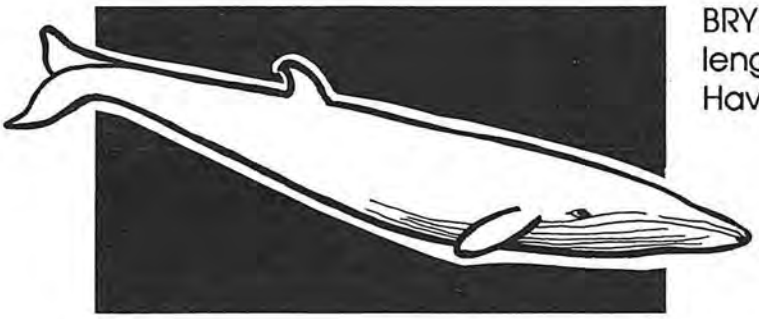


FIN WHALE
length 25 metres, weight 80 tonnes. Have a distinct fin far down their backs with a unique white patch on the right side of their head.

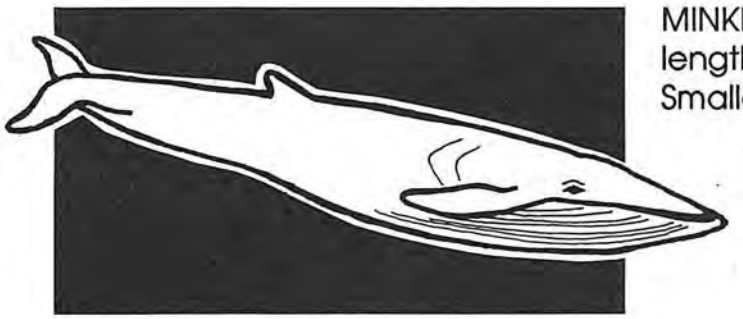


SEI WHALE
length 18 metres, weight 30 tonnes. They are long and slim and have a single ridge along the top of their heads.

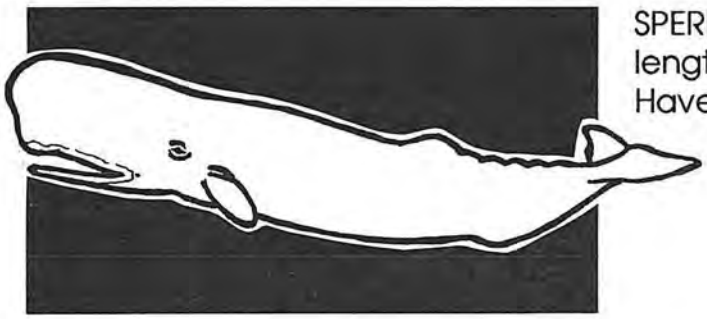
RESOURCE SHEET 15



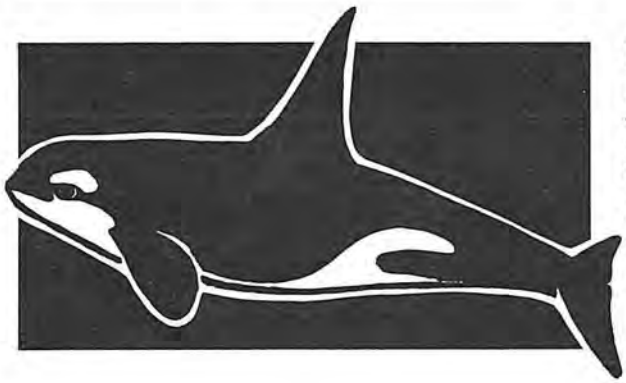
BRYDE'S WHALE
length 13 metres, weight 26 tonnes.
Have 3 ridges on the top of their head.



MINKE WHALE
length 11 metres, weight 10 tonnes.
Smallest of the great whales.



SPERM WHALE
length 20 metres, weight 70 tonnes.
Have teeth and a square head.



KILLER WHALE OR ORCA
Length 8 m, weight 14 tonnes.
Tall dorsal fin (particularly in males).
Conspicuous black and white markings, toothed.

WORKSHEET 24

Name: _____
Date: _____

WHALES

You have been chosen as a promising marine biologist to complete an information search on a whale of your choice. This information is valuable in the conservation of whales.

NAME OF WHALE: _____

TYPE: BALEEN TOOTHED

SIZE: _____ WEIGHT: _____

COLOUR: _____

WHERE ARE THEY FOUND? _____

_____

_____

WHAT DO THEY EAT? _____

_____

HOW DO THEY COMMUNICATE WITH EACH OTHER? _____

_____

_____

WHERE AND WHY DO THEY MIGRATE? _____

_____

_____

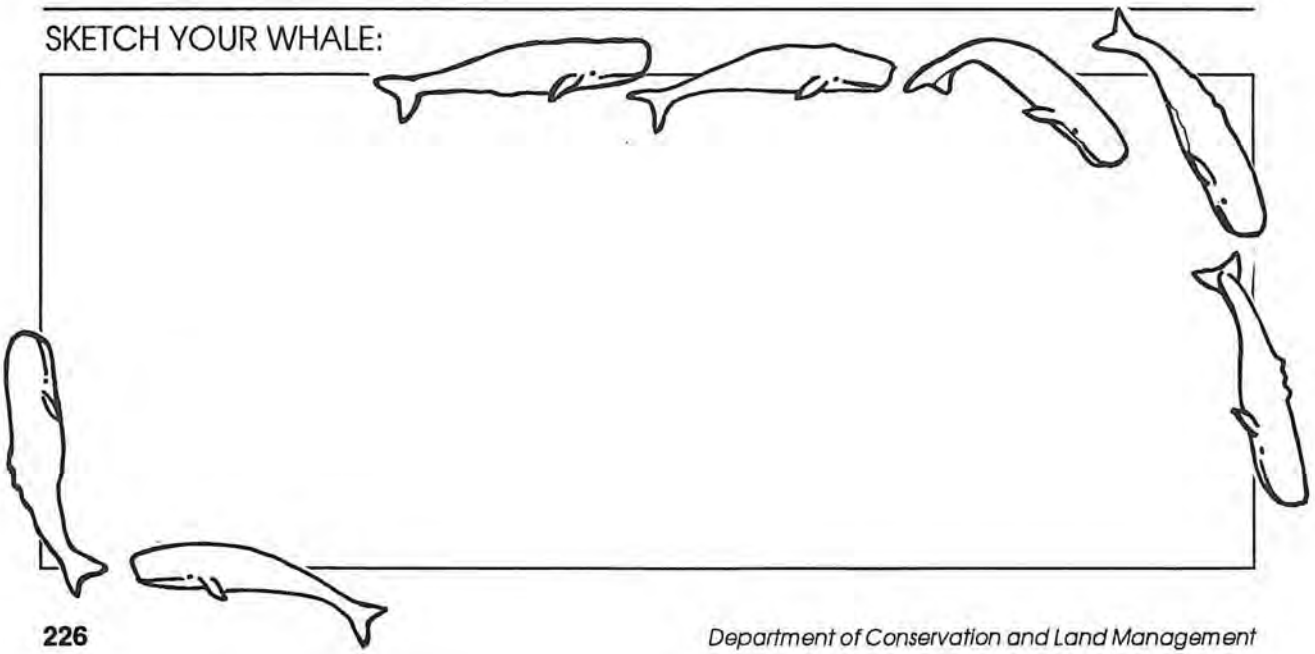
_____

DO THEY HAVE ANY UNUSUAL FEATURES? _____

_____

_____

SKETCH YOUR WHALE:



Find my Home

Students will complete a "beach walk" to collect, examine and classify as many pieces of evidence which will demonstrate that the sea is in constant motion and that motion delivers objects from the ocean depths to the shore.

CONCEPTS

- The ocean depths differ from coastal regions in the diversity of animals and plants.
- Humans have a major impact on oceans and beaches and need to be aware of this.
- The ocean is in constant motion and objects from thousands of kilometres away can be dumped upon the shore.

OBJECTIVES

Students will be able:

- To identify as many different items as possible from their beach walk and observations.
- To classify the items found into groups according to their original habitat.
- To define and understand how humans impact on the ocean.

VALUES

- To understand the care needed and conservation methods required by the community to help protect the ocean environment .

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Arts and Craft	5,6,7		Shape and Form.
Health	5	Community, Environmental	Effect of pollution on health and the environment.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Working Scientifically	4.2 Collects and records information as accurately as equipment permits and investigation purposes require.

BACKGROUND INFORMATION

"The living things of the seashore are truly marine (i.e., they have come from the sea). In fact, the very nature of the seashore is made by the sea. Without the sea, there would not be a seashore."

I.Bennett

Even the sand has been produced from decaying matter and eroded shells and bones. Wind, waves, tides and currents all have a part to play in transporting marine animal parts, plastics and decaying matter to the shore.

The ocean is the large mass of water covering about 70 per cent of the Earth's surface. It contains approximately 97 per cent of the Earth's water.

The ocean has many values; for recreation, food, energy, regulating air temperature, supplying moisture for rainfall and providing a means for transport.

The deep ocean and ocean floor have provided a fascination for man because little was known about them until the 1940s, when seismic methods were used. The ocean floor showed similar topography to the land, with hills, mountains, valleys, ridges and trenches.

Because of the depths and strong currents of the ocean, few items from the deep are found on the beach. The amount of damage and erosion of washed-up material may indicate that the items have come from a long way off.

The beach and ocean floor are made from plant and animal materials that have come from the ocean, so remember to return all items to where they were found.

The pollutants found on the beach usually come from rubbish dumped from boats, or washed along the shore by the waves. The general source of the pollutants is usually easy to determine.

KEY WORDS

continental shelf, biodegradable, pollutants

REFERENCES / RESOURCES

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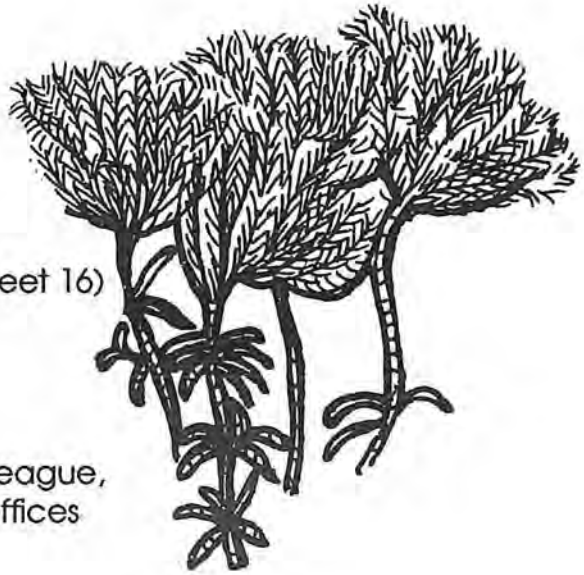
—*Nature of Australia: Seas Under Capricorn.* Melbourne 1988 55mins BRN 583213.
—*Sea Creatures.* Video (available from District Offices).



TEACHER DIRECTIONS

Materials

Plastic bags or buckets to carry rubbish
Overhead of continental shelf profile (Resource Sheet 16)
Large hoops (5)
Student notebook
Camera
Hand lens
Beachcombing Chart, available from the Gould League,
The video - *Sea Creatures*, available from district offices

LESSON OUTLINE

Pre-excursion Activities:

Examine Resource Sheet 16 and discuss.

View the video *Sea Creatures* and discuss the animals most likely to come from the deep sea. Discuss animal movement, camouflage, defence and any unusual features.

In groups, students list items they expect to find on the beach and note where each item might come from.
Collate the group predictions onto the board. Students copy data onto Worksheet 25.

Excursion Activity

Stress the need for students:

- to return items to the place they were found,
- to use established paths over dunes,
- to take care when picking up rubbish, and
- to leave syringes alone and ask the teacher to dispose of them.

The students search the beach for marine plants and animals and any rubbish. Tick off items from Worksheet 25 and place all rubbish into plastic bags.

On completion, discuss a set of criteria for classifying the items found into groups (e.g. ocean, sandy shallows, reef, and cultural). The hoops provided will represent each of the groupings.

Teacher selects a few items from each hoop and asks the students the reasons for classifying them into the respective hoop.

Examine the rubbish found and decide where each piece may have originated (e.g. ships, people on the beach, drains, or blown from elsewhere). Discuss the environmental damage that may be caused by these objects to both the living and non-living components of the environment.

Take the bags of rubbish back to school and return all other items to the places where they were found.

Post-excursion Activities:

Discuss the results of Worksheet 25. Use the beachcombing chart to identify the various objects.

Research the items not identified at the beach and investigate some books to help identify the origin. (e.g. cuttlefish).

EVALUATION

- Were students able to classify the objects?
- Were they able to find or predict the homes of various animals and plants?
- Were cultural objects evaluated as a major problem on the shore?

COMPLEMENTARY ACTIVITIES

Display items of rubbish collected, along the blackboard. Students design one of the following creatures using sketches of the rubbish:

Ocean Critters
Reef Peepers
Rotty Rubbishers
Great Unknowns.

Write a letter or report from an animal's (seal, dolphin, fish) point of view, stating its concern for its habitat because of the increasing rubbish being dumped in the ocean.

Design posters advertising the need for conservation of animals, collecting rubbish from the beach and bringing rubbish home after fishing trips.

Design bumper stickers that stress the need for conservation in our oceans. Reproduce the designs on white contact so students can have their own stickers.

Produce ten rules for people to abide by to conserve the marine environment (see 'The Pledge' activity in 'Limestone Reefs' section).

PROFILE OF THE OCEAN FLOOR

WORKSHEET 25

Name: _____
Date: _____

ITEM - Home address

ITEM - Home address

FIND MY HOME

Homes: reef, sandy shallows, the deep.

ITEM - Home address

ITEM - Home address

Depths of the Ocean

To examine the depths of the ocean and the diverse animal and plant groupings that live there.

CONCEPTS

- There are three different layers within the ocean depths and a variety of changes in temperature, light and marine animals between these layers.
- Plants need light to survive, thus they are unable to survive on the bottom of the ocean depths.
- Animals have made a number of adaptations to survive in the dark depths of the ocean.

OBJECTIVES

Students will be able to:

- demonstrate their understanding of the ocean structure by creating a diorama,
- become aware of the diversity of plants and animals in the layers and their adaptations to their environment,
- gain an understanding of the relationship between water pressure and depth,
- understand what the 'Dark' means in the deep ocean.

VALUES

- To understand that the deep sea is a fragile environment that can be affected by human impact so needs to be cared for.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDING / TOPICS
Science	7	Energy Plants	Investigating the reflection of light. Hypothesising about plant adaptations in harsh environments.

STUDENT OUTCOME STATEMENT LINKS

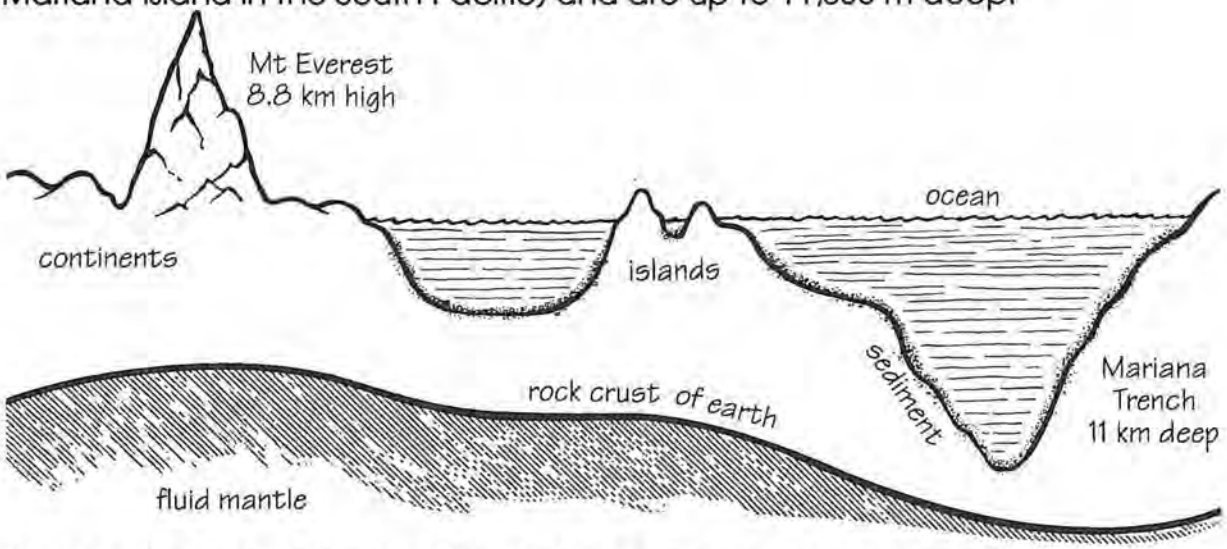
PROFILE	STRAND	LEVEL
Science	Life and Living	3.13 Maps relationships between living things in a habitat. 5.15 Identifies features of groups of living things that enables them to compete successfully in their environments.
The Arts	Creating, Making and Presenting	4.2 Selects, combines and manipulates arts elements using arrange of skills, techniques and processes.

BACKGROUND INFORMATION

The waters of the oceans fill the enormous hollows in the hard outer rock surface of the planet. The 'continental shelf' is the great rock platform that surrounds each continent.

The waves, currents, and rivers have dumped heaps of sand, mud and loose debris from the land over the Shelf. The 'shelf' is inhabited by many seaweeds and a variety of animals such as sea anemones, smaller molluscs, sponges and sea urchins. The shelf dips to the 'continental slope' and then into the 'continental rise' where there are less plants and animals, but include larger molluscs, squid, octopuses and cuttlefish. The 'rise' leads to the 'abyssal plains', which supports unusual fish, free swimming molluscs but none or little plant life.

Mountain ranges rise from the abyssal plains followed by trenches. The greatest depths known in the ocean are in the Mariana Trench (South of Mariana Island in the South Pacific) and are up to 11,038 m deep.



The ocean divides into three levels depending on the amount of sunlight. Near the surface is the sunlit zone (or photic) 0—200 metres. This is where most creatures like jellyfish, dolphins, fish and plankton live because it is warm and sunny.

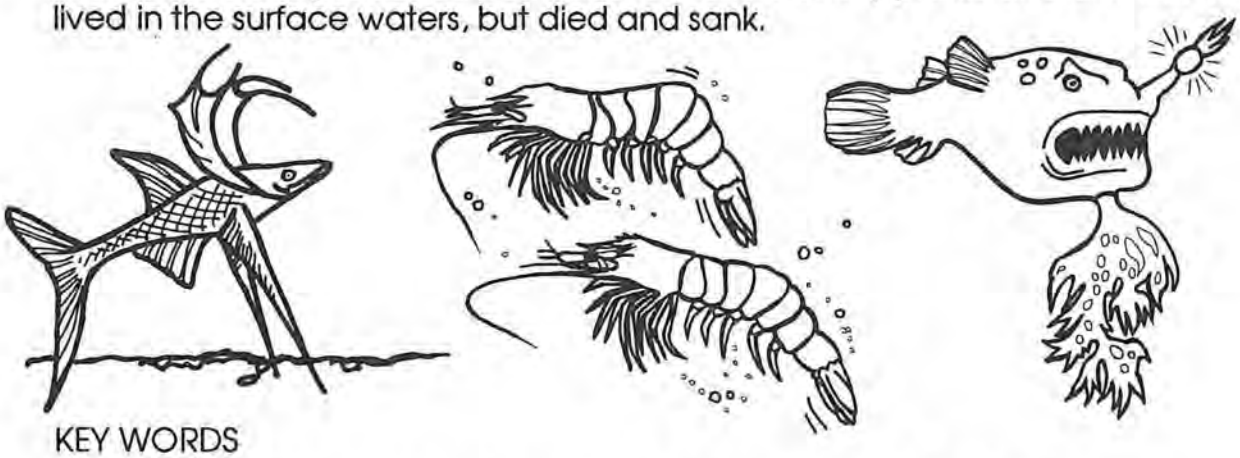
The second level is the twilight zone, 200—1000 metres, where only blue light remains. Here, the water pressure increases and the temperature drops. Plants cannot grow in these waters. The animals use bioluminescence to attract mates, but often it is on the lower parts of their body to camouflage themselves against the prey in the sunlit zone. Animals living here include lantern fish, viperfish and hatchetfish.

The third level is the deep sea zone, below 1000 metres. Often known as the 'Midnight Zone', the water pressure increases strongly, temperatures are near freezing and it is completely dark.

The animals in this level have adapted to their environment by using special organs or lights (bioluminescence) which shine to lure their prey. Most deep sea fish are black, due to the lack of light. They usually have big jaws for swallowing their prey (e.g. gulper eels and angler fish). Few fish live here because food is scarce.

The very bottom dwellers (or Bethnic creatures) are blind or have no eyes. They are usually white and do not use bioluminescence. These creatures include the tripod fish, annelids, shrimp, criooid and the brittlestar.

Although the ocean floor is solid rock, most of it is covered with a soft ooze which has been produced from billions of shells of tiny plants and animals that lived in the surface waters, but died and sank.



KEY WORDS

bioluminescence, decomposing, continental shelf, trench, habitat, continental slope.

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—*World Book Encyclopaedia.* (1992) Vol. 14, World Book Inc. Sydney.

—*The Living Planet : a Portrait of the Earth Part 11,* Video 1984 BRN238923.

TEACHER DIRECTIONS

Materials

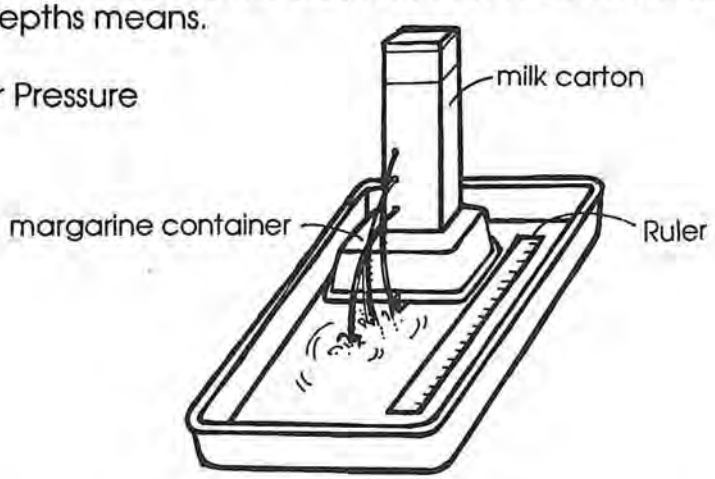
Library resources
Paints and brushes
Cellophane
Art paper
Glue
Balloons
Plastic tubing
One empty litre milk carton
Nails (3)
Ruler
Empty margarine container
Large tray
Water

LESSON OUTLINE

Using Resource Sheet 17 discuss the three layers of the ocean depths; their features and the adaptations of the animals to the lack of light and the water pressure.

Play blindman's buff so the students can understand what the 'dark' of the ocean depths means.

(i) Water Pressure



Open the top of the milk carton. Then push the 3 nails through one side of the carton about 2.5 cm apart, making sure the lowest is 7 cm above the bottom of the carton. Place the ruler along the bottom of the tray so the 30 cm end is touching one end of the tray.

Place the margarine container upside down at the 1 cm end. Place the milk carton on top of the tub with the nails pointing towards the 30 cm end.

Fill the carton with water, pull out the nails and keep pouring water into the carton so it is always full.

How far does each jet squirt and why? What does this tell you about the pressure as you go deeper under the ocean?

The bottom jet should travel further because it is under the greatest pressure from the water above. Life in the ocean depths is adapted to this.

Have each student blow up a balloon. Fill a dish full of water and have the students attempt to blow up the balloons while holding under water. Plastic tubing may need to be connected to the neck of the balloon. Discuss the difficulties of blowing up the balloon under water and how the water pressure causes this.

(ii) Ocean Zones

Distribute Resource Sheet 17, describing the characteristics of each photic level.

Allocate a zone to each group or pair and ask them to use the information in the Resource Sheet to complete Worksheet 26.

Each group, or pair, should then create an invitation to a 'party' in their zone. The invitation may take the form of a 'rap' song, or be a more formal invitation, as in Worksheet 27.

Complete Worksheet 28 (word sleuth).

EVALUATION

- Were they able to demonstrate the diversity and adaptations of the animals and plants in their group's level of the ocean correctly?

COMPLEMENTARY ACTIVITIES

Create the most unusual fish of your choice that lives in the deep dark ocean providing it with your own ideas of adaptation (e.g. attracting and catching its prey). See 'Creature Feature' in the 'Limestone Reef' section of this package.

Produce a class mural to display the different levels of the ocean and its inhabitants.

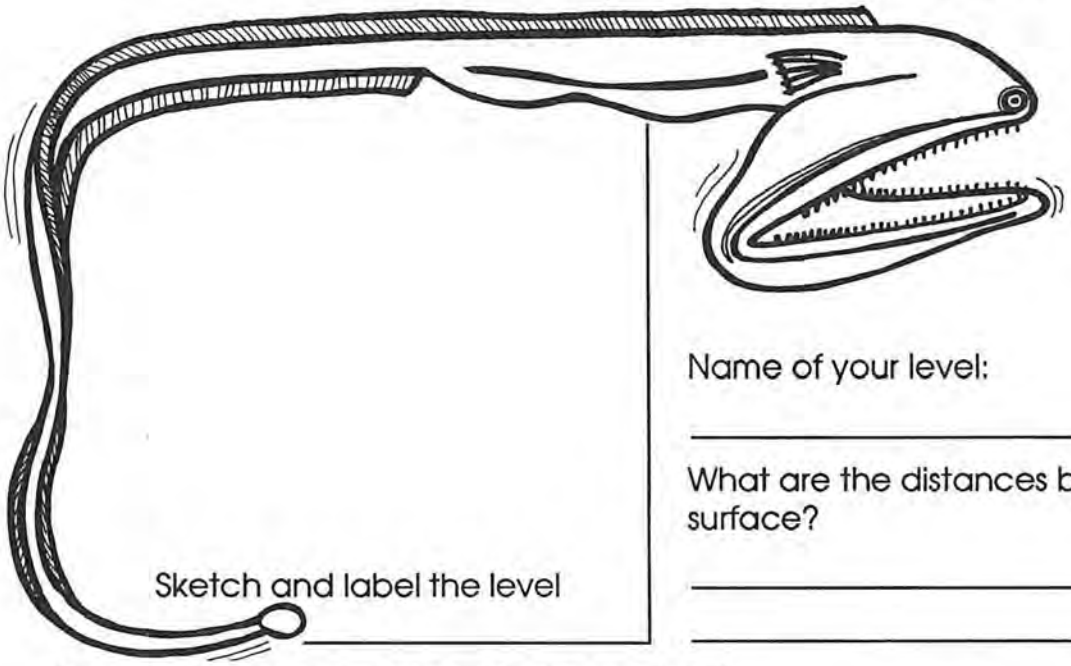
Invite a diver to come to talk about the undersea world and the effects of pressure on divers while diving. Ask them to explain what 'the bends' are.

Each group can create a diorama of their level, including samples of the inhabitants of that layer. The dioramas could fit on top of each other to show the depths of the ocean and the changes that occur.

WORKSHEET 26

Name: _____
Date: _____

DEPTHS OF THE OCEAN



Sketch and label the level

Name of your level:

_____

What are the distances below the surface?

_____

_____

Are plants able to survive there successfully? _____

Explain why _____

_____

_____

Describe the type of animals that live there _____

_____

_____

_____

How have they adapted to the environment? _____

_____

_____

Explain what they eat and how they obtain it. _____

_____

_____

_____

_____

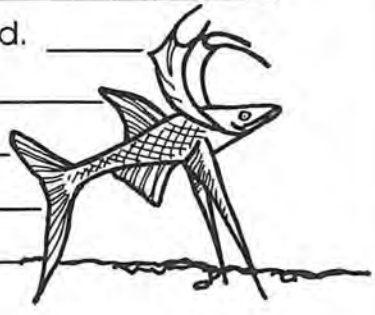
Report on any other interesting features you have discovered. _____

_____

_____

_____

_____



RESOURCE SHEET 17

ZONES OF THE OCEAN

PLANKTON

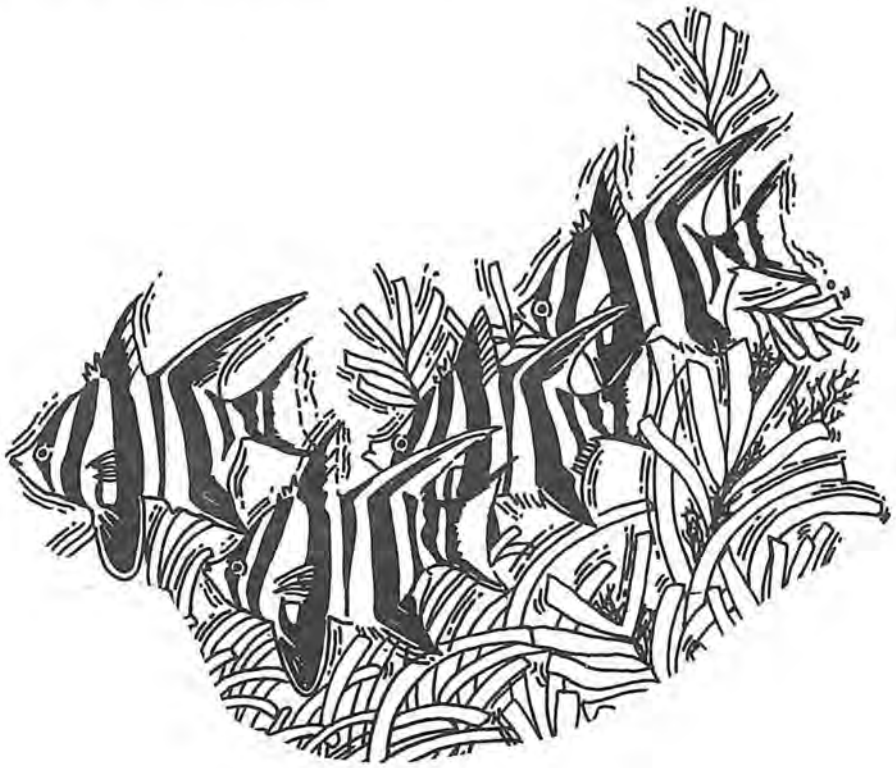
Organisms, plants (phytoplankton) or animals (zooplankton) which float in the Sunlit layer drifting at the mercy of the water currents require the light for photosynthesis. These microscopic organisms provide most of the food for the larger organisms. Examples of larger zooplankton are larvae, krill or sea jellies. The "UPWELLINGS" from the ocean floor refertize the plankton with nutrients released by bacterial decomposition of organisms on the floor.

NEKTON

These are the larger and stronger swimming animals of the ocean such as fish and squid. The surface dwellers tend to be stronger swimmers and more streamlined whereas the bottom dwellers tend to be slower and flatter.

BETHNOS

Consists mostly of invertebrates that burrow into the sand or shelter in crevices or attach themselves to rocks. They fee don scraps that float down from the top layers or decaying matter.



ZONES OF THE DEEP
Sunlight
Flying fish
Seaweed
Diatoms
PHYTOPLANKTON
Corepods
Medusae
Herring-like fishes
Porpoise
Blue whale
Seal
Krill
ZOOPLANKTON
LITTORAL
BETHNIC ZONE
Flagellates
Crab larvae
Mackeral
Bonito
Tuna
Pteropods
Salps
Squid
Toothed shark
Heteropods
Ctenophores
Lantern fish
Swordfish
NEKTON
Chaetognaths
Hatchet fish
Sperm whale
Large squid
Octopus
Worms
Scarlet prawns
Sablefish
Viperfish
Anglerfish
Anglerfish
Swallowers
Arctic shark
Gulper
Squid
Tripod fish
Crinoids
Lamp shells
Sponges
Brittlestars
Upwellings of nutrients
SUNLIT OR PHOTIC
TWILIGHT
MIDNIGHT
BETHNIC ZONE
PELAGIC ZONE

WORKSHEET 27

Name: _____
Date: _____

OCEAN DEEP PARTY

To _____

You are invited to a _____ party.

Time _____

Date _____

Menu _____

_____

_____

_____

_____

Other guests _____

_____

_____

_____

_____

What to wear _____

_____

_____

Games & entertainment _____

_____

_____

_____

_____

B.Y.O. _____

_____

_____

_____

WORKSHEET 28

Name: _____

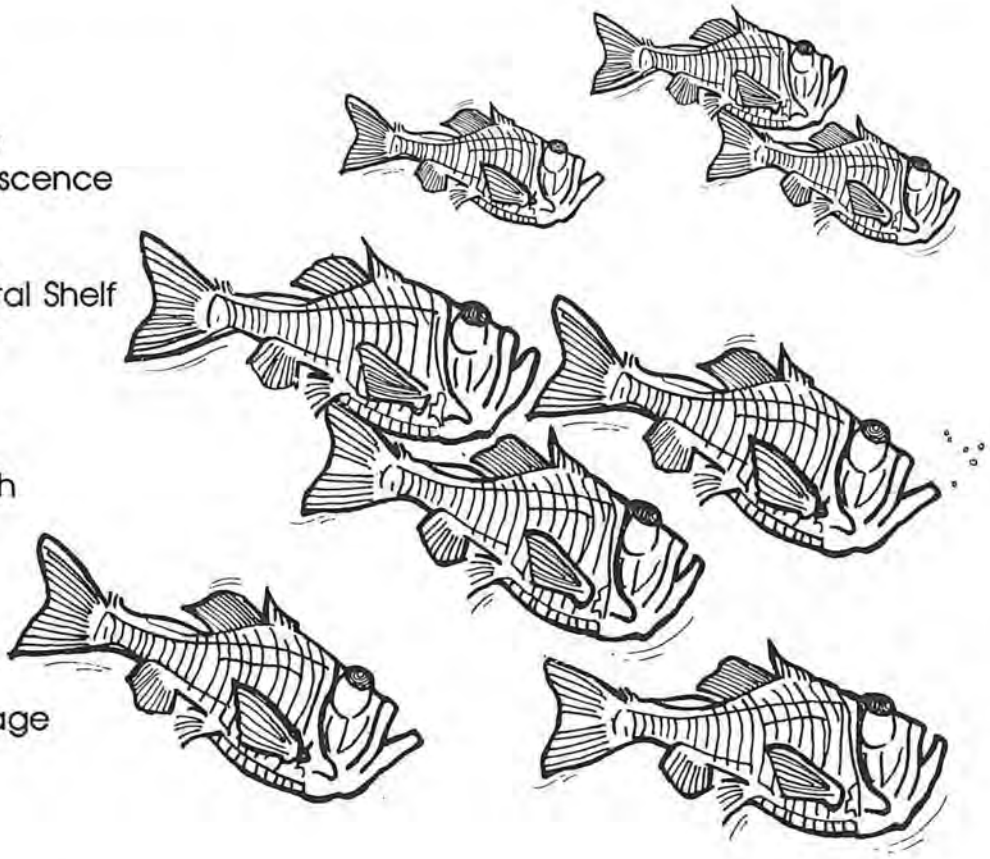
Date: _____

WORD SLEUTH OF THE DEEP

N	P	R	E	D	A	T	O	R	M	P	O	M	O	G	U
I	Y	P	J	O	A	N	G	L	E	R	F	I	S	H	G
S	O	E	S	P	M	G	O	G	U	L	P	E	R	L	I
U	M	O	G	I	O	U	A	S	G	W	S	O	K	T	M
O	S	U	E	R	P	L	A	N	K	T	O	N	E	R	P
N	O	M	P	T	F	E	P	R	E	S	S	U	R	E	L
I	S	S	G	U	G	L	E	S	E	D	I	M	E	N	T
M	P	H	O	T	I	C	U	B	E	T	H	N	I	C	O
U	O	M	U	W	M	V	I	P	E	R	E	U	E	H	L
L	A	N	T	E	R	N	F	I	S	H	P	M	P	O	W
C	O	N	T	I	N	E	N	T	A	L	S	H	E	L	F
O	B	I	O	L	U	M	I	N	E	S	C	E	N	C	E

ANSWERS:

1. Anglerfish
2. Bioluminescence
3. Plankton
4. Luminous
5. Continental Shelf
6. Sediment
7. Trench
8. Predator
9. Pressure
10. Lanternfish
11. Viper
12. Gulper
13. Bethnic
14. Photic
15. Tripod
16. Camouflage



Why is the Sea Salty?

The students will examine reasons why the sea is salty and experiment with the properties of salt.

CONCEPTS

- Salt water is denser than fresh water, thus allowing plants and animals greater buoyancy in the ocean.
- Sea water is composed of a variety of salts and minerals which are used by marine organisms in a variety of ways including building stronger shells.
- Salinity varies from ocean to ocean around the world.

OBJECTIVES

Students will be able to:

- understand where the salt in the ocean comes from,
- determine some of the properties of salt water.

VALUES

- To understand the importance of human care in rubbish disposal, pouring substances into the sink and using fertilisers, because they eventually end up in the ocean and cause an imbalance in the ecology.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	7	Matter	Testing selected properties of solids, liquids and gases.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Working Scientifically	4.3 Draws conclusions linked to the information gathered and the purposes of the investigation.
Science	Natural and Processed Materials	3.17 Makes connections between the structure of common materials and their properties.

BACKGROUND INFORMATION

The chemical composition of sea water is important to scientists to help determine why some areas of the oceans are more productive than others (e.g. in producing more fish and prawns). Seawater provides food for microscopic animals and for seaweeds which only have holdfasts and do not absorb nutrients from the soil. Sea water provides oxygen for marine life.

Sea water contains about three per cent of sodium chloride (common salt). The body fluids of marine invertebrates is about the same whereas land animals have about half that amount.

Sea water contains a number of other chemicals, such as magnesium, calcium sulphur and potassium.

The amount of salt in the ocean (salinity) varies from place to place.

Many of the salts in the ocean come from the land. As rocks break down they release chemicals which are washed into the oceans via rivers and streams. Water running off the land brings with it dissolved salts and chemicals, as well as effluent.

Chemicals are also released by undersea volcanoes and springs.

Evaporation, precipitation (rainfall) and temperature affect the oceans' salinity, making them differ in their levels of salinity.

In hotter regions, evaporation removes the fresh water leaving a higher concentration of salt in the oceans. Areas of high precipitation return fresh water to the ocean, which dilutes the salt concentration. Fresh water, from rivers also lowers the level of salinity in oceans.

Salt that comes from evaporated sea water is called sea salt and is produced commercially from a series of evaporation ponds.

Marine life use calcium, silicon and phosphates from the sea water to produce their shells and skeletons, and to build cellular tissue.

Salt makes water heavier than fresh water. This makes it easier for marine plants and animals, such as jellyfish, whales and microorganisms, to float.

KEY WORDS

salinity, buoyancy, evaporation, precipitation, solution, solubility.

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TEACHER DIRECTION

Materials

see individual experiments

LESSON OUTLINE

- Discuss sea water properties such as the salt in water allowing for greater buoyancy which helps whales and jellyfish float, how the salt comes from the land and how marine organisms utilise these properties for their survival.

NB. The following experiments can be done as a rotational activity or all together.

Expt 1: Salt solution - *This evaporation process shows how rock pools that dry out show salt remains and how salt is collected commercially.*

Materials

Salt
Water
Jar or beaker
Saucer

Fill a jar or beaker with water. Dissolve as much salt as possible. Pour the saturated solution into a saucer and place in a warm, dry place in the water for a few days. Observe and record results each day. Discuss what is happening and why.

(Each day the water evaporates until only salt crystals are left.)

Expt 2: Buoyancy - *This experiment demonstrates how the marine plants and animals are aided in their movements by the salt water.*

Materials:

Salt
Water
Jars or beakers (4)
Petri dish or saucer
Eggs (2) or plasticine
Eye dropper

Fill two glass jars with water. Place three tablespoons of salt in one of the jars and stir until all the salt has dissolved.

Place an egg into the unsalted jar of water and observe what happens. (It will sink).

Place an egg into the salted jar and observe what happens. (It will float).

(Salt water is denser than fresh water, thus allowing marine plants and animals to be more buoyant.)

Expt 3: The Salty Sea - *This experiment demonstrates how saltier water is denser than fresher water and will sink more, thus showing that fresher river water flowing into the ocean will remain near the surface.*

Materials:

Jars (5)
Food colouring
Eye droppers
Salt
Scale

Dissolve 35 g of salt in 1 lt of water (sea solution).

Pour a cup of salt water solution into two of the jars and label them A & B.

Add an extra teaspoon of salt to solution A and stir.

Pour 1/4 cup of solution A into another jar and label the new jar C. Add 4 to 5 drops of food colouring to jar C.

Pour 4 cm of solution B into another jar and label it D, then add 20 drops of solution C into the jar. Observe what happens as the coloured extra salty solution drips into less salty water.

Now pour 1/4 cup of solution B into another jar and add 4 to 5 drops of food colouring and stir. Label this jar E.

Pour 4 cm of solution A into a jar, drop 20 drops of solution D into the jar. Observe what happens as less salty water drips into extra salty water.

Expt. 4: The Ocean Currents - *This experiment demonstrates how denser colder, saltier water will flow underneath other normal water. Similarly, the colder waters of the polar regions sink and flow towards the warmer Equator. These cold currents are important to the oceans' circulation.*

Materials:

Water
One clear, flat dish
Salt water solution
Ice cube tray
Freezer
Food colouring
Lukewarm tap water
One jar

Add 5 drops of food colouring into a jar of salt water solution and stir well. Fill four compartments in an ice cube tray with the coloured solution and freeze.

Fill the clear tray with lukewarm tap water. Line the four ice cubes along one end of the tray. You may need to hold them to stop them floating away.

Observe what happens as the ice melts. Look from all angles. Explain why you think this happens. Predict what might happen in colder areas of the ocean.

EVALUATION

- Were the students able to conduct the experiments successfully, and observe and record their findings?
- Were the students able to extrapolate from the experiments to the real world?

COMPLEMENTARY ACTIVITIES

Design your own experiment to demonstrate other properties of salt water .

Produce a cartoon demonstrating the properties of salt in the ocean.

Investigate the causes of the saltiness of Hamelin Pool (Shark Bay), and how this affects the marine life, including stromatolites (with few predators).

Produce a chart of the Water Cycle and how this relates to the seawater.

Grow your own salt crystals and examine them under a microscope .

Exploring Coastal Waters

Touching Wonders

Students are introduced to the marine environment through the interactive medium of a touch pool. They discover, first hand, the wonders of the marine world in the comfort and safety of the beach. Touching Wonders is an excellent activity to bring together all the concepts of the package.

CONCEPTS

- A large range of organisms have evolved in the marine environment.
- Each organism has developed special adaptations.
- Ocean currents assist in distributing organisms and populating areas.

OBJECTIVES

Students will be able to:

- recognise some of the inhabitants of the marine environment
- identify some of the adaptations developed by marine organisms to survive in their environment.

VALUES

- Students will appreciate the diversity of and special adaptations developed by marine organisms.

CURRICULUM LINKS

CURRICULUM AREAS	STAGE / YEAR	NUMBER / STRAND	UNDERSTANDINGS / TOPICS
Science	5	Plants	Investigating plants which do not reproduce by seeds.
	6	Animals	Investigating the responses of animals to their environment.
	7	Plants/Animals	Investigating animal/plant interdependence.

STUDENT OUTCOME STATEMENT LINKS

PROFILE	STRAND	LEVEL
Science	Energy and Change	4.11 Identifies processes of energy transfer and conditions that affect them.
	Life and Living	3.13 Maps relationships between living things in a habitat.
		4.13 Identifies events that affect balance in an ecosystem.

BACKGROUND INFORMATION

The touch pool is a window to the marine environment. It provides an opportunity for discussion about marine ecology, conservation and the diversity of species beneath the waves. It brings the marine environment to the student and encourages further and careful exploration.

Each organism has its special story. Much of this information can be found in the Resource Notes attached to the previous activities.

Some topics for discussion at the touch pool may include:

1. **Ecology**

   (See 'Hopping Rock Pools', 'Seagrass Forests', and 'A Happy Family' for further development of the concept).

(a) Ecosystems
The concept of organisms interacting with each other and their environment in a defined space, such as a rock pool, reef etc.

(b) Energy Flow
Energy flows through the food chain. It is a one-way flow—energy is not recycled in the same way as nutrients. Solar energy is utilised by green plants and this energy is passed on to herbivores and carnivores along the food chain.

Between each link of the food chain, energy is lost, so a far greater mass of living organisms of lower level producers/consumers is required to support fewer higher level consumers.

(c) Evolution
The survival and development of species through adaptations and natural selection (eg. sea urchin spines, camouflage of some fish, algae holdfasts, octopus ink).

(See 'Rocky Shore Safari', Creature Feature', Depths of the Ocean', What's that Shell?', and 'See Birds', for more ideas.)

(d) People and the Marine Environment
Many people value the marine environment for its recreational uses or consumable resources (fish, minerals). However, it is also regarded by some as a dumping ground for wastes. As co-inhabitants of the earth, we have a responsibility to ensure the conservation of this resource. (See 'Role Coasting', Seagrass Forests', 'Conservation Code', for ideas for discussion.)

2. Some Common Marine Inhabitants

Resource Notes throughout the package will provide useful information. Some discussion points may include:

(a) Sponges
The most primitive of animals consisting of an inner and outer layer of cells supported by a skeleton of spicules — the latter is what you find washed up on the beach.

Some sponges are capable of regenerating from a tiny piece of the original sponge and will reform if broken up.

Sponges do not have a nervous system. Most reproduce both sexually and asexually.

(b) Corals, sea anemones, jellyfish
These organisms essentially consist of a mouth surrounded by tentacles.

The tentacles contain special stinging cells (nematocysts), which are activated on contact with their prey.

(c) Marine worms
These worms have a segmented body with a pair of paddle-like extensions. They generally live inside burrows or tubes and filter their food from passing currents.

(d) Starfish, sea urchins, sea cucumbers
The bodies of these organisms are radially symmetrical with tubed feet for movement and gas exchange.

Starfish feed by prying open shellfish with their arms, dropping out their stomachs onto the flesh, digesting the food, then returning their stomachs through their mouths.

Sea urchins use their sharp beaks to scrape algae off the reefs. They often scrape themselves into the rock and are difficult to dislodge.

Sea cucumbers ingest sand, digest the food then expel ribbons of sand excreta. Some species spit sticky white threads over potential predators to dissuade their advances. They will also throw out their stomachs for predators to eat while they make their escape and regrow their internal organs.

(e) Molluscs
Common marine animals with a hard shell and a muscular foot for anchorage and movement. Examples include chitons, mussels, abalone, squid, octopus and nudibranchs.

(f) Sea squirts
These animals are often mistaken for plants, but are, in fact, ancestors of humans. In their larval stages, they are free swimming with a rudimentary brain, eye spot and the beginnings of a backbone. After a short time, they attach themselves head first onto something solid. They are filter feeders.

KEY WORDS

marine ecology, conservation, diversity, organism, ecosystem, evolution, energy flow, spicules, asexually, segmented, symmetric, radially, molluscs.

REFERENCES

Dakin, W.J. and Bennett I, (1992) *Australian Seashores.* Collins, Angus & Robertson Pty Ltd. NSW

TEACHER DIRECTIONS

Materials:

Shovel
Large waterproof sheet (minimum size 5m x 5m)
Plastic buckets (2)
Beach umbrella
Catch bag
Snorkel set (ie. mask, snorkel, fins, dive knife)
Pair of gloves

LESSON OUTLINE

Pool Construction
Choose a relatively flat and deep sandy site, well above the high water mark, but close to the collection area.

(Remember: no specimens may be taken from Sanctuary Zones. Talk to CALM staff before conducting the activity in a marine park.)

Dig out a hole of about 3m x 3m x 0.4m deep (for a 5m x 5m sheet) and line with sheeting. Allow a 1m overhang of the sheet at the edge of the hole. Secure the edges with sand.

Three quarters fill the hole with sea water.

Shade area with the beach umbrella.

Collect any shells or traces of marine life that have been washed up on the beach.

Specimen Collection

Always wear gloves and collect specimens in catch bags - many marine organisms have efficient self-defence mechanisms.

Collect a number of organisms from the chosen area. Include seagrass (with roots), algae (complete with holdfast) and a selection of the more common animals.

Investigate areas under overhangs and ledges, check in shells and crevices, and follow tracks in the sand to find some of the more secretive species. Remove carefully by hand or by gentle use of the diving knife. A fine scoop net, made from a stocking stretched over a coat hanger, will enable you to collect some of the smaller, free-swimming organisms.

Ensure you remember the type of habitat from which each organism was collected so that they can be returned.

Transfer all specimens to the touch pool as quickly as possible.

Segregate any organisms with potential safety hazards (for example some of the 'slimy' sponges have glass-like spicules which cause irritation). These species may be discussed, but should not be handled by the students. Ensure there are no associated hazards — blue ringed octopus sheltering inside shells etc.

Touch Pool Activity

Group the students around the touch pool, ensuring all can see and hear. Make sure they are adequately protected from the sun.

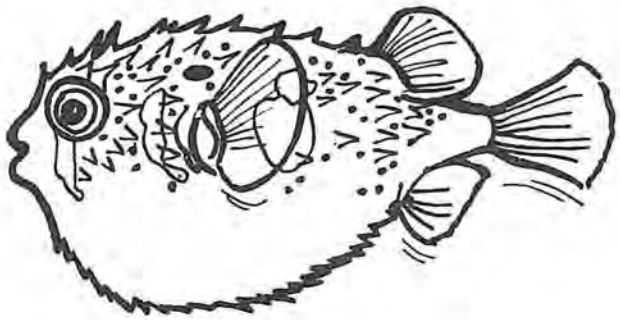
Discussions can centre around any of the topics outlined in the 'Background Notes'.

Pass around the 'safe' organisms for closer study. Specimens may be augmented by shells and other items previously found on the beach.

On completion, return all organisms to appropriate areas.

EVALUATION

- Were the students able to recognise the adaptations of the organisms collected?
- Were students aware of the biodiversity of rock pools?



COMPLEMENTARY ACTIVITIES

Take the students for a snorkel in the area where the specimens were collected. See if they can discover more or different organisms.

Allocate groups to a particular species and ask them to investigate what's different or special about the species.

Working in buddy pairs close to shore, the students can develop a 'snorkel nature trail' or a 'mini marine park' and write up a brochure to describe its features.

Reef Walker

START

WHAT YOU NEED
Some dice - one will do.
Shells of different shapes or colours - one for each player.

REMEMBER
When you land on a crab - choose a habitat.
Team mate to pick up a card and ask you a question from that habitat.
A correct answer will earn you another turn.

WINNER

Remembered to Slip, Slop, Slap, Wrap - and to wear shoes. Move on 5.

Cut through dunes. Miss a turn.

Used path through dunes to save plants. Move on 4.

Discovered a fossil. Move ahead 3.

Picked up a shell. Blue ringed octopus inside! Miss a turn.

Get pricked by a sea urchin - go back 2.

Run ahead 2 spaces to avoid waves crashing on reef.

Tasted the sea lettuce. Move on 4.

Discovered a crab - despite its camouflage. Move on 4.

Pulled off an alga from rock pool - food for limpet. Go back 3

Watched Dog Whelk eating a limpet. Go ahead 2 spaces.

Pulled a bag of rubbish from the water. Move on 3.

Boat motor leaking oil. Miss a turn to fix it.

See a single fin - panic! Go back 5.

Spotted some whales breaching. Move ahead 3.

Dropped anchor into seagrass. Go back 5.

Noticed seagrass tangled in propeller. Go back 5.

Rowed back to shore to protect seagrass. Move ahead 3.

Discovered heaps of tiny fish in seagrass. Move on 3.

CARDS

(Questions)

Limestone Reefs
Why has the government put catching limits on abalone and crayfish?

To protect the species so they are not fished out

Sandy Beaches
Are summer or winter waves more destructive?

Winter

Seagrass Meadows
What do decomposers do? An example?

Break down organic compounds - eg. bacteria, fungi

The Deep
The most luminous fish in the ocean is called ....?

The lantern fish

(Answers)

(Questions)

Limestone Reefs
Is a sea anemone a plant or an animal?

Animal

Sandy Beaches
What is 'persistent rubbish'?

Takes many years to break down

Seagrass Meadows
Do seagrasses flower?

Yes

The Deep
What is the largest animal on Earth?

The blue whale

(Answers)

(Questions)

Limestone Reefs
What are two reasons for some reef creatures to have a shell?

Protection, reduce water loss

Sandy Beaches
Which species of birds found on the coast has a hierarchy of dominance?

Silver gulls

Seagrass Meadows
Does seagrass grow in shallow or deep water?

Shallow

The Deep
Why do whales migrate?

Breeding and feeding

(Answers)

(Questions)

Limestone Reefs
How do starfish digest their food?

Prise shell apart with its arms, plop out stomach onto flesh, digest, return stomach through mouth

Sandy Beaches
What is a bivalve?

A shell made up of two hinged parts.

Seagrass Meadows
Seagrasses have roots, what do seaweeds have?

Holdfasts

The Deep
Which animals led sailors to believe in mermaids?

The sea cow or dugong

(Answers)

(Questions)

Limestone Reefs
What state government department is responsible for managing WA's marine parks?

Conservation & Land Management

Sandy Beaches
How are most waves formed?

By the wind moving over the surface of the water

Seagrass Meadows
How does algae kill seagrass?

Algae grows on the leaves of the seagrass and prevents it from getting sunlight

The Deep
There is no light in the bottom or bethnic layer of the ocean. Where do the animals get their food?

Material from the upper layers falling to the bottom

(Answers)

(Questions)

Limestone Reefs
What are the strong muscular feet of molluscs used for?

To hold them securely to the reef or rock

Sandy Beaches
Name three harmful effects plastics can have on marine wildlife.

Animals become entangled, strangled, suffocated, drowned, or starve if they ingest it

Seagrass Meadows
What are 'producers'?

Organisms that make their own food using the Sun's energy

The Deep
What is 'echo location'?

The way dolphins and whales communicate and navigate

(Answers)

(Questions)

Limestone Reefs
What is a carnivore?

A meat eating plant or animal

Sandy Beaches
What is the adaptation bird's feet have for a water environment?

They are webbed

Seagrass Meadows
Which shell creature breeds in seagrass?

Prawns, crabs

The Deep
The rock platform that surrounds the continent is called .....?

The Continental Shelf

(Answers)

(Questions)

Limestone Reefs
What is conservation?

Caring for and preserving our environment

Sandy Beaches
What will give a good indication of the type of food a bird eats?

The shape of its beak

Seagrass Meadows
Omnivores eat what?

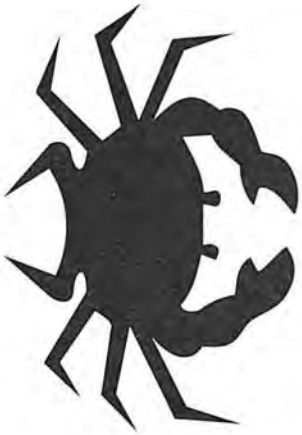
Plants and animals

The Deep
What percentage of the Earth is covered by water?

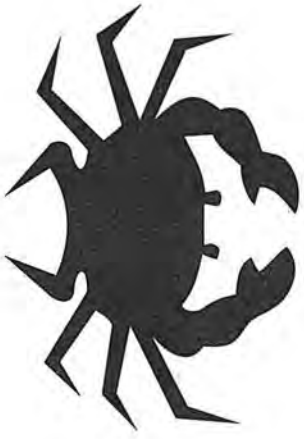
72%

(Answers)







(Questions)

Limestone Reefs
What harmful impacts can people have on the marine environment?

Over-fishing, 4WDiving on the dunes, rubbish, pollution down drains to sea, etc

Sandy Beaches
Clams, scallops and oysters belong to which group of shells?

Bivalves

Seagrass Meadows
How do nudibranchs disguise themselves?

They blend in with pebbles and the sand

The Deep
Animals of the depths use their eyes to see - true or false?

False

(Answers)

(Questions)

Limestone Reefs
What is an ecosystem?

Community of animals and plants living together in a certain area

Sandy Beaches
What is the main difference between gastropods and bivalves?

Gastropods - one shell, bivalves - two shells

Seagrass Meadows
What natural process can damage seagrass meadows?

Storms

The Deep
What is the temperature at the bottom of the ocean?

Near freezing

(Answers)

(Questions)

Limestone Reefs
What do limpets feed upon?

Algae

Sandy Beaches
What is a 'constructive' wave?

One that deposits sand on the beach

Seagrass Meadows
What country has the largest expanses of seagrass meadows?

Australia

The Deep
Name two mythical sea creatures.

Mermaids, Loch Ness monster, kraken, sirens, sea serpents

(Answers)

(Questions)

Limestone Reefs
What is a 'food chain'?

Shows feeding relationships between living organisms within an ecosystem

Sandy Beaches
Which water bird does not have waterproof wings?

The cormorant

Seagrass Meadows
What two parts of a boat can destroy seagrass meadows?

The propeller, the anchor and anchor chain

The Deep
The ocean is divided into two main layers - the pelagic and the ....?

Bathnic

(Answers)

(Questions)

Limestone Reefs
Is a coral a plant or an animal?

Animal

Sandy Beaches
Name two sources of rubbish found on the beach.

Domestic (homes), fishing industry

Seagrass Meadows
What is the ooze at the bottom of the ocean called?

Detritus

The Deep
How do pollutants from far out at sea, reach the beach?

Ocean currents, tides

(Answers)

(Questions)

Limestone Reefs
What is a 'herbivore'?

A creature that eats plants

Sandy Beaches
Abalone, periwinkles, and whelks belong to which group of shells?

Gastropods or univalves

Seagrass Meadows
What are the three colours of seaweed?

Brown, red, green

The Deep
Which is denser, salt or fresh water?

Salt water

(Answers)

(Questions)

Limestone Reefs
How many pairs of legs does a crab have?

Five

Sandy Beaches
What is a 'destructive' wave?

One that erodes sand from the beach

Seagrass Meadows
Few animals actually feed on the leaves of seagrass - true or false?

True

The Deep
The floor of the ocean is called ....?

The abyssal plain

(Answers)

(Questions)

Limestone Reefs
Is a sponge an animal or a plant?

A colony of primitive animals

Sandy Beaches
Why is vegetation important on sand dunes?

Holds sand in place, preventing it from being blown or washed away

Seagrass Meadows
What is the origin of excessive nutrients in the ocean?

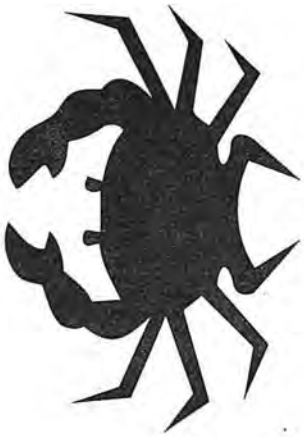
Fertilisers, sewage, pollutants washed down drains

The Deep
How do fish adapt to changes in water pressure?

Increasing the amount of air in their swim bladders

(Answers)








(Questions)

Limestone Reefs

Sandy Beaches

Seagrass Meadows

The Deep

(Answers)

(Questions)

Limestone Reefs

Sandy Beaches

Seagrass Meadows

The Deep

(Answers)

(Questions)

Limestone Reefs

Name two non-living parts of our environment which are essential for life ...

Air, water, sunlight

Sandy Beaches

How do reefs protect beaches?

Stop destructive waves from reaching the beach. Form a barrier where such waves can dissipate their energy

Seagrass Meadows

Name three things that make seagrass meadows important

Nurseries for juvenile fish, stabilise sand, form detritus which a number of species depend upon

The Deep

The .... fish has a lure at the top of its head to attract prey?

Angler

(Answers)

(Questions)

Limestone Reefs

Detrivores break down what sort of organic matter?

Dead

Sandy Beaches

What is beach sand made from?

Rocks, marine skeletal material

Seagrass Meadows

What would happen to the sand if seagrass meadows weren't there?

Be eroded away by waves, storms and currents

The Deep

What is the name for the tiny plants and animals that drift in the surface layer of the ocean?

Plankton

(Answers)

(Questions)

Limestone Reefs

Sandy Beaches

Seagrass Meadows

The Deep

(Answers)

(Questions)

Limestone Reefs

Sandy Beaches

Seagrass Meadows

The Deep

(Answers)

(Questions)

Limestone Reefs

Are periwinkles molluscs?

Yes

Sandy Beaches

What is a man-made structure which affects coastal erosion?

A groyne

Seagrass Meadows

Where is Cockburn Sound?

Western Australia

The Deep

What do people use the oceans for?

Recreation, transport, food

(Answers)

(Questions)

Limestone Reefs

For how many years can a sea urchin live?

Ten

Sandy Beaches

If a Silver gull is in a 'forward posture' position, what does it probably mean?

Submission

Seagrass Meadows

What is kelp?

Brown seaweed

The Deep

What are the two main categories of whales?

Toothed, and Baleen whales

(Answers)








GLOSSARY

adaptations: any characteristics that an organism has evolved to make it particularly suitable to survive and thrive in its environment

algae: aquatic photosynthetic plants which reproduce by spores.

anterior: the front of an animal or shell

aperture: the opening of a gastropod shell through which the animal emerges

autotrophs: an organism which can manufacture its organic constituents from inorganic materials (eg. most chlorophyll-containing plants manufacture organic materials from water, CO_2, nitrates, etc).

biodegradable: capable of decomposing by the action of living organisms esp. bacteria

bioluminescence: production of light by living organisms

bivalve: animal with a shell in two parts hinged together

buoyancy: keeps organism afloat

calcium carbonate: chemical compound. Is a major component of limestone

camouflage: the means by which any creature renders itself indistinguishable from its background assuming the colour, shape or texture of objects in that background

carnivore /ous: flesh eating

cetacean: an order of placental mammals which includes whales, dolphins, porpoises.

chairperson: one who presides

chlorophyll: green pigment found in most algae and higher plants. Responsible for light capture in photosynthesis

code: collection of rules

conflict: antagonism, as of interests or principles

conservation: the act of keeping unimpaired esp. natural resources

consumers: one which uses, esp. devours

cooperation: acting together

current: a portion of a large body of water moving in a certain direction

decay: rot

decline: to deteriorate

decomposers: disintegrators

density: closely set or crowded condition

detritivore: organism which consumes detritus

detritus: any disintegrated material

diorama: a miniature scene produced in three dimensions

dredging: to remove sand, silt, mud from the bottom of

dugong: an aquatic herbivorous mammal found in the tropical coastal areas of the Indian Ocean. Has front limbs adapted as flippers, no hind limbs and a horizontal lobed tail

echolocation: determination of the position of objects by detecting the reflection from them of sounds produced by the animal

ecology: study of the relations of animals and plants communities to their surroundings animate and inanimate

ecosystem: a community of organisms interacting with one another plus the environment in which they live and with which they also interact

effluent: liquid industrial waste

emissions: giving off or out (of radiation, heat, smell, noise, fluid, from body, etc)

environment: biological conditions in which an organism lives esp. a balanced system

epiphyte: a plant which grows on another but which does not get food, water or minerals from it

equivalve: bivalves where the two shell valves are of equal size

erosion: the process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc

evaporation: the giving off of vapour

gastropod: class of Mollusca, including snails, slugs, sea hares. Often a single shell (univalve)

globus: rounded

groyne: a small jetty built out into the sea in order to prevent erosion of the beach or bank

habitat: the native environment where a given animal or plant naturally lives or grows

headland: a prominatory extending into the sea

herbivore: plant eating animal

hermaphrodite: an animal or plant having normally both the male and female organs of the generation

heterotrophs: an organism requiring a supply of organic material (food) from its environment. All animals and fungi are heterotrophs

hinge: the movable joint on which a door, lid, etc. turns or moves

histogram: diagram in which columns represent frequencies of various ranges of values of a quantity

holdfast: an anchoring device which strongly holds seaweeds to rocks

industrialisation: introduction of industry into an area on a large scale

inequilateral: bivalve shells where the umbo is not in the centre of the shell

intertidal: the region of the shoreline between high and low water marks

invertebrates: without a backbone

kraken: mythical giant squid or octopus

leach: to remove soluble constituents from by percolation

lichens: fungi in symbiotic union with algae having vegetative body

limestone: a rock consisting wholly or chiefly of calcium carbonate originating principally from the calcareous remains of organisms

marine: of or pertaining to the sea

microbe: a germ

migration: the act of passing periodically from one region to another

mineral: neither animal nor vegetable, inorganic

millennium: thousand year period

mobility: the act of being moveable

mollusc: any invertebrate of the phylum Mollusca, characterised by a calcareous shell (sometimes lacking) of one two or more pieces that wholly or partially enclose the soft, unsegmented body, includes chitons, squids, octopuses

mythical: supernatural

nitrogen: colourless, odourless gas that makes up about four fifths of the volume of the atmosphere and is present in animal and vegetable tissues (chiefly in proteins)

omnivore: organism which eats all kinds of foods indiscriminately

operculum: the trapdoor of a gastropod shell which seals the aperture when the animal withdraws. It may be either calcified or horny

organism: any form of animal or plant life

orbicular: circular

ovate: egg-shaped

periwinkle: any of the various marine gastropods or sea snails used for food

phosphate: a salt or ester of phosphoric acid. *agric.* a fertiliser containing compounds of

phosphorus: non-metallic element existing in allotropic forms, incl. a yellowish waxlike substance undergoing slow combustion at ordinary temperatures and hence appearing luminous in the dark

photodegradable: breaks down in light

photosynthesis: the synthesis of complex organic materials by plants from carbon dioxide, water, and inorganic salts using sunlight as the source of energy and with the aid with a catalyst such as chlorophyll

phytoplankton: plants of plankton

pledge: a solemn promise to do or refrain from doing something

point: a tapering extremity, as a cape

pollutants/pollution: something that makes the environment unclean

precipitation: the falling of products of condensation from a state of vapour in the atmosphere (rain, hail, snow, etc)

predator: organism which preys on another animal

producers: organisms which can convert the energy of the sun to readily useable forms

productivity: fertility

profile: a vertical section (eg of a soil or rock face)

reclamation: the bringing of (wild, waste, or marshy land) into a condition suitable for cultivation or other use

recolonisation: the replanting or re-establishment of a colony

resolution: solution or explanation of a problem, a doubtful point, etc.

salinity: the salt content of

seagrass: any of various marine plants of the genus Zostera of temperate seas having long strap-like leaves

seaweed: any plant or plants growing in the ocean esp. marine algae

sediment: matter which settles to the bottom of a liquid

sedimentary: set down in layers (as in sedimentary rock)

sirens: mythical creatures with upper body of a woman and the lower body of a bird or fish. Their singing would lure sailors to their deaths

solubility: capability of being dissolved

solution: dissolved state

species: the basic category of biological classification, intended to designate a single kind of animal or plant

spire: in gastropods, all of the shell above the body whorl

sponge: any of a group of aquatic (usually marine) animals which are characterised by a porous structure and usually a horny, sandy or calcareous skeleton or framework and which except in the larval state are fixed occurring in large complex often plant-like colonies

subtidal: the region of a shoreline below the lowest level reached at low tide

toxic: poisonous

transect: line or belt of vegetation etc selected for charting plants and animals

trench: a deep furrow

umbo: the curved dorsal (back) peak of a bivalve. This is the original part of the shell

valve: a part of the shell. There is one valve in gastropods and two in bivalves

KEY PHRASES:

active fish eaters: are larger fish like bream that are constantly active in their search for smaller fish and invertebrates. They are often caught for food by people.

at rest: (with gulls) resting, not displaying any special behaviour

coastal erosion: the wearing away of the coast by wind and wave action

community group: a group of people from within a community sharing a particular interest

constructive waves: waves that deposit sand on the beach

continental shelf: that part of a continent submerged under relatively shallow sea

continental slope: relatively steep, separates the continental shelf from the deep ocean basins

deposit feeders: generally burrowing animals, like small crabs that feed on detritus

destructive waves: waves that erode sand from the beach

dog whelk: carnivorous mollusc with thick shell and rasping tongue that can drill holes in the shells of prey

food chain: chain of organisms existing in any natural community through which energy is transferred

food web: all the food chains in a community make up the food web

forward posture: common silver gull behaviour signalling submission, head dropped, bill up

grass pulling: common silver gull behaviour possibly signalling territory

grass stabbing: as with 'grass pulling' above

hunched threat: common silver gull threatening behaviour. Bird makes quick walking movements at other birds

larval stages: the immature form

life cycle: progressive series of changes undergone by an organism

Loch Ness monster: mythical serpent-type monster living in Loch McNess in Scotland

mineral sands: used in the production of vast range of materials - from paper, cosmetics, and textiles to rubber and plastics. Grains of weathered rock washed to sea then deposited on pre-historic beaches up to two million years ago

muscular foot: a muscular foot of molluscs that hold them securely onto rocks

net fishing: fishing with a net. Regulations apply.

oblique threat posture: common gull threat behaviour, head down, neck stretched up

rock crab: a small red and blue crab found in rocks in the intertidal zone

sea anemone: soft bodied relative of coral and jellyfish. Looks like flower

sea cucumber: soft, sausage shaped animal which feeds on nutrients in the sand

sea lettuce: bright green, flat leaved alga

sea slug: sea snails without shells. Have frilly gills on back which are retracted when in danger

sea star: animal has five or more hollow arms with rows of tube feet. A whole animal will grow from a severed arm.

sea urchin: animal related to star fish. Round slightly flattened body with chalky spines

suspension feeders: feed on floating materials, usually plankton and detritus. Examples include mussels, barnacles, sponges and tube worms.

VIDEO LIST

VIDEOS FROM THE STATE FILM LIBRARY OF WESTERN AUSTRALIA

The State Film and Video Library has an excellent range of videos including many relevant to these activities. The videos are listed under subject headings for your convenience.

Your school should be a member of the State Film and Video Library, but if you need more information, please use the following contact numbers;

Telephone: (09) 427 3159
Fax: (09) 427 3256

MARINE LIFE

The Living Planet: a portrait of the earth (parts 10-12)
Bristol, England, 1984 165 mins BRN 238 923

Pt. 11. 70% of the earth's surface is covered by ocean, the food chains and evolution of its creatures are featured.

Nature of Australia: a portrait of the island continent.
Ep 2, Seas Under Capricorn
Melbourne, 1988. 55 mins. BRN 583 213

This program focuses on the development of the seas and marine life from Gondwanaland to today - includes camouflage, feeding grounds, predators, possible dangers, and underwater beauty.

The Living Planet: a portrait of the Earth (parts 7-9)
Bristol, England, 1984. 165 mins. BRN 238 021

Pt 9. Life between the tides and other aspects of coastal ecology are examined.

The Sharks
US. 1982. 59 mins BRN 477 694

Observing sharks around the world, this program offers facts about the anatomy, behaviour and vulnerability to people.

Whales
New Zealand 1987 47 mins BRN 569 111

"Whales" weave together spectacular and rare footage of these magnificent animals with stories of people who prey on them and the struggle to protect them.

Sea Creatures
WA 12 mins District Audio Visual

No commentary. Displays a variety of marine animals and feeding, movement, camouflage, relationships and adaptations to their environment.

Dive to Midnight Waters
London, 1986. 28 mins. BRN 608 232

A team of biologists demonstrate how underwater animals and plants are observed, and collected for further study. Filmed in California.

Beneath the Keel
Bristol, 1984. 47 mins. BRN 533 105

Two underwater enthusiasts go on a diving expedition along the south west coast of the English Channel. Their exploration reveals a world of exotic beauty and fascinating marine life.

Sea Lovers
Australia, 1983. 48 mins. BRN 223 530

Ron and Valerie Taylor, a well known film making team, have produced this program showing footage of a Great White Shark in its natural habitat to their most recent experiments with a chain mail suit.

Kingdom of the Crabs
London, c1987 30 mins. BRN 620 181

Christmas Island has the unique phenomenon of hundreds of millions of crabs, most of which are land crabs. Their annual trip to the sea and their mating habits are described as well as the march of millions back to the jungle.

The Fastest Claw in the West
Bristol, 1985. 25 mins BRN 532 321

Narrated by David Attenborough, looks at the mantis shrimp, a little known crustacean that looks like a praying mantis insect and lives in the coral beaches of Hawaii.

Seabirds
England, 1981. 29 mins. BRN 548 487

Fascinating study of how the hundreds of thousands of birds that throng the British coats in the breeding season have adopted to master the problems of life in their uncompromising environment.

CORAL REEFS

Ribbon of Life: One Man's Reef
Australia c1981 49 mins. BRN 561 908

The Great Barrier Reef is the richest place on earth in terms of diversity of life forms. In this program a marine biologist shows how the corals grow and how the reef is a vast growing system.

The Reef
Melbourne, 1987. 50 mins. BRN 616 912

The Great Barrier Reef is one of the natural wonders of the world. An underwater cameraman captures the coral formations and the wide variety of fish and wildlife in the area.

Coral Reef Community
Melbourne, c1977. 22 mins. BRN 552 165

The study of the Great Barrier Reef shows how the coral reef is a whole community. Examines some of the close relationships formed between different animal species and their dependence on each other for survival and support.

HISTORY

Spirit of the Tall Ships
Sydney, 1988. 54 mins BRN 577 368

Australia Day January 26 1988. The climax of the Australia Bicentenary celebration with a parade of tall ships entering Sydney Harbour. The video traces the voyage of two of the ships to Australia.

Ocean Challenges
Sydney 1988. 44 mins. BRN 578 135

Follows the adventure of eight Australian school children on a high seas voyage into history, retracing the voyage of their forebears in the First Fleet from England to Australia in 1787.

Shipmates
Australia, c1987. 27 mins. BRN 556 570

An Australian sea-side drama about Emily and her model of the 'Loch Ard', one of the clipper ships which foundered on the coast.

Albany Whalers
Western Australia, (197-), 9 mins BRN 523 775

SEAGRASS

The Seagrass Story
Victoria, 1989. 35 mins. BRN 598 270

Documents a 3 year community project to raise awareness about the damage being caused to Westernport Bay's ecology by the pressure of industrial and recreational development.

A Problem in Albany's Harbour
Western Australia, 1988. 13 mins. BRN 555 104

The loss of seagrass has affected the ecosystem in this area. Identifies pollution problems and suggests possible solutions.

THE SEA

Alaska: Oil on the Rocks
London, c 1989, 40 mins. BRN 619 136

Documentary about the devastating effects of the Exon Valdez oil spill on the wildlife of Alaska.

The World of Jacques-Yves Cousteau
US, 1966. 52 mins. BRN 487 435

The research and living conditions of six men working for 27 days inside a steel sphere on the bed of the Mediterranean Ocean, turbulence and pollution at depths, growth of plants under artificial light, etc.

Understanding Weather at Sea
England, 1988. 20 mins. BRN 643 193

An introduction to understanding weather at sea; discusses what is weather, wind variation, weather forecasts, clouds and weather charts.

20,000 Leagues Under The Sea
Australia. 1985. 50 mins. BRN 489 961

Evil Captain Nemo controls the sea and is ready to control the world with his submarine in the Nautilus, that is, until he fishes Aronnax, Ned Land and Conseil out of the water. Animated.

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