Underwater Reefs

Educator's Guide

IYOR 2008
INTERNATIONAL YEAR OF THE REEF

NPC CEMENT CONCRETE AGGREGATE
CIMPOR
SEA WORLD EDUCATION CENTRE

UNEP

SAAMBR
SOUTH AFRICAN ASSOCIATION FOR MARINE BIOLOGICAL RESEARCH

First published: 2008
Publisher: NPC Sea World Education Centre, South African Association for Marine Biological Research (SAAMBR)
P.O. Box 10712, Marine Parade, Durban, 4056, South Africa Tel : 031 328 8195 Fax : 031 328 8211

Compiled by: Heidi Simpson and Jone Porter
Illustrations: Sylvia Jacobs, Nat Kistnasamy
Editing: Jone Porter, Lyn Britz, Alison Page

Printing: Share-Net, P. O. Box 394, Howick, 3290 Tel: 033 330 3931

The printing of the Underwater Reefs Educator's Guide was made possible thanks to from the United Nations Environment Programme (UNEP)

A SHARE-NET RESOURCE

People.
Places & Publications for
Environmental Education

Environmental education resource materials are marketed on a cost-recovery basis thanks to the support of Shell South Africa, Gold Fields, WWF-SA and the Mazda Wildlife Fund. Text and illustrations in this booklet may be reproduced COPYRIGHT FREE by any school teacher or any member of the Environmental Education Association of Southern Africa)EEASA), provided that due acknowledgement of authorship is made.

First Edition: October 2008

First Impression: October 2008
ISBN No.

Contents Page

Introduction

The NPC Sea World Education Centre would like to invite you on an underwater journey to discover the amazing world of the reefs. We hope that through using the Underwater Reefs Educator's Guide, both you and your learners will discover the huge variety of life found on reefs in South African waters and how this provides for other life in the ocean. We are all part of this web of life and we hope you find ideas that will help you to care for South Africa's special marine plants and animals. None of us can live without the sea, no matter where in South Africa we are.

The **International Year of the Reef 2008** is a worldwide campaign to raise awareness about the value and importance of coral reefs and threats to their sustainability, and to motivate people to take action to protect them.

We want to:

- Strengthen awareness about the ecological, economic, social and cultural value of coral reefs and associated ecosystems
- Improve understanding of the critical threats to coral reefs and generate both practical and innovative solutions to reduce these threats
- Generate urgent action at all levels to develop and implement effective management strategies for conservation and sustainable use of these ecosystems.

Benefits of Coral Reefs

Coral reefs are often called the rainforests of the sea, both due to the vast amount of species they harbour, and to the high productivity they yield. Aside from the hundreds of species of coral, reefs support extraordinary biodiversity and are home to a multitude of different types of fish, invertebrates and sea mammals. Covering less than one percent of the ocean floor, reefs support an estimated twenty-five percent of all marine life, with over 4,000 species of fish alone. Reefs provide spawning, nursery, refuge and feeding areas for a large variety of organisms, including sponges, cnidarians, worms, crustaceans (including shrimp, spiny lobsters and crabs), molluscs (including cephalopods), echinoderms (including starfish, sea urchins and sea cucumbers), sea squirts, sea turtles and sea snakes.

Their beauty makes coral reefs a powerful attraction for tourism, and well managed tourism provides a sustainable means of earning foreign currency and employment for people around the world, even in remote areas of developing countries.
In summary, healthy coral reefs provide:

- **Habitat:** Home to over 1 million diverse aquatic species, including thousands of fish species
- **Income:** Billions of dollars and millions of jobs in over 100 countries around the world
- **Food:** For people living near coral reefs, especially on small islands
- **Protection:** A natural barrier protecting coastal cities, communities and beaches
- **Medicine:** The potential for treatments for many of the world's most prevalent and dangerous illnesses and diseases.

How to use this Guide

The guide has been divided into sections that cover topics not necessarily related to each other. Each section is made up of a number of parts which are organised under the following headings:

Information
This will give you some background to the topic, especially how it fits with the marine environment. This should be read in conjunction with textbooks.

The background reading is very important. It will enable you to facilitate the various activities. Many of the concepts may not be familiar to you and you will need to be thoroughly familiar with the concepts before facing a class with a new activity. Please read the background information!

Activities
There are a number of activity ideas for each topic. The guide will take you through the activities step by step.

Curriculum Links
This will help you align your activities to the National Curriculum Statements for Grades 7 to 12.

Glossary
In the text, certain words are highlighted and simple definitions are given at the end of each section.

1.WHAT IS A REEF?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 8 & 9	LO1 – Scientific Investigation	
	LO2 – Constructing Scientific Knowledge	
Grade 10	LO2 – Construction & Application of Knowledge	

Assessment Standards:

Grade 8 & 9	LO1 – AS 3	Evaluate data and communicate findings
	LO2 – AS 2	Categorize information
	- AS 3	Interpret information
	- AS 4	Apply knowledge to problems
Grade 10	LO 2 – AS 1	Access Knowledge
	- AS 2	Interpret and make meaning of knowledge

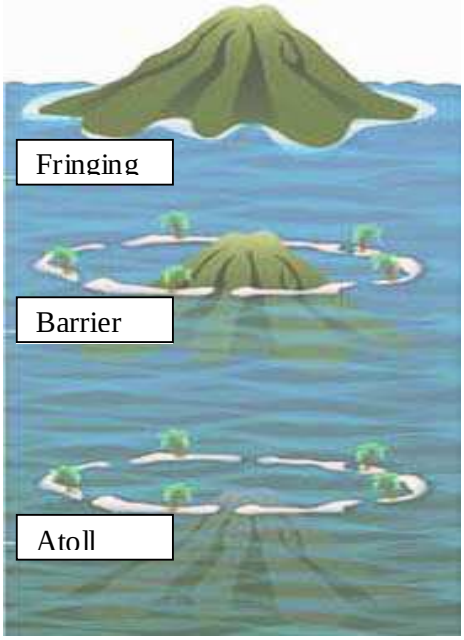
In **nautical** terminology, a reef is a rock, **sandbar**, or other feature lying beneath the surface of the water. Many reefs result from **abiotic** processes—**deposition** of sand and wave erosion of rocky outcrops, but the best-known reefs are coral reefs.

Coral reefs are massive accumulations of **limestone** created by reef building organisms with calcite skeletons, and a mound of these skeletons build up over thousands of years. There are a number of biotic reef types, including oyster reefs, but the most massive and widely distributed are tropical coral reefs.

Coral reefs are underwater homes to hundreds of thousands of different species, and are mainly found in tropical and sub-tropical waters.

Reefs can also be created artificially either by special construction or through deliberately sinking specially cleaned, old ships. These structures are usually created to enhance featureless sand bottoms in order to attract organisms, especially fish.

There are four types of reefs:



Fringing reefs – they hug the coast line and have a flat top area with a gentle slope and then a drop off. Many are found in the tropics.

Barrier reefs – They are found further out and have a lagoon in between them and the shore line. Found in Australia (Great Barrier Reef)

Atolls – are the remains of a sunken island that has left a circular shape reef peaking out on the surface. Found in the Maldives and Seychelles

Submerged dunes – are the rocky remains of old sand dunes that run parallel to the coast. These are the most common form of natural reef in South Africa. Aliwal shoal is an example of this type of reef.

Rocky Reefs are fascinating habitats that are rich in life. Reefs are found where rocks occur above or below the waterline. As the rocks are eroded by wave action, cracks and holes appear which increase the availability of shelter for living things. Different rock types weather in different ways and may have different species.

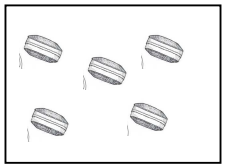
Rocky reefs that are exposed at low tide are great places to explore as there are many animals and some plants that can survive out of the water for some time. The presence of rock pools, **crevices**, and boulders increases the diversity of life because of the shelter provided. Below the low tide mark rocky reefs can support marine plants, and often have brightly coloured communities of invertebrates.

Rocky reefs are also important because they provide habitats for many species of fish, and our two most commercially valuable marine species, the West Coast rock lobster and the abalone.

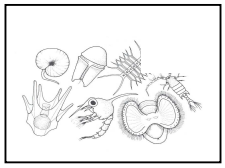
The animals and plants that live between the high and low tide have to cope with a wide variety of challenges to their survival and live in an environment that is constantly changing. Many species occupy different parts of the shoreline based upon their **adaptations** and ability to cope with pressures associated with the rise and fall of the tides.

The **intertidal** rocky shore is an extreme habitat that is in a state of almost constant change when compared with the land or the sea. Because of water movements associated with tides, waves and spray, the conditions affecting different levels on the rocky shore vary continuously throughout the day.

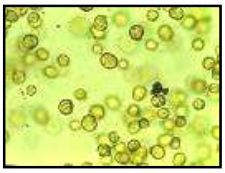
ANIMAL FACT SHEET:



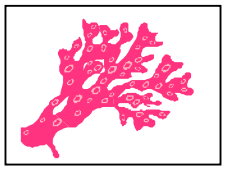
Phytoplankton: Are microscopic plants that use light to photosynthesise, and are free floating in the water column.



Zooplankton: Are microscopic animals that feed on phytoplankton. They range in size from single celled organisms to larvae from other organisms. They are also found floating in the water column.

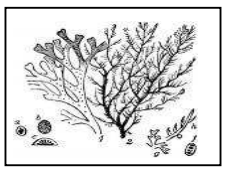


Zooxanthellae: Are a single celled algae that live within the tissue of the coral animal. These algae photosynthesise and provide food to the coral. If conditions become unfavorable (too warm), the zooxanthellae leave the coral which causes the coral to lose its colour. This is called coral bleaching. Without these symbiotic algae many corals will die after a few days.

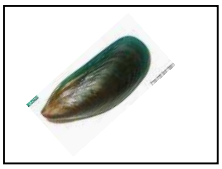


Coral: A small animal that usually lives in colonies. They have a rounded body shape with one body opening and tentacles with stinging cells. Some secrete a hard substance in order to make a home to live in (Hard Coral), while others have spicules and group together loosely to form soft coral. Coral has a **mutualistic** relationship with the zooxanthellae. The Zooxanthelle photosynthesise producing food which they share with the coral. The coral also feeds on plankton using its tentacles.

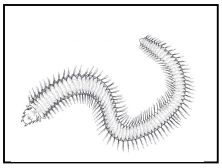
Sea Anemone: A round, hollow-bodied animal with a ring of stinging tentacles. They are often found on rocky or shallow reefs, and feed on plankton.



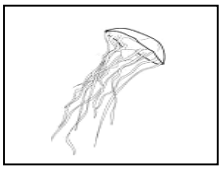
Algae: May be small or even microscopic, or larger macro algae or seaweeds. They need light to photosynthesise, and attach themselves to rock surfaces, or even other animals with shells.



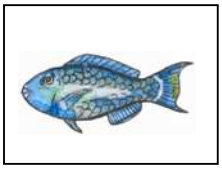
Brown Mussel: A bivalve that occurs in rocky reef areas, forming beds of mussels from the intertidal zone to depths of 40m, and feeds on plankton.



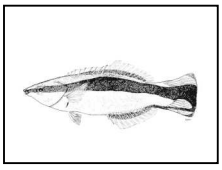
Benthic worms: Segmented worms that live on the sea floor and feed on detritus or plankton.



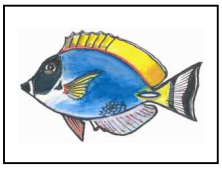
Jellies: Are gelatinous creatures that drift with the ocean currents and feed on large planktonic animals.



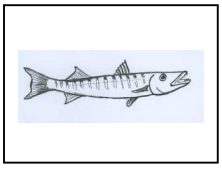
Parrot fish: A sturdy fish with a blunt snout and fused teeth to create a beak like structure. It likes to live around the coral reef and feeds on algae.



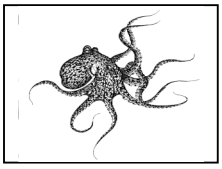
Cleaner wrasse: A small fish that sets up 'cleaning stations' for other fish on the reef. It will remove invertebrate ecto-parasites from their skin, mouth and gills.



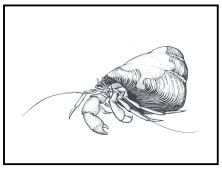
Surgeon fish: Has a compressed, oval, bright blue with black and white head, has a spine on either side of the **caudal peduncle**. The surgeon feeds on sea weed, algae and small invertebrates, and is found close to the reef.



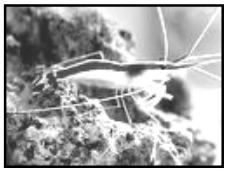
Barracuda: An elongated fish with sharp teeth. It is found in small shoals near coastal reefs. These predators feed on other fish.



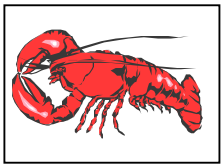
Octopus: is a shell-less, eight armed animal that lives in water depths down to 200m. It preys on crabs, rock lobsters and other shellfish, and likes to hide in crevices.



Hermit crab: Will inhabit an empty shell until it gets too big for the shell, then will move into a bigger shell. Most species are scavengers, and they live in and around reef areas.



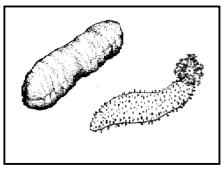
Cleaner shrimp: A brightly coloured individual that inhabits coral reefs. They also remove parasites and bacterial growths from the surfaces of other fish.



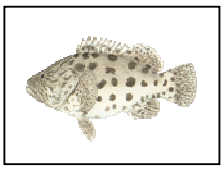
Rock Lobster: Found on rocky reefs where it likes to hide in rock crevices at depths of 1 – 36m. They like to feed on mussels.

Eel: Has a snake like body, and lives in rock crevices on reefs. They like to feed on octopus as part of their diet. But may also feed on crustaceans and small fish.

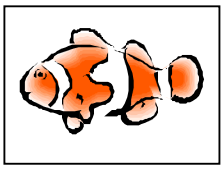
Sea Star: A star shaped animal moves about on rocky or coral reefs, and they are either scavengers or predators. Their diet may include small snails, invertebrates or even coral.



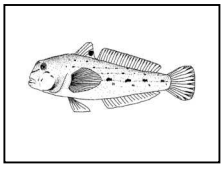
Sea Cucumber: A tube like, soft bodied animal that has **retractable** tentacles which it uses to feed on detritus or plankton. They are bottom dwellers.



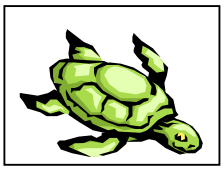
Potato Bass: A large robust fish that lives on rock and coral reefs down to depths of 150m. It is a solitary top predator that feeds on other fish.



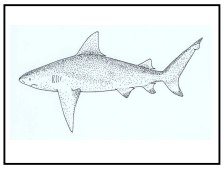
Clown Fish: A small fish that was made famous by the movie 'Finding Nemo'. These fish live in pairs and are associated with the sea anemone. The fish will 'brush' against the anemone tentacles each day so that they become **immune** to the venom in the nematocysts of the anemone. This then provides them with a protective place to stay. They lay eggs under the anemone.



Goby: A small bottom dweller that burrows in the sand. It feeds on small invertebrates.



Turtle: A reptile that will spend most of its life at sea. It has modified flippers and is able to dive to great depths while holding it's breath for about an hour at a time. Some species (Loggerhead) feed on mussels, crabs and rock lobsters, while other species (Leatherback) feed on jellies and blue bottles. There are 5 different species living in South African waters.



Reef Shark: These are slender sharks that reach a length of up to 2m and swim in and around the reef. They will feed on other fish, octopus and shellfish. They are the top predators in a reef ecosystem, and are important for keeping the balance within the food web.

1.1 WHERE DO CORAL REEFS GROW?

Reef building corals need warm water, best between 18°C and 29°C with 24°C being **optimum**. They also require a strong salt content in the water (25-40ppt), fresh water will kill them. They also need lots of sunlight and do not like sediment or turbid water. Findings suggest that net rates of coral growth are between 0.8 to 26 mm/year.

ACTIVITY 1: Locating Coral reefs

Grade 10: LO2 – AS 1 Use prescribed methods to access information

Grade 8 & 9: LO2 – AS 3 Interpret information & make predictions

What you need:

- The introductory information about coral reefs
- The "Locating Reefs" worksheet
- Coloured pencils or pens for each learner

What to do:

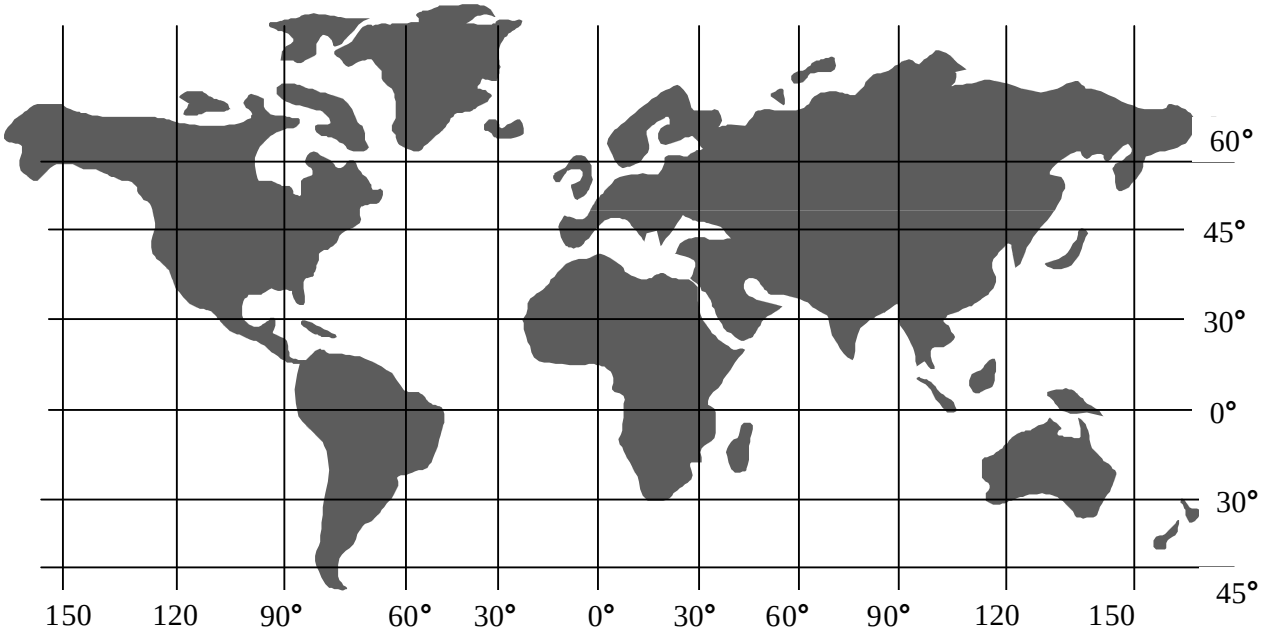
- Explain to learners how to read longitude and latitude lines and sets of co-ordinates
- Discuss why warmer water is near the equator and colder water is near the poles
- Explain the movement of our South African currents – the warm Agulhas Current down our east coast, and the cold Benguela Current up our west coast.
- Let the learners complete the worksheet.

Locating Coral reefs

Use the **latitudes** and **longitudes** in the table below to locate the following coral reefs.

Then colour in the reef belt. Between which two latitudes does it lie?

Location	Latitude	Longitude
Great barrier Reef	19°10'S	149°E
Maui in Hawaii	20°45'N	156°20'W
Key West, Florida	24°33'N	81°48'W
French Polynesia	16°S	145°W
Red Sea	25°N	38°W
Jamaica	18°15'N	77°30'W
Seychelles	8°S	55°E
Philippines Islands	13°N	122°E
Bahamas Islands	24°15'N	76°W



1. Do the reefs grow every where in the tropics? Why?
2. Using arrows to show direction, draw our South African currents onto your map (use red for the warm current & blue for the cool current). Use this to help you predict the direction of the currents for Australia and South America – draw them onto your map.
3. What is the relationship between the water temperature and coral **distribution**?
4. Where do you think you would you find coral reefs in South Africa?

1.2 DIFFERENT AREAS ON A CORAL REEF

Coral Reefs have different areas; some may be shallow and inshore, while others may be deeper and further out. The depth of the reef will influence the amount of light that reaches that part of the reef – the deeper, the less light. This will then affect photosynthesis (food production). This, in turn, affects the kinds of plants and animals that will be found in different areas.

Activity 2: Finding the Differences

Grade 9: LO2 – AS 3 Interpret information & make predictions

- AS4 Applying Knowledge of animals to infer feeding and movement

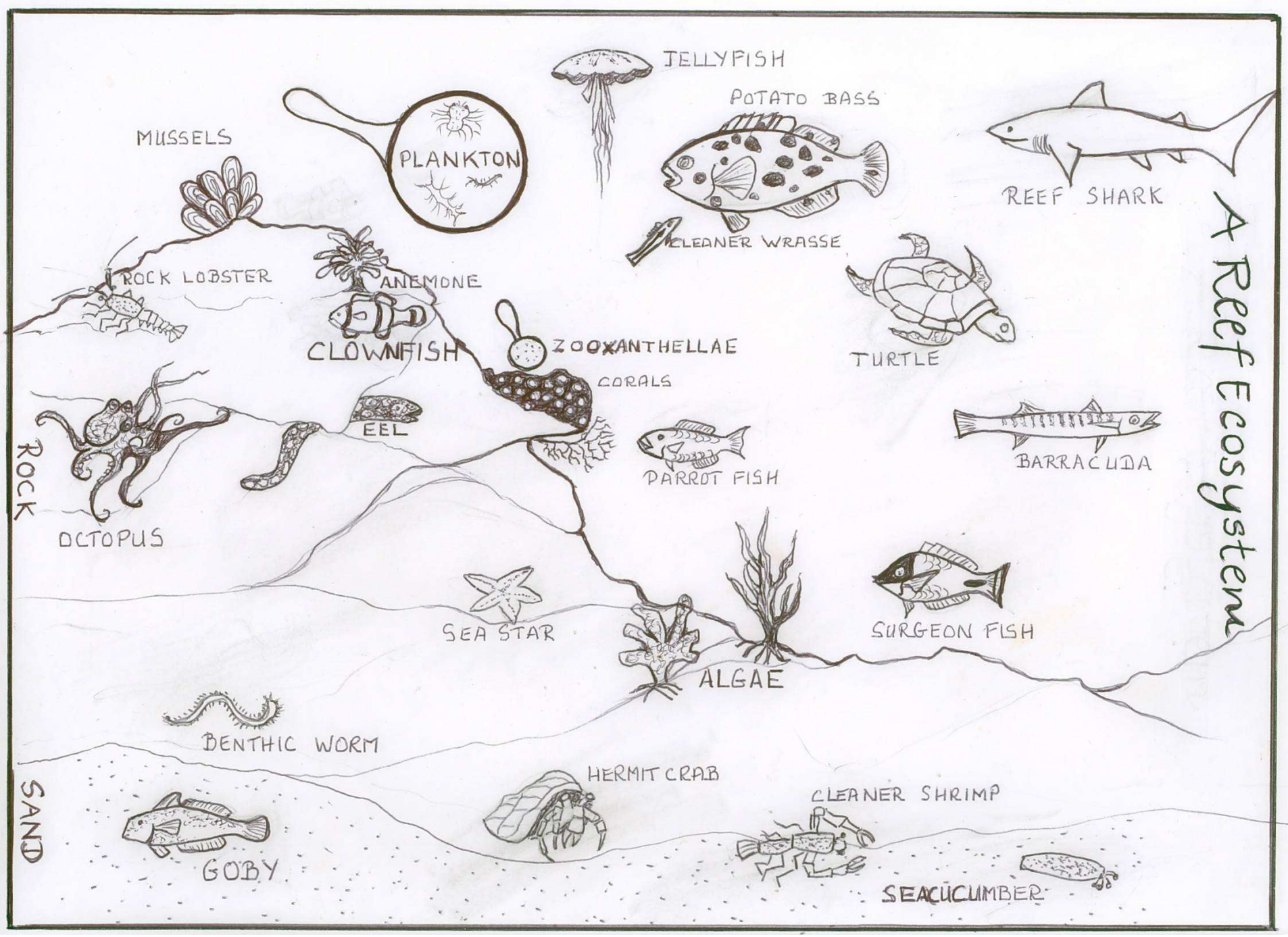
Grade 10: LO2 – AS2 Identify Ecosystem concepts and describe and explain

What you need:

- The introductory information about coral reefs
- The Reef **Ecosystem** diagram
- The fact sheets
- Your work book or paper

What to do:

- Study the Reef ecosystem diagram. Using the fact sheets identify each animal on the reef.
- Use this information to help you decide what two main ecosystems are illustrated.
- Choose 4 animals from each ecosystem –Describe how each of the animals feeds, moves and survives in their habitat.


A Reef Ecosystem
JELLYFISH
POTATO BASS
REEF SHARK
MUSSELS
PLANKTON
CLEANER WRASSE
ROCK LOBSTER
ANEMONE
CLOWNFISH
ZOOXANTHELLAE
CORALS
TURTLE
EEL
PARROT FISH
BARRACUDA
ROCK
OCTOPUS
SEA STAR
ALGAE
SURGEON FISH
BENTHIC WORM
HERMIT CRAB
CLEANER SHRIMP
SAND
GOBY
SEACUCUMBER

1.3 THE FOOD WEB CONNECTION

All plants and animals need organic compounds and water in order to survive. Plants are able to produce their own organic compounds, and they are called **producers**. Animals feed off plants and other animals, and they are called **consumers**. The animals that eat plants are called primary consumers, and the ones that eat other animals may be called secondary or tertiary consumers. The organisms that break down the dead material are called **decomposers**.

An animal may eat more than one food item, and this then creates a food web within an ecosystem. Each link in the food web is important in keeping the ecosystem in balance.

Activity 3: Connecting the Web

Grade 8: LO2 – AS 2 Categorizing animals according to their feeding habits

- AS4 Applying Knowledge of animals feeding habits in an unfamiliar situation

What you need:

- A copy of the Reef Ecosystem diagram
- The fact sheets
- Your work book or paper

What to do:

- Study the Reef ecosystem diagram. Using the fact sheets, identify each animal on the reef. Then make the food web connections between the animals and plants. Note down what you notice about your food web.

Glossary:

Abiotic: The non-living components of an environment.

Adaptation: The process of changing to suit a new situation.

Calcareous: Composed of, containing, or characteristic of calcium carbonate, calcium, or limestone; chalky.

Caudal Peduncle: The narrow part of a fish's body to which the **caudal** or tail fin is attached.

Consumer: An organism, usually an animal that feeds on plants or other animals.

Crevice: A narrow crack or opening; a fissure or cleft.

Decomposer: An organism, usually a bacterium or fungus that breaks down the cells of dead plants and animals into simpler substances.

Deposition: The natural process of laying down a deposit of something.

Distribution: The spatial or geographic property of being scattered about over a range, area, or volume.

Ecosystem: A system formed by the interaction of a community of organisms with their environment.

Immune: Not susceptible or responsive; *especially* : having a high degree of resistance.

Intertidal: Of or pertaining to the littoral region that is above the low-water mark and below the high-water mark.

Latitude: The angular distance north or south from the equator of a point on the earth's surface, measured on the meridian of the point.

Limestone: A sedimentary rock consisting predominantly of calcium carbonate, varieties of which are formed from the skeletons of marine microorganisms and coral: used as a building stone and in the manufacture of lime.

Longitude: Angular distance east or west on the earth's surface, measured by the angle contained between the meridian of a particular place and some prime meridian, as that of Greenwich, England, and expressed in degrees.

Mutualistic: A relationship between two species of organisms in which both benefit from the association.

Nautical: relating to, or characteristic of ships, shipping, sailors, or navigation on a body of water.

Nutrients: A source of nourishment, especially a nourishing ingredient in a food.

Optimum: The best or most favorable point, degree, amount, etc., as of temperature, light, and moisture for the growth or reproduction of an organism.

Producer: An organism, as a plant, that is able to produce its own food from inorganic substances.

Retractable: To draw or shrink back.

Sandbar: A ridge of sand formed in a river or along a shore by the action of waves or currents.

Useful Websites:

www.sedwickmuseum.org/wenlock/dive/reefs/index.html

www.coris.noaa.gov/about/what_are/

2. WHAT ARE CORALS?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 8 & 9	LO2 – Constructing Scientific Knowledge	
Grade 10	LO3 – Life Science, Technology, Environment and Society	

Assessment Standards:

Grade 8 & 9	LO2 – AS 1	Recall meaningful information
	- AS 3	Interpret information
Grade 10	LO 3 – AS 2	Compare & Evaluate the use/development of resources or products and their effect on the environment.

There are many different **species** of coral. There are two main types of coral: 'Hard' coral and 'Soft' coral.

Corals come in many different shapes and sizes, but are all made up of tiny **polyps**. A polyp is a tiny animal that looks like an upside down jelly or anemone. (See page 21 for diagram)

Hard coral are animals with an outer skeleton made of Calcium Carbonate, while soft corals only have small pieces of Calcium Carbonate inside their tissue. Reefs form when hundreds of hard corals grow next to each other and on top of each other. They use their tentacles to catch plankton from the water. However, plankton only forms part of their diet. In many species each polyp houses tiny **algae** within its body tissue. These algae are called **zooxanthellae**. The zooxanthellae use sunlight to photosynthesise and produce food. They then share this food with the coral. They have a **symbiotic** relationship and rely on each other.

If conditions become unfavorable for the zooxanthellae, they will leave the coral. This is known as coral bleaching. Although the coral do feed by themselves, they do not get enough nutrients this way, and therefore would not survive long once the zooxanthellae have left.

2.1 MAKING CORAL

Making coral structures can help the learners understand the structure of coral polyps and the coral **colonial** life style. Learners will also realize that coral can **extract** the material that it needs to make its skeleton from the sea water in which it lives.

Activity 1: An egg carton coral

Grade 8 & 9: LO2 – AS 1 Recall procedures in making the coral and the process of building models

What you need:

- Egg cartons, paper, tape, scissors, coloured pencils, markers or paint.

What to do:

- Cut an A4 piece of paper into 3 strips, and roll each strip into a tube about the diameter of your finger. This represents the polyp.
- Tape the bottom of the tube so that it is closed off.
- Make several cuts at the top of the tube – about ¾ of the way to the bottom.
- Curl the cut pieces with a pair of scissors. These are the tentacles.
- Using the bottom half of an egg tray, punch a hole in each compartment, just wide enough for the tube. Insert the tube into the punched hole. (Tentacles should be on the top end of the egg carton.)
- Use coloured pens to make dots on the polyps to represent the zooxanthelle.

A large reef is built on the skeletons of thousands of coral polyps. Although each polyp is an individual animal, they are linked in a colony, and share food. The polyps can move in and out of their skeletons, and this can be demonstrated by pulling the polyp back into the egg carton.
You can use the model to look at feeding and life as a colony.

In nature, **lime** is dissolved in sea water. This demonstration suggests how corals are able to produce Calcium Carbonate from sea water. We cannot demonstrate the exact process, but this experiment gives an idea of how corals can extract the material from clear sea water. Ocean acidification is defined as the reduction of the pH of the world's oceans. Scientists have discovered that the average level of acidity in the oceans has risen by about 25 percent in the last 150 years, since the advent of fossil fuel burning. Researchers have already predicted that a more acidic ocean will make it more difficult for corals to build their calcium carbonate skeletons, and the new finding suggests that the reef's broader structure may also suffer because a lower pH reduces the formation of the reef's cement binder.

Activity 2: Making a coral skeleton

Grade 8 & 9: LO2 – AS 1 Recall procedures in making the coral and the process of building models

What you need:

- A glass jar 2-3 cup full
- 1 cup of white vinegar
- 1 stick of white chalk broken into several pieces
- 1 cup of tap water
- 6 teaspoons of baking soda

What to do:

- Mix the vinegar with the chalk and let it stand for two hours. Pour off the clear liquid (and keep), and throw out the remaining chalk.
- In another container, mix the tap water and the baking soda; stir until most of the baking soda has dissolved. Pour off the clear liquid (and keep) and throw the remaining baking soda away.
- Combine the two clear liquids in the glass jar. A white precipitate will form and settle. This mixing process represents a coral polyp extracting calcium from the sea water, and combining it with carbon dioxide, to produce the hard materials of coral skeletons.
- You may then drain the liquid off and dry the 'coral' material to look at.

2.2 CORALS IN THEIR ENVIRONMENT

Almost all corals are **sedentary** animals, and unable to move around. They need to capture food from the surrounding waters, and rely on zooxanthellae to help them obtain food.

If environmental conditions become unfavourable, the coral run the risk of losing their zooxanthellae and could die. There are many abiotic factors to which they have to be adapted to in order to survive. Humans have an added effect on their environment through **pollution, habitat destruction** and **global warming**.

Activity 3: Adapted to survive

Grade 10: LO3 – AS 2 Evaluate the impact of technology and human endeavors on the environment.
Grade 8: LO2 – AS1 Recall meaningful information on corals AS3 Make predictions about the corals survival from their

What you need:

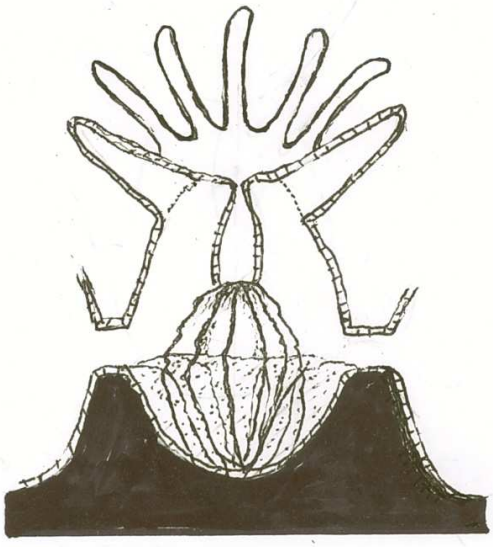
- The diagram of the coral polyp and coral colony
- The fact sheets
- Your work book or paper

What to do:

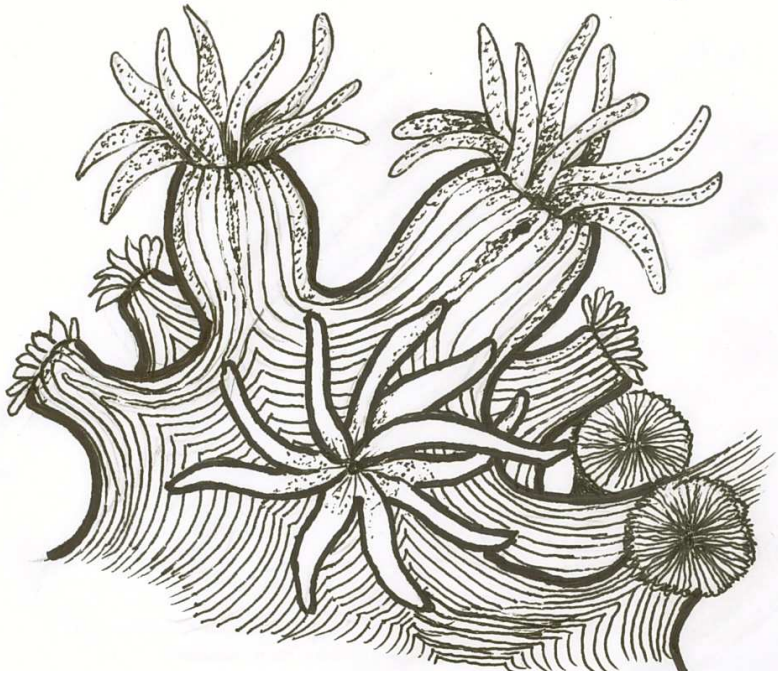
- Examine the diagrams of the coral and the coral colony, and then try to infer how the corals survive.

1. What kinds of abiotic conditions affect the coral?
2. How is the body of the coral formed to adapt and cope with these conditions?
3. Explain how the following human influences affect corals: pollution, habitat destruction and global warming.
4. What 3 suggestions do you have that could reduce man's impact on corals?

A coral Polyp



A coral colony



Glossary:

Algae: Primitive chlorophyll-containing mainly aquatic eukaryotic organisms lacking true stems and roots and leaves.

Colony: A group of organisms of the same kind living or growing in close association.

Extract: To get, pull, or draw out, usually with special effort, skill, or force.

Global Warming: An increase in the earth's average atmospheric temperature that causes corresponding changes in climate and that may result from the greenhouse effect.

Habitat Destruction: The process in which a natural **habitat** is rendered functionally unable to support the species originally present

Lime: A white or grayish-white, odorless, lumpy, very slightly water-soluble solid, CaO.

Polyp: A sedentary type of animal form characterized by a more or less fixed base, columnar body, and free end with mouth and tentacles, especially. as applied to cnidarians.

Sedentary: Pertaining to animals that move about little or are permanently attached to something, for example a barnacle.

Species: Related individuals that resemble one another, are able to breed among themselves, but are not able to breed with members of another species.

Symbiotic: The living together of two dissimilar organisms, as in mutualism, commensalism, or parasitism.

Zooxanthellae: Any of various yellow-green or green algae that live symbiotically within the cells of other organisms For example, corals or giant clams.

Useful Websites:

http://en.wikipedia.org/wiki/coral

www.mdpi.org/fis2005/F.70.poster.pdf

3. WHAT ANIMALS ARE FOUND ON A REEF?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 7 & 8

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 7 & 8	LO2 – Constructing Scientific Knowledge	
Grade 10	LO2 – Construction & Application of Knowledge	

Assessment Standards:

Grade 7 & 8	LO2 – AS 2	Categorize information
	- AS 3	Interpret information
Grade 10	LO 2 - AS 2	Interpret and make meaning of knowledge

Coral reefs provide **habitats** for a large variety of organisms. These organisms rely on corals as a source of food and shelter. Some organisms that use corals through mutualism, **commensalism** and **parasitism** are in the groups of the Porifera (sponges), Polychaeta (worms), Gastropoda (snails), Crustacea (lobsters & Crabs), Echinodermata (sea stars, sea urchins & sea cucumbers) and Pisces (Fish).

Sponges (Porifera) are found inhabiting cavities in the reef. They remove small chips of calcium carbonate from corals. These sponges can cause **bioerosion** in corals. Sponges inhabit corals for the purpose of protection from **predators**.

Polychaetes and some Gastropods depend on corals for food. Crustaceans such as shrimps and crabs depend on corals for shelter. Fish also depend on corals for protection against predators, such as the parrot fish. Echinoderms can be coral predators, like the crown-of-thorns starfish that relies on corals for food.

There are many other species of fungi, sponges, sea worms, crustaceans and molluscs that **bore** into coral skeletons. Other organisms that inhabit the coral reefs include sea urchins, jellyfish, oysters, clams, turtles and sea anemones.

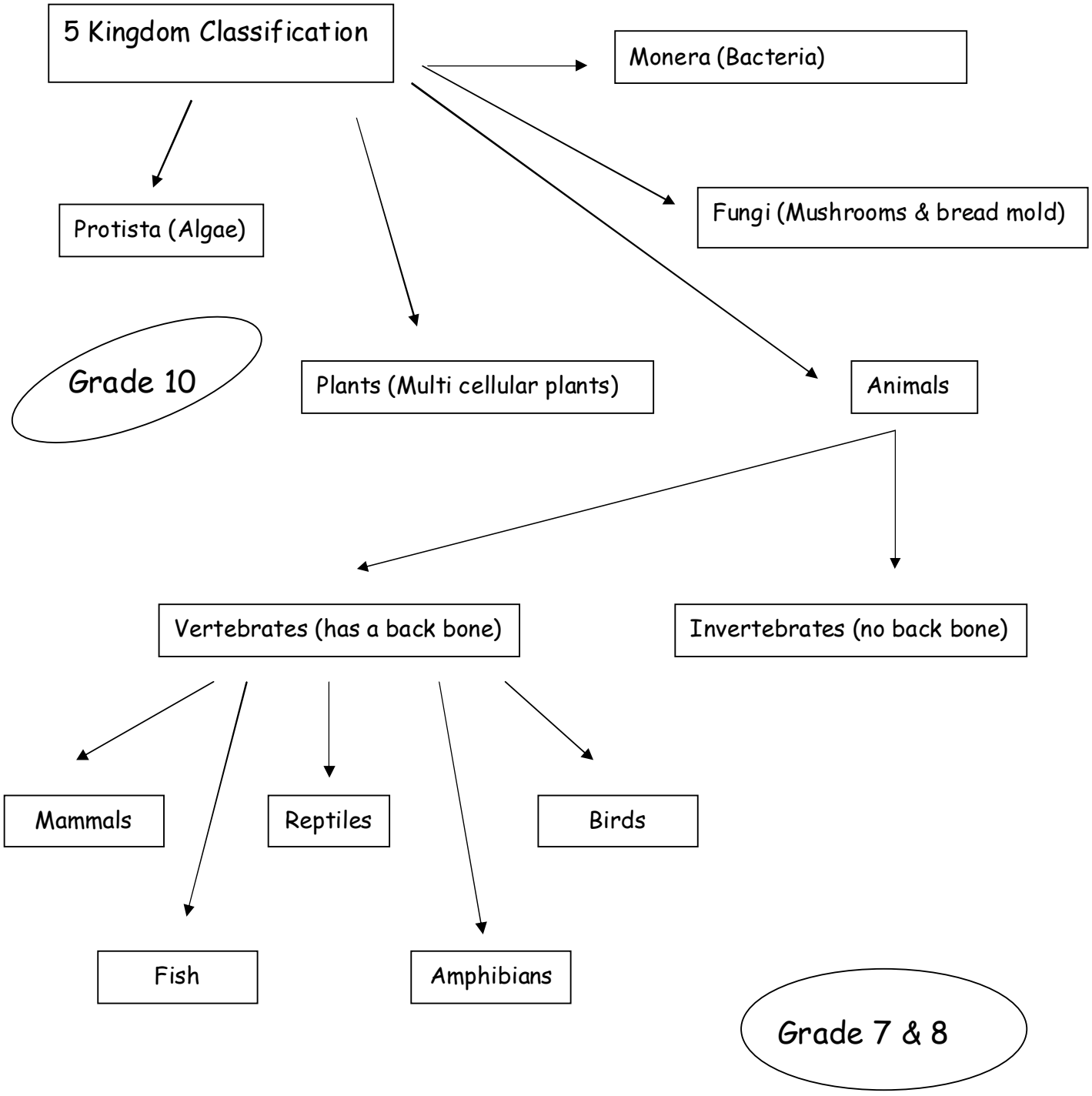
All of these animals are closely linked through the food web and each one is important in keeping the ecosystem in balance.

Rocky Reefs are fascinating habitats that are rich in life. Many marine animals and plants need to attach themselves to something solid for their survival.

Reefs are found where rocks occur above or below the waterline. As the rocks are eroded by the action of water, cracks and holes appear which increase the availability of shelter for living things. Different rock types weather in different ways and may have different species. Rocky reefs are also important because they provide habitat for many species of fish, and rock lobster and the abalone.

Rocky reefs that are exposed at low tide are great places to explore as there are many animals and some plants that can survive out of the water for some time. The presence of rockpools, crevices, and boulders increases the diversity of life because of the shelter provided.

Classification Outline



Scientists classify living things into groups called Kingdoms. Organisms that are related are grouped together. Within each Kingdom the organisms are divided into groups called Phyla (singular Phylum). The Phylum is further divided into more closely related classes, which then contain orders and families, genera and species. *(Coastal Care Fact Sheet)*

3.1 AQUATIC HOMES & FAMILIES

Aquatic ecosystems are **classified** according to their abiotic factors, mostly salt content. Underwater reefs are found in marine ecosystems, and have a salt content of 35ppm. Organisms in a marine environment are divided into three main groups. They are: **Plankton** – free swimming microscopic organisms found in the water column (They may be phytoplankton (plants) or zooplankton (animals). **Nekton** – this consists of the bigger fish, sea turtles, dolphins, and whales. They are generally strong swimmers and can migrate over long distances. **Benton** – are the organisms that attach themselves to the substrate or burrow into the sand, they are the bottom dwellers.

Activity 1: Classification Key

Grade 7: LO2 – AS 2 Comparing the features of different organisms to classify them into a group

Grade 10: LO2 – AS 2 Interpret information using the diagram
- AS 3 Show an understanding of the grouping of reef organisms

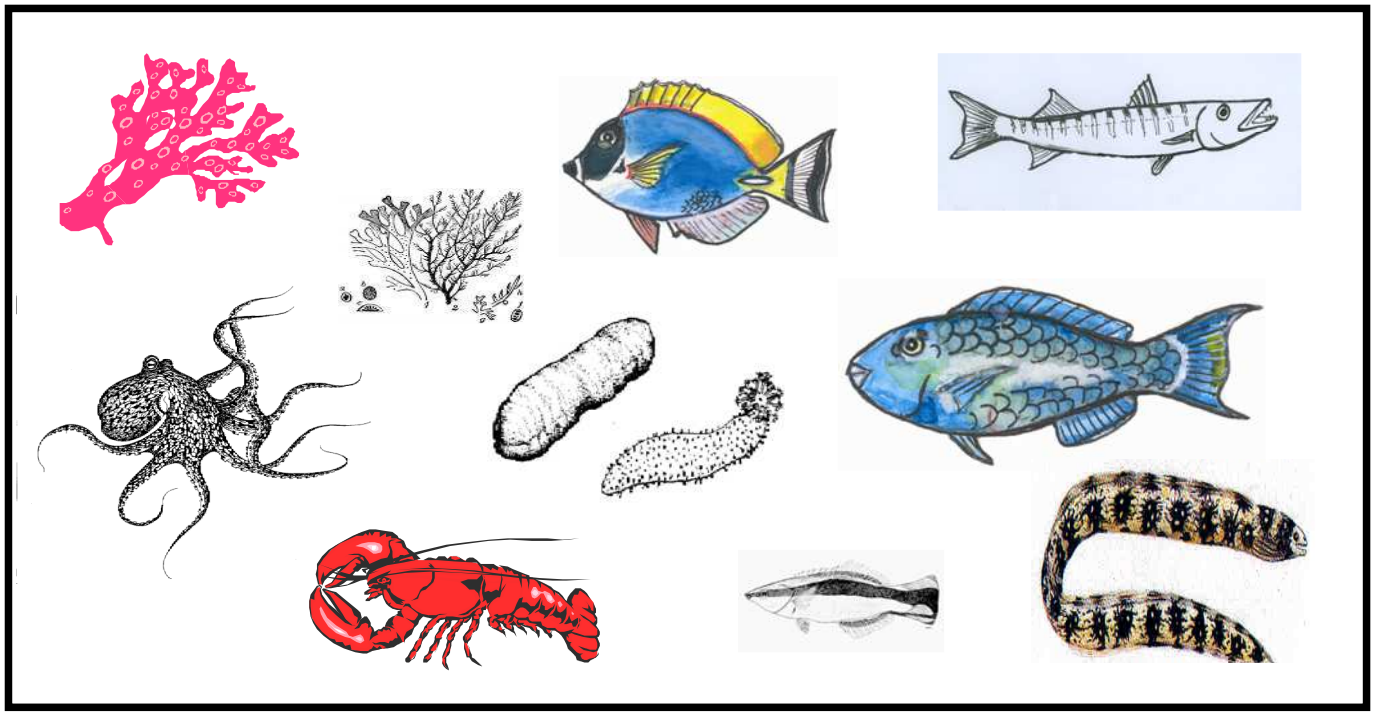
What you need:

- The diagram of the 10m reef and the classification key
- The fact sheets

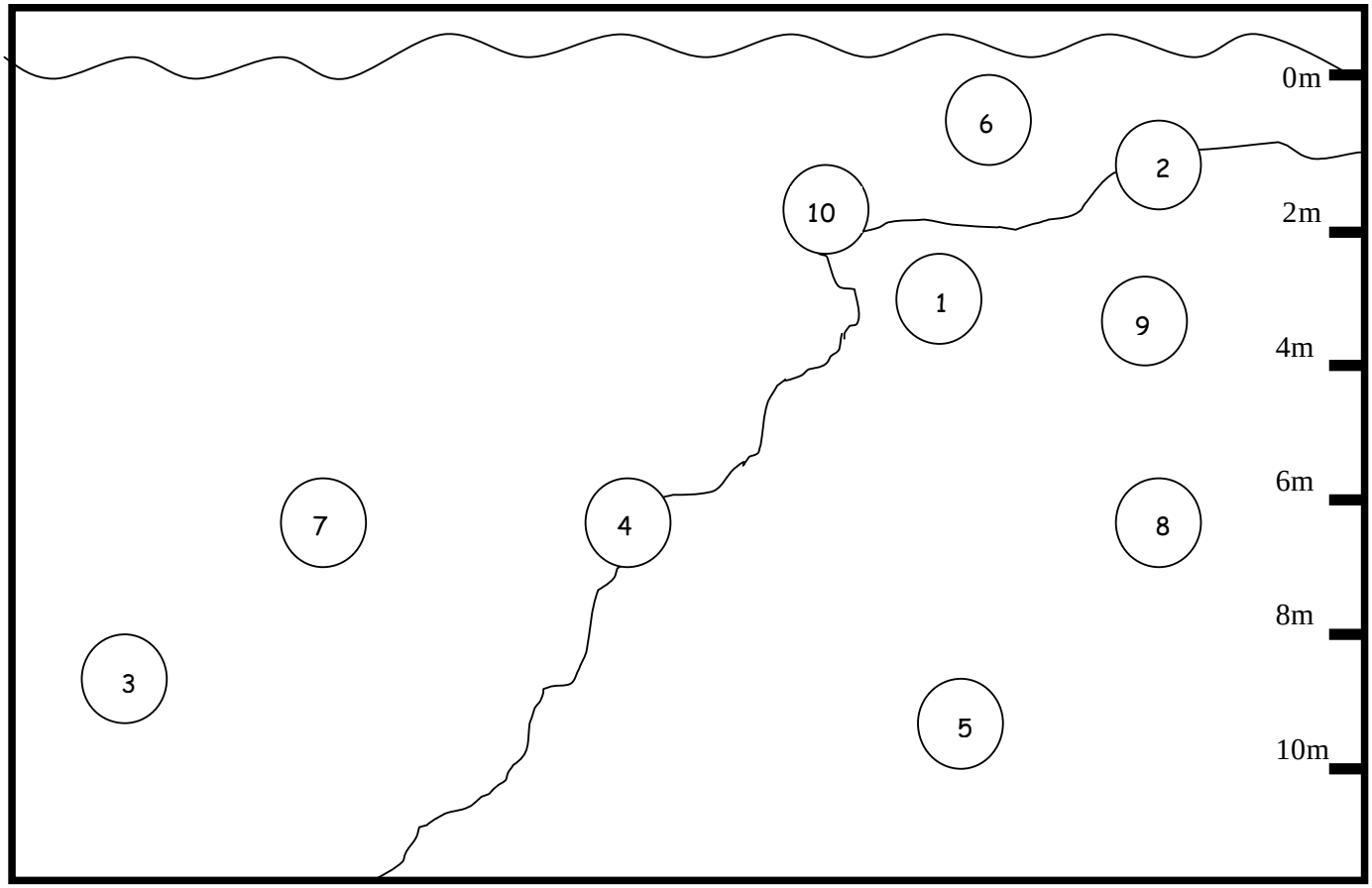
What to do:

- Looking at the diagram of each organism, use the key to try to work out what animal it is and then match it up to its place on the 10m Reef.
- Use the fact sheet information to help you.

The Organisms



10m Reef



Key to organisms

1.	Organism looks plant-like, greenish ……	2
	Organism is not a plant …… ……	3
2.	Organism looks like a flower, has plants living inside its body …….	CORAL
	Organism is a plant, containing chlorophyll ……	ALGAE
3.	Animal has a backbone……	4
	Animal has no backbone ……	8
4.	Animal is a fish that lives in the open ocean ……	BARRACUDA
	Fish lives on the reef ……	5
5.	Fish is long, slender, snake-like body ……	EEL
	Fish has a typical fish-shaped body ……	6
6.	Fish has fused, big teeth for crushing coral …….	PARROT FISH
	No crushing teeth……	7
7.	Fish has blade on tail, near tailfin, eats only seaweed……	SURGEON
	Smallest fish on our reef, blue and black, hang around other fish……	CLEANER WRASSE
8.	Animal has skeleton on outside of body ……	LOBSTER
	Animal has soft body……	9
9.	Animal has 8 legs and lives in rock caves……	OCTOPUS
	Animal lives on and eats sand (Removing the microscopic plants and animals) ……	SEA CUCUMBER

3.2 WHO IS IN YOUR FAMILY?

Invertebrate animals are grouped into different groups called **phyla**. The animals in each phylum have certain common characteristics that allow the animals in those groups to be grouped together.
The four main groups are: Cnidaria, Mollusca, Arthropoda and Echinodermata.

Cnidaria – Corals, Anemones

Cnidarians have stinging cells, **radial symmetry** and only one body opening. They have a simple muscle and nervous system, and their body wall is made of two layers of cells. They also have two body forms – a **polyp** and a **medusa.**

Mollusca – Mussels, Octopus,

These are soft bodied creatures with no segments, but their body is divided into a head, body and foot region. Some of these animals have external shells, while others have an internal shell, or no shell at all. Most of them live on or around rocks.

Arthropoda – Crabs, Rock Lobsters

These animals have their bodies divided into segments. Their body is covered by an exoskeleton and need to moult to grow. They have jointed legs. They are **bilaterally symmetrical**, and they have got gills, so they are able to exchange gases under water.

Echinodermata – Sea stars, Urchins

These are very slow moving animals. They have a **five-rayed symmetry** (or multiples of five). Their skin is tough and often spiny. They do not have eyes. They are the only group that is only found in the sea.

Activity 2: Finding a Phylum

Grade 10: LO2 – AS 2 Comparing the features of different organisms to classify them into a group

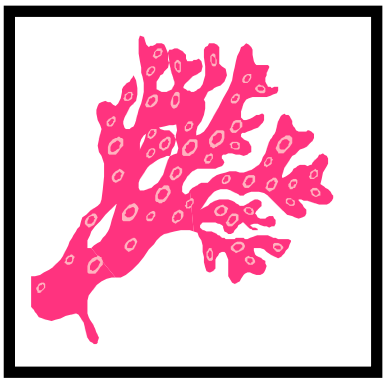
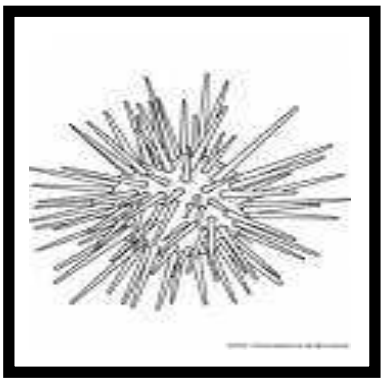
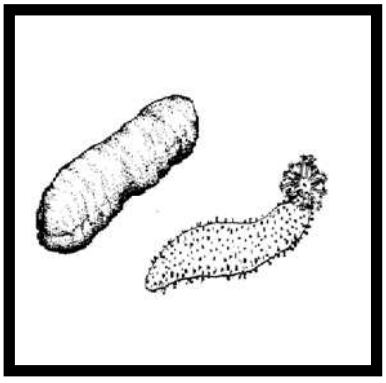
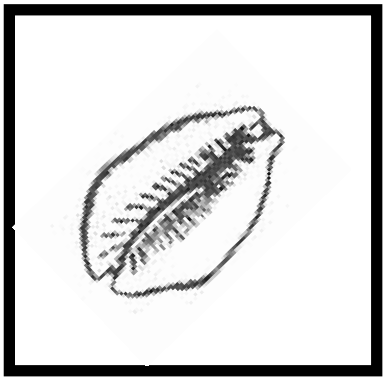
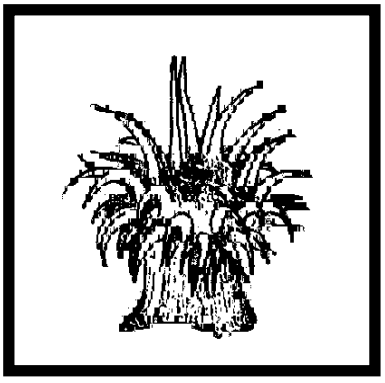
What you need:

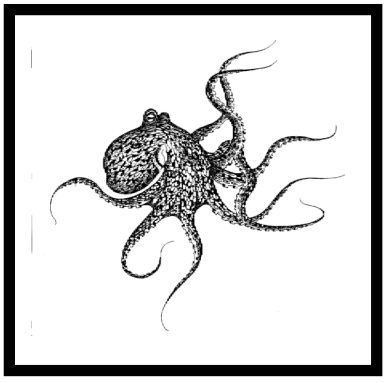
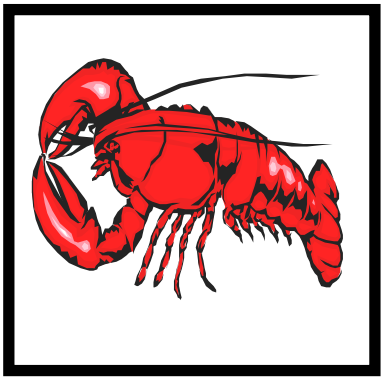
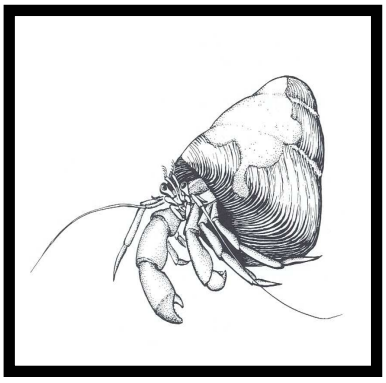
- The diagram of the animals to be classified & the fact sheets

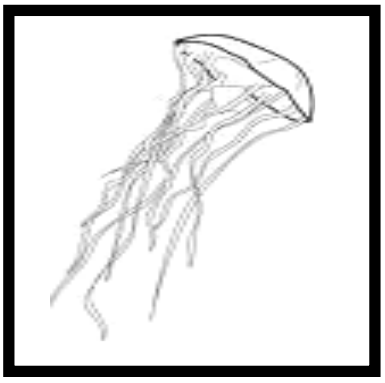
What to do:

Looking at the diagram of each organism try to match it to its correct phylum.

Da Family



3.3 MATCH A MATE?

Survival **strategies** on reefs extend beyond the usual adaptations of **camouflage**, spines, stingers and other physical features. Relationships between animals as well as between animals and plants have evolved on the reef to include a variety of social and biological interactions in which one or all of the organisms involved receive some benefit from the relationship. The amount of benefit (and cost) may change over time as the relationships change in response to environmental changes. Scientists call these interactions symbiotic relationships.

The corals themselves act as hosts to a variety of **symbionts**, including the zooxanthellae. These "helper algae" live in the tissues of the coral polyp and use the sun's energy to produce sugars that are necessary for the survival of the coral. The relationship between the coral and the zooxanthellae is an example of mutualism. The corals receive organic compounds from the zooxanthelle (as a result of photosynthesis), while the zooxanthelle receive protection within the body tissue of the coral. Another mutualistic relationship involves the sea anemone and the clownfish. The anemone's tentacles contain cells with small stinging structures that harm most small creatures, including fish. However, the clownfish builds a defense by acquiring a mucus coat that protects against the stinging cells and makes a home within the anemone's tentacles providing a safe place for it and its companion. In turn, the clownfish brings its meals back to the anemone where, while it eats, bits of the prey may fall into the anemone's tentacles, providing an easy snack for the anemone. The anemone plays a part in another mutualistic relationship—this one with a specific type of hermit crab. The hermit crab first finds a snail shell to use as a mobile shelter, and then adds the anemone to the shell. The anemone serves two purposes—camouflage and stinging protection. In turn, the anemone has found a place to live and gather scraps of food (space can be limited on the reef).

<u>Activity 3</u>: Wanted ads

Grade 7 & 8: LO2 – AS 2 Comparing the features of different organisms to classify them into a group

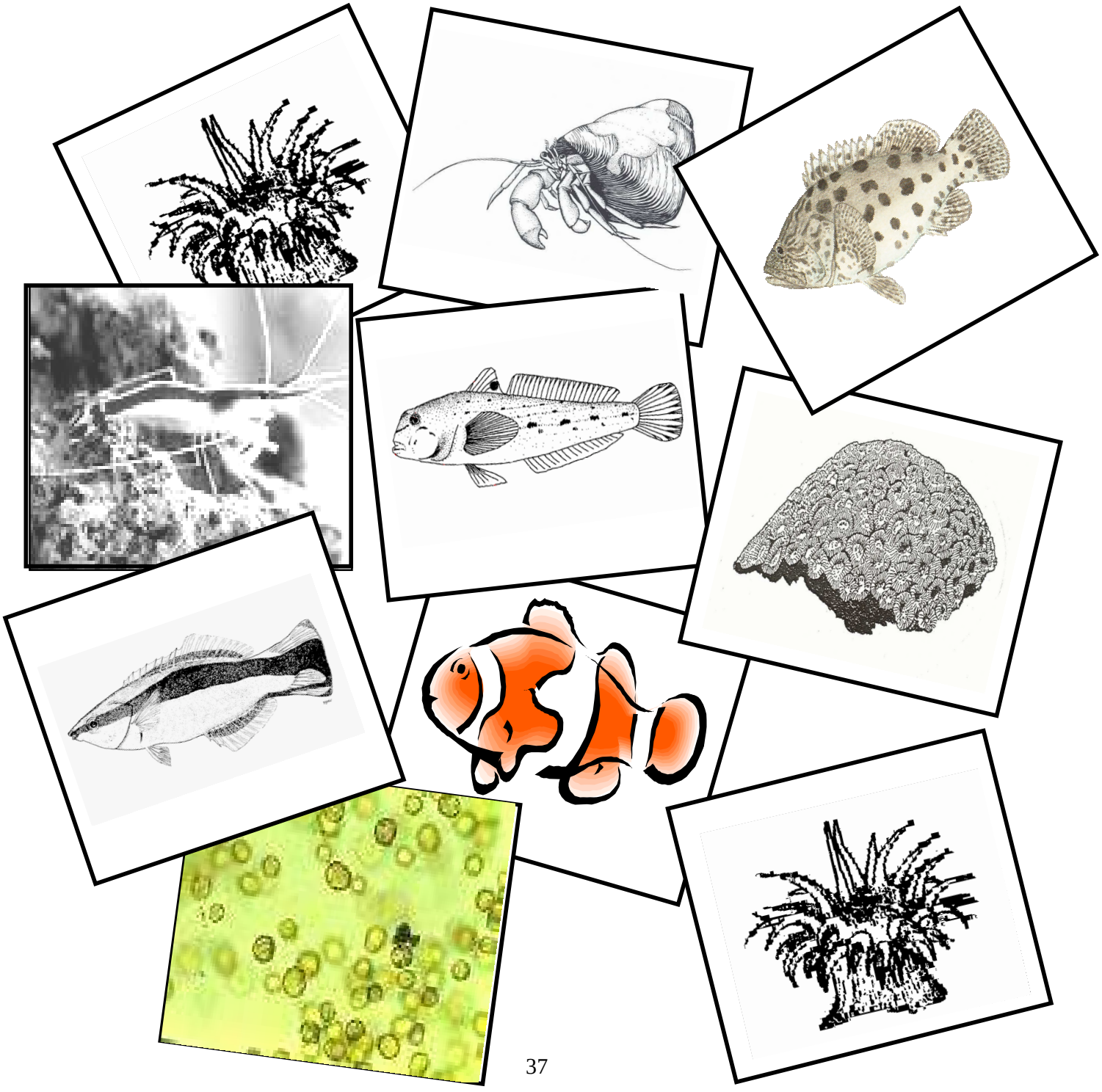
- AS3 Interpreting key ideas and patterns from the information given

What you need:

- The wanted ads and the animals who placed them or who are looking for partners.

What to do:

- Discuss with learners the partnerships found in, on and around a reef. Ask them to explain the different types of relationships the inhabitants of the reef have with each other. Ask students to explain symbiosis, mutualism, commensalism, and parasitism. Ask students to think about how humans might disrupt these relationships. Write their descriptions on the board.
- Then give them the "wanted ads" sheet and get them to match up the pairs.



Wanted Ads

Will Work for Food

Diverse group of maids available to clean. If interested, stop by Wrasse Alley during daylight hours. Only trustworthy fish allowed.

Rental Property Available

Mobile Home in A 4 meter square area. Subject to high turnover in ownership. Future relocation assistance available through original owner.

Dental Hygienist Needed

Desperate for a good teeth and gill cleaning. I may look tough, but you can trust me not to eat you!

Grocery Delivery Offered

Attractive fish couple looking for nice, safe home with security. Willing to do grocery shopping in exchange for rent.

The End is Near!

Photosynthetic partners needed immediately! Global warming threatens health of reef. Volunteers needed to aid in fight for survival. If available, report to any reef-building coral immediately.

Bodyguard Available

Off-duty security officer seeks room for rent. Willing to offer security services in exchange for rent. Would prefer a bottom dwelling.

House for Rent

Spacious and clean 100-tentacle home available. Built-in security system. Rent charges may be waived in exchange for other services.

Got Algae?

Have you recently lost your "helper" algae? Free-floating algae available and interested in "settling down" in the tropics. If you or a loved one are in need of assistance, call toll free 1-800-HELP.

Roommate Wanted

Visually impaired reef resident, looking for roommate to share luxury apartment on Benthic Avenue. Room and board FREE in exchange for security services.

Sodwana or Bust

Daily transportation around reef needed. I am deceptively beautiful and can offer bodyguard services in exchange for transportation.

Glossary:

Benton: Organisms associated with the bottom substrate of the ocean.

Bilateral Symmetry: A basic body plan in which the left and right sides of the organism can be divided into approximate mirror images of each other along the midline.

Bioerosion: **Bioerosion** describes the **erosion** of hard ocean substrates by living organisms by a number of mechanisms.

Bore: To make a hole in a solid substance.

Camouflage: The act, means, or result of obscuring things to deceive an enemy, as by painting or screening objects so that they are lost to view in the background.

Classification: The assignment of organisms to groups within a system of categories distinguished by structure, origin, etc. The usual series of categories is *phylum* (or, esp. in botany, *division*), *class, order, family, genus, species,* and *variety.*

Commensalism: Asymbiotic relationship in which one organism benefits but the other does not benefit, but is not harmed.

Five-rayed Symmetry: Having the parts in two or more series of organs the same in number – either 5 or multiplies of 5; exhibiting a symmetry.

Habitat: The natural environment of an organism; place that is natural for the life and growth of an organism.

Invertebrate: Of or pertaining to creatures without a backbone.

Medusa: A saucer-shaped or dome-shaped, free-swimming jellyfish or hydra.

Mutualism: A symbiotic relationship in which both organisms benefit.

Nekton: The aggregate of actively swimming aquatic organisms in a body of water, able to move independently of water currents.

Parasitism: A relationship between organisms in which one benefits from the relationship (Parasite) and the other (Host) is harmed.

Phylum: A group that has genetic relationship.

Plankton: The aggregate of passively floating, drifting, or somewhat motile organisms occurring in a body of water, primarily comprising microscopic algae and protozoa.

Polyp: Sedentary type of animal form characterized by a more or less fixed base, columnar body, and free end with mouth and tentacles, esp. as applied to coelenterates.

Predator: Any organism that exists by hunting and killing other organisms.

Radial Symmetry: A basic body plan in which the organism can be divided into similar halves by passing a plane at any angle along a central axis, characteristic of sessile and bottom-dwelling animals, as the sea anemone and starfish.

Sessile: Permanently attached; not freely moving.

Strategy: A plan, method, or series of manouvers for obtaining a specific result.

Symbiont: An organism in a symbiotic relationship.

Symbiosis: A relationship between two different types of organisms.

Useful Websites:

www.enchantedlearning.com/biomes/coralreef/coralreef.shtml

www.coralrealm.com

4. HOW DO CORALS EAT & REPRODUCE?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 7 & 8

Life Sciences Grade 10

Knowledge Area:

Life & Living and Energy & Change

Environmental Studies

Learning Outcomes:

Grade 7	LO2 – Constructing Scientific Knowledge	
Grade 10	LO2 – Construction & Application of Knowledge	

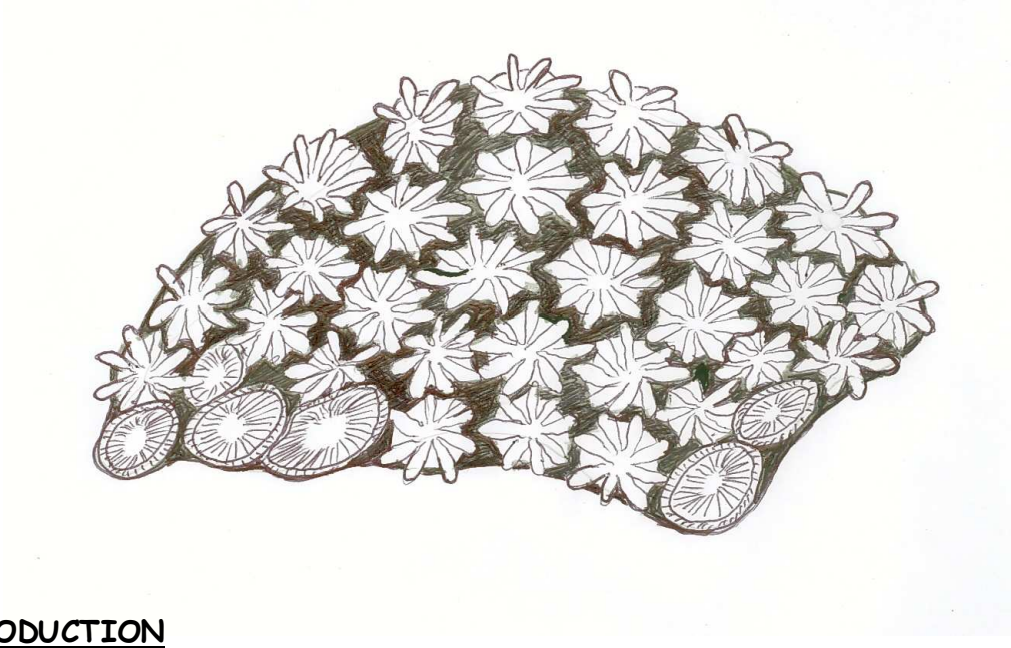
Assessment Standards:

Grade 7	LO2 – AS 4	Apply Knowledge to problems
Grade 10	LO 2 – AS 1	Accessing Knowledge
	- AS 2	Interpret and make meaning of knowledge
	- AS 3	Show an understanding of how knowledge is applied in every day life.

FEEDING

Corals can obtain food in a variety of ways. Reef-building corals rely on the **photosynthetic** products of zooxanthellae for most of their nutrients. However, corals also capture zooplankton for food. Their tentacles are used to sting prey and move it into the mouth. Some corals will trap prey in sticky **mucus** on their tentacles and move the prey into its mouth.

Most corals feed at night. This may be because night is when the zooplankton travel into the water column and become available for capture. Keeping the tentacles **retracted** during the day may also help corals avoid predation, protect themselves from UV light, and avoid shading their zooxanthellae.



REPRODUCTION

Corals exhibit **sexual** and **asexual** reproduction. The coral colony expands in size by **budding**. A common type of asexual reproduction in corals is by **fragmentation**. Broken pieces of corals that land on a suitable substrate may begin growing and produce a new colony. This type of reproduction is common in branching corals.

Many coral species mass **spawn**. Within a 24 hour period, all the corals from one species release their eggs and sperm at the same time. The **zygote** develops into a **larva** called **planula** which attaches itself to a suitable **substrate** and grows into a new colony.

4.1 HOW CORALS FEED

Corals, for the most part, are **carnivorous**, feeding mostly on small animals (zooplankton, suspended in the water column of the ocean in the evening and at night). Although a large colony of coral, each little polyp feeds individually by using its tentacles.

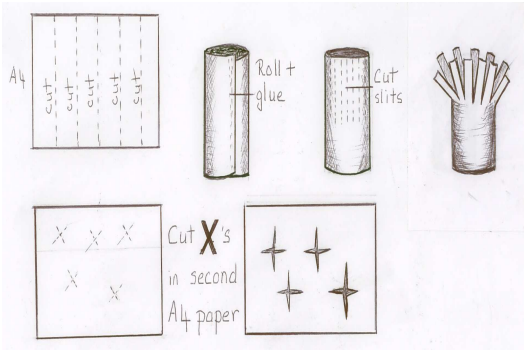
<u>Activity 1</u>: How the corals get their meal

Grade 10: LO2 – AS 1, 2 & 3 Using conceptual knowledge of how corals feed and relate it to the unfamiliar situation of building a feeding coral.

What you need:

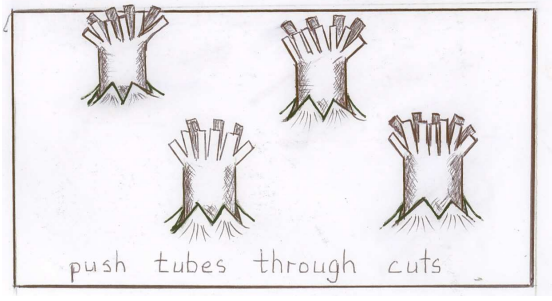
- 2 A4 coloured pieces of paper per learner,

scissors, glue or tape and Green pencils



What to do:

- Using the first A4 sheet, cut 3 strips 7cm wide length ways
- Cut each of those strips into 5cm pieces
- You should have 18 5cm x 7cm pieces of paper
- Dot each tube with a green pencil
- Roll each of the pieces of paper into a tube and fasten with glue or tape.
- Cut slits in each tube half way down
- Using the second A4 sheet cut small x (big enough for your tubes) in random points on the paper and place your tubes through.
- You can now demonstrate how the polyps can pull in and out of the 'skeleton' when feeding



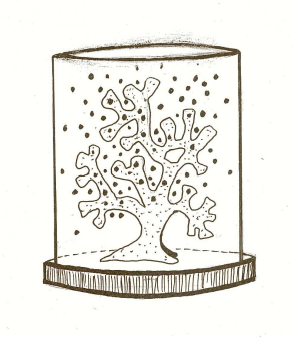
4.2 HOW CORALS REPRODUCE

Corals only spawn once a year, at night, near to or just after full moon. They will all spawn at the same time. Each species has its own time of year for spawning, and the eggs and sperm are released into the water column.

Activity 2: Coral Magic

Grade 7: LO2 – AS 4 Linking conceptual knowledge of how corals spawn and relate it to the building of a spawning coral model.

What you need:



- Play-dough or Clay
- Empty baby food jar, glitter, blue food colouring, foil, beads, glue, scissors and any other useful items.

What to do:

- Describe the different ways in which coral can reproduce – budding, fragmentation and spawning.
- Give each learner some play-dough or clay and ask them to make a coral polyp. Get them to then represent how the budding and fragmentation process works.
- Then give each learner a glass jar. Get them to make a miniature reef on the inside of the lid using all the other craft material. Make sure that it is glued down securely.
- Fill the jar with water and add a few drops of blue food colouring, and some glitter.
- Place the lid on tightly and shake.
- When the glitter moves around the reef, you can point out to learners that this represents how the corals spawn.

Glossary:

Asexual: Independent of sexual processes, especially not involving the union of male and female germ cells.

Budding: (In certain animals of low organization) A prominence that develops into a new individual, sometimes permanently attached to the parent and sometimes becoming detached.

Carnivorous: Flesh-eating.

Fragmentation: The act or process of breaking into fragments.

Larvae: The newly hatched, earliest stage of any of various animals that undergo metamorphosis, differing markedly in form and appearance from the adult.

Mucus: Protective secretion of the mucus membranes.

Photosynthetic: The synthesis of complex organic materials, esp. carbohydrates, from carbon dioxide, water, and inorganic salts, using sunlight as the source of energy and with the aid of chlorophyll and associated pigments.

Planula: Free-swimming larva of a coelenterate.

Retract: To draw back within itself or oneself, fold up, or the like, or to be capable of doing this.

Sexual: Having sexual organs or reproducing by processes involving both sexes.

Spawn: The mass of eggs deposited by fishes, amphibians, mollusks, crustaceans.

Substrate: A surface on which an organism grows or is attached.

Zygote: The cell formed by the union of two gametes, especially a fertilized ovum before cleavage.

Useful Websites:

www.seaworld.org/animal-info/info-books/coral/diet.htm

http://library.thinkquest.org/25713/corals.html

5. WHERE ARE CORAL REEFS FOUND?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies and Diversity & Change

Learning Outcomes:

Grade 8 & 9	LO2 – Constructing Scientific Knowledge
Grade 10	LO1 – Scientific Enquiry and Problem Solving
	LO2 – Construction & Application of Knowledge

Assessment Standards:

Grade 8 & 9	LO2 - AS 3	Interpret information
Grade 10	LO1 – AS 3	Analyze, synthesis and evaluate data
	LO2 – AS3	Show an understanding of knowledge in everyday life

Reef-building corals are restricted in their geographic distribution by their physiology. For instance, reef-building corals cannot tolerate water temperatures below 18^0 Celsius (C). Many grow optimally in water temperatures between 23^0 and 29^0C, but some can tolerate temperatures as high as 40^0C for short periods, in certain parts of the world. Most also require salty water ranging from 32 to 42 parts per thousand, which must also be clear so that a maximum amount of light penetrates it. The corals' requirement for high light is also very high, and most reef-building species are restricted to regions in the ocean where light penetrates to a depth of approximately 70 meters. The number of species of corals on a reef declines rapidly in deeper water. Corals are also generally absent in turbid, or murky waters, because high levels of suspended sediments smother them, clogging their mouths, and preventing feeding. In colder regions, murkier waters, or at depths below 70 m, certain species of corals still exist on hard substrates, but their ability to secrete calcium carbonate is greatly reduced.

With such tough environmental requirements, reefs generally are confined to tropical and semitropical waters. Not only are reef-building corals confined by a specific range of environmental conditions, but as adults, almost all of them are sessile. This means that for their entire lives, they remain on the same spot on the sea floor.

Corals are also sensitive indicators of the health of the aquatic environment. They flourish in a fairly narrow range of temperatures, salinity, and water purity, so the die-off of corals indicates the health of our oceans, and healthy oceans are essential if life on the planet is to be sustained in its current form.

Off the KZN coast line, near Umkomaas, lies Aliwal Shoal. This is a rocky reef that formed many years ago. The area used to be a bed of sand dunes, and as heavy rains fell, so the sand and shell dissolved and formed a compound of calcium carbonate and dune rock. With prehistoric rise in sea levels the dune became submerged and more deposits were made.

The topography was very rugged with pinnacles, gullies and caves. This rocky reef has developed into a fascinating site with an abundance of soft corals, sponges, fish, turtles and sharks. Healthy coral reefs foster species diversity. Sponges, molluscs, oysters, clams, crabs, shrimps, sea urchins, turtles, and many fish seek food and shelter on reefs. The architecture of corals provides reef fish protection from carnivorous species such as sharks and barracudas. Sea cucumbers, worms, and molluscs burrow into the reefs sand to hide from their enemies. Reefs include only 0.3 percent of the ocean area, but one in of every four ocean species has been identified as a reef-dweller; this includes at least 65 percent of marine fish species.

5.1 SUCCESSFUL CONDITIONS

Corals release thousands of eggs and sperm, and some will join to form planulae. But not all of the Planulae will survive. Many planulae are eaten by other marine organisms before they are able to settle on the bottom and start growing. By producing large numbers of offspring the corals increase their rate of survival.

Activity 1: Who will survive?

> **Grade 10**: LO2 – AS 3 Show an understanding of how corals reproduce and how their reproduction numbers may be limited.

What you need:

- The cut out numbers
- The introductory information

What to do:

- Talk about the **limiting conditions** of coral survival, and the reproduction process (read back in chapter 4).
- Give each learner in the class an **environmental factor** (Depth, Temperature & Wave action) number for the three conditions. You may photocopy and repeat the number sequence – so more than one learner will have the same number.
- Get all of the learners to stand up.
- Then call out 3 temperature numbers – only the learners with those temperatures may remain standing – the rest must sit.
- Then call out 3 depth numbers – if they have the number they may remain standing.
- Then call out 3 wave action numbers – if they have the numbers they may remain standing.
- You can now discuss how few learners are left standing, and how this represents the few coral polyps that survive.

Who will survive activity sheet

Depth: Only depths between 0m and 28m may be called out, the others are too deep.

0	2	4	6	8
10	12	14	16	18
20	22	24	26	28
30	32	34	36	38
40	42	44	46	48

Temperature: Only temperatures between 23°C and 29°C may be called out, the others will be too warm or cold.

18	19	20	21	22
23	24	25	26	27
28	29	30	31	32
33	34	35	36	37
38	39	40	41	42

Wave Action: Only numbers between 4 and 6 may be called out, the others are too weak (and don't bring nutrients) or strong (and cause damage to the reef).

0	1	2	3	4
5	6	7	8	9
0	1	2	3	4
5	6	7	8	9
0	1	2	3	4

5.2 BIODIVERSITY

There are many more different organisms found on coral reefs than re found in any other environment in the ocean. Coral reefs cover less than 0.2% of the total area of the ocean, yet they have some of the highest **productivity** on the earth, and house 25% of all marine creatures. Like a rain forest, coral reefs support a wide **variety** of life.

Activity 2: Vast Variety

> **Grade 10**: LO2 – AS 3 Show an understanding of the variety of life on a coral reef, and how the organisms manage to survive.

What you need:

- The reef variety picture
- The introduction information

What to do:

- Talk about **Biodiversity**, and why it is important.
- Talk about how animals/plants have adapted themselves for that environment, and why this creates biodiversity.
- Give each learner a copy of the Reef Variety picture, and let them find something that describes the clues.
- They need to describe how those animals are adapted to their environment.
- They could then give a brief statement about why the variety reef could be considered diverse.

The Variety Reef

See if you can find the following creatures:

A medusa shape

Something with a flattened body

Something spiky

Something swift

Something with a shell

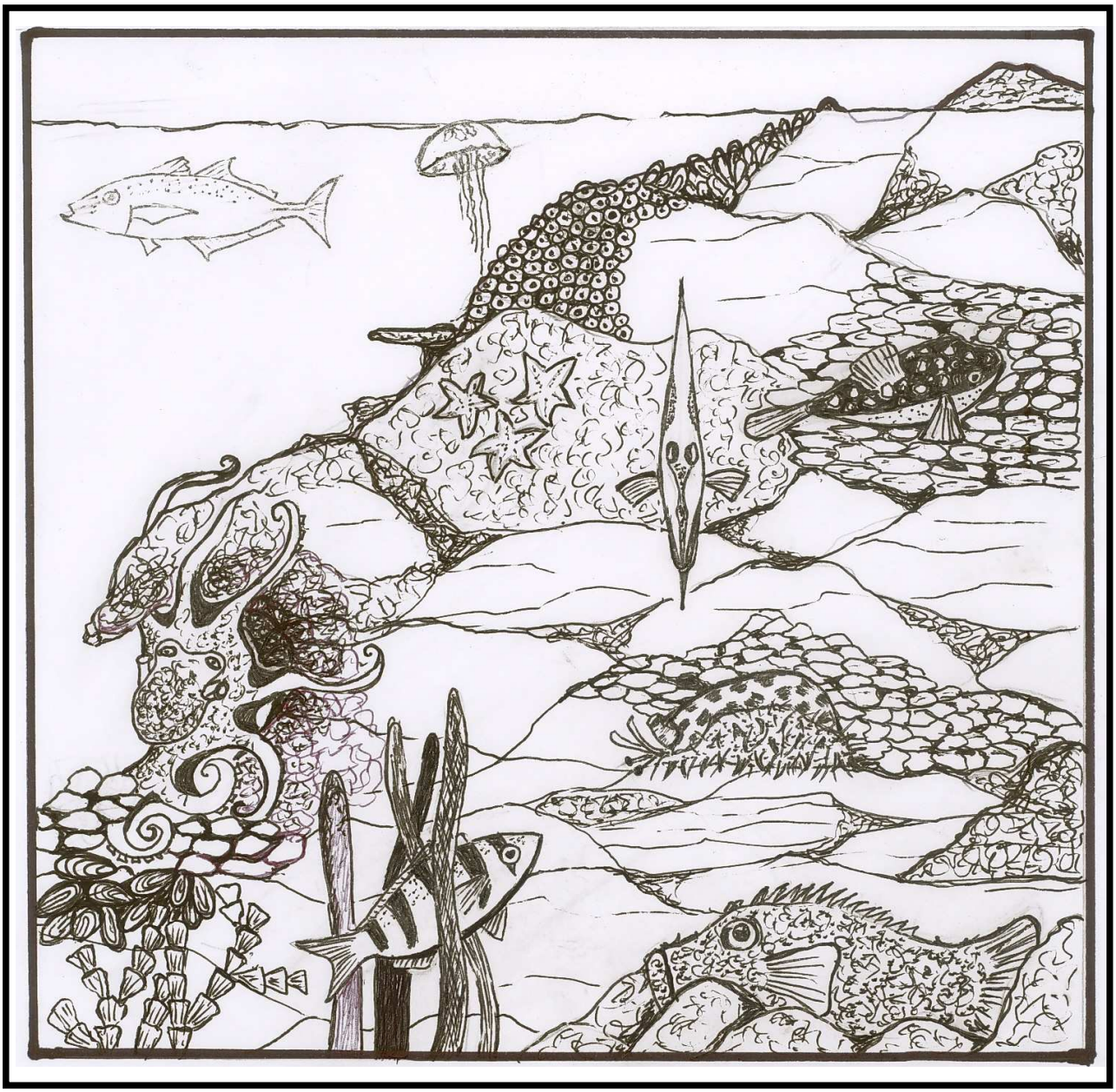
Something with stripes

Something with legs

Something well camouflaged

Something soft

Something jelly-like



Activity 3: Reading graphs

Grade 8 & 9:	LO2 – AS 3 Using graphs to interpret and translate information about Reef Biodiversity and therefore make predictions.
Grade 10:	LO1 – AS 3 Analyse, synthesise and evaluate the data about Reef Biodiversity using the graph.

What you need:

- The Worksheet on graphs

What to do:

- Go through how to read graphs with the learners, and how to **predict trends**.
- Give them the worksheet and let them complete it.
- Once they have completed it, go through it with them and make sure they have the understanding of how to interpret the information correctly.

Losing Biodiversity - Why?

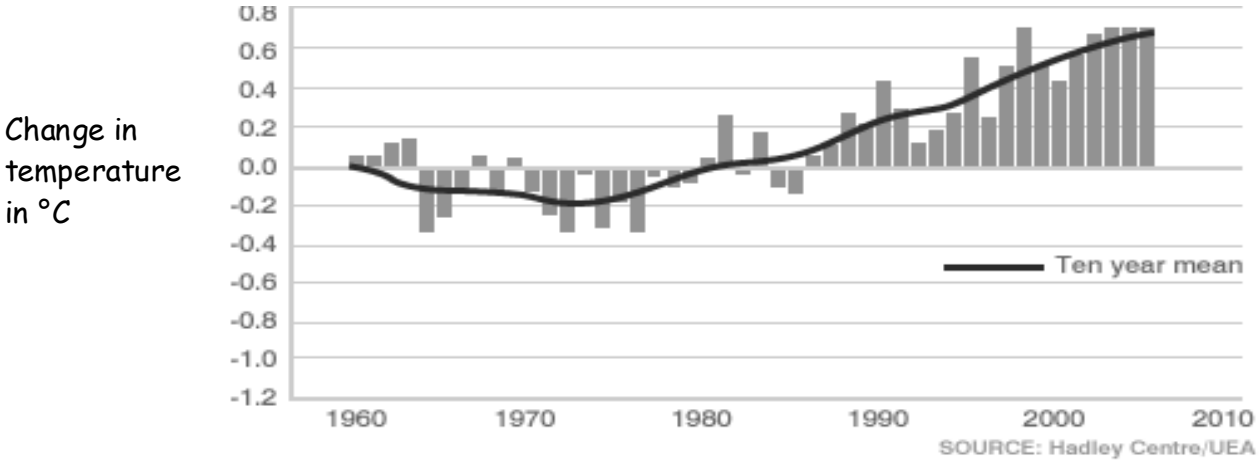
Status of Coral Reefs 1992 - 2004

(Dr. Clive Wilkinson, http://www.iyor.org/cbd/)

year	**Reefs lost %**	Reefs critical %	Reefs threatened	**Reefs healthy**
1992	**10**	30	30	**30**
1998	*	27	31	**42**
2000	**27**	14	18	**41**
2004	**20**	19	21	**40**

1. Use the information from the table to construct a bar graph.
2. What are the emerging trends that you can see between 1992 and 2004?
3. Do you think that people have been taking notice of the problem, and trying to do something to prevent it? Explain your answer.

The Change in Temperature between 1960 and 2005



Use this graph to predict what will happen by 2010, and how this will affect the biodiversity of coral reefs.

Glossary:

Biodiversity: Diversity among and within plant and animal species in an environment.

Environmental Factors: Both the biotic and abiotic components that affect a system.

Limiting Conditions: Conditions that affect or halt a situation.

Prediction: A statement made about the future.

Productivity: The rate at which radiant energy is used by producers to form organic substances as food for consumers.

Trends: The general direction in which something tends to move.

Variety: A taxonomic subdivision of a species consisting of naturally occurring or selectively bred populations or individuals that differ from the remainder of the species in certain minor characteristics.

Useful Websites:

http:www.solcomhouse.com/coralreef.htm

6. WHY ARE REEFS IMPORTANT?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 7, 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 7, 8 & 9	LO3 – Science, Society and the Environment	
Grade 10	LO3 – Life Science, Technology, Environment and Society.	

Assessment Standards:

Grade 7, 8 & 9	LO3 – AS 2	Understand sustainable use of the Earth's resources
Grade 10	LO 3 - AS 2	Compare and evaluate the use/development of resources and their impacts on the environment
	LO3 – AS 3	compare the influence of different beliefs attitudes of Scientific Knowledge

Reefs are like the underwater gardens of the sea. Like your own garden, they house a variety of creatures and plants that all co-exist together. Reefs are responsible for supporting an incredible amount of life. If they were not there, that area would be **barren**.

All people, all over the world depend on reefs for food and protection against **wave action**. Some tropical islands are constructed solely on coral **fragments**.

6.1 THE IMPORTANCE OF REEF ECOSYSTEMS

Healthy coral reefs provide:

- **Habitat:** Home to over 1 million diverse aquatic species, including thousands of fish species.
- **Income:** Huge source of income and millions of jobs in over 100 countries around the world from fishing and reef monitoring.
- **Food:** For people living near reefs, especially on small islands.
- **Protection:** A natural barrier protecting coastal cities, communities and beaches from wave action and natural disasters.
- **Medicine:** The potential for treatments for many of the world's most prevalent and dangerous illnesses and diseases. The Cone Shell poison is being researched for properties that could alleviate heart disease.
- **Aesthetic:** Also, their beauty makes reefs a powerful attraction for **tourism**, and well managed tourism provides a sustainable means of earning foreign currency and employment for people around the world, even in remote areas of developing countries.

<u>Activity 1</u>: What your choice says about you!

Grade 7, 8 & 9: LO3 – AS 2 Understanding the **sustainable** use of the earth's resources with a focus on reefs	
Grade 10:	LO3 – AS 3 Influence of beliefs/attitudes on scientific knowledge

What you need:

- The Worksheet below with statements about the importance of reefs.

What to do:

•Let the learners read the statements and rank them in order of importance to them – they can then look at what their choice says about them.

1

A place with huge *biodiversity*, that is home to many animals – some of which are endangered.

2

Attracts many *tourists* from throughout the world – they spend lots of money, and it supports local business.

3

The reef provides our growing populations with a source of *food* – many species live and reproduce on reefs.

4

Coral reefs have provided *scientists* with many new medicines & foods, and things useful in

5

Reefs are ***bio-indicators***. They tell us when things are going wrong with our air and water and other ecological processes.

6

Reefs provide *protection* from erosion of the shore, and damaging wave action, as they act as barriers.

1 – Nature Lover
2 - Business orientated
3 – Look after peoples' basic needs
4 – Enjoy Science & Technology
5 – Conservation & think of the bigger picture
6 – Practical person who respects the natural order of things

Activity 2: Fishy Problems

Grade 10: LO3 – AS 2 A look at the use and development of technology and their impact on coral reefs

What you need:

- The fishy problems worksheet

What to do:

- Discuss the fact that human beings have an impact on reef ecosystems through fishing pressure.
- Let the learners work through the worksheet, and discuss it when they are complete.

Fishy Problems

1. The world's oceans are filled with more than 1 million large fishing vessels and 2 million smaller ones. About 12, 5 million people make their living from fishing, and 150 million are involved in the processing of fish.

a) How many ships fish the world's ocean?
b) On average, how many people are needed for each boat that is out at sea?
c) On average, how many people are needed on shore for each boat that is out at sea?

2. Coral reefs in the Philippines have been damaged due to dynamite explosions. Up to 6 explosions per hour kill 1800Kg of fish.

a) Assuming that there are 8 fishing hours in a day, how many fish were killed in one day?
b) How may Kg of fish have been caught in one day?

3. In the Philippines, it is estimated that 1Km^2 of poor condition reef can produce 5 tons of fish in a year – this can only feed 10 people. If you had a healthy reef that can feed between 400 – 700 people per year, how many tons of fish would that reef produce?
4. An estimate suggested that 37% loss of fish production in a year due to coral destruction, and only 159 000 tons of fish were produced in a year. If fish production was 100%, how many tons of fish would there be?

6.2 ECO-TOURISM

Scuba (Self Contained Underwater Breathing Apparatus) Diving has one of the greatest impacts on coral reefs. Each year hundreds of divers visit reefs around the world to participate in the recreational activity of SCUBA Diving. This industry provides a lot of wealth for both tour operators and the hospitality industry, yet the only ones to suffer are the reefs themselves.

Amateur divers who have not got their **buoyancy** right, often bump and crash over the reef, damaging corals and other animal homes as they go.

Some divers may disturb animals as they swim past, or collect **souvenirs** to take home. Not to mention the damage that the dive operator's anchor does when slamming into the reef. And some dive operators **'chum'** the water (place fish blood and oils into the water) in order to attract lots of fish and sharks – this creates a very false impression for the divers.

Two strategies that may reduce impacts of SCUBA divers on coral reefs are managing the behaviour of divers to minimise contact with the substratum and managing impacts through appropriate selection of dive sites.

Dive tourism operators can promote 'environmentally friendly' diver behaviour at their sites by;

- presenting a short commentary to visiting divers about the vulnerability of corals to physical stress,
- encouraging divers to stay at least 1 meter above or away from the reef, and
- encouraging underwater photographers to be more aware of their actions when taking photographs.

Operators can also minimize diver impacts by selecting dive sites that have minimal cover of branching corals.

Individual divers can make sure that they choose eco-friendly dive operators; this should encourage more environmentally friendly practices.

Activity 3: Sustainable diving

Grade 10: LO3 – AS 2 A look at the use and development of technology and their impact on coral reefs

What you need:

- The 3 coral reef templates with coral cut outs and instructions.

What to do:

- Discuss with the learners about the impacts of divers and tour operators, and possible ways of making the process eco-friendly.
- You can divide the class up into groups. Give each group a set of reefs with their rules.
- Within each group they will need to divided themselves into 3 groups, and choose an inspector.
- They will follow the step by step instructions and see how their reefs are impacted.
- Afterwards you can discuss the concept of sustainability with the learners.

Sustainable Diving Instructions

Each group should have been given a reef with 20 cut outs of the coral animals.

There are 3 Tour operators; Dolphin Deep Diving, Turtle Express Diving and Reef Adventure Diving.

Each tour operator takes divers out to their own reef area. They operate with different numbers of people and at different times, each of them therefore impacting on their reef differently.

Dolphin Deep Dive changes their dive numbers per week, but tries to keep it at a minimum of two.

Turtle Express has a fixed requirement of 4 divers per week.

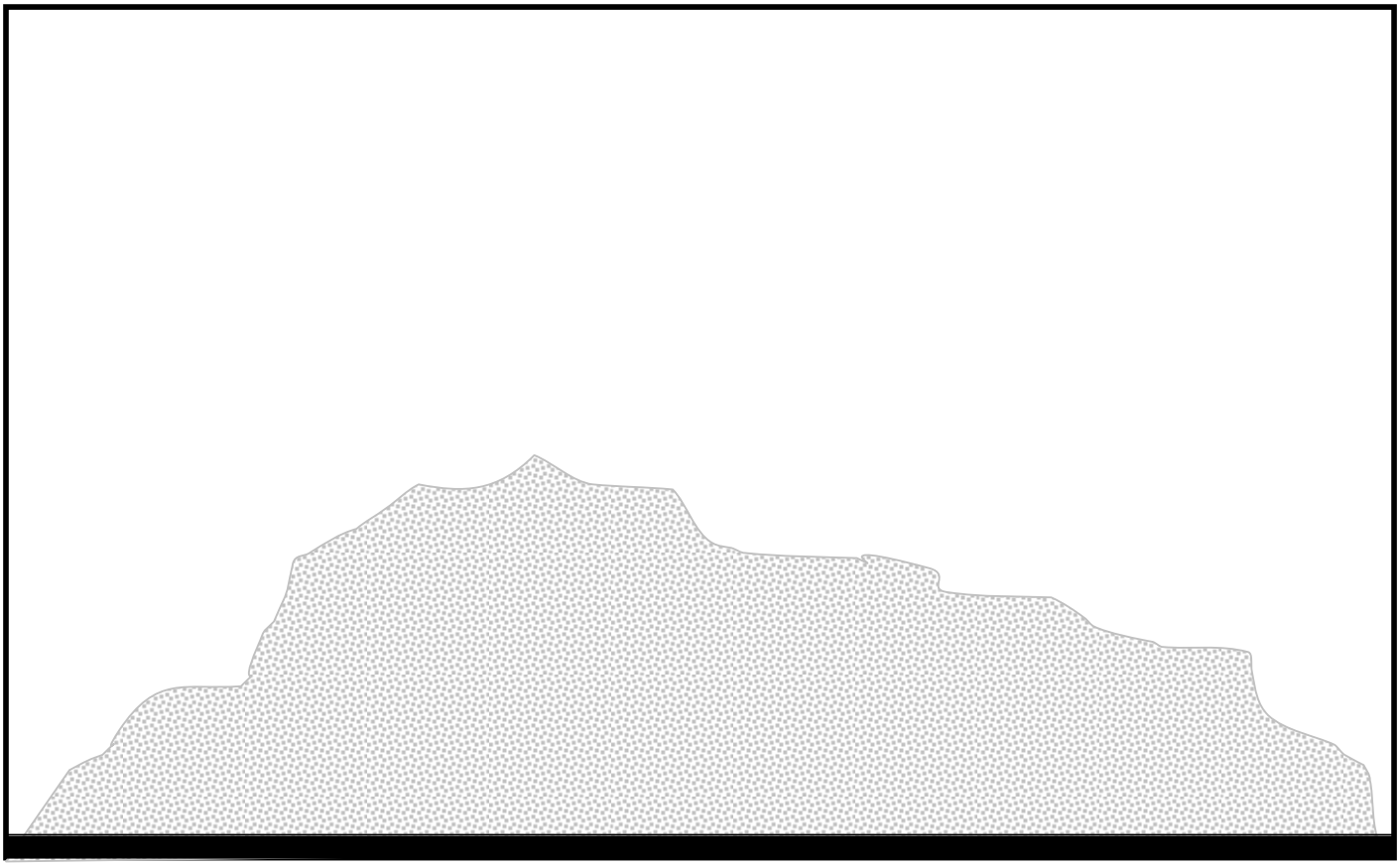
Reef Adventure Diving increases their divers as the business grows.

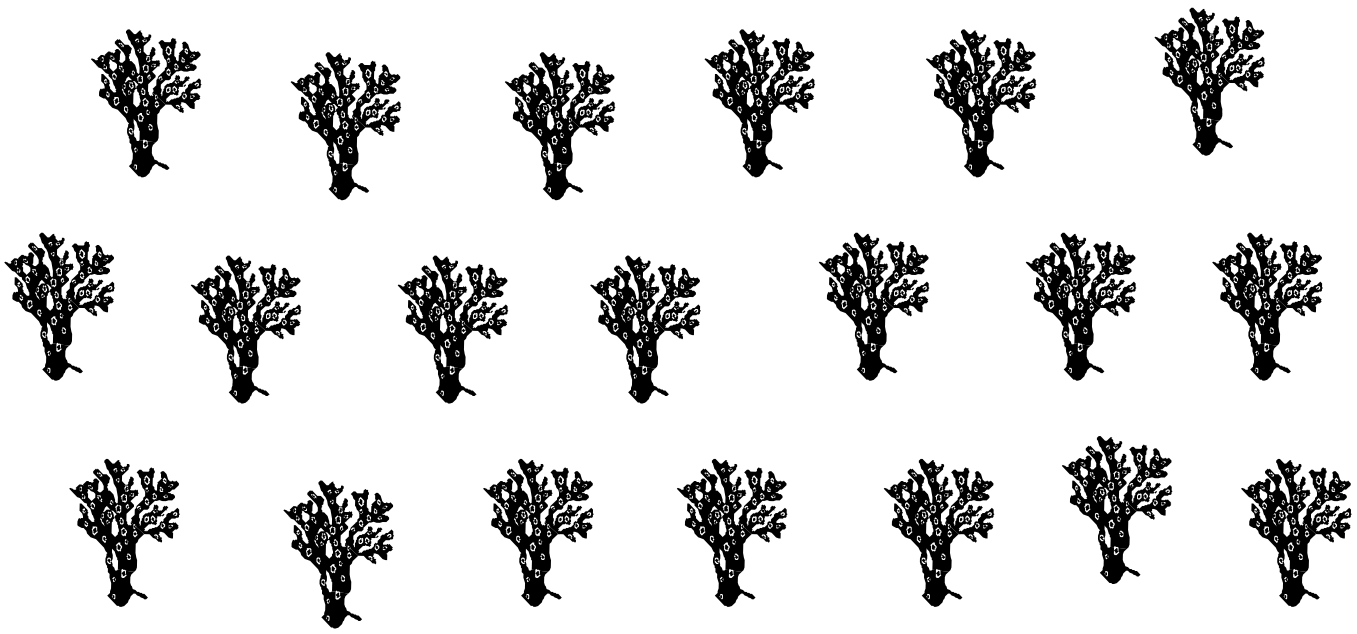
For each diver that goes down at any time, one piece of coral is damaged. Three corals are replaced every two weeks.

Follow the movements of each of the dive operators and see what happens to their reefs. You will take the correct number of damaged corals out and only replace 3 corals every two weeks. Remember – if there are no corals left, no corals can be reproduced.

Week	Dolphin Deep Divers	Turtle Express Diving	Reef Adventure diving
1	3 divers	4 divers	3 divers
2	5 divers	4 divers	3 divers
3	2 divers	4 divers	4 divers
4	4 divers	4 divers	4 divers
5	2 divers	4 divers	6 divers
6	2 divers	4 divers	6 divers
Total coral left			

You will need to replicate this page for each of the operators. Cut out the corals and place them on the reef.





Glossary:

Amateur: A person who engages in a study, sport, or other activity for pleasure rather than for financial benefit or professional reasons.

Barren: Not producing or incapable of producing.

Bio-Indicators: Species or chemicals used to monitor the health of an environment or ecosystem.

Buoyancy: The power of supporting a body so that it floats; upward pressure exerted by the fluid in which a body is immersed.

'Chum': Cut or ground bait dumped into the water to attract fish to the area where one is fishing.

Fragments: A small part broken off or detached.

SCUBA: Self Contained Underwater Breathing Apparatus.

Souvenirs: A token of remembrance; a memento.

Sustainable: Capable of being continued with minimal long-term effect on the environment.

Wave action: The wave movements over a substrate or inshore area.

Useful Websites:

http://oceanworld.tamu.edu/students/coral/

http://www.coralfilm.com/edu.html#guide

7. WHY ARE CORAL REEFS THREATENED?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 8 & 9	LO2 – Constructing Scientific Knowledge	
Grade 10	LO2 – Construction & Application of Knowledge	
	LO3 – Life science, Technology, Environment and Society	

Assessment Standards:

Grade 8 & 9	LO2 – AS 2	Categorise information
	- AS 3	Interpret information
Grade 10	LO2 - AS 3	Show an understanding of how knowledge is Applied in everyday life
	LO3 – AS 2	Compare & evaluate the use and development of resources/products and their impact on the environment

Coral reefs may be threatened due to natural events or due to human influence.

Natural events may be in the forms of hurricanes, **typhoons**, **El Nino**, coral eating organisms or disease. They cannot be controlled, and could affect coral reefs at any time.

Wave action caused by hurricanes, typhoons and El Nino affect both hard and soft coral, and can cause changes in water temperature and **salinity**.

Animals like fish, snails, worms, crabs, prawns, sea stars and over grown algae can cause the death of corals. Parrot fish also kill coral when they break open the calcium carbonate skeleton to eat the coral polyp.

Human Threats may be in the forms of over fishing, destructive fishing practices, **sedimentation**, coastal development, **sewage**, other pollution, and rising global temperatures.

Over fishing and destructive fishing practices cause damage on the reefs by dislodging the reef with anchors or nets or sinkers.

Sedimentation that is caused by agriculture and erosion on land, that is then washed into the rivers and out to sea, smothers the coral reefs and they soon die off.

Coastal development, sewage and other pollutants affect the reefs – being washed down the rivers and dumping toxic waste over the reefs.

Rising global temperatures, which are caused by increased carbon emissions, cause the sea temperature to rise and the zooxanthellae leave the corals causing coral bleaching. The uptake of CO_2 by oceans initiates a series of chemical reactions that increase acidity and decrease carbonate ion concentration in seawater. Corals and other marine organisms use carbonate ions to build their skeletons or shells. With fewer carbonate ions available, there could be a dramatic reduction in the growth of both the corals and marine plankton species that make their shells from aragonite. As the oceans become more acidic, corals are expected to build weaker skeletons, a process similar to osteoporosis in humans.

7.1 THREATS TO REEFS

Reefs have survived countless changes in the environment, and yet today they are a lot more threatened than ever before. See if you can figure out why!

<u>Activity 1</u>: Natural or Man made?

Grade 8 & 9: LO2 – AS 2 Categorizing information about coral reefs into the two categories of natural and man made.

What you need:

- The Introductory information about the threats to reefs.
- The statements below.

What to do:

- Discuss with the learners the threats to reefs, both natural and man made.
- Then get them to mark the statements with an N for natural and an M for man made.

Natural or Man Made?

_____ 1. Cyclones and storms break off pieces of coral.

_____ 2. Construction on the coast causes muddy water which smothers the reef.

_____ 3. Fishing methods such as dynamite blasting, boat anchors, nets all damage the reef.

_____ 4. A high amount of rainfall dilutes the sea water and makes it too fresh for corals.

_____ 5. Divers, fishermen, and snorkelers damage the reef with boats and anchors, as well as touching and breaking pieces off the coral.

_____ 6. Changes in the ocean currents can cause sediment build up.

_____ 7. Collecting tropical fish and other animals as pets or for trade can deplete the reef of life.

_____ 8. Pollution affects the water quality and corals are unable to cope.

_____ 9. Predators such as parrot fish or crown of thorns sea star damage and eat coral reefs.

_____ 10. Coral bleaching occurs due to warmer water caused by global temperature increase.

<u>Activity 2</u>: Coral bleaching – colour loss (due to the loss of zooxanthelle)

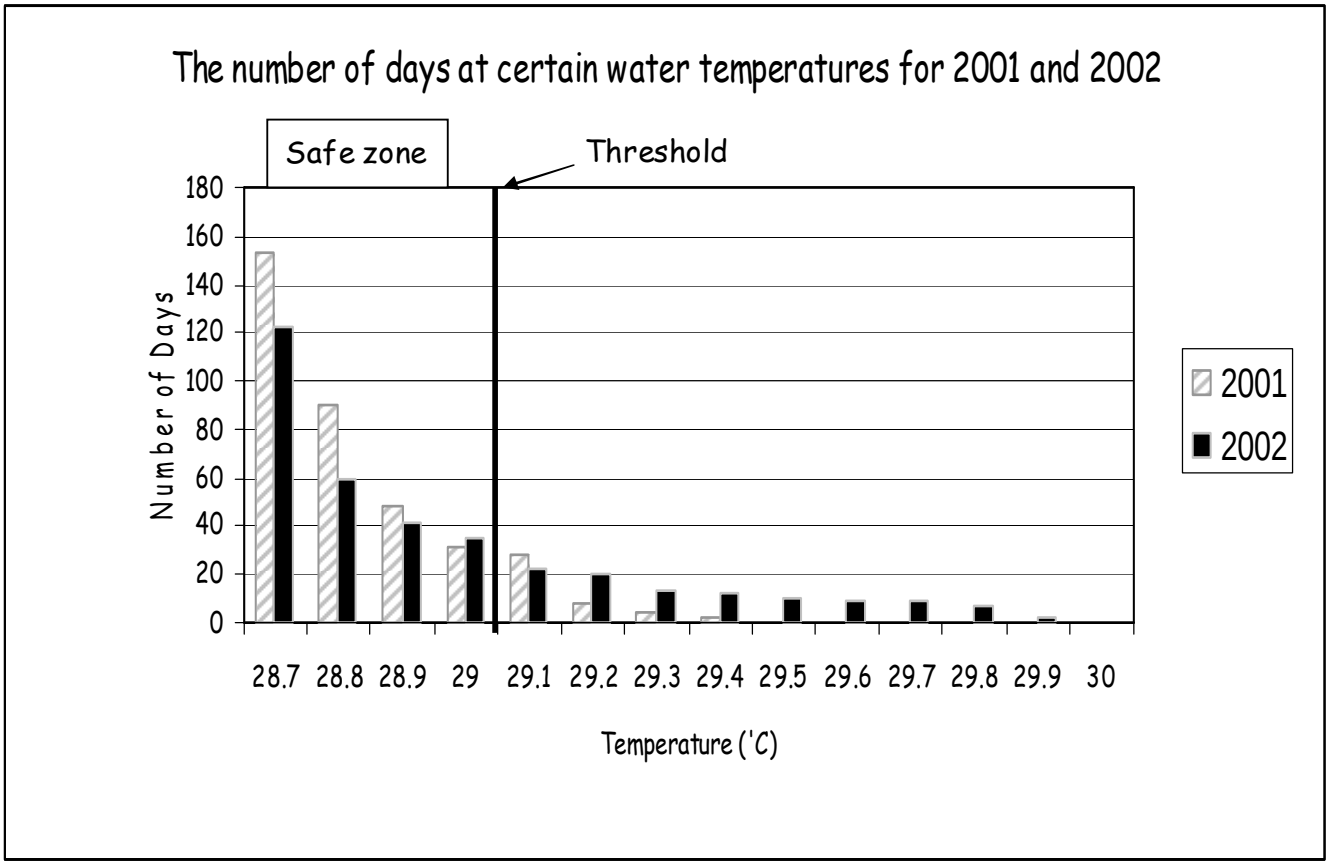
Grade 9 & 10: LO2 – AS 3 Translate the given data and make predictions of what might happen to coral reef ecosystems when temperature rises.

What you need:

- The graph and questions below

What to do:

- Talk about the relationship between temperature and coral bleaching.
- Go through the graph with the learners, and allow them to answer the questions



Questions:

1) What do you think is meant by the safe zone?

2) What do you think is meant by the word **Threshold**?

3) What can you say about the 2001 water temperatures?

4) What happened to the water temperatures in 2002? Explain.

5) How would this affect the corals?

6) Explain your answer in 5 using the word threshold.

7) What is the difference between 2001 and 2002, in the number of days, where the temperature is greater than 29°C?

8) Do you think this is very significant?

9) If you had to predict what was going to happen in the next 10 years, what would you say?

10) What can we do to try and prevent this from happening?

7.2 THREATS TO BIODIVERSITY

Biodiversity can be described as the number of different organisms found within an area. There are many environmental factors which affect this. Biodiversity is often used as a measure of the health of biological systems.

During the last century, a decrease in biodiversity has been increasingly observed. Some studies show that about one eighth known plant species is threatened with extinction. Some estimates put the loss at up to 140,000 species per year. This figure indicates unsustainable ecological practices, because only a small number of species reproduce each year. Almost all scientists acknowledge that the rate of species loss is greater now than at any time in human history, with extinctions occurring at rates hundreds of times higher than previously. The factors that threaten biodiversity have been variously categorized. Edward O. Wilson prefers the acronym HIPPO, standing for Habitat destruction, Invasive species, Pollution, Population, and Over harvesting.

Activity 3: Threats to biodiversity

Grade 10: LO3 – AS 2 A look at how technology has impacted on the environment in terms of alien invasive.

What you need:

- The diagram below

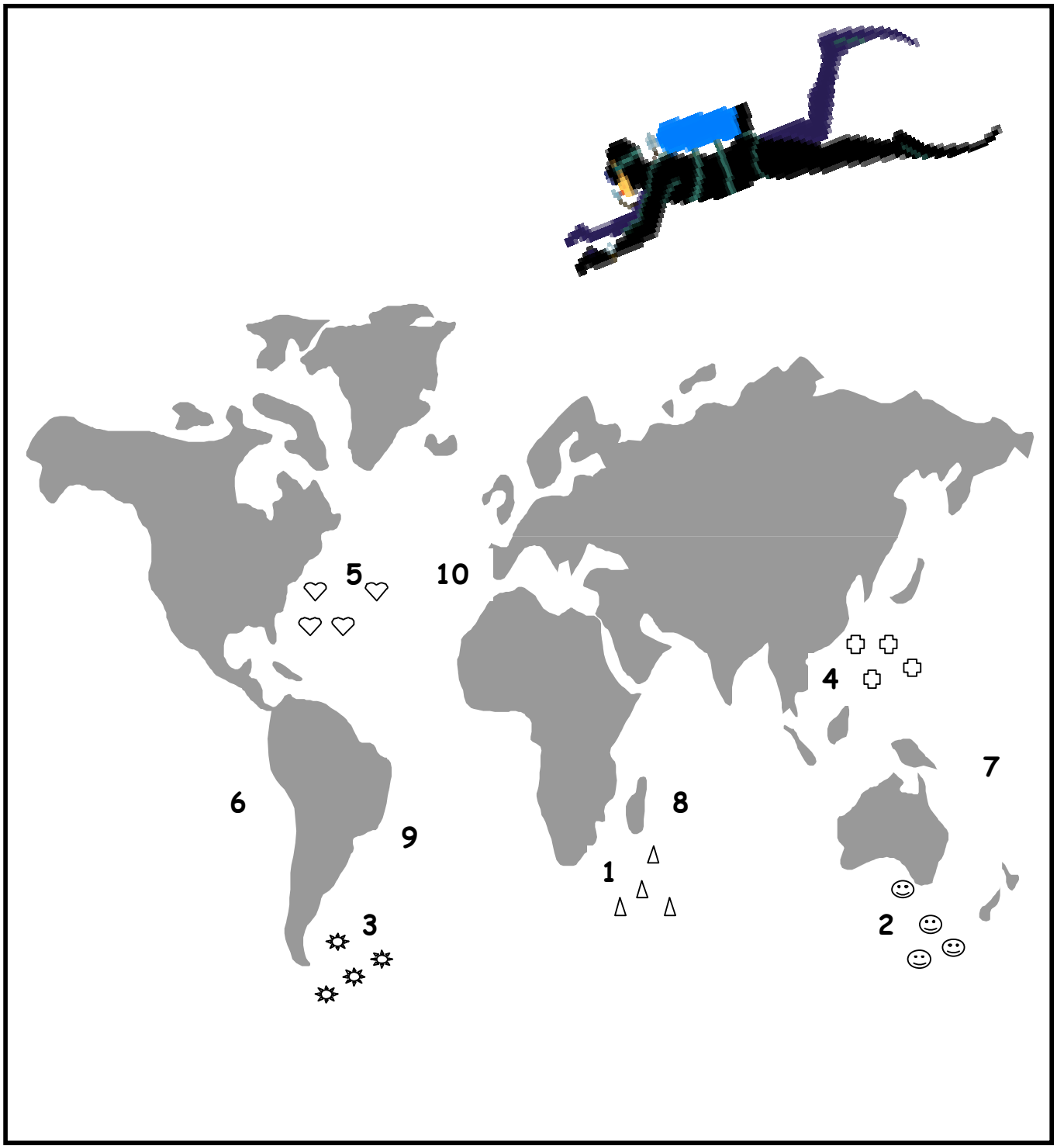
What to do:

- Discuss the factors that threaten biodiversity, and then focus on alien invasive species.
- Describe what alien invasive species are, and how they may be transported from one place to another. Then follow the diver around the map.

A Dangerous Dive Adventure

Use the map, and follow the diver as he moves around the world diving. Each time he dives, something climbs into his gear – he is not eco-friendly, and does not wash his gear. As he moves from place to place he deposits alien animals from the previous place into the new place. Draw in the alien animals that are deposited each time he moves.

At the end of his diving adventure, describe what the map now looks like compared to the start. How will this affect all the natural inhabitants of each Reef?



7.3 THREATS ON ROCKY REEFS

Exploitation of various reef-dwelling sparid species often has a great impact on the reef ecosystem. Many sparids are a popular target for boat, line and spear fishermen. However, sparids grow slowly and are long lived, reaching ages of 17 to 21 years. This makes them vulnerable to fishing pressures as they grow slowly and mature at a late age. They also have the ability to change sex, and because of this, the larger fish are all of the same sex. So if only the large fish are caught, it reduces the number of males or females and therefore the reproductive ability of the species. Observed data shows that sex ratios outside the marine reserve were skewed towards the females, a result of size selective exploitation. Considering the possibility that reproduction could be impaired as a result of changes in population structure, the tactic of protection through marine reserves is supported.

Activity 1: Threats to Rocky reef species and management practices

Grade 10: LO3 – AS 2 A look at different management practices and how they impact on a rocky reef environment.

What you need:

- The Fish Chart below & possible management options

What to do:

- Discuss the management options below.
- Using the management options, and decide which options you could put in place to best protect the fish species. Consider when the fish breeds, how big it grows and where it is found.

Size Limit: The maximum or minimum size allowed.

Bag Limit: The total number of fish that may be caught in one day by one person.

Gear Limit: A restriction on the type of equipment used to catch that species.

Marine Protected Area: A closed area where no fishing may take place.

Closed season: A certain time period when that species may not be fished.

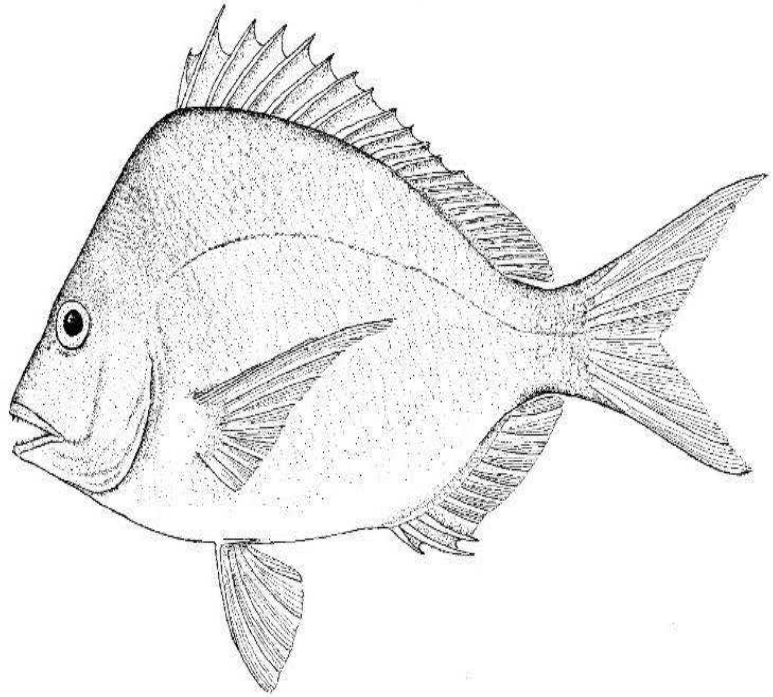
SLINGER

Min size = 25cm

Bag Lim = 5

IDENTIFICATION: Slinger is a deep bodied fish with a steep forehead. They are pink in colour, and have distinct blue under the eye. It reaches a maximum length of 600mm

REPRODUCTION: Slinger reaches sexual maturity at 240mm (females). As they grow they change sex from female to male at approximately 35cm. Spawning occurs June to October.



GROWTH: Slinger reach a maximum age of about 15 years. Females mature at about 3 years and change sex at between 5 & 6 years old.

FISHERY: Slinger are an important line fish & make up 30% of total commercial catch by weight. In KZN ratio of males:females is 1:20, but at St Lucia it is 1:4

Glossary:

Cyclone: A large-scale, atmospheric wind-and-pressure system characterized by low pressure at its center and by circular wind motion, counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere.

El Nino: A warm ocean current of variable intensity that develops after late December along the coast of Ecuador and Peru and sometimes causes catastrophic weather conditions.

Salinity: The relative proportion of salt in a solution.

Sedimentation: The phenomenon of sediment or gravel accumulating.

Sewage: Liquid and solid waste carried off in sewers or drains.

Sparid: A family group of fish that is able to change their sex at different points in their reproductive cycle.

Threshold: The point that must be exceeded to begin producing a given effect or result or to elicit a response: *a low threshold of pain.*

Useful Websites:

http://www.lizasreef.com/HOPE%20THE%20OCEANS/threats_to_coral_reefs.htm

http://www.oceansalive.org/exlore.cfm?subnav=article@contentID=4709

8. HOW CAN WE PROTECT REEFS?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 7, 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 7, 8 & 9	LO3 – Science, Society and the Environment	
Grade 10	LO3 – Life Science, Technology, Environment and Society.	

Assessment Standards:

Grade 7, 8 & 9	LO3 – AS 2	Understand sustainable use of the Earth's resources
Grade 10	LO 3 - AS 2	Compare and evaluate the use/development of resources and their impacts on the environment

The **Greenhouse effect** is a natural phenomenon that is needed to keep the earth warm.

As solar energy enters into our atmosphere and is reflected off the earth's surface, some is trapped within the atmosphere, and this is caused by the gases in the atmosphere.

But with modern technology, we are producing more and more greenhouse gases. These gases include Nitrogen oxides, ozone, carbon dioxide, methane and Carbonfluorocarbons (CFC's).

These gases trap the solar energy that is usually reflected off the earth's surface, and cause an overall warming of the earth.

Carbon dioxide accounts for more than 64% of the total absorption of infrared energy, and this is having a significant effect on **Global warming**. As mentioned previously, an increase in temperature causes the zooxanthellae to leave the coral (known as coral bleaching) and the corals cannot survive for long with out them.

Unless we all take an active part in trying to reduce our carbon **emissions** and slowing down this process, there will be a doomed destiny for our coral reefs.

We need to look at ways and practices that can protect our natural environments and reef areas.

8.1 DIFFERENT PRESPECTIVES ON THE STATE OF OUR REEFS

Most people will have a different perspective on a situation, depending on what your goals are. Often goals are money related or self motivated – very seldom for the greater good.

Activity 1: Gloomy days

Grade 8 & 9: LO3 – AS 2 A look at the different perspectives of people and how this impacts on coral reefs

What you need:

- Some paper to make notes on, and props for you production (you can get the learners to bring their own)

What to do:

- Divide the class into groups of 12 and give them each a role (see below)
- Explain that they will be writing a play production on the management of a reef.
- Go through some of the concerns that each role may have (what are their objectives and goals – what do they want to see being done, and how will it benefit them)
- Let the groups work on their productions, and then let them present it for the class

Roles:

Government authority Commercial fisherman Scuba diver
Indigenous community member Resort Developer Conservationist
Manager of souvenir shop Scientist Industry (causes pollution)
Fish collector (pet trade) Recreational fisherman Holiday maker

8.2 LAND ACTIVITY IMPACTS THAT AFFECT OUR OCEANS

Without us even knowing it, many of our activities on land affect the oceans in some way.

Agriculture causes soil erosion, and silt, pollution (herbicides, pesticides and fertilizers) are washed down our rivers and **smother** corals.

Many things that we pour down our drains end up in the ocean causing poisoning of many marine animals.

Activity 2: Fishy marathon

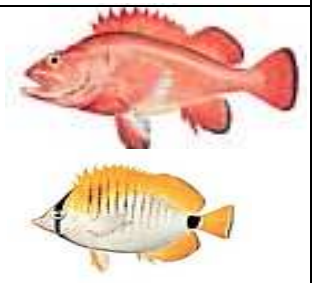
Grade 7 - 9: LO3 – AS 2 Understanding **sustainable** use of the earth's resources

What you need:

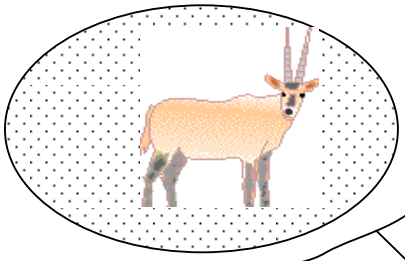
- A copy of the board game, A copy of the call cards and the counters and a dice – you will need to work out answers to the cards depending on your age group.

What to do:

- Divide the class into groups of 4 and give them each a board game.
- Throw the dice, and move the relevant number of places.
- When they land on a square they must follow the relevant instructions.
- If their card requires them to answer a question, and they get the question right, they may advance two places.
- Which ever fish finishes first is the winner.

OVER GRAZING Too many animals are using the river, how will this impact?	OVER GRAZING Having too many animals in one area causes over grazing, how does this affect the soil?	OVER GRAZING Soil is washed into the river, how does this affect the ecological functioning?	OVER GRAZING Soil is eroding, explain what will happen to the surrounding area.
FACTORY POLLUTION Give two ways to prevent pollution.	FACTORY POLLUTION Factories discharge chemical waste into the river, how does this affect the water quality?	FACTORY POLLUTION Factories discharge chemical waste into the river, how will this affect things down stream?	FACTORY POLLUTION Factories discharge chemical waste into the river, how will this affect the fish?
AGRICULTURE You have been heavily affected by agriculture, move back four places.	AGRICULTURE Increased water use may affect the river – How?	AGRICULTURE How may agriculture affect the area in terms of alien species?	AGRICULTURE Increased use of fertilizers wash into the river – what effect does this have?
HUMAN SETTLEMENT People are washing in the river – what impact does this cause?	HUMAN SETTLEMENT Water use from the river impacts down stream how?	HUMAN SETTLEMENT What kind of impact does littering near a river cause?	HUMAN SETTLEMENT People are defecating next to the river – what are the impacts?
SEWAGE WORKS Discharge of sewage in to water may cause _____?	SEWAGE WORKS Discharged sewage is unpleasant because _____?	SEWAGE WORKS Increased water flow can cause more frequent breaching of the estuary. How does this affect the ecosystem?	SEWAGE WORKS Discharged sewage into the water causes algal blooms – how does this affect the fish?
GILL NETS How does the use of gill nets affect long term economic growth?	GILL NETS Gill nets are harmful to fish because?	GILL NETS How does the use of a gill net affect the fish population?	GILL NETS Are gill nets legal in an estuary?
ESTUARY – CLOSED Some estuaries are temporarily open estuaries, and close to help productivity. You cant get out – go back two places	ESTUARY – OPEN You can swim out to sea		

Fishy Marathon



START

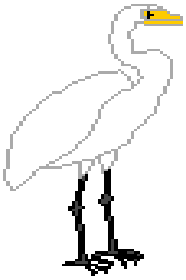
Clean water enters river – advance 2 places

Pick an Overgrazing card

You lack food – go back 3 places

Pick a Factory card

Fertilizer in the river – pick an agriculture card



You have been eaten by a predator bird – go back to the start

Lots of nutrients – advance 3 spaces

Good water quality – advance 2 places

Swim back 4 spaces to avoid being caught by a fisherman

Pick a human settlement card

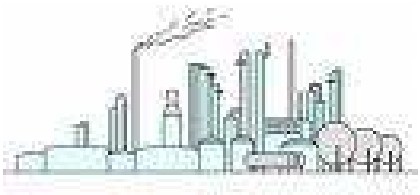
Pick a sewage card

Pick a gill nets card

Heavy pollution – move back 10 places

Open/Closed Pick a card

Open Ocean – The end



8.3 WASTE MANAGEMENT

We as human beings produce a large amount of waste every day, and that waste all has to go somewhere, and much of it ends up in our oceans.

Litter gets washed down rivers and into the sea; sewage effluent gets washed into estuaries and into the sea; and ships dump huge quantities of unwanted material overboard.

What can we do to make sure we do our part?

Activity 3: Where does it all go?

Grade 10: LO3 – AS 2 Compare & evaluate the uses and development of resources and their products, and the impact this has on our environment and society

What you need:

- Access to reference material for each learner – either from the internet of the library, newspapers or magazines.

What to do:

- Get each learner to do some research on how waste is managed in the greater Durban Area.
- They will need to look at the types of waste that are produced and choose one.
- They should find out how that waste is produced, where it is stored and how it is disposed of.
- You can get them to write a report, or report back to the class.

Some Ideas: They could look at the waste from ships, land fills, factories and sewage plants.

Glossary:

Emissions: A substance discharged into the air.

Greenhouse Effect: The **greenhouse effect** causes a rise in temperature that the earth experiences because certain gases in the atmosphere trap the ultra violet light.

Global Warming: An increase in the earth's average atmospheric temperature that causes corresponding changes in climate and that may result from the greenhouse effect.

Smother: To destroy the life of by suffocation; to deprive of the air necessary for life.

Useful Websites:

http://www.yoto98.noaa.gov

http://www.reefrelief.org

http://www.projectaware.org

9. WHAT CAN I DO?

CURRICULUM LINKS

Suggested Learning Area:

Natural Science Grades 8 & 9

Life Sciences Grade 10

Knowledge Area:

Life & Living

Environmental Studies

Learning Outcomes:

Grade 8 & 9	LO3 – Science, Society and the Environment	
Grade 10	LO3 – Life Science, Technology, Environment and Society.	

Assessment Standards:

Grade 8 & 9	LO3 – AS 1	Understand Science as a human Endeavour
Grade 10	LO 3 - AS 3	Compare the influence of different beliefs Or attitudes and values on scientific knowledge

1. **Support reef-friendly businesses**. Ask what your dive shop, boating store, tour operators, hotel, and other coastal businesses are doing to save the coral reefs. This is especially important in coastal areas with reefs. Let them know you are an informed consumer and that you care about reefs.

2. **Don't use chemically enhanced pesticides and fertilizers**. Although you may live thousands of miles from a coral reef ecosystem, these products end up in the watershed and may ultimately impact the waters that support coral.

3. **Volunteer for a reef cleanup**. You don't live near a coral reef? Then do what many people do with their vacations: visit a coral reef. Spend an afternoon enjoying the beauty of one of the world's treasures while helping to preserve it for future generations.

4. **Learn more about coral reefs**. How many different species live in reefs? What new medicines have been discovered in reef organisms? Participate in training or educational programs that focus on reef ecology. When you further your own education, you can help others understand the fragility and value of the world's coral reefs.

5. **Become a member of your local aquarium or zoo**. Ask what they are doing and what your donation can do toward saving the world's coral reefs. The answer may pleasantly surprise you.

6. **Recycle**. This is the first step each of us can take to make a change. Recycle anything and everything. If your community doesn't have a program, do it anyway, and get one started.

7. **Conserve water**. The less water you use, the less runoff and wastewater that eventually finds its way back into our oceans.

8. **Report dumping or other illegal activities**. Environmental enforcement cannot be everywhere, and your involvement can make a big difference.

9. **Keep it clean**. You may be in the habit of picking up your own trash. You may even participate in an organized cleanup. But have you considered carrying away the trash that others have left behind?

10. **Only buy marine aquarium fish if you know they have been collected in an ecologically sound manner**. In some areas, marine fish harvested for the pet trade are stunned with sodium cyanide so that capturing them is easier.

11. **Surf the net!** Many different addresses exist to link you to information about coral reefs and what you can do to become involved. A good starting point is at http://www.publicaffairs.noaa.gov/coral-reef.html

12. **Hire local guides when visiting coral reef ecosystems**. Not only do you learn about the local resources, but you will be protecting the future of the reef by supporting a non-consumptive economy around the reef.

13. **Don't anchor on the reef**. If you go boating near a coral reef, use mooring buoy systems when they are available.

14. **If you dive, don't touch!** Take only pictures and leave only bubbles! Keep your fins' gear, and hands away from the coral, as this contact can hurt you and will damage the delicate coral animals. Stay off the bottom because stirred-up sediment can settle on coral and smother it.

15. **Volunteer**. Volunteer and community coral reef monitoring programs are very important. If you do not live near a coast, get involved in your local save the river (bay, lake, or other estuarine environment) program. Remember, all watersheds affect the oceans and eventually the coral reefs.

16. **Support the creation and maintenance of marine parks and reserves**. Encourage your friends to get involved with projects to protect special areas.

17. **Be a wastewater crusader!** Make sure that sewage from your boat, from other boats, and from land is correctly treated. The nutrients from sewage feed growing algae that can smother a kill corals.

18. **Inform yourself**. Find out about existing and proposed laws, programs, and projects that could affect the world's coral reefs.

19. The Three R's - **Reduce, Reuse and Recycle!** Enough said.

20. Spread the word - Tell your parents and friends that coral reefs need protection. Challenge them to protect coral reefs by following these simple steps.

Year of the Oceans publications

Activity 1: Ecological Footprint Calculator

To calculate your ecological footprint, a number of different categories are used. They include; waste, food, living space, energy and travel. This will show you the impact that you are leaving behind on the environment.

Grade 8 - 10: LO3 – Your impact on the environment

What you need:

- The Ecological footprint score sheet
- The question cards

What to do:

- Give each learner a copy of the score sheet a question cards. Alternatively you could get them to work in groups with one copy, but each making their own scores in their work books.
- Select an answer to each of the six questions and record it in the relevant space on the score sheet.
- Work out your total EF score, and work out how many planet earths would be needed if 47 million people in South Africa lived like you.

Your Total EF score	Planet Earths Needed
72	Less than 1
100	1
204	2
267	3
398	4
496	5
602	6
699	7
798	8

PERSONAL TOTAL ECOLOGICAL FOOTPRINT SCORE

Questions	My actual EF Score	My EF could change to:	Average African total EF	Average 'Developed' total EF
1. Energy			6	36
2. Waste			40	106
3. Food			21	90
4. Living			0	3
5. Travel to school			3	14
6. Travel on holiday			1	18
Total EF score			72	267
No. of Earths			Less than 1	3 earths

1. ENERGY

What energy source do you use in your home?

People per house hold

	> 5	3 - 5	1 - 2
Only wood & charcoal	8	15	40
Electricity & wood	3	6	17
Mostly electricity	7	14	36
Only electricity	10	19	52
Electricity for basics & non-essential things	31	62	166

2. MATERIALS & WASTE

How much waste do you produce each month?

How much waste is reused/recycled?

	> ½	about ½	< 1/3
Less than 180L	26	31	40
180 - 840L	50	60	77
> than 840L	153	185	238

Remember that it is your own individual waste

3. FOOD

How much & what type of meat do you eat?

How much of your food is home grown?

	> 50%	< 50%	None
No meat	15	16	17
Local meat & fish	22	23	24
Eat shop meat 1xweek	20	21	23
Eat shop meat 2-3 x week	51	53	57
Eat mainly shop bought meat	68	70	76
Eat only shop bought meat	87	90	97

4. LIVING SPACE

How big is your house - how many rooms are there?

How many people live in your house?

	> 5	3 - 5	1 - 2
1 - 5 rooms	0.2	0.4	1
6 - 8 rooms	0.5	1	3
9 rooms or more	1	2	4

5. TRAVEL TO SCHOOL

What forms of travel do you use to get to school?

How far do you travel?

	< 4Km	5 - 19Km	20-60Km	> 60Km
walk	0	0	0	0
taxi	1	3	9	36
bus/train	2	6	22	84
taxi(car)	4	11	37	142
motorbike	4	11	38	147
car	5	14	46	177

6. TRAVEL ON HOLIDAY

What forms of travel do you use when you go on holiday?

How many Km do you travel?

	None	<1000	1000-3000	3000-17000	> 17000
walk	0	0	0	0	0
taxi	0	0.3	1	5	9
bus/train	0	0.6	2	12	20
taxi(car)	0	1.1	4	20	35
motorbike	0	1	4	20	33
car	0	1.3	5	25	42
plane	0	5	18	89	150

9. WHAT IS THE INTERNATIONAL CORAL REEF INITIATIVE?

The International Coral Reef Initiative (ICRI) was established in 1995 as a unique partnership that brings together governments, international organizations, scientific bodies and non-governmental organizations committed to reversing the global degradation of coral reefs and related ecosystems by promoting the conservation and sustainable management/use of these resources for future generations. ICRI provides a global platform for sharing information on the health of coral reefs and to mobilize efforts to increase capacity and political support for their protection

The **ICRI International Year of the Reef 2008** is a worldwide campaign to raise awareness about the value and importance of coral reefs and threats to their sustainability, and to motivate people to take action to protect them. All individuals, corporations, schools, governments, and organizations are welcome and actively encouraged to participate in IYOR 2008

International Year of the Reef (IYOR) Highlights

Celebrate World Ocean Day on the 8th of June each year.

Whether you live along the coast or far inland, each one of us is connected to the world's ocean.

The ocean ties us all together, regulates our climate, provides us with seafood, gives us rest and relaxation, and is full of special places and diverse life worth celebrating.

This year's theme (2008) is "helping our climate/helping our ocean" with a special focus on coral reefs. As you celebrate consider ways you can reduce your carbon dioxide emissions and give generations to come a healthy ocean to celebrate.

Take part of International Coastal Clean-ups held each year.

Useful Websites:

http://www.iyor.org

http://www.icriforum.org

References:

Newton, A; Walker,SH and Oritz,A. 1997. Coral Reefs – An English Compilation of Activities for Middle School Students. National Centre for Environmental Publications and Information.

MacGillivaray, G. 1997. MacGillivray Freeman's Coral Reef Adventure – An educational Resource for Teachers. National Science Foundation.