

Cover text:

Teacher's Manual

# Below The Surface:

## Coral Reefs in Papua New Guinea



CONSERVATION  
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Coral polyp diagram from *Coastal Environments in the South Pacific* booklet (SPREP)

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# Below The Surface: Coral Reefs in Papua New Guinea

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Activity	Time	Materials	Educational objectives
Your Marine Scene	Two 30 min sessions	Paper and colour crayons, pencils or markers	Define biodiversity and share perceptions of the marine environment through art.
The Web of Life	45 min	Ball of rope/string	Demonstrate understanding of how different members of the coral reef ecosystem are interconnected.
The Coral Reef Challenge	Three 45 min sessions	Coral Reef Poster, cardboard, glue, scissors, question cards	Identify members of the coral reef ecosystem, describe some aspects of coral reef ecology, and explain positive and negative human impacts on the marine environment.
Community Connections	Variable	Paper and pencils	Investigate the community, and identify issues of local importance.
Coral Reefs: Values and Beliefs	Preparation: 30 min + homework Role play: 90 min	Paper and pencil	Identify and analyze a local environmental issue through a role-play, clarify values, and collaboratively develop a conservation plan.
Reef Relief: Make it Happen	Variable	Variable	Plan and implement a conservation project.

# Introduction

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Hello teachers!

With fishes, sharks, dolphins, turtles, and brightly coloured corals, Papua New Guinea has one of the most striking marine environments in the world!

**Below the Surface** is an environmental education (EE) manual developed specifically for teachers in PNG schools. It addresses key concerns of PNG's coastal communities, and encourages students to discover, cherish and protect their coastal environments.

This manual will guide you step by step through a series of activities that pose a challenge to your students: how to conserve coral reefs for their future. Your students will do an art activity to explore biodiversity in **Your Marine Scene**, discover interconnectedness of the marine world in the **Web of Life**, play the **Coral Reef Challenge**, and follow-up with a community investigation in **Community Connections**. Finally, they will work collaboratively to design creative solutions to environmental conservation issues in **Corals Reefs, Values & Beliefs**, and will have the opportunity to design and implement a real-life conservation project in **Reef Relief: Make it Happen!**

## Teacher's Role

Since the activities in this manual direct students to investigate and discuss real issues in their communities, you should be particularly sensitive to local values and practices. EE should never advocate one point of view, or tell children *what* to think, but instead should teach them *how* to think about environmental issues. The teacher's neutral role in facilitating activities is essential.

## What is EE?

EE is recognized worldwide as the "process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivation and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones" (UNESCO 1978).

EE should help students not only gain knowledge and awareness about environmental issues, but should help students gain the skills they need to become life-long problem-solvers and informed decision-makers. Good EE is good education, because it connects learning in school to real-life issues.

# Curriculum Correlation

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Conservation International developed this manual in collaboration with the PNG Department of Education, and distributes it to teachers throughout PNG's coastal communities. Each activity meets objectives of the Department of Education's Environmental Studies Syllabus for grades 3-5. These activities can be integrated into the Grade 3-5 Course Overview, as they will:

- Develop students' pride in PNG's rich and unique coastal environment
- Develop students' critical understanding of changes that occur as a result of human activities
- Discourage destructive practices that threaten coral reefs
- Empower students through investigation, dialogue, and a conservation project

The activities are designed to meet the following objectives:

## **Environmental Education and Environmental Studies**

- ✓ Acquire knowledge on the environment and environmental issues, including potential solutions and environmental management tools
- ✓ Enhance skills in investigation and research
- ✓ Develop favourable attitudes and values towards the environment. Recognise the value of and develop pride in PNG's unique environment and culture.
- ✓ Develop problem-solving and critical thinking skills
- ✓ Participate actively, individually and collectively, to solve environmental challenges

This activity could be easily undertaken within the following units of your Environmental Studies Syllabus:

- *Grade 3:* Unit 3.1 - Exploring My Environment. These activities could be used for your long-term project.
- *Grade 4:* Unit 4.3 - The Environments of Papua New Guinea. Use these activities as a case study to learn more about PNG's coastal environment.
- *Grade 5:* Unit 5.2 - Large Changes to the Environment. Start the activity in this unit and carry it through to Units 5.3 and 5.4 (Looking After My Environment and Development in the Future).

# Coral Reef Primer

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(Words in bold italics are defined in the Glossary, p. \*\*\*)

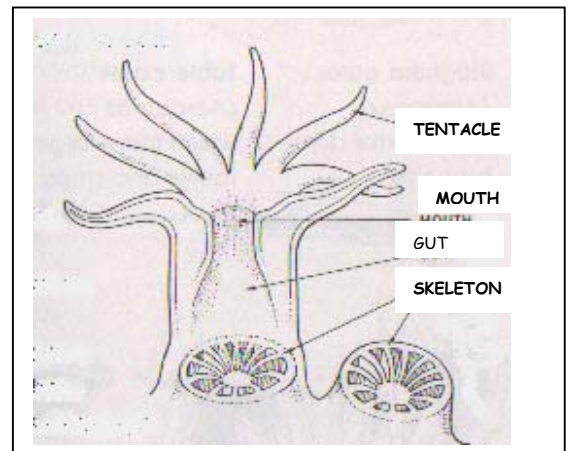
## Oceans: the world's watery wonders

Over 70 percent of the earth's surface is covered by oceans, which hold about 98 percent of all of the water on the planet. The ocean holds much more life than all the life on land. Oceans are home to thousands of different creatures, including fishes, *marine mammals*, birds, *molluscs*, *crustaceans*, seaweed and *plankton*. Over 3.5 billion years of evolution and a unique combination of physical factors have created this astonishing *diversity* of life, or *biodiversity*.

## What exactly are coral reefs?

Coral reefs are some of the most valuable and spectacular places on our planet - amazingly complex underwater communities composed of stony structures built by living plants and animals. They are the most diverse communities on the planet, and there are hundreds of different types of corals, including *hard and soft corals*. Scientists estimate that coral reefs are home to approximately 25% of the ocean's species. Contrary to popular belief, corals are not mineral formations. In fact, corals are made up of colonies of tiny animals (less than 1cm in diameter), called coral *polyps*. Polyps are nocturnal animals that live in groups or colonies and look like tiny interconnected sea anemones. Some coral polyps feed on plankton and some also get food from tiny algae (simple plants) that live inside the coral and produce food for the coral using the sun's energy.

In the case of hard, reef-building corals, the polyp grows and leaves behind its skeleton. These layers of old polyp skeletons covered with live corals growing on their surface provide the rocky frameworks and massive branching structure of coral reefs. Coral reefs grow VERY slowly, and they are actually the oldest communities on earth. Most of the reefs we see now have been growing for over 5,000 years! Since they grow so slowly, reef ecosystems are very fragile, and cannot recover quickly from damage.



This is an illustration of a coral polyp showing the major parts of the polyp and the skeleton beneath. A skeleton without its polyp is shown on the far right.

Coral reefs form the following main structures:

- Fringing reefs: usually present along mainland shores and around the edges of islands
- Barrier reefs: coral reefs separated from nearby land by open water
- Atolls: circular reefs growing upwards from an underwater volcanic peak with a lagoon in the center

Coral reefs are full of life; they provide homes for a huge variety of animals including fish, sharks, turtles, sea urchins, lobsters, giant clams, sea cucumbers, and much more. Marine creatures find food, protection and shelter in coral reefs. Scientists estimate that more than 25,000 species live in reef habitats - many more types of animals than in tropical rain forests!

## What's so special about PNG's reefs?

PNG is lucky to have one of the longest coastlines in the world, with over 600 islands surrounded by coral reefs. Coral reefs occur along most of PNG's coasts and there are many offshore reefs as well. The coastal areas and reefs in PNG support some of the richest marine biodiversity in the world!

Milne Bay Province has been recognised as exceptional in terms of reef biodiversity. There are over 430 species of corals, 1100 species of fish and 900 species of molluscs in Milne Bay. Other coastal provinces in PNG also have exceedingly rich and pristine coral reefs.

People in PNG depend on coral reefs for food, income, and even for cultural practices. PNG's fishing industry, one of the country's most important sources of income, depends on healthy reefs for its survival. Most of the commercial **species fish**, like lobster, grouper, and **sea cucumbers snapper**, live or breed in reefs. Reefs protect coastal villages and coastlines from the enormous waves caused by cyclones and storms, by breaking the **force fore** of the waves before they reach the shore. The skeletons of old corals are eventually broken down into sand by waves, helping build up our beaches. These beaches and healthy coral reefs are potentially worth millions of dollars in tourism to PNG - no tourist wants to dive in a dead reef with no fish. Also, corals can help save lives, since certain important medicines from corals are being developed and used to help cure people around the world of diseases like cancer. We still have much to learn about coral reefs - some reef dwellers don't even have names yet!

## Trouble in the Reefs!

Most reefs in PNG are in relatively good condition, but we must remember that despite their size, we can affect the health of the oceans. Coral reefs happen to be one of Earth's most fragile environments. Reefs around the world are in serious trouble, and we have brought many reef species to extinction. Many animals depend on coral reefs for

protection, and when reefs are damaged, many animals that depend on reefs die. The following human activities are seriously threatening the health of our coral reefs in PNG:

- **Harmful fishing practices** - Species of fish are disappearing from coral reefs around the world due to damaging fishing techniques and over-fishing (fish are being harvested faster than they are reproducing). This is the greatest threat to PNG's reef ecosystems. In PNG, traditional fishing methods are being replaced with modern technologies that have drastically increased the rate at which fish are caught. These include the use of dynamite to supply the high demand for fresh fish to Port Moresby and to other countries. Derris roots, dynamite, and *cyanide* poisoning are used illegally to collect fish. These methods not only kill fish, but also kill the coral polyps. Reefs are occasionally damaged by fishermen who mechanically break them in order to capture live fish. Fishing nets often accidentally capture unwanted animals such as *juvenile* fish, dugongs, sharks, turtles, whales or porpoises. Over-harvesting one type of animal from the reef often has a bad effect on the delicate balance between living things on the reef. There is great evidence of over-fishing around Port Moresby; all around the country, people are over-harvesting creatures like sea cucumbers, trochus, green snails, and clams.
- **Pollution** - The biggest threat to corals worldwide is pollution from industrial chemicals, sewage, agricultural chemicals, and household toxic wastes. After it rains, water running over the ground carries **rubbish trash**, oils, and other pollution from the land into the rivers and eventually into the sea. Large quantities of pollution are toxic (poisonous) to corals. In addition to chemical and toxic waste, litter consisting mostly of plastic waste piles up in PNG's mangroves, reefs and coastal areas. Many species die when they become entangled in old discarded nylon fishing lines, nets and plastic **'six-pack' rings**. Sea birds and turtles can also suffocate after feeding on plastic bags and balloons that look like jellyfish - one of their favourite food sources.
- **Coral collection** - A significant threat to corals in some areas is the collection of live corals to sell to tourists as souvenirs. In the case of coral mining, coral is collected to use as building blocks in construction, since materials to build roads, buildings, and schools are often scarce or **non-existent** on islands. Corals are also used for lime production (used when chewing betel nut).
- **Deforestation** - Cutting coastal forests can cause soil to erode and wash down to the ocean with the rains. When the soil gets to the ocean, it clogs up the coral reefs with **sediments** and suffocates them, depriving the coral polyps of necessary nutrients and oxygen. Furthermore, silty waters prevent sunlight from reaching the corals, so photosynthesis doesn't occur and coral growth stops.
- **Boats and divers** - Anchoring or poling boats on top of reefs damage coral reefs, which take hundreds of years to grow back. Also, people who dive or snorkel damage reefs when they accidentally break off pieces with their gear. Propellers from boats can also churn up sediments that smother reefs.



- **Coral bleaching and climate change** -The potential warming of the Earth's climate from greenhouse gas emissions (like carbon dioxide) poses a great threat to coral reefs. As the surface temperature of water rises, corals can die and become bleached. The tiny algae that live in corals provide corals with food and bright coloring. When corals are stressed by water temperature changes the algae can die making corals lose their colors and turn white. In fact, in 1996 and 1997, about 54% of the coral in Milne Bay experienced bleaching. It can take approximately 20 to 50 years for a reef to recover from bleaching. Scientists believe that coral reefs may be the first ecosystem to clearly reveal the potential impacts of global climate change.
- **Mangrove Destruction** - The destruction of *mangroves* for development can seriously affect reef fish, since mangroves serve as breeding and *nursery areas* for many fish.
- **Dredging** - Dredging is the act of clearing a channel in the water for shipping and shaping of marinas and ports. Dredging ships also work to obtain sand and coral rock for road building, airport runways, and other coastal construction activities. When the dredgers scrape along the floor of the ocean, they produce huge clouds of silt in the water and break off pieces of coral and marine plants. The silt is then swept along the coast in ocean currents, often smothering coral reefs that are miles away from where dredging occurred.

When reefs are lost, the human communities that depend upon them can also be threatened, as they no longer have their primary source of food, jobs, cultural heritage, and prosperity. By working together, we have the potential to help protect PNG's coral reefs - one of the most precious treasures of our planet.

### Solutions to Save the Reefs!

If we don't act quickly to protect the unique coral reefs of PNG, these destructive practices could threaten the survival of marine life and the future of fisheries in our country. In Indonesia and the Philippines, people have destroyed most of their coral reefs. Without reefs, people have less fish left to feed their families or to sell to make a living. The following are some practical steps people are taking to protect reefs around the world:

- **Education** - The most important thing you can do to help save reefs is to maximize your role as an educator. In order to protect coral reefs, people need to understand the important role they play in the natural balance of the Earth, and in the diversity of life that they hold. Understanding often leads to concern, concern leads to a desire to protect, and a desire to protect leads to action - the ultimate goal. If you can help even several of your students to understand, care about, and protect coral reefs, you have fulfilled a very important goal. If you want to take your role one step further, you can even lead a coral reef conservation club in your school, or take the conservation message to the community.

- **Fishing Reserves and Marine Protected Areas** - A fishing reserve is a place where fishing is prohibited in certain areas or times of year, thus providing safe areas for breeding. These reserves allow areas that have been over-fished to regenerate damaged fish populations. The success of the reserves, however, depends on the involvement of local people, particularly fishers. Specifically, they must be given a reason to cooperate. Conservation International (CI), along with PNG government departments and other organisations, is working towards the implementation of community-based Marine Protected Areas in Milne Bay Province (areas where destructive fishing practices or marine activities are restricted, banned and/or closely monitored).
- **Marine Zoning** - Different uses can be assigned to different areas of a reef, which is called marine zoning. One zone can provide total protection from humans, while another area can be used for tourism, and another for fishing.
- **Pollution Prevention** - Preventing pollution is a much better solution than cleaning it up later. Some companies are looking for new ways to make their products without using potential pollutants. Consumer pressure plays a key role in pressuring companies to stop polluting. Another way to reduce industrial pollution is through carefully designed government regulations. New regulations to protect marine environments can be founded on the "polluter pays principle" which says that whoever is engaged in activities that harm the environment should pay for the installation of equipment to prevent such pollution. Polluters can also be held accountable for cleaning up environments that their activities have damaged.
- **Government Regulations** - The fourth goal of our nation's constitution pledges to safeguard PNG's environment, including marine ecosystems. The government also has several legislative acts protecting marine resources, like the Fauna Protection and Control Act (1982) which declares the dugong and leatherback turtle protected species. Under the Fisheries Management Act (1998), the use of destructive fishing methods such as explosives and poisonous chemicals are prohibited. Effective monitoring and enforcement are key to successful regulations.
- **Moorings, not anchors** - To protect reefs, boats can use permanent mooring buoys that are drilled into the sea floor instead of using anchors along the reef.
- **Decrease deforestation** - One strategy to prevent *siltation* on coral reefs is to stop cutting trees on steep slopes near water bodies. Logging and exposing loose soil on steep slopes is particularly damaging, since erosion occurs faster on steep inclines. One way to prevent deforestation is to find ways to use coastal forests without cutting them, since standing forests can provide many financial rewards for local people.

**Conservation and protection of reefs will ensure continued abundance of fish for the coming generations.**

# ACTIVITY 1:

## Your Marine Scene

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### Objective

Students will define biodiversity and share their perceptions of the marine environment through art.

### Skills

Creative thinking, artistic design and expression, comparing and contrasting, counting, summarizing, and writing

### Materials

Construction paper, crayons, colored pencils, or markers

### Time

60 minutes. Students should have at least a half-hour for their drawings, and set aside an additional half-hour for discussion.

### Age

Grades 3-5

### Introduction

This activity will give students an introduction to biodiversity and the marine world. By creating their own picture of the underwater world, students will explore their own perceptions of the marine environment and will learn the importance of high-biodiversity ecosystems like coral reefs.

### Getting Ready

To introduce this activity to your students, begin with a group discussion of students' experiences of the ocean or bay and what creatures inhabit this environment. Talk about the different marine animals and plants that students have seen or know. Ask students if any of them have gone swimming or snorkeling around coral reefs and what their experience was like.

### What to Do

Pass out paper and drawing materials and ask the students to use their imagination to draw and color an underwater scene, complete with creatures that inhabit the ocean.

Once everyone has finished, have each student briefly explain what he or she has drawn. Collectively compare the drawings for similarities and differences. Have they drawn fish? Fishermen? Coral reefs? Sharks? Turtles? How many different types of animals are there in all the drawings?

Focus the discussion on the variety of all the different species in the drawings and introduce the term **biodiversity**. Explain that biodiversity is the variety of life on Earth - all the species of plants, and animals and the **ecosystems** in which they live. Compare the students' drawings and point out the drawings that depict particularly high levels of biodiversity. Explain that certain ecosystems, like coral reefs, have very high levels of biodiversity - more than any other ecosystem on Earth!

Next, talk about real-life ways biodiversity can be damaged. Are there any humans present in the drawings, or is there evidence of human actions? Are any of the human

actions pictured damaging to the marine ecosystem and harming biodiversity? Is there pollution? Is there destructive fishing (derris roots, explosives)?

### Finishing Up

Ask students to write a paragraph summarizing the life under the sea represented in their picture. This can be assigned as homework or done in class. Finally, the paragraphs can be cut out and attached to the pictures, which can be hung up in the classroom, at home or somewhere in the community.

## Activity 2: The Web of Life

**Objective:** Students will demonstrate their understanding of how different members of the coral reef ecosystem are interconnected..

**Skills:**  
Creative thinking, oral expression, role playing, cause and effect, cooperation

### Materials

Long rope, twine, or heavy-duty string (at least 50 feet)

Optional:

- Paper
- Crayons, colored pencils, or markers
- Scissors
- tape

### Time:

25 minutes for selection of creatures, and optional drawing of creatures, 20 minutes to play the game

**Age:** Grades 2 through 6

### Introduction:

In this activity, students will demonstrate the complex interactions in a coral reef ecosystem by taking on the roles of different coral reef creatures and creating a web of life among themselves with a ball of string.

### Getting Ready:

Assign each student the name of a plant, animal or non-living thing in the marine ecosystem (see list below for ideas). If you have time, students can write the name of their creature and draw it on a piece of paper and tape it to the front of their shirts. Having these signs on their shirts will help the students remember who is who throughout the activity.

### What to do:

Ask students to stand in a circle and explain that together, they represent a coral reef ecosystem, and each student represents one part of the ecosystem. Have students look around the circle and think about how life in a coral reef is connected. Each student will then hold onto the string and toss the rest of it to another student, explaining his or her ecological connection to that other student. For example, the coral student might say that she is connected to the butterfly fish student because she tries to protect him from predators. The butterfly fish then might say that

he is connected to the shark because sharks eat butterfly fish, etc. As each student makes a connection, help wrap the rope around the back of each students' waist, forming a big complicated star shaped web between the students. It works best if students are connected to others across the circle from themselves, rather than next to each other. When all students are connected, the leader should tie the two ends of the rope together tightly. At this point, if the web is well constructed, all the students can gently lean back, balancing each other, which represents ecological balance.

While the web remains in balance, explain that harming any part of the web hurts the entire web, because everyone is connected to everyone else in a coral reef ecosystem. Have the students imagine what would happen, for example, if the water was polluted (the water student can start to shake, or tug on the rope), or if the turtles went extinct (have the turtle student fall to the ground). When one student falls, the entire web will collapse, with all students tumbling to the ground.

Finishing up:

After students have played for a while, have them stop and discuss which members of the ecosystem have the most connections to others, and why this might be the case (everyone depends on water, for example). Discuss the status of coral reefs in their area - are they in ecological balance, healthy with all important members of the ecosystem, or has there been some sort of disturbance to the system (pollution, deforestation, over-fishing, or dynamite explosions).

Sample Coral Reef Ecosystem Members:	
Sun	Water
Plankton	Coral polyps
Butterfly fish	Sea anemone
Flounder	Coral trout
Shark	Reef
Sea turtle	Eel
Sting ray	Sea horse
Sea cucumber	Clam
Octopus	Lobster
Gobies	Damselfish
Dugong	
Dolphin	Moorish idol

*Sample Coral Reef Connections:*  
 Encourage students to think creatively about the connections and similarities between the different members of a coral reef ecosystem. For example, remember to use some of the following connections:

- Creatures that eat others
- Using the sun for energy (plankton and other sea plants convert the sun's energy, and rays, clams, fish, and coral polyps all eat plankton)
- Using the coral reef for protection and shelter (all the fish, turtle, sea cucumber, sea horse, lobster)

## ACTIVITY 3: The Coral Reef Challenge

### Objective

Students will be able to identify members of the coral reef ecosystem, describe some aspects of coral reef ecology, and explain positive and negative human impacts on the marine environment.

### Skills

Discussing, defining and solving problems, inferring, analyzing

### Materials

#### Puzzle

Thin cardboard, glue, pencils, scissors and the marine picture that is provided in the centre of this booklet.

#### Part 1

*Adventures of the Coral Critters*

#### Part 2

Questions for Coral Reef Challenge

### Time

Part 1: two 30 min periods

Part 2: 45 min, or more if students choose to prepare a puppet show or play

Part 3: 45 min

### Introduction

By reading a story and testing their knowledge with a puzzle game, students will learn about coral reef ecology and human impacts on the marine ecosystem.

### Getting Ready

Before you read the story or play the game, students will collaborate to make a puzzle. First, glue the marine picture provided in the center of this manual onto the cardboard. Then on the back of the cardboard, have the students draw the puzzle pieces. The puzzle pieces can be any size and shape but try to end up with about 25 pieces. Once the picture has been divided into pieces, students can cut out each piece until the whole picture has been cut up into puzzle pieces.

### What to Do

#### Part 1:

Read the story *Adventures of the Coral Critters* aloud to your class. Talk with your class about what happens in the story. Who lives in a coral reef? What does a reef need to stay healthy? What are some things humans do that help or harm coral reefs? This is a good opportunity for you to explore some of the background information in the **Coral Reef Primer (p.\*\*\*)**.

**Part 2:** After reading the story, you are ready to play the **Coral Reef Challenge**. Divide the class into teams of about 4 students each and let them choose their team name. Explain that the Challenge is like a game show. Each team will have an opportunity to answer a question about coral reefs and the story. If they answer correctly, they win a puzzle piece or two. If not, the other teams can raise their hands and try to answer. Questions are worth one or two puzzle pieces, depending on

difficulty. You should ask students to explain how they knew the answer. Most answers give supplementary information deepening the understanding of the issue at hand so that you can discuss the issues raised in the question in greater depth. You should try to help

students see all sides of the issues raised. When all the questions have been asked, the team with the most pieces wins. All students will then work together to assemble the puzzle.

## Finishing Up

There will probably be some puzzle pieces still missing. When you have completed the 20 questions, you may present the final question to all.

### FINAL QUESTION

What solution would you propose so that the people in your village will be able to continue fishing on the coral reefs for many more years to come (ie: that the coral reefs are conserved and may even flourish to continue meeting the needs of your people)?

Each player is required to give a personal answer to this question. This last part should help students finish the puzzle, but should also encourage them to think about possible solutions for the healthy management of their coastal environment. Depending on the number of pieces remaining to end the puzzle, this last question may be worth 1, 2 or 3 pieces each. It's easy, the player only needs to give a heart-felt answer, and you decide!

If students have completed the puzzle before answering all 20 questions, use the final question to trigger a discussion. In order to conclude the activity, review the students' proposed solutions and evaluate them together in greater detail. See the Coral Reef Primer (p.\*\*\*) for some

ideas. You can also paste the puzzle onto a large piece of paper and hang it up in your classroom.

## The Quiz

Note: For each question, the correct answer is indicated in bold.

### Question 1

A coral is a \_\_\_\_\_

- a) Rock
- b) Animal**
- c) Plant

Coral reefs are made up of the skeletons of many small animals called polyps.

### Question 2

How long does it take for one meter of coral reef to grow?

- a) 5 years
- b) 20 years
- c) 250 years**

Some of the world's largest coral reefs began to form 450 million years ago!

#### Question 4

What does a coral polyp need in order to live (2 correct answers)?

- a) **Sunlight**
- b) **Clear, warm sea water**
- c) Fresh river water

Reef corals only live in shallow coastal waters (not in the deep sea), because they need sunlight to live. They also need clear and warm salt water, and if there is soil erosion along the coast (due, for instance, to deforestation), the resulting murky waters may damage the reefs.

#### Question 5

Name five animals that live in the coral reefs of Papua New Guinea.

Students may mention any of the following, among others: dolphins, sharks, sea turtles, fish, stingrays, sea urchins, lobsters, shrimp, clams, jelly fish, starfish, sea horse, octopus, coral polyps, eels, snails, and many more.

#### Question 6

What do the fish gain from living in coral reefs (2 correct answers)?

- a) **Food**
- b) Shade
- c) **Shelter**
- d) Air pockets

In the tropics, coral reefs offer habitat for a large number of fishes, anemones, lobsters, clams, crabs, sea cucumbers, among many other organisms.

#### Question 7

Coral reef ecosystems are healthier when there are no fish around them.

- a) True
- b) **False**

When there are plenty of fish corals grow well and in turn make places for the fish to live.

#### Question 8

Baby turtles are born \_\_\_\_\_.

- a) In very deep waters
- b) **Amidst the coral reefs**



**c) On beaches**

The female turtle lays her eggs in a hole in the sand and then she returns to the sea. Several weeks later, the young turtles hatch from the eggs on their own, and make daring runs to the ocean in order to escape the various predators that feed on them (birds, small animals, etc.).

**Question 9**

A dolphin is a big fish.

- a) True
- b) False**

Dolphins, whales and dugongs are marine mammals. They are warm-blooded animals that need to surface regularly in order to breathe the air.

**Question 10**

What caused the "booming" noises in the story?

- a) Explosions from net fishing
- b) Explosions from cyanide fishing
- c) Explosions from dynamite fishing**

**Question 11**

Which of the following three living organisms is situated at the top of the marine food chain?

- a) The shrimp
- b) The shark**
- c) The giant clam

The majority of shark species are carnivores. As active predators they capture and eat larger herbivores (molluscs, parrotfish, sea urchins, etc.) and carnivores. Other marine species may also be carnivorous: cuttlefish, jellyfish, anemones, etc.

**Question 12**

Coral reefs often have more species than a tropical rainforest.

- a) True**
- b) False

**Question 13**

Coral polyps never float freely around ocean waters.

- a) True
- b) False**

When polyps are "babies," in their larval stage, they drift through the ocean currents before settling in one spot where they will spend the remainder of their lives.

#### Question 14

Anchors contribute to coral reef damage in the following way:

- a) The material used to make anchors is extracted from the coral reefs
- b) Anchors scare the fish away
- c) When anchors are tossed down, they often break off pieces of coral**

#### Question 15

What kind of fishing technique is *most* destructive to coral?

- a) Dynamite fishing**
- b) Hook and line fishing
- c) Net fishing

While excessive net fishing and hook and line fishing can decrease fish populations around coral reefs, dynamite fishing most frequently damages the coral itself, as the explosions can blast away large coral formations that have taken hundreds, even thousands of years to grow.

#### Question 16

A common predator found in a coral reef ecosystem is:

- a) Nurse shark**
- b) Coral polyps
- c) Plankton

A predator is an animal that eats other animals, such as the nurse shark. Plankton is not an animal, but rather a plant that gets its energy from the sun, and coral polyps eat plankton, not other animals.

#### Question 17

Whales usually live in coral reef ecosystems.

- a) True
- b) False**

Whales do not live around coral reefs, mainly because coral reefs are in shallow waters, and most whales are too big.

#### Question 18

Which activities are illegal in Papua New Guinea (2 correct answers)?

- a) Dynamite fishing**

- b) Net fishing
- c) **Cyanide fishing**

Under the Fisheries Management Act (1998) of PNG, the use of destructive fishing methods such as explosives and poisonous chemicals are prohibited.

### Question 19

Where is the richest coral reef system in PNG?

- a) West New Britain
- b) Loloata Island
- c) **Milne Bay Province**

Nowhere else in the world is there such a large area of exceedingly rich and pristine coral reefs which are characterised by minimal human population pressure and found within the borders of one nation and one provincial body.

### Question 20

Which human activities threaten coral reefs?

- a) **Deforestation**
- b) **Excessive fishing**
- a) **Pollution**

When humans change coastal habitats by cutting down mangrove forests, destroying seagrass beds, mining corals and coral sand for building materials, or building new houses, we often dramatically reduce biodiversity and alter natural cycles and processes in ways we cannot always predict.

Over-harvesting of fish is destroying unique populations of marine organisms. Many of today's fishing practices such as explosive fishing and cyanide fishing destroy or alter marine habitats. Land based sources of pollution - runoff from industry and agriculture containing nutrients from fertilizers and waste, sewage, pesticides, debris, etc. - make lethal soup of near-shore waters.

#### Objective:

Students will investigate their own community, and identify issues of local importance.

#### Skills:

Formulating questions, observation, researching, organizing information, comparing and contrasting

#### Materials:

Notebooks and pencils

#### Time:

45 min to organize  
1-2 hours to investigate  
30 min to wrap up

**Ages:** 4th grade and up

## ACTIVITY 4:

# Community Connections

## Introduction

As a follow-up exercise to the quiz game, students are asked to investigate their own community. The investigation will reveal the presence of coral reefs close to their village, their families' dependence on these resources, existing fishing practices, and some community concerns. Conduct the investigation in class, outside in the village, or even out on the shore at low tide!

## Getting Ready

To launch the community investigation, compare the students' drawings with the puzzle (from Activities 1 and 3). What are the similarities? What are the differences? Which activities from the puzzle take place in the community? What is the state of coral reefs in your community?

## What to Do

Ask your students what they would like to know about coral reefs in their community. As a class, write down a list of questions and a list of people students could talk to for more information. You can use the **Community Log Sheet** as a guide to help students organize their investigation.

Students can work in pairs or in small groups to do the investigation, and each group should create their own copy of a log sheet. Students can add their own questions, but the focus should be on the status of coral reefs in their community, how humans impact the marine environment (positively or negatively), and how human interactions with the environment have changed over time. Students can interview neighbors and family members, or you could invite a guest speaker to visit your class as part of the investigation.

### Things to think about

If a class is visiting the community, the school should:

1. Inform the Board of Studies and the Parents and Citizens' association about their plans.
2. The teacher must set a plan of action (location, what to do, how, etc.).
3. Organise the children for the visit. Remind children about safety rules, ask the community to assist with the supervision of children. Delegate responsibilities to the class captains.
4. Give very clear instructions to the children and tell them what to do during the visit.
5. Prepare questionnaires that children can use as a guide for collecting information.
6. Conduct the excursion in consultation with the community.
7. Evaluate the visit.

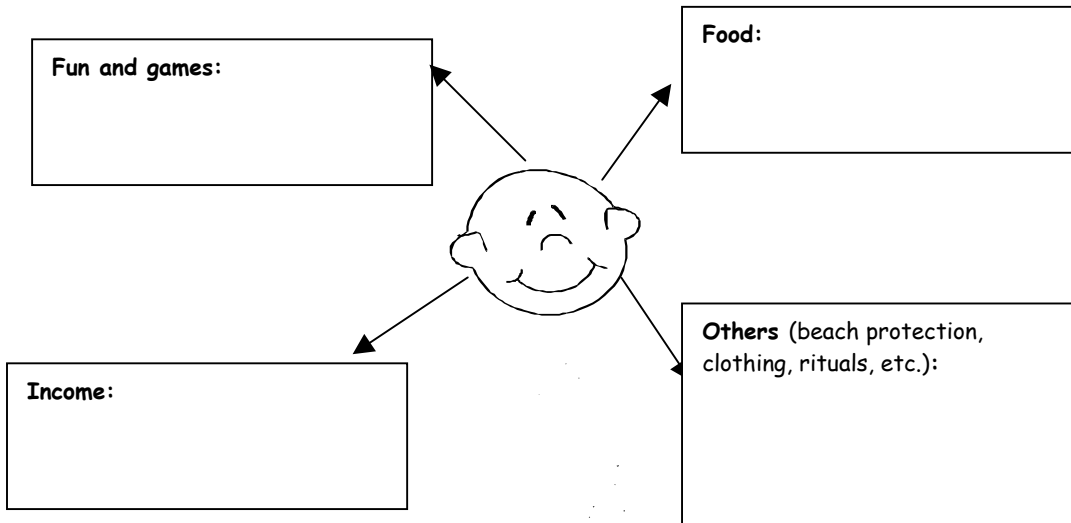
Below

### Finishing up

Once students have gathered the information on their log sheets, you should work as a class to pull all the information together. One way to do this would be to write down all the class' observations and findings on one large sheet of paper and post it in your classroom for future reference.

# COMMUNITY INVESTIGATION LOG SHEET

USES: In what way do coral reefs contribute to your daily life?



Are there cultural rituals that are practiced in relationship to fishing in the village? What are they? Do the elders know about other rituals that were once practiced? Did they have the same fishing tools (motor boats, nets, etc.)? Did they catch more or less fish in the old days? What do they think about modern fishing practices? (Invite a village elder to tell you how they fished in the old days.)

CHANGES: What is the state of coral reefs in your community?

Indicators	Observations
Dynamite, derris root or cyanide fishing?	
Reef life (abundance and diversity of fish, molluscs, corals, etc.)?	
Water quality (clear)?	
Deforestation (mangroves, forests, etc.)?	
Jobs people do for a living?	
Pollution (domestic, industrial, agricultural)?	

## ACTIVITY 5:

# Corals Reefs, Values & Beliefs

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### Objectives:

Students will identify and analyze a local environmental issue through a role-play scenario, clarify values, and collaboratively develop a conservation plan.

### Skills:

Research, critical thinking, problem solving, public speaking, collaboration

### Time:

20 minutes to introduce activity  
Several days to investigate and prepare  
90 minutes for role-play

### Materials

Notebooks, pens, chalk

### Ages:

## Introduction

With the information gathered during the community investigation, students should begin to identify environmental problems and some of the different perspectives that exist in the community on how people should manage marine resources. This activity gives students an opportunity to explore the values and interests behind certain positions.

## Getting ready

Students should make a list of the *environmental problems* (e.g. low fish populations) and *issues* (how to keep fish populations stable) surrounding the marine environment in their community. Students should then choose one primary issue to investigate.

Initiate a discussion on how people have different ideas about how to solve a problem or manage a resource. Make a list of all the groups of people who have a stake in the chosen issue (e.g. fishermen, children, conservationists, the government, industries), and talk about the interests and concerns of each chosen public.

Divide the class into groups. Each group will represent one group of *stakeholders*, and will work as a team to develop interview questions and investigate the issue from their stakeholder's point of view. They should discuss the answers to questions like: Why do you care about this issue? What do you think should be done? What are your concerns?

What would you be willing to do to solve the problem?

Each group will have one week to investigate and prepare to play the role of their stakeholder group in a conservation planning meeting. During this week, they should prepare a written report about their group, including at least one proposed solution.

## What to Do

To begin the role-play, set up the following scenario. Tell your students that they have been selected to design an important marine conservation plan for their community. The

plan should offer solutions to the environmental issue the class has been investigating. All the different stakeholders have been invited, and are challenged to come up with a final conservation plan that everyone must agree on. Throughout the entire session, make the meeting seem as "real life" as possible, and treat your students as you would treat the professional stakeholders they are representing. Tell the students to maintain their roles throughout.

One member of each group will present their group's viewpoint on the issue. You should take notes on the blackboard summarizing each group's main concerns. When all groups have given their introduction, ask the class to think of some possible solutions to the problem. Encourage students to think creatively, and then create a list on the blackboard summarizing each of the proposed solutions. In their roles, the class should talk through different solutions and why they might or might not work. You should make sure all students participate in the discussion.

When the different stakeholders find common ground on any point, you should write down their agreement. If students have trouble agreeing, remind them that they should look for solutions they can "live with" and to try to propose solutions that they think the others can agree to. They should try to be creative, yet realistic in their plans.

When you have 30 minutes left, students should be ready to create an outline of the final plan.

### Finishing up

When students have finished the consensus building exercise, each group will write up their section of the Conservation Plan. For example, the fishermen will write up what they will do to solve the issue and conserve marine biodiversity. You can then put all the group's sections together into one final report.

Potential Stakeholders	
Traditional Fishermen	Modern Fishermen
Children	Loggers
Dive boat operators	Shop owners
Tourists	Conservationists
Exporters of marine products	

## Activity 6: Reef Relief: Make it Happen!

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### Objectives:

Plan and implement a conservation project

### Skills:

Organization, solving problems, communication

### Time:

variable

### Materials

variable

### Ages:

3<sup>rd</sup> grade and up

After the students have finished their conservation plan, you can build upon their enthusiasm by planning an action project. For example, your class could decide to adopt their village reef and care for it. Here are some other project ideas:

- Go swimming or snorkeling to explore the reef, or make observations from a boat. Collect data on all the different species of marine life you see. Keep track of any changes over time.
- Organize a community / beach clean-up day
- Put on an environmental play or puppet-show to share your ideas for conserving the marine environment and coral reefs with the community.
- Paint a coral reef environmental mural at the school or other public area
- Write an environmental newsletter
- Create and post signs all around the school or community encouraging and reminding people to do things to protect coral reefs.

When doing a project, make sure you involve local community organizations and government agencies. They may be able to provide guidance, and possibly even funding to help make the project a reality.



# Glossary

<i>Biodiversity:</i>	the diversity of life, including genes, species, and ecosystems.
<i>Coral polyp:</i>	a small individual coral animal with a tube-shaped body and a mouth surrounded by tentacles (refer to the diagram on page ***).
<i>Crustacean:</i>	<b>aquatic</b> gill breathing animals often having a hard carapace or shell (eg: lobster, crab, prawn, etc.).
<i>Cyanide:</i>	extremely dangerous chemical product, composed of nitrogen and carbon, used by fishermen to stun reef fish
<i>Deforestation</i>	the practice of cutting down entire areas of forest
<i>Diversity:</i>	a great variety of different things such as species of plants and animals.
<i>Ecosystem:</i>	the interaction of living and non-living things in a particular environment
<i>Environmental Issue:</i>	a disagreement about how to resolve a particular <b>environmental problem</b>
<i>Environmental Problem:</i>	a negative interaction between man and the environment
<i>Estuary:</i>	the mouth of a river, bay or lagoon, where fresh water from the land meets saltwater from incoming tides.
<i>Habitat:</i>	an area that provides an animal or plant with food, water, shelter and living space
<i>Hard Corals:</i>	Reef-building corals that excrete external limestone skeletons and typically have tentacles in multiples of six
<i>Juvenile:</i>	young, not having reached reproductive maturity.
<i>Marine</i>	warm-blooded animals that need to surface regularly in order to breathe
<i>Mammals:</i>	air, give birth to live offspring, have a four-chambered heart, a body covered with very small hair, and/or feed their young on milk from the breast (eg: dugongs, dolphins and whales).
<i>Mangroves:</i>	a coastal tropical forest, where trees have special above-ground roots to keep them out of the water. Mangroves are important <b>nursery areas</b> for marine life, and can help keep pollution and <b>sediment</b> run-off from reaching coral reefs.
<i>Mollusks:</i>	soft bodied animal usually enclosed in a hard shell (e.g.: mussel, oyster, snail)
<i>Mudflat:</i>	sheltered parts of estuaries that are covered by water at high tide and exposed at low tide
<i>Nocturnal:</i>	term used to describe animals that become active during the night
<i>Nursery area:</i>	area (often sea grass and mangrove areas) where the young of a marine animal grow up before moving out to join the adults
<i>Plankton:</i>	minuscule plants and animals floating in the ocean currents
<i>Pollution:</i>	harmful substances deposited in the air, land or water

<i>Pristine:</i>	virgin, unspoiled.
<i>Sediment:</i>	fine particles of solid matter (often soil) suspended in water, or settling to the bottom of a body of water
<i>Siltation:</i>	when sediment settles out of the water, covering the bottom of a body of water or the surface of coral reefs
<i>Soft Corals:</i>	coral polyps that secrete flexible skeletons
<i>Spawning area:</i>	area where animals such as fish and molluscs reproduce by depositing /releasing their eggs and sperm
<i>Stakeholder:</i>	a person who has an interest / stake in a particular issue

## Extension Ideas

1. Marine issue story writing: Pretend you are a journalist and pick a marine environmental issue that concerns you. It can be real or imaginary, like a disastrous oil spill, tropical fish smuggling, explosive fishing, a tidal wave, etc. Write a story explaining how it happened, and what the consequences were to the people and animals involved.
2. Make an "ocean events" bulletin board in your classroom. Check the newspapers and put newspaper and magazine articles on the board, or add your own class observations. You can also do a more general environmental issues bulletin board.
3. Participate in a coastal clean-up day.
4. Marine Environmental Issues Science Fair: Organise a mini-science fair, with each student studying and presenting an environmental issue related to the ocean world.
5. Raise awareness in the village by having your classroom make presentations to organised community groups such as the women's fellowship, youth groups, or council meetings.
6. Select long-term projects for students to do over a period of time (see **Reef Relief**, p. \*\*\* for ideas).
7. Invite guest speakers to the school to talk about environmental issues affecting the community.
8. Show environmental educational videos.
9. Use the National Educational Weeks such as Literacy Week or Book Week to talk about environmental issues affecting the community.

## Resources

For more information on coral reefs or marine conservation, contact:

Conservation International PNG  
PO Box 106  
Waigani, NCD  
PAPUA NEW GUINEA

Conservation International PNG-Alotau  
PO Box 804  
Alotau, Milne Bay Province  
PAPUA NEW GUINEA

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