

**CONSERVATION AND SUSTAINABLE USE
OF THE
MESOAMERICAN BARRIER REEF SYSTEMS PROJECT
(MBRS)**

Belize – Guatemala – Honduras - Mexico



**TEACHERS' GUIDE
FOR
SECONDARY SCHOOLS**

**Infusing the Mesoamerican Barrier
Reef Systems Themes
Into the Secondary Schools Curricula**

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Document Adaptation and Editing

MBRS Project Team

PROLOGUE

The main objective of the MBRS Teachers' Guide is to enable educators to take full advantage of the students' readiness and capability to learn; to improve understanding and retention; to present complex, overwhelming problems and possible solutions to the threats facing coral reefs in more solvable, understandable pieces.

The guide also presents students with different ways to take action to save the reefs, thereby instilling in them the understanding and confidence that they can improve the environment in which they live.

The Teachers' Guide is organized into sections, namely, Background Information, Lesson Plans, Resources and Annexes. The lessons plans are formatted as follows: Grade(s), Subject, Objective, Concept, Material and Procedures.

The Background Information provides teachers of all grades with extensive information about the MBRS, so that they can effectively instruct their students and use the lesson plans. It addresses three major areas:

1. Coral Reef Biology and Ecology describes the anatomy, reproduction and feeding behaviours of coral polyps, coral reef partner ecosystems as well as their geographic location and formation.
2. People and Coral Reefs explains the coastal development and pollution, alternative livelihoods, Marine Protected Areas, biodiversity of the coral reef ecosystem and describes the protection and predation techniques of the myriad of marine life that makes up the coral reef food chain. This section also introduces four native coastal peoples and shows how they are taking action to protect their marine environment.
3. Transboundary connectivity emphasizes the economic and ecological importance of coral reef resources to both humans and ecosystems. It demonstrates the marine transboundary inter-relationships, the anthropogenic threats that reefs are facing and possible solutions to these problems.

Each lesson provides the teacher with clear educational objectives and an interdisciplinary index to relate the curriculum to pertinent subject areas, such as natural science, social studies, biology and geography. It also provides guidelines for presentation of the material, and suggestions for follow-up to and extension of the lessons.

Additional activities and resources are at the end of the Teachers' Guide. It is a resource section containing a glossary, bibliography, references for students, a list of coral reef-related organizations, educational merchandise, and action programs. This material supports and enhances the teachers' ability to present information about coastal and marine resources in an efficient and thorough manner, and to expand the students' study and involvement with reefs if desired.

Table of Contents

Introduction	5
How to use this guide	6
MBRS Thematic Codes	9
Tables of Schools' Curricula with Lesson links	11-16
Table of Lesson plans	18-19
Lessons	
Lesson 1: Chance of success	21
Lesson 2: Coral need clear water to live	23
Lesson 3: Students as coral reef scientists	25
Lesson 4: Coral reefs in hot water	30
Lesson 5: Biological & physical agents of change	36
Lesson 6: Explore the coral reefs	38
Lesson 7: Build a reef	41
Lesson 8: Survival factors	47
Lesson 9: Animal population sizes	50
Lesson 10: The coral conservation game	53
Lesson 11: Products of the sea	60
Lesson 12: Food from the sea	61
Lesson 13: Fishing for Future	63
Lesson 14: Depletion of marine resources	69
Lesson 15: Save the mangroves	71
Lesson 16: Mangrove community	74
Lesson 17: Zonation on mangrove trunks	77
Lesson 18: Seagrass turnover	79
Lesson 19: Sensational seagrass	81
Lesson 20: What if the reef dies	82

Lesson 21: Tree vs Fish	83
Lesson 22: Design tasks for coral reef marine reserve	85
Lesson 23: Ecological sustainable development	88
Lesson 24: Personal actions	91
Lesson 25: Green points challenge	92
Evaluation	95
Glossary	97
Resources	102
References	104

Introduction

This guide has been prepared as part of the Mesoamerican Barrier Reef System project Environmental Education Component. The MBRS extends some 1,000 km from the Yucatan Peninsula to the Bay Islands of Honduras, including the second longest barrier reef in the world. Due to the MBRS' uniqueness in the Western Hemisphere for its size, reef types and luxuriance of corals, the MBRS project was established. The project addresses the conservation and sustainable use of MBRS resources.

This guide offers educators the opportunity to integrate coral reef education into their lessons. The guide is a compilation of lessons that help to bring the themes related to the Mesoamerican Barrier Reef System into the classroom. The themes, ranging from coral biology to transboundary issues, relate to the coral reefs and other relevant coastal and marine ecosystems.

Knowledge of natural systems helps students understand the interconnections between all life and the way human actions affect these systems. Alternative solutions cannot be explored unless students have an understanding of the basic processes involved. It should be linked with a critical knowledge of the social systems that shape their lives. Only this combination provides an adequate basis for understanding causes, exploring alternative solutions, making decisions and taking responsible action. Learning to respond thoughtfully to issues is an important part of growing up and needs to be part of the school curriculum.

The goals of Education for Sustainability are:

- to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- to create new patterns of behavior of individuals, groups and society as a whole towards the environment.

The categories of EfS objectives are:

- *Awareness*: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
- *Knowledge*: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
- *Attitudes*: to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
- *Skills*: to help social groups and individuals acquire the skills for identifying and solving environmental problems.
- *Participation*: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

Education for sustainability can enrich many subject areas. It draws on scientific knowledge and understanding as well as the processes of making predictions, obtaining and evaluating evidence. While it is an excellent vehicle for spoken and written language work, it also uses mathematical data and geographical skills and knowledge. It promotes historical understanding and can provide a stimulating and relevant context for work in almost every other area of the curriculum.

How to Use this Guide

The guide is divided into four areas:

Section I	Table of thematic areas
Section II	Table of country curriculum with lesson links
Section III	Table of Lessons
Section IV	Lessons

There are two ways to access the lessons.

1. Go to the section that contains your country's tables of curriculum areas, find the relevant subject area under your country curriculum. Find the appropriate topic and find the corresponding lesson number. Go to the main section of the guide and find that lesson. Some topic areas of the curriculum have more than one corresponding lesson, just choose the one you wish to use.
2. Go to the section that contains the table of lessons. You can review the list of objectives on the list and choose the lesson you would like to use.

SECTION I

Mesoamerican Barrier Reef System Project (Thematic Areas)

Coral Reef Biology & Ecology		
Coral Biology & Geology	BIO1	Formation of coral reefs: the three types
	BIO2	Biology of coral types
Reef Organisms	ORG1	Vertebrates
	ORG2	Plants
	ORG3	Invertebrates
Coral Reef Ecology	ECO1	Level of organization (individual, population, community)
	ECO2	Relationships among organisms
	ECO3	Food chain, food web
	ECO4	Natural disturbances to coral reefs: coral bleaching, hurricanes
Coral Reef Partner Ecosystems	PAR	Connectivity between coral reefs, seagrass beds and mangroves
People & Coral Reefs		
Goods & Services of Coral Reefs: coastal protection, fisheries, biodiversity, sand, building materials, medicinal cures	SVC	
Reef Fisheries	FIS	
Coastal Development & Pollution	DEV	
Alternative Livelihoods	ALT	
Marine Protected Areas	MPA	
Transboundary Connectivity		
	TRA1	Fish Spawning Aggregations
	TRA2	Ocean Currents (moving larvae & pollutants)
	TRA3	Fishing

Section II

Tables of School's Curriculum With Link to Appropriate Lessons

Secondary Education Plan - Mexico

Secondary Education Plans - Mexico		
BIOLOGY	Grade 1	
		Lesson(s)
	<u>The Living World & Study of Science</u> <i>Meaning & use of Biology Studies</i> -environmental conservation	22
	<u>Evolution: Change of Living Things in the Environment</u> <i>Evolution, Diversity & Adaptation</i> -origin of bio diversity & speciation -principle of Adaptation	7
	<u>Living Things in the Planet</u> <i>Biodiversity</i> -types of living things (terrestrial, aquatic, aerobic, anaerobic, autotroph, heterotroph) -importance of biodiversity -reasons for cause of biodiversity loss -species in extinction	
	<u>Ecology: Living Things & their Environment</u> <i>What is Ecology</i> -origin of the term -imp of studying ecological processes	3
	<u>Ecological Systems</u> -biotic & abiotic factors of the environment -carbon, nitrogen, water cycles -principles of photosynthesis -food chains & energy transfer	3, 7, 9
	<u>Ecosystems</u> -dynamic of an ecosystem -different types of ecosystem -local ecosystems	7, 18
	<u>Consequences of Human Activity in the Environment</u> -environmental conservation -loss of biodiversity	14
	<u>Actions to Prevent Environmental Problems</u> -alternative forms of energy -regeneration of the ground/earth -reforestation & recycling -anticontamination measures	11, 21 22

Secondary Education Plans - Mexico		
GEOGRAPHY	Grade 2	
		Lesson(s)
	<u>Water in Mexico</u> Oceanic Waters -fishery & mineral resources (their use/exploitation)	12, 13, 14
	<u>Climate & Natural Regions in Mexico</u> Natural Regions of Mexico -tropical regions, temperate & dry -their characteristics & distribution -biodiversity of Mexico & its worldwide importance	1,2 3,
	Relation between the Natural Regions, Population Distribution & Economic Activities	12, 14
	Alterations Natural Regions have Suffered through Human Action	8, 13, 14
	<u>Economic Activities in Mexico</u> Fishery	12, 13, 14

Secondary Education Plan - Belize

Lower Secondary Curriculum – Belize (still being developed)		
SCIENCE	Grades 1 & 2	
		Lesson(s)
	Classification -habitats -the physical environment -biotic environment – interdependence -balancing the ecosystem -reefs, mangroves, rainforests	3, 6, 7
	Food Chains & Food Webs	3, 7
	Some human activities Have long term adverse consequences on the ecosystem; over exploit the natural resources on Earth; air, water and land pollution	10, 20

Secondary Education Plan - Honduras

Basic Secondary Education Plan-Honduras	
Grade 2/	
SOCIAL STUDIES	Lesson(s)
<p><u>Describe the Basic Characteristics of Sustainable development:</u></p> <p>Diverse concepts related to the idea of sustainable development.</p> <p>Central approaches known & ratified in the Rio de Janeiro Summit (Brazil, 1993 and the meeting of Central American presidents (Managua, 1994)</p> <p>Cultural standards & the idea of mother nature as guided by the behaviour of the ethnic groups: Aymara (Bolivia), Sioux (US), Pech (Honduras) Maya-Lacandones (Mexico)</p> <p>Apply the cultural experiences of the Aymara, Sioux, Maya-Lacandones and the central ideas of the approaches from Rio and Managua the ideal model of sustainable development.</p>	15, 21, 22
<p><u>Identify the Principal Natural Resources of Latin America that guarantees Sustainable Development:</u></p> <p>Natural resources of America: renewable & non-renewable.</p>	10, 15
<p>Describe the natural resources that are fundamental to food consumption, natural medicine, raw materials.</p>	11,12

Secondary Education Plan - Honduras

Basic Secondary Education Plan - Honduras				
NATURAL SCIENCE	Grade 1/Course 1		Grade 2/Course 2	
		Lesson(s)		Lesson(s)
	<p>Recognize an Ecosystem & Understand the terms Ecology & Environmental Education. Components of ecosystem - biotic, abiotic. Biotic components of an ecosystem: producers, consumers, decomposers Aquatic ecosystems local & Honduras. Concepts: biosphere, habitat, ecological niche. Laws & principles of ecology.</p>	<p>1, 3, 6, 7</p> <p>16, 17, 18</p>	<p>Apply to Daily Situations some Terms Used in Ecology Ecological news most important for our country. Application & importance of ecology. Terms: habitat, ecological niche, biosphere, ecosystem, biotic & abiotic factors</p>	<p>15, 19</p> <p>3, 7</p>
	<p>Determine Factors that unbalance Ecosystems 5 factors that alter aquatic & terrestrial ecosystems. Contaminants found in aquatic & terrestrial ecosystems of the community. Environmental problem of the community & general environmental problem of the country. Habits of the population that causes contamination. -Measures population can employ to avoid contamination in home & community</p>	<p>4, 5</p> <p>20</p> <p>13</p> <p>20</p>	<p>Community Community & its characteristics. Biotic factors: producers, herbivores (primary consumers), carnivores (secondary consumers), omnivores and decomposers. Interactions & food chains. Relationships among living things: symbiotic (mutual, companion) and antagonist relations (competition, parasitism).</p>	<p>3</p> <p>9, 16</p> <p>3, 6, 17</p>
	<p>Conserving the Environment Identify environmental problems, their causes, effects, consequences & the application of solutions.</p>	<p>4, 5, 8</p>	<p>Forests & Coastal Ecosystems of Honduras Coastal ecosystems of Honduras: mangroves, reefs.</p>	<p>15, 16, 18, 19</p>
			<p>Categories of Protected Areas in Honduras National parks Biological reserves Biosphere reserve Natural monument Marine parks Multiple use zones Local environmental laws w/references to environmental protection</p>	<p>22</p>

Secondary Education Plan - Guatemala

Basic Secondary Education-Guatemala						
N A T U R A L S C I E N C E S	Grade 1		Grade 2		Grade 3	
		Lesson		Lesson		Lesson
	Our Planet Earth Natural resources: use & conservation Renewables, non-renewable Protected areas as one option of natural resource conservation	10, 12,15, 19	Humans & Relationships with animals & plants of Community Animals & plants for food, medicine, industry	11, 12	Environmental Conservation Principal environmental problems & its causes, effects on municipality, district, country Deforestation, erosion Loss of habitat	5, 8
	Organisms & Environment Ecosystems Factors of ecosystems Abiotic & biotic factors	3, 7, 18	Guatemala's Fauna & Flora Importance of conservation & its economic importance Threatened species & protected areas as a conservation alternative	21, 23 22	Contamination Fertilizers, pesticides	2
	Organisms & relationship with Environment Interspecies relationships: symbiosis, mutualism, food chain, web	7, 17	Economic resources of Guatemala Agriculture, industry, ecotourism, fishery Location of principal productive zone of country	12, 13 2,3 6,19	Conservation action & Sustainable in District & Country Knowledge & analysis of laws on environmental protection in country Protected areas an alternative of conservation	22, 21, 22, 23
	Deterioration of Environment by human actions Contamination of air, water, ground	8, 10	Environmental Conservation Principal environmental problems & its causes, effects in the municipality, district, country Deforestation Loss of habitat for	8, 14, 15, 18		
	Identify Environmental problems in Community	8, 10, 14				
	Institutions involved in natural resource conservation Laws of environmental protection Sustainable development	22, 23, 24				

Basic Secondary Education-Guatemala						
S O C I A L S C I E N C E S	Grade 1		Grade 2		Grade 3	
		Lesson		Lesson		Lesson
	Municipal Community Economic activities: agriculture, industry, fishing, mining, ecotourism	12	Guatemala Society: our district Natural resources are the base of society	10	Guatemala – National Community Use of natural resources on a grand scale.	11,
	Economic activities & their relationship with sustainable development. Importance & impact of sustainable development over short, medium, long time.	21, 22			Sectors of national productivity: fishery, agriculture	13, 14
	The Municipality Geographic location, boundaries, maps	6,	Economic Activities: Agriculture, ecotourism, fishery, etc. & impact on district's environment.	13, 14	Guatemala in Relation to the world World problems: social, environmental, natural phenomena	4, 5
	Natural resources	7, 10 15			Development, subdevelopment, sustainable development	21, 23
	Guatemala in Relation to Central America Geographic location in the Central America isthmus	21,	Cooperatives Legal base & types of cooperatives. Cooperatives of district & their role in environmental conservation.	12		
	Relationships of Guatemalans with their habitats. Natural & caused disasters & contingency plans	21, 23,	Environmental laws (forestry, protected areas, environment)	15, 22		
	International relations: diplomatic, cultural, economic & other with Central American countries	24				
			Guatemala in relation to America Common characteristics & factors w/other Latin American countries: politics, economy, common environmental problems, etc.	3, 6		
			International relations of Guatemala with other countries of America:	13, 14		
			Geographic location (climate, water availability, soil) Climatic changes as products of environmental alterations & its effect on regional economy & politics			

Section III

List of Lessons

linked with the
Mesoamerican
Barrier Reef System
thematic codes

	Lesson Titles	Objectives	CODE
Lesson 1	Chance of Success	Conditions for coral reef development	BIO1/2 TRA2
Lesson 2	Corals Need Clear Water to Live	Conditions for coral reef development	BIO1 DEV
Lesson 3	Students as Coral Reef Scientists	Coral Biology Coral reef ecology	BIO1/2 ECO2 ALT DEV
Lesson 4	Coral Reefs in Hot Water	Coral Biology & Geology Natural disturbances to coral reefs: Bleaching	BIO1/2 ORG2 SVC DEV ECO4
Lesson 5	Biological & Physical Agents of Change	Natural Phenomena & organisms that affect coral reef Actions that affect the coral reef	ECO4 SVC DEV
Lesson 6	Explore the Coral Reefs	Conditions for coral reef development Types of coral Reef Organisms	BIO1/2 ORG1/2 TRA2
Lesson 7	Build a Reef	Organisms that make up a reef ecosystem Relationships among organisms on reef	BIO1 ORG1/2/3 ECO2
Lesson 8	Survival Factors	Reef Organisms Human actions that affect ecosystems	ECO1/2 DEV FIS ALT TRA3
Lesson 9	Animal Populations Sizes (Fieldwork)	Reef Organisms Levels of organization	ECO1
Lesson 10	The Coral Conservation Game	Services, functions of coral reefs Reef Fisheries Human actions that affect ecosystems	BIO1/2 SVC FIS DEV TRA3
Lesson 11	Products of the Sea	Services, functions of sea/reef Conservation/Alternatives	SVC ALT
Lesson 12	Food from the Sea (Fieldwork)	Goods & Services of Coral Reefs Fisheries	SVC FIS
Lesson 13	Fishing For Future	Fisheries Alternatives	FIS ALT
Lesson 14	Depletion of Marine Resources	Fisheries Conservation/Alternatives	SVC FIS ALT TRA3
Lesson 15	Save the Mangroves	Values of coastal systems Conservation	PAR DEV ALT
Lesson 16	Mangrove Community (Fieldwork)	Connectivity of marine Ecosystems Coastal Development & Pollution Reef Organisms	PAR
Lesson 17	Zonation on Mangrove Trunks (Fieldwork)	Reef Organisms Connectivity between marine ecosystems	ORG1/2/3 ECO2 PAR
Lesson 18	Seagrass Turnover (Fieldwork)	Connectivity of marine ecosystems Reef Organisms Food Chain, Food Web	ECO3 PAR
Lesson 19	Sensational Seagrass	Values of coastal systems	ORG1 PAR
Lesson 20	What if the Reef Dies	Coastal Development & pollution	DEV
Lesson 21	Tree vs Fish	Conservation/Alternative	PAR ALT DEV
Lesson 22	Design Tasks for Coral Reef Marine	Human actions that affect coral reefs	SVC

	Reserve	Conservation	FIS DEV MPA TRA3
Lesson 23	Ecological Sustainable Development	Human actions that affect coral reef Reef Fisheries Conservation/Alternatives	DEV FIS ALT TRA MPA
Lesson 24	Personal Actions	Coral Reef Conservation	PAR DEV ALT TRA3
Lesson 25	Green Points Challenge	Coral Reef Conservation	PAR DEV ALT

Section IV

Lessons

A CHANCE OF SUCCESS

Grade(s): secondary
Subject(s): science, geography

Objectives:

Learn about the physical factors that limit where coral reefs develop.
 Understands relationships among organisms and their physical environment
 Knows the physical processes that shape patterns on Earth's surface

Materials:

- 1 die
- copy of score card

Procedure:

1. Lead students in a discussion about what things might limit where coral reefs develop. Ask them to name some of the conditions they know reef-building corals need to survive. (*Right water temperature; clear, shallow water; strong wave action to bring in nutrients*) Write these on the board.

Explain to students that a site must meet all these criteria for a reef to successfully establish and thrive.

2. Show students the die and explain that they'll be playing a game in which they'll all be coral planulae in search of a settling site. Each student will roll the die three times, once for each survival factor.

3. Explain that to survive, they must roll one of these numbers when casting the die for that condition:

Temperature = 2,3,4,5 (1 too cold, 6 too hot)

Substrate/depth = 1,2,3,4 (5,6 too deep)

Wave action = 4,5,6 (1,2,3 too weak to bring in nutrients)

4. Place the score sheet on an overhead projector, or have a student keep score on the board.

5. Invite students up one at a time to roll the die. Be sure to state what factor they're rolling for each time. If they get a good number for all three rolls, they qualify for the next round.

6. Gather the qualifying "planulas" [planulae] in front of the class for the final round. Ask each student the following questions:

! What are coral temperature requirements?

! What are depth requirements?

! Why do reef-building corals need strong wave action?

Those students that can answer the questions are the winning polyps.

7. Remind your students that corals release thousands of eggs and sperm, some of which join and develop into planulae. Do they think all the planulae survive? Why not? Explain

that the reproductive process leans towards high numbers to allow for high mortality. Many planulae are eaten by marine animals before they settle and attach to the bottom. By producing hundreds of thousands of eggs at a time, a coral polyp increases the chance that one of its offspring will mature

and reproduce, the measure of a species' survival success.

Deeper Depth: Calculate the percentage of planulae that survive each round.

NAME	WATER TEMPERATURE	WATER DEPTH	WAVE ACTION

Source: Dr. Sharon H. Walker, R. Amanda Newton, Dr. Alida Ortiz, *Coral Reefs: An English/Spanish Compilation of Activities for Middle School Students*, 2001, J.L. Scott Marine Education Center & Aquarium, all rights reserved

CORALS NEED CRYSTAL CLEAR WATER TO LIVE

Grade(s): secondary

Subject(s): science, geography

Objectives:

Understands relationships among organisms and their physical environment

Understand that clean, clear water is essential for coral growth

Turbidity

Turbid water might be described as “murky” in appearance; the clearer the appearance of the water, the lower its turbidity. When turbidity is high, water loses its ability to support a diversity of aquatic organisms. Solid particles—such as sediment—suspended in the water can block out light that aquatic plants and organisms need. Suspended solids can also absorb heat from sunlight, raising the temperature of the water. As the water becomes warmer, it loses its ability to hold oxygen. This causes dissolved oxygen levels to drop, further reducing the number of plants and animals that can live in the water.

You will use a Secchi disk to measure turbidity. A Secchi disk is a scientific tool for measuring the relative clarity of deep water. The clearer the water, the lower the turbidity. The murkier the water, the higher the turbidity.

Materials

- Plastic lid, white or light-colored, 20 cm (about 8 in) in diameter
- One black waterproof marker
- Several meters of fishing line
- Flagging tape or strips of colored ribbon
- Meter stick
- Eyebolt with 2 nuts and washers
- Several sharpened pencils

Procedure:

1. Use a sharpened pencil to punch a hole in the center of the plastic lid.
2. Use your waterproof marker to divide the top (outside) of the lid into four pie-shaped pieces of equal size (see illustration). Color the upper left and lower right sections black.
3. Thread a nut and washer (in that order) onto the eyebolt.
4. With the nut and washer on the eyebolt, insert the eyebolt through the hole in the center of the lid. Then add the other washer and nut (in that order) to the eyebolt on the underside of the lid (see illustration).
5. Tie one end of the fishing line to the eye of the eyebolt. Using the meter stick, measure out from the eyebolt 250 centimeters (about 10 in) along the line, and tightly tie ribbon around the line. Continue tying ribbons to the line every 250 centimeters. In the field, you will lower the Secchi disk into the water. As soon as you can no longer see it, you will stop and count the number of ribbons to determine the turbidity level.

Field Experiment

1. If possible, stand on a bridge over the water at your aquatic site. If there is no bridge, simply conduct this experiment from the bank. Lower the Secchi disk into the water just to the point where you can no longer see it.

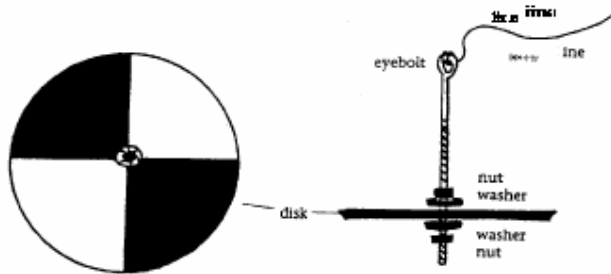
2. When you can no longer see the Secchi disk, count the number of ribbons remaining above the surface of the water. Subtract this number from the total number of ribbons on the line to calculate the number of ribbons submerged with the disk. This is your turbidity reading.

Example: Suppose you count 10 ribbons above the water at the time you can no longer see your Secchi disk. If your fishing line has a total of 15 ribbons, you would subtract 10

from 15, and your turbidity reading would be 5.

If your Secchi disk reaches the bottom and you can still see it, you should still record the number of ribbons submerged with the disk. If you are still able to see the disk after

it has reached the bottom, what do you think it means?



Repeat the experiment one or two times. Record the turbidity each time. To get an average of your Readings, add the turbidity readings and then divide by the number of times you did the experiment.

STUDENTS AS CORAL REEF SCIENTISTS

Grade(s): secondary

Subject(s): science, geography

Objectives

Represent the structure and symbiotic relationship of a coral reef ecosystem.

Identify the major conditions in which coral reefs can grow (light, temperature, sediments, salinity, depth of sea).

Describe where coral reefs grow.

Lesson context:

The main topic of investigation for this mission is protection of coral reefs. To address the overall problem, students will need to have a basic understanding of coral reefs. During this lesson, students participate in the following hands-on activities about coral reefs:

- drawing a picture of coral reefs,
- discussing symbiosis and relating it to coral reefs,
- constructing paper models of different types of island coral reefs, and
- building different types of coral reefs with Plaster of Paris.

Based on the understanding of what coral reefs are, how they work, what features they have, and where they grow, students can determine what data they will need to collect to evaluate whether restrictions should be applied to tourism, recreation, or commercial enterprises around the coral reefs within the Mesoamerican Barrier Reef System.

Estimated time required: 2 to 3 class periods

Materials

- Activity sheets for these activities
- Construction paper, cardboard
- Plaster of Paris, clay

Activity 1: What is a Coral Reef?

Inform students that they will be participating in different activities in order to develop their understanding of coral reefs. Involve students in the demonstration and initial discussion of a coral reef's structure and location.

1. Show students a short movie that includes the motion of coral and other marine invertebrates and ask them what questions come to mind with the focus on the structure

2. Ask students

- What is a coral reef?
- How do they live?
- Where do they live?

3. Prompt students to draw a picture of coral reefs on *Activity Sheet 1: What Does a Coral Reef Look Like?*

Activity 2: Coral Reef Symbiosis

1. Introduce the concept of symbiosis by having students think about a time when they helped each other and it turned out they were helping themselves too.
2. Prompt students to write a brief explanation of what they investigated. See *Activity Sheet 2: Coral Reef Symbiosis*.

Activity 3: Constructing three paper models that describe coral reefs.

1. Ask students to research the types of coral reefs. See *Activity Sheet 3: Researching the Types of Coral Reefs*

2. Divide your students into three groups and assign each group to create one of the following types of coral reefs. Show students animation of how a reef progression from a fringing reef to a barrier reef and then finally to an atoll.

- Making a fringing reef
- Making a barrier reef
- Making an atoll

3. Prompt students to write a brief explanation of what they investigated.
4. After students build different types of coral reefs, have them share with each other the important characteristics of each.
5. Explore the conditions under which coral reefs can grow and have students build different models of coral reefs.

Activity 4: Goldilocks and Coral Reefs

1. Introduce the lesson by reminding the students the story of *Goldilocks and Three Bears*

- o What kinds of chairs did Goldilocks find in the bear's house?
- o Why did Goldilocks think that *Little bear's* chair was made just for her?
- o Why did Goldilocks think that Papa bear's pie and Mama bear's pie were not tasty?
- o Like a Goldilocks story, can we find favorable conditions that coral reefs can grow well—not too extreme in temperature, salinity, wave action, depth of sea?

2. Prompt students to explore the growing conditions that coral reefs can grow well by investigating the following websites.

3. Tell students to write a brief explanation of what they investigated. See *Activity Sheet 4: Goldilocks and Coral Reefs*

3. Provide students with the various images of the Mesoamerican coral reefs.
 - o Brain coral
 - o Elkhorn coral
 - o Finger coral

4. Ask students to find where the Mesoamerican Barrier Reef is located.

Activity Sheet 1: What Does a Coral Reef Look Like?

Name:

1. Draw a picture of a coral reef and label its features.

Parts of a Coral Polyp



<Reference> <http://library.thinkquest.org/J002237/corals/partscoralpolyp.gif>

Teacher Note: In reality, each polyp in the picture is extremely small, about 1mm across.

2. What does your picture show about real coral reefs?

A coral reef is made up of the shells of single, small marine animals called coral polyps. When coral polyps grow into a group they are called a coral colony. As polyps die, new ones grow on top of the old empty shells. Over time, the collection of shells left behind by dead coral polyps and dead coral colonies build large groups of rock-like structure called a coral reef. Although the entire coral reef looks like a lot of large rocks, the top surfaces are actually covered with new coral colonies that are very much alive.

Activity Sheet 2: Coral Reef Symbiosis

1. Did you have a time when you helped someone and it ended up benefiting both of you? Please write about this situation in 1-2 paragraphs.

Examples:

- Boosting another person up to reach something of importance to both –like a cookie they would share.
- Running a relay race
- A grandparent living in the same house as their children. They are provided with room and board for free, while they baby-sit for the parents, or do the laundry.

2. What you described in item 1 is symbiosis. Combine what you learned from this experience and what you found out about its definition to define symbiosis in your own

Symbiosis means sustaining the life of each other by living together in harmony. What students should have described in answer one was an action whose purpose was to benefit the other.

3. Define zooxanthellae.

Zooxanthellae are one-celled yellow-brown (dinoflagellate) algae that live symbiotically in the reef-building corals.

4. Why do we say that coral reefs live symbiotically?

Inside the sac of each coral polyp lives a one-celled algae called zooxanthellae (zoo-zanthy). The algae gives off oxygen and other nutrients that the coral polyps need to live and in return the polyp gives the algae carbon dioxide and other substances the algae needs. In addition to the symbiotic relationship between zooxanthellae and the coral polyps, many other fish live symbiotically with the coral reefs.

5. Why do coral reefs grow so near the surface of the water?

Because the algae (zooxanthellae) need sunlight to create food through photosynthesis, they live in ocean waters less than 100 meters deep.

6. Why do you think that symbiosis is important to coral reefs?

Without the algae, the coral could not live. Without the coral, giving off carbon dioxide and other substances, the algae could not live.

Activity Sheet 3: Researching the Types of Coral Reefs

Name:

1. What is the difference between *fringing*, *barrier*, and *atoll* coral reefs?

The main difference between each type of reef is the distance it lies from the beach shoreline.

2. Define *fringing* coral reefs.

Fringing reefs attach themselves to the beach where they can find much food and clean, rather than muddy, freshwater. These are the simplest and most common kind of reef.

3. Define *barrier* coral reefs.

Barrier reefs grow out from the beach as far as 100 km from shore, often rimming and protecting a relatively deep lagoon on the ocean side. Some are 2000 km in length. The lagoon is a common place for boats to dock, and therefore can threaten the coral.

4. Define *atolls*.

Atolls are circular, surrounding a lagoon. Its upper surface is nearly flat with steep outer slopes. They are found far from land. Charles Darwin, solving the puzzle of how they are formed, determined that they formed around islands that are sinking. As the island sinks, the reefs continue to grow upward at the same pace, and therefore remain visible.

Activity Sheet 4: Goldilocks and Coral Reefs

Name:

1. Where do coral reefs grow?

Coral reefs can be seen throughout the tropical and subtropical Western Atlantic and Indo-Pacific oceans, generally within 30 degrees N and 30 degrees S latitudes.

2. Why do you think that coral reefs only occur between certain latitudes, and then only within certain areas?

Studies have shown that most reefs grow well between the temperatures of 79-80 degrees F. The temperature is ideal year round in these locations, not too hot, and not too cold.

3. What major factors limit where coral reefs can found? List 5 major factors limiting the occurrence of coral reefs.

Factor	Requirements	Why is it important
Temperature	64-86F (18-30C)	Stable temperature between 64-86F is necessary for the survival of coral reefs.
Salinity	33-36 parts per thousand	
Light	The maximum dept for actively growing coral is 70m.	The need for light for coral reefs' symbiotic plant is thought to limit reef building corals to shallow water.
Wave action	Reef development is generally more abundant in areas that are subject to strong wave action	Waves carry food, nutrients and oxygen to the reef. Waves distribute coral larvae. Waves prevent sediment from settling on the coral reef.

Activity Sheet 5: Analyzing their Living Conditions

Name:

1. Search for locations where coral reefs can be found.

- Where is the Mesoamerican Barrier Reef System?

1. Do you think that the area around the Mesoamerican Barrier Reef are ideal environment for a coral reef? Why?

They have a stable temperature. Salinity is perfect, and there is enough wave action.

2. Do you think that coral reefs could live in your area? Why or why not?

This answer depends on the location of your school. Test the salinity, temperature, wave action and sediment in water near you to determine this.

CORAL REEFS IN HOT WATER

Grade(s): secondary

Subject(s): science

Objectives

Define coral reefs, their formation, and location

Define coral bleaching and its causes

Understand how coral bleaching affects different environments

Materials

- 2 world maps
- Push pins
- Computers with Internet access
- Student activity sheets
- Different color highlighters
- Infrared satellite image of the Earth obtained from the CURRENT 'DAILY' SST ANOMALY CHARTS web page.

Procedure

1. Group students into teams of 2 or 3. Using the Internet, teams independently research information on coral reefs and answer Questions 1–7 on Student Activity Sheet 1: Coral Reefs. The list of sites given in the Resource section may be used as a guide, or students can conduct independent searches.

2. Each group will research specific locations of coral reefs around the world. These regions can be assigned or chosen by the groups. When finished, they will take turns to mark, with a push pin, points on the world map where coral reefs are found. (Examples can be found at <http://www.reefrelief.org/library.html>, under the section ALL ABOUT CORAL REEFS, and at <http://www.cgjar.org/iclarm/reefbase/frameq/>, the REEF BASE HOME PAGE.)

3. Discuss with the class some of the threats they found to coral reefs in their research. Pose the question "What is coral bleaching?" Give each group 10 minutes to come up with a possible definition and answer Question 8 on Student Activity Sheet 1: Coral Reefs. Discuss their answers, and then have them research coral bleaching on the Internet. Answer the rest of the questions on Student Activity Sheet 1: Coral Reefs.

4. Present the infrared satellite image of the Earth to illustrate where warmer waters occur. Ask students to verbally theorize what could cause changes in the ocean's water temperatures. (Their responses may include, for example, El Niño, climate variability and change, local weather patterns, rain or lack of rain, and runoff from wastewater treatment plants or nuclear power plants.)

5. Discuss information on coral bleaching. Have groups look up information on specific regions and prepare presentations on how coral bleaching has or is affecting these regions. Use Student Activity Sheet 2: Coral Bleaching Presentation to guide them in their research. Use the map at the following site to help determine assigned locations: <http://www.reefrelief.org/library.html>.

6. Each group will conduct a 5–10 minute presentation on their findings. They should prepare a 1 page review of their research, to hand out to the class.

7. Have groups combine their findings to make a composite map of coral bleaching occurrences, using the second world map. Each group will use a highlighter to mark the areas they studied. Compare the two world maps and discuss the similarities and differences.

CONCLUSION

- Discuss with the students the importance of coral reefs.
- Ask the students to describe coral bleaching and what they think is the most predominant threat to coral reefs.
- Discuss climate variability and change and have the students describe its potential effects on coral reefs.

Adapted from Mary Cerullo, Education Director, Gulf of Maine Aquarium, Portland, ME. *The Potential Consequences of Climate Variability and Change Coastal Areas: Coral Reefs in Hot Water*; Institute for Global Environmental Strategies

Student Activity Sheet 1: CORAL REEFS

N a m e s

Answer the following questions in complete sentences, using your own words:

1.What is coral?

2.What are coral reefs?

3. How do coral reefs form? What are they formed from?

4.What type of environments are coral reefs found in?

5. Give at least 10 organisms that live in coral reefs.

6. Why are coral reefs important?

7. What are some threats to coral reefs?

8. What does your group think coral bleaching is?

9. What is coral bleaching? Be sure to include possible causes.

10. Was your definition correct? Why or why not?

11. Where does it occur?

Answer Key [Student Activity Sheet 1: CORAL REEFS](#)

Students' answers should be in their own words and in complete sentences.

1. Corals are colonies of tiny animals, or polyps, that grow slowly upward and outward as a thin layer of living tissue. Coral skeletons are the framework of coral reefs.

2. Coral reefs are underwater mounds composed of fragments of coral, coral sands, and solid limestone that are found slightly below sea level. They are known to have diverse communities of marine plants and animals. Organisms, such as coralline algae, bind the components together, and can make up as much as half the coral reef.

3. Coral reefs form as thin layers of calcium carbonate skeletons, produced by coral polyps, are cemented together over thousands of years. Coralline algae cement the corals together with a calcium compound. Added to this are hard parts of other organisms, such as tubeworms and mollusks. Living polyps grow on top of the limestone remains of former colonies to create reefs. Only the surface layer of a coral reef is made up of living coral organisms.

4. Many coral reef organisms are very sensitive to change and therefore can tolerate only a narrow range of environmental conditions. Warm, clear tropical water, with an optimum temperature of 24° C (75° F) is their ideal environment. Due to ocean currents, necessary water temperatures are found along eastern continental coastlines. Warm equatorial currents travel along eastern coastlines, while cold polar waters are carried along the western coastlines of continents. Coral reefs require clear water in shallow environments so enough sunlight can penetrate to allow algal photosynthesis, which provides coral with necessary nutrients and oxygen. Because of these, they are not able to grow where there are too many suspended particles in the water or at a depth below 230 feet.

5. Coral reefs are home to one of the most diverse ecosystems in the world, containing more than a quarter of all known fish species. Answers could include, but should not be limited to: algae (red, brown and green), anemones, arthropods, basses, basslets, butterflyfish, cardinalfish, coral polyps, crabs, damselfish, dolphins, hard coral, lobsters,

mollusks, pearlfish, rays, reef shark, shrimp, snails, soft coral, soldierfish, sponges, squirrelfish, sweepers, starfish, turtles, zooxanthellae.

6. Coral reefs are important for many reasons. Because of their natural beauty, coral reefs bring revenue to the local communities in the form of tourism, fishing, and recreation. Also, they provide food and shelter for many organisms. Barrier coral reefs act to protect shorelines against erosional and storm damage. Medically, coral reefs, and the organisms that live in them, provide compounds that are being used or studied for medicinal value.

7. Because many coral reef organisms can tolerate only a narrow range of environmental conditions, reefs are sensitive to damage from environmental changes. Corals are susceptible to diseases and bleaching. Also, dramatic natural events such as hurricanes can damage coral reefs. In addition, many problems to reefs are caused by humans, including overfishing, coastal development, pollution (polluted water discharge, garbage), anchor damage, accidental boat groundings, diver/ snorkeler touching, standing and dragging equipment, boat propellers, siltation (coastal development and beach renourishment), overdevelopment, poor infrastructure, coral harvesting, destructive fishing/harvesting techniques, overharvesting, mining coral as a mineral supplement, poor land management, dumping of sewage, poaching, coral collecting, dredging for boat access, mill discharges, agricultural runoff.

8. Answers will vary.

9. Coral bleaching occurs when symbiotic algae are expelled from coral due to environmental stresses. This algae provides the coral with color, food, and most of their ability to grow skeletons. Scientists have found many possible causes of coral bleaching, such as changes in temperature, salt concentrations, light intensity and amount of suspended sediments. However, the primary cause is suspected to be elevations in sea surface temperature. Changes as little as 1° C have been determined to cause coral bleaching. If the stresses worsen, the corals can die, but if they lessen, most corals can recover.

10 . Answers will vary.

11. Before the 1980s, coral bleaching was a small scale phenomenon. Since the 1980s it has become a large scale problem that effects all coral reef regions.

BIOLOGICAL & PHYSICAL AGENTS OF CHANGE ON A CORAL REEF

Grade(s): 5
Subject(s): Science

Objective:

Compare the agents of change on a coral reef and in a forest.

Background:

A reef is made of coral and coralline algae that form a structure used by other organisms as a dwelling place. A coral reef, like a forest, is a complex community of many associated plants and animals. Organisms act as agents of change to cause the reef to grow or be destroyed. Physical conditions also determine the growth or destruction of the reef.

Biological agents of change include all the plants and animals that build up and destroy reefs. See Table 1. Reef-building agents are organisms that secrete the calcium carbonate skeletons that form the reef. *Crack-filling agents* are organisms that produce sediment or live in the cracks and crevices of the reef. *Passive agents* use the structure of the reef to live and hide in. They do not affect the reef structure but may eat other reef organisms or be eaten by them. *Destructive agents* erode the reef by grinding, chewing, or boring into it.

Physical agents of change—waves, currents, pollution, moving sand, silt deposits, fresh water, and severe shifts in temperature—kill corals and wear away the reef. See Table 1.

Materials:

- copies of Table 1 & 2

Procedure:

1. Fill in Table 2 with examples of specific agents that affect the structure of a forest.
2. Compare Table 2 with Table 1 and discuss the similarities and differences between the agents of change on a coral reef and in a forest.

Questions:

1. What do we mean by the “structure” of a forest? Of a reef? Describe the structure of the reef.
2. In what ways are corals in a reef like trees in a forest? How are they different?
3. What happens to the trees when they die? To the corals?
4. What are the differences between the growth of a tree and the growth of a forest? What are the differences between the growth of a single coral colony and the growth of a coral reef?
5. Compare the biological and physical agents that damage a forest and a coral reef. How are they similar? How are they different?
6. How does the amount of sunlight affect the growth of a coral reef? A forest?

Table 1 Coral Reefs

Agents of change	Examples
Constructive agents	
Crack fillers	Encrusting coralline algae Fragments of corals Molluscs Echinoderms
Passive agents	Boring sponges Coral-eating fish (parrotfish) Worms Sea urchins & sea stars Boring molluscs
Destructive biological agents	
Constructive physical agents (builders)	
Destructive physical agents	

Table 2 Forests

Agents & conditions of change	Examples
Forest builders	
Forest floor organisms	
Passive residents	
Destructive organisms	
Constructive physical agents	
Destructive physical agents	

Source: Dr. Sharon H. Walker, R. Amanda Newton, Dr. Alida Ortiz, *Coral Reefs: An English/Spanish Compilation of Activities for Middle School Students*, J.L. Scott Marine Education Center & Aquarium, 2001,

EXPLORE THE CORAL REEFS

Grade(s): secondary

Subject(s): science, geography

Objectives

Understand how coral reefs are formed

Describe types of corals found within the Mesoamerican Barrier Reef System

Identify some organisms found on coral reefs

Materials

- Copies of student's page
- Coral reef worksheet
- Reference materials
- Clay

Procedure

1. Photocopy copies of student's page and worksheets and distribute to students. You can let them pair up and share pages.

2. Use the coral reef research sheet to map out the coral reefs in the world

3. Using the reference materials, the library, internet have students write and illustrate a story pretending they are an animal living on the coral reef. Include 3-5 facts learned about the coral reef. Explain to students that they will be giving an oral presentation to their classmates.

4. Create a diorama displaying at least five different animals that you have learned about that live on the coral reef.

5. Use clay to build two different types of corals that are found on the reef

Explore Coral Reefs – Student Page

Introduction

Pretend you are an oceanographer traveling in a submarine. Suddenly, you see the most beautiful school of fish you have ever seen. You wonder where you are and realize you have entered the amazing world called the **CORAL REEF!**

The Task

Now, you are the oceanographer. Work with a partner to explore the fascinating world of the coral reef! As you explore the environment you will:

- Use the coral reef [worksheet](#) to map out where coral reefs are located.
- Use resource books and world wide web to learn how coral reefs are formed.
- Use clay to build two different types of corals found on the reef.
- Create a diorama displaying at least five different creatures found in the coral reefs.
- Write and illustrate a story, pretending you are an animal living on the coral reef.

Resources

The Process

As you explore the Coral Reef using the resources you will:

1. Use the coral reef research sheet to map out the coral reefs in the world
2. Write and illustrate a story pretending you are an animal living on the coral reef. Include 3-5 facts that you have learned about the coral reef. Give as an oral presentation to your classmates.
3. Create a diorama displaying at least five different animals that you have learned about that live on the coral reef.
4. Use clay to build two different types of corals that are found on the reef

Evaluation

You will give an oral presentation. Make sure that your presentation includes:

1. 3-5 facts that you have learned about the coral reef.
2. Information you have learned about 3-5 animals found on the coral reef.

Conclusion

Now that you have learned so much about the coral reefs, share your learning experience with your family and friends.

CORAL REEF MAP WORKSHEET

Student Name -



BUILD A REEF

Grade: secondary

Subject(s): Science

Objective:

Understand the organisms that make up the coral reef ecosystem.

Understand the relationships among the organisms in the coral reef ecosystem.

Background

If you look closely at a reef ecosystem, you see that it is made up of hundreds of thousands of tiny animals called coral polyps plus various other algae and marine animals. Together these make up the coral rim-reef community. All these organisms live together, sometimes helping each other and sometimes fiercely competing with each other. Survival is very important. This coral rim-reef is an active place teeming with inhabitants competing for food and space.

Materials

- Scissors
- Envelopes
- Elmer's Glue
- Coral Reef Organism Worksheet
- Colored Pencils, Markers, Crayons, Paint or Brushes
- Paper (8.5 x 11 inches of paper, ex. Construction paper) or poster board
- Sticky Tac (putty-like material used to affix items on walls)
- Blue cellophane (plastic wrap) [optional]
-

You can build your coral reef many different ways- by yourself on one sheet of paper or work with a group to build an almost life-sized reef on a bulletin board display. Choose the size reef you're going to build and here's how to get started.

Procedure

1. Gather together all the materials needed- paper, glue, scissors, and worksheet.
2. Give students a sheet that has drawings of all the types of organisms might be seen on a rim-reef in the MBRS.
3. After you have found the organisms (using reference materials), color them according to what you saw on the page.
4. Using scissors cut out each of the organisms. As soon as you finish cutting out each organism, place it in your envelope.

Build the Reef

A. Take the pieces out of the envelope and spread them all out on the desktop to see what they are and how they will be used to build your reef. What should go on the paper first? Have students think about the order in which they will put the organisms on the paper. Make a plan!

- Hints:**
1. Think about which organisms can be found on the bottom?
 2. Are any of the organisms growing attached to something else?
 3. Which organisms are swimming?

4. Where do you think you'll find the phytoplankton and zooplankton (the really tiny organisms that we've made large enough for you to see)?

B. Using a tiny piece of Sticky Tac, place the organisms on the paper according to your plan.

C. Have students use reference materials to figure out if their plan for arranging the organisms is correct. Have the students ask the questions:

1. Does your paper look like the pictures in the references? It does? Great!
2. Do you need to move something? Carefully lift up the organism and move it where it should be.

D. Now students are ready to glue their organisms to the paper. They have to glue down the paper organism but also have to remove the Sticky Tac. Students should decide upon the steps that they'll need to take to accomplish both these things.

E. Check to make sure that they don't have any globs of glue showing on your paper? Do you think you'd see that on a coral reef?

F. One last thing students need to do is to sign their name to your paper. If they decide to add blue cellophane to the paper, add it now that everything else is completed. Cut a piece a just slightly wider than the paper. Add a small amount of glue to the left and right sides of the cellophane and attach it to the reef paper

G. Congratulations- students have built a reef!

TEACHER HINTS

Following is a list of suggested steps for preparing this activity:

- * Photocopy the *Build a Reef Activity Sheet* and *Coral Reef Organism Worksheet*
- * Crayons and colored pencils are easier to use and less messy than markers,
- * If you use colored paper as the background to build your reef upon, then you may want to use clear cellophane or Saran Wrap(instead of the blue. Use the blue cellophane if you use white paper for your background.
- * There are steps in the building of the reef that require the students to problem solve. Act as a guide or facilitator but do not give your students specific answers or directions. Guide their thinking or reasoning. What they should realize is that corals need to be placed first as they are the platform upon which many of the remaining organisms grow or swim above.

EXTENSIONS
















1. Bulletin Board: You will need to enlarge the organisms to build your reef on a bulletin board. Make sure you enlarge **all** the organisms by the same amount. For instance, 100% may be large enough for your size board, so you may have to cut the organism sheet in half and enlarge half at a time. Try different percentages until you arrive at a size large enough for your purposes. Since these organisms will be so much larger, have one student color one organism. The board will then be a collaborative effort. Add dimensionality to your board by stuffing some of the organisms, such as the brain coral, with newspaper or paper towels.

2. Mobile: Instead of building a reef, you can make a mobile using the *Coral Reef Organism Worksheet*. Enlarge the organisms slightly and then color them as for the reef-building activity. Have your students cut out each organism or even just cut out representative organisms instead of the entire collection. Use coat hangers, sticks, wooden dowels, or Styrofoam plates (with holes punched around the perimeter) from which to suspend the reef organisms.


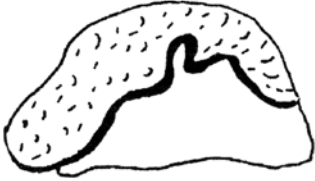







3. Transparency Overlays: Instead of photocopying the *Coral Reef Organism Worksheet* onto regular copy paper, copy it onto transparency sheets. You may make the copy darker than you would for regular photocopying. [Boxes of transparencies can be obtained for low cost- you don't need high quality transparency sheets.] You will use another blank transparency sheet (instead of paper) to build your reef upon. Use permanent markers to color the organisms, again in the appropriate colors seen on the web site. Carefully cut out the outline of each of the organisms that have been colored. Follow the same directions as for the paper reef-building activity except use double-sided transparent tape to attach the organisms to the blank transparency sheet. You can still attach the blue cellophane over the completed reef. Have a showing of the completed reefs. Place each reef on an overhead projector or hang them in a sunlit window.

Source: Pat Pierce and Cheryl Schroeder BBSR and TCOE Coral Web Site Team
<http://www.coexploration.org/bbsr/coral> Funded by a grant from the Goldman Foundation, 1999

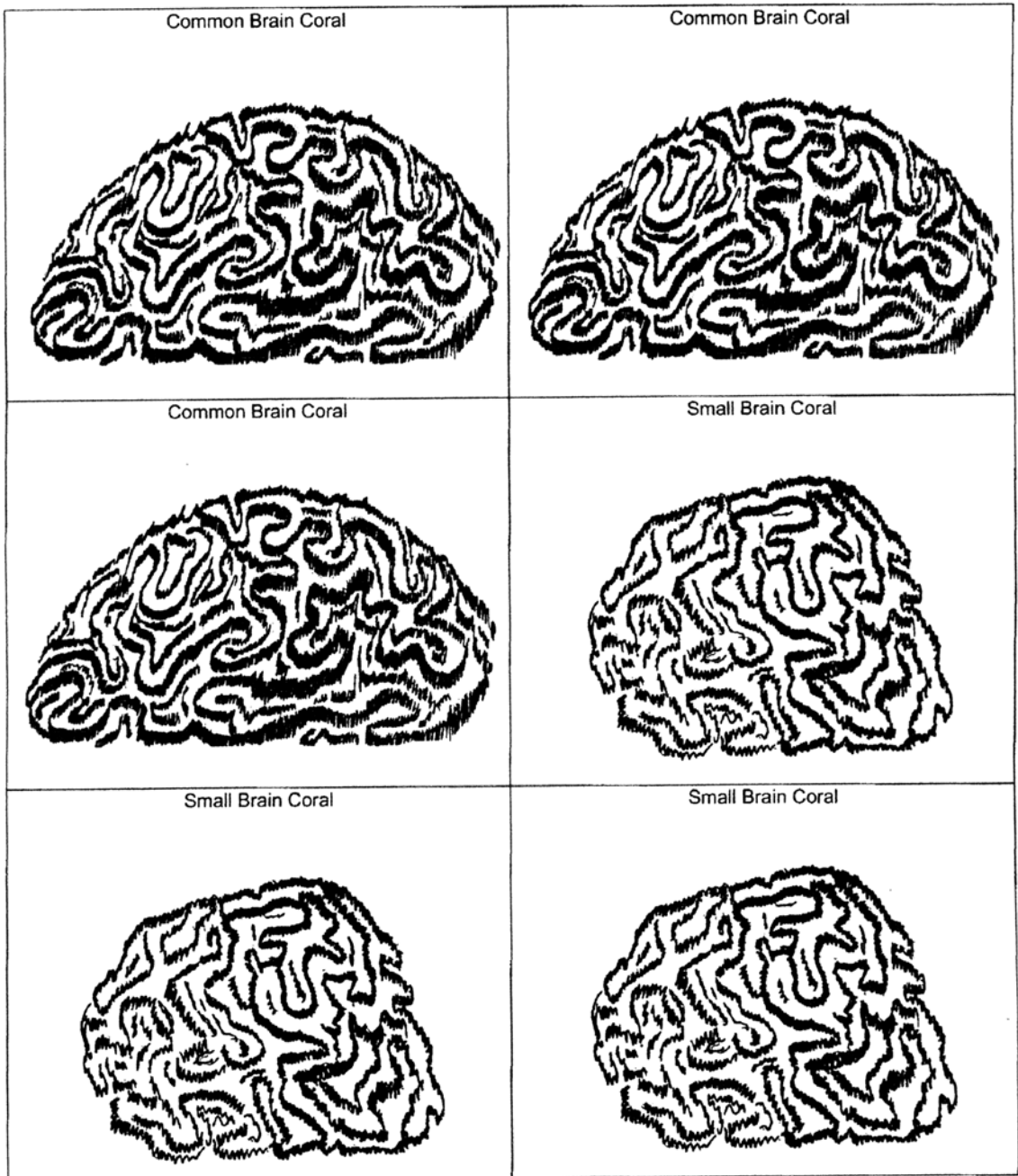
CORAL REEF ORGANISM WORKSHEET

 <p>Silver Porgy</p>	 <p>Houndfish</p>	 <p>Phytoplankton</p>
 <p>Yellowhead Wrasse</p>	 <p>Four-eye Butterfly Fish</p>	 <p>Zooplankton</p>
 <p>Rock Beauty Damselfish</p>	 <p>Blue Tang</p>	 <p>Sea Pudding</p>
 <p>Grape Sand Moss</p>	 <p>Sergeant Major</p>	 <p>Purple Sea Urchin</p>
 <p>Sea Rods</p>	 <p>Blue Parrot Fish</p>	 <p>Purple Sea Squirt</p>

CORAL REEF ORGANISM WORKSHEET

<p>Hat Coral</p> 	<p>Mustard Hill Coral</p> 	<p>Star Coral</p> 
<p>Common Sea Fan</p> 	<p>Mustard Hill Coral</p> 	<p>Star Coral</p> 
<p>Common Sea Fan</p> 	<p>Sea Whips</p> 	<p>Sea Pens</p> 

CORAL REEF ORGANISM WORKSHEET



SURVIVAL FACTORS

Grade(s): secondary

Subjects: social studies, geography

Objective:

Analyze the impact of humans on the coral reef ecosystem as a result of human social, political, and economic activities.

Understands the characteristics of coral reef ecosystems

Understands how human actions modify the physical environment

Understands relationships among organisms and their physical environment

Materials:

- copies of Survival Factor cards, copies of Identity cards enlarged 200%
- small construction paper squares (five per student)
- yarn

Procedure:

1. Copy and cut Survival Factor cards and Identity cards. Attach yarn to Identity cards so students can wear them around their necks.

2. Have students stand in a circle. Pass out Identity cards. Each student now represents a life-form found in a coral reef ecosystem.

3. Give each student five paper squares. Explain that each square represents a population of organisms. [A population is made up of all the organisms found in a specific area.]

4. Tell students that you're going to read some statements that describe events that take place everyday that might or might not affect the reef and its inhabitants. Explain that if they think the statement you read would make it difficult or impossible for their organism to survive, they must put one of their paper squares on the floor in front of them. When students have one square left, they must stand on one foot. When they lose their balance and fall, they must sit down—this species is no longer found on the reef. They also must sit down when they run out of squares.

5. Continue to play until everyone is sitting.

6. Discuss the game with students. Tell them that their species became endangered when they became few in number, as represented by the one paper square. Explain that endangered refers to a population that is in danger of extinction, or disappearing completely. Was it easy for the students to stay in the game when they reached the point of standing on one foot? When a species becomes endangered, they're on shaky survival ground.

Deeper Depths:

Have students compare and contrast other habitats (old growth forest, wetlands, desert) and their survival factors. What survival factors are the same for each habitat? Different? How can each one of us make a difference in protecting the balance in each type of habitat?

Source: Dr. Sharon H. Walker, R. Amanda Newton, Dr. Alida Ortiz, *Coral Reefs: An English/Spanish Compilation of Activities for Middle School Students*, J.L. Scott Marine Education Center & Aquarium, 2001,

Recreational boaters drop anchors on you.	A tourist takes you from the reef to carry home as a souvenir.
An oil tanker spills thousands of gallons of oil into the water over you.	You swallow some abandoned fishing line.
Agricultural fertilizers have washed into the sea, so now there is a lot more algae in the water around you.	To make money from the tropical fish trade, collectors use dynamite and cyanide, a poison, to stun and capture you and your relatives.
You become tangled in a drift net.	Large pieces of your skeleton are broken off and sold for use in home aquariums.
Ocean pollution from pesticides, heavy metals, and garbage is surrounding you.	The water temperature surrounding the reef mysteriously rises, causing you to expel your zooxanthellae.
A snorkler sits on you and pokes around to get a better look at marine life.	A tropical forest is cleared, washing topsoil down river and into the ocean in the vicinity of your home, a large reef ecosystem.
A scuba diver takes more than the legal limit of your species.	Coastal development destroys the beach you breed on.
Human population growth increases.	Humans think you're delicious, and actively hunt you.

IDENTITY CARDS

pillar coral	zebra moray eel	monk seal
hawksbill sea turtle	queen conch (snail)	painted triggerfish
green sea turtle	four-eyed butterflyfish	trumpet triton(snail)
lined sea horse	king crab	brain coral
barracuda	striped shrimp	elkhorn coral
star eyed hermit crab	sharpnose pufferfish	emperor angelfish
cowfish	sea urchin	sea anemone
anemone fish	blue-barred parrotfish	stony coral
little star coral	slipper lobster	sea star
branching coral	reef octopus	moorish idol (fish)

ANIMAL POPULATION SIZES

Grade(s): secondary

Subject(s): science

Objectives

Determine the numbers of some common benthic (living on the sea floor) marine animals.

Observe the relationship between animal populations, environmental factors and human impact.

Curriculum links Animal populations, fisheries, environmental impact.

Time required: 2 - 3 hours in the field.

Materials

- the types of animals to be counted should be studied before the field activity. (If the students have experience in data processing, the results can be processed on a computer with suitable programmes prepared before, the fieldwork.)
- a rope and stakes, or square or round quadrat frames, for defining areas within which animals are to be counted
- shovels and sieves if the animals are in sediments
- field notebooks or slates and pencil
- computer (optional)

Procedure

Question: How many animals are there per unit of area.

In preparation, chooses a relevant field site: a shallow coral reef is best, but a mangrove area or mud flat with adequate animals can also be used.

1. Quantitative measures of animal populations per unit area are often useful in ecology. This activity involves counting some obvious or important animals in the coastal marine environment. The animals counted, the techniques used, and the areas sampled will all depend on the type of habitat. The following suggestions for some typical habitats will need to be adapted to local conditions.

2. Lay out one or more areas to be sampled:

coral reef: drive a stake into the reef, and define a 50 square meter area in a circle around the stake using a rope 4 meters long with loops at both ends.

sandy/muddy bottom: use one square meter quadrats, digging up and sieving the sediment to a depth of 20 - 30 cm. rocky shore: the quadrat size defined by a quadrat

frame or rope and stakes can vary from 1 square meter to 50 square meters, depending on the animals to be counted.

3. Count the numbers of common or obvious animals in the sample area, especially those with indicator value:

coral reef: mushroom corals (*Fungia* spp.) are among the first things to be picked up by tourists; giant clams are often subject to heavy fishing pressure: synaptid holothurians may increase in

number with heavy organic pollution; other holothurians are sometimes fished for food as beche-de-mer; Acanthaster (Crown-of-thorns) starfish may become numerous and damage the reef; other starfish are often obvious and colourful; sea urchins may go through big population changes; large shellfish like Trochus are often collected for food or export. (Figure 39)

sandy/muddy
bottom:

bivalve molluscs may be important food organisms; crabs may be numerous and ecologically important.

4. If several samples are taken, compare the results between samples as related to zonation, environmental or human factors.

5. Process the data using tests of statistical significance and presenting the results in graphic form. (Use a computer if available.)

Follow Up

Animal counts lend themselves to monitoring and environmental impact studies (Activities 32 and 33 pages 14 and 150) and analysis of the effects of overfishing (Activity 30 page 143). They can also be correlated with environmental parameters.

Teaching hints

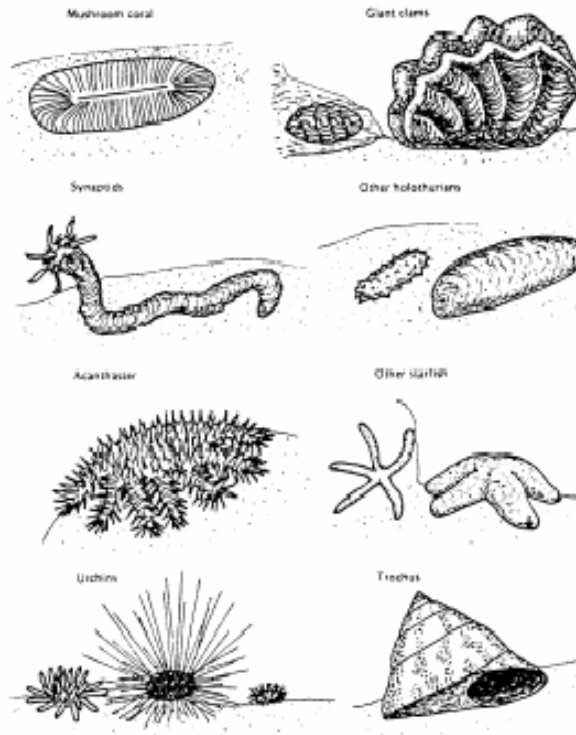
Select the few animals that best illustrate topics in the curriculum, or that are important in the local economy.

Select a site with as many interesting benthic animals as possible.

The activity and its interpretation will have to be modified somewhat depending on the type of habitat chosen.

FIGURE 39

CORAL REEF ANIMALS TO BE COUNTED



THE CORAL CONSERVATION GAME

Grade(s): secondary

Subject(s): science, geography

Objectives:

Name four ways that coral reefs benefit people.

Name four ways that people damage coral reefs and corals.

Discuss important factors in “managing” a coral reef.

Give pro and cons of exploiting commercial uses of coral reefs.

Understands relationships among organisms and their physical environment

Understands the characteristics of ecosystems

Understands how human actions modify the physical environment

Materials:

- Game boards (You may duplicate the enclosed game board by copying its folded quarters and taping it together. Make enough game boards for four players per game.)
- One piece of notepaper per student, and pen or pencil.

Make copies in the following quantities:

- Game Board: one board per game (four students)
- Chance Cards: one set per game
- Option, Spinner, Token page: one per game
- Game Summary sheet: one per game
- Currency: twenty pages per game

Student Background:

Today you will play a game called The Coral Reef Game. On the game board you will use, the game is drawn on the outline of a coral that looks something like elkhorn coral—a rapidly-growing coral.

In this game, you are a fisherman who makes at least part of your living from coral. You have a problem shared by nearly all fishermen—if you take lots of coral, you make good money at first. But if you and others do this for too long, the coral will not be able to grow back fast enough. Then, there will be none, or very little, and you will have lost the source of your business.

The secret, of course, is wise use and protection of the natural resource you make a living from. And that is no easy task, as you will see from the game you are about to play.

The object of this game is to arrive at the FINISH space with the most coral. Coral grows on offshore reefs around the island and amounts of coral are measured in centimeters. Players may also gain centimeters of other types of coral, such as the valuable but delicate black coral. Players should keep a record of all the centimeters of coral they gain or lose throughout the game.

Use the tally sheet you have been given. You should also carefully control the amount of money you have. As the game starts, assume that one inch of coral is worth about \$500.

Procedure:

1. Prior to class assign background reading. [E.g., *Coral Reef Coloring Book* written and illustrated by Katherine Orr, © 1988, Stemmer House Publishers, Inc.
2. This game requires copying, if the entire class is to play the game at once. If you cannot make copies, have students play the game in groups of four, during several class periods. Use your judgement as to whether to have students help you assemble Game Boards, cut Chance and Option cards, assemble spinners and tokens (glued on cardboard, for best use), and cut up currency.
3. Divide the class into groups of four. Have them move desks together to play.
4. Distribute game boards, spinners, tokens, and currency (20 sheets of money per game, \$2,000 per player). Give each student an Option Card also. Keep spare currency on the side, "in the bank" for payments to players.
5. Read **Background** and remaining instructions (5-11) to students.
6. Begin at the **START** space with \$2,000 and 25 centimeters of coral. Shuffle the **CHANCE** cards and place them face down near the board. Now, write down your beginning assets on a sheet of notepaper.

Organize your notepaper like this: (**Show on blackboard. . .**)

Coral	Money
Start: +25 cm	+2,000
Turn 1
Turn 2
Etc.

7. Two to four players may play at one time. Spin the spinner to see who moves first. The player with the highest number will move first. Play then goes around the board to the left.
8. Move around the games board by moving your token the number of spaces hown on the spinner. Change your amount of money and coral as the board and **CHANCE** cards direct.
9. Early in the game you will have to choose which path you wish to take around the board. The regular path may be followed, or you may choose the "High Finance Bypass" and take extra risks in order to finish earlier. You may not back-track after choosing one path or the other.
10. If you spin **CHANCE** or land on a **CHANCE** space, pick up the top CHANCE card and do as it instructs. Then put the card back on the bottom of the deck.
11. Each player receives on **OPTION** card as the game starts. This card gives you an opportunity to make a deal with other players, buying or selling any amount of coral for which a price can be agreed. Once you have used your option card, you must give it up.

12. You cannot go “in the red” and spend more than you have, and if you run out of money, you are no longer a competitor for coral. The same rule applies to running out of coral. You may continue to play in hopes of gaining more money or coral, but if you should be required to spend money or lose centimeters that you do not have, you are out of the game.

13. You must land exactly on the **FINISH** space to complete the game. The first player to reach **FINISH** earns an additional \$1,000, but the game is not over until all players have finished or been eliminated. The winner is the person having the most coral. It is possible that there will be no winner!

14. After each group has finished their game, fill out the Game Summary Sheet together.

15. Discuss the Game Summary with the class. If you live in a coral reef area, be sure to discuss important negative and positive influences going on nearby.

Summary Sheet

1. In the chart on the following page, list human and natural factors your group encountered in the game.
2. For each factor, note below its positive or negative effect on the amount of coral (+ or - cm) and its positive or negative economic impact (+ or - dollars).
3. Discuss how the results of human factors change. Can people alter natural events as well? How and with what impacts?

Source: Dr. Sharon H. Walker, R. Amanda Newton, Dr. Alida Ortiz, *Coral Reefs: An English/Spanish Compilation of Activities for Middle School Students*, J.L. Scott Marine Education Center & Aquarium, 2001.

Natural Factors

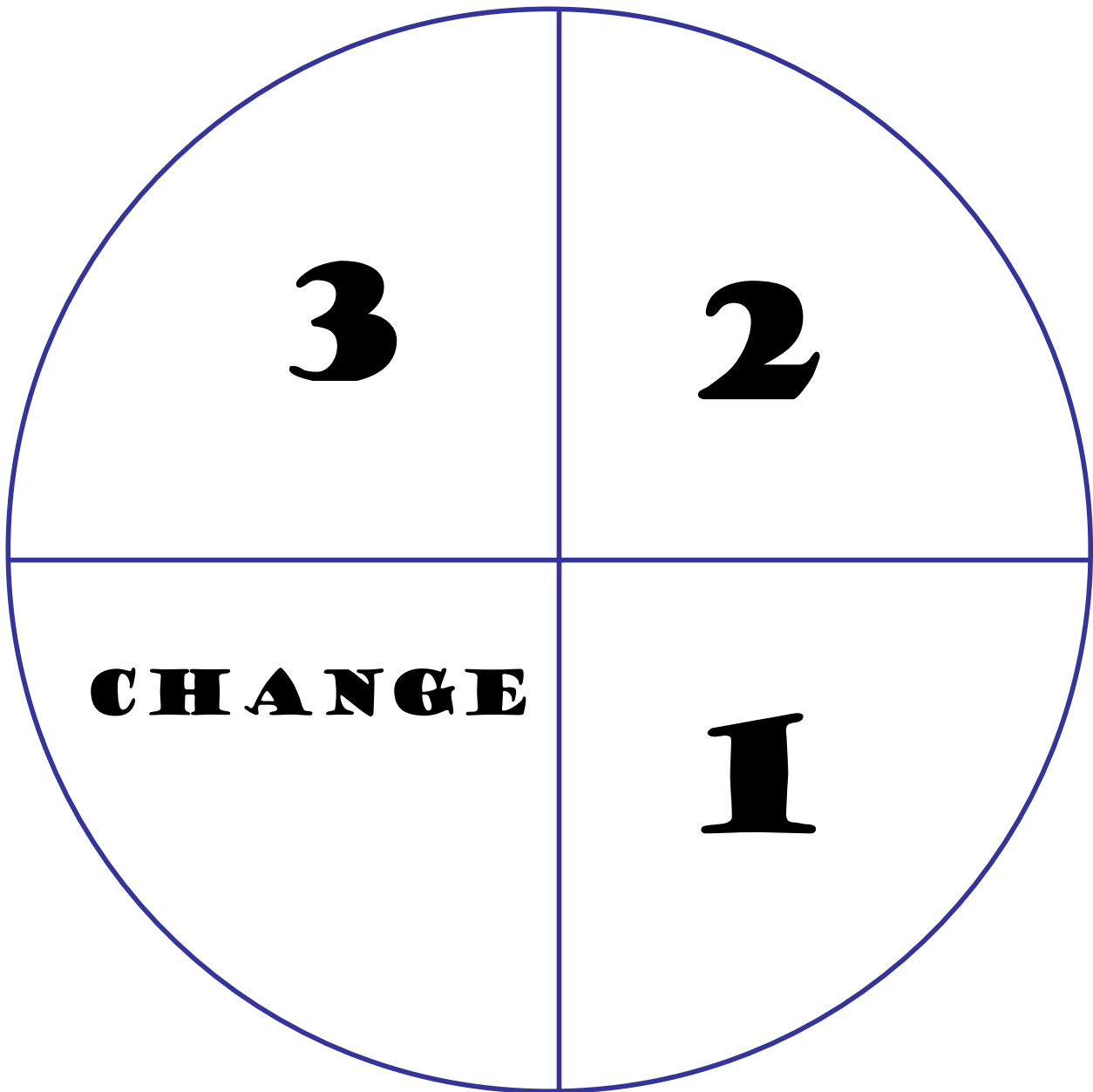
Type of Factor	Effects on	
	Coral	Economics
e.g. Hurricane	-5cm	-\$800

Human Factors

Type of Effect	Effects on	
	Coral	Economics
e.g. Island Festival	-4cm	+\$350

OPTION	OPTION
OPTION	OPTION

Officials decide not to dredge the harbors this year. Silting of reefs is prevented, but trade drops off. Lose \$2,000 and gain 5cm of coral.	Fertilizers from fields wash into water. Excessive algae growth threatens coral. Spend \$1,000 for runoff control, or lose 8cm.
Hurricane bypasses the islands, and expected rains do not come. Fresh water can kill coral, but this time disaster was prevented. Take another turn.	Loss of species diversity (fewer types of animals) makes the reef more susceptible to ecological disturbances. All players lose 5 cm.
People all over the Caribbean watch a television program about the importance of coral reefs. Surveys show increased knowledge and improved attitudes. All players gain 5cm.	Stop to visit the underwater park. Skip one turn.
Coral reefs break the force of waves and prevent destruction of beach property when violent storms come. Collect \$3,000 for protecting the coastline.	A harbor festival brings in new customers for coral. You may exchange up to 10cm and receive \$500 per 3cm.
Warm waters and gentle waves in the coral lagoon and encourage more tourists to visit these areas. All players earn an extra \$1,000.	Classrooms teach children about the value of the reef. Protection allows 5cm more to grow for all players.
The price tourists will pay for good coral specimens goes up 25% may sell up to 25cm to other players if a price can be agreed upon.	Brain corals resist damage better than branching forms. Take another turn.
The island hosts a water festival drawing many tourists. Great damage to reefs from anchors, hull-dragging, and unlicensed collectors. All players lose 12cm.	Parrotfish eat algae that competes with coral. You gain 3cm.
Barracudas eat most of the queen triggerfish. Urchin population explodes and coral loses 5cm. If you choose to skip one turn, 3 cm of coral can grow back.	Dead coral skeletons are inhabited by sea anemones that compete with live corals. Lose one turn.
Island-hopping. Exchange places with any player you choose.	Coral provide shelter for cleaning shrimp. Take another turn.
Scuba divers with spearguns take many groupers from the reef. Spend \$500 for protection against this.	Toxic chemical spill is caused by the player on your left. Collect \$2,000 in damages from that player.



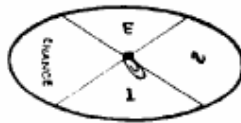
Cut out the spinner and paste it onto a piece of cardboard. Punch a hole in the center and put a paper fastener through the hole so it will hold the paper clip and allow it to spin.



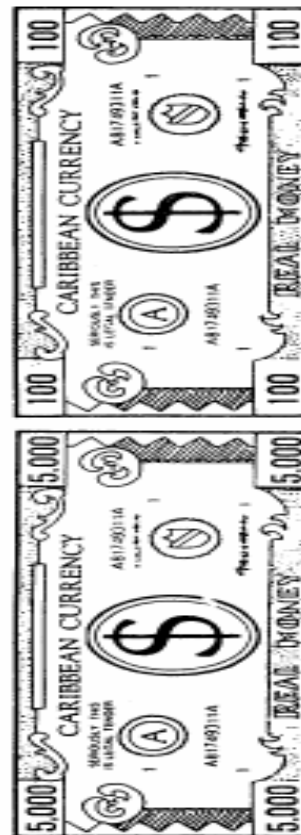
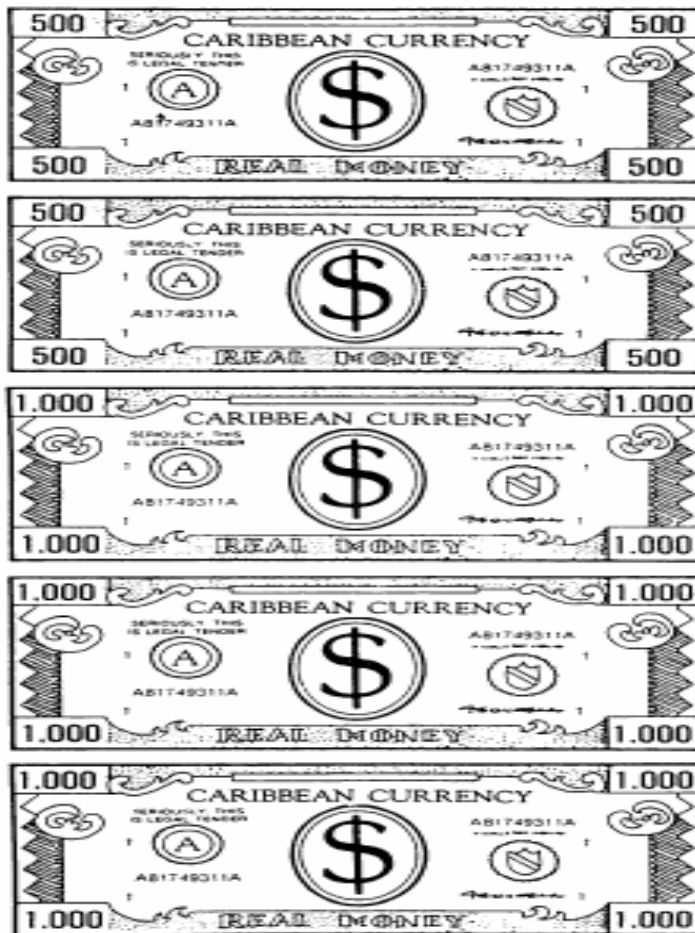
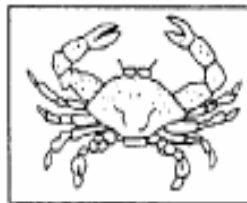
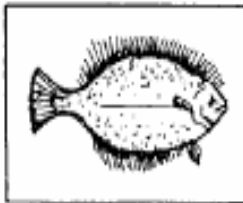
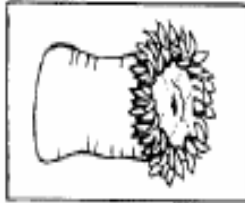
Paper clip



Paper fastener



Tokens (Cut out and color)



PRODUCTS OF THE SEA

Grade(s): secondary
Subjects(s): science

Objectives:

Understand the sea provides lots of services for humans.
Identify new sustainable ways to use the sea and its resources.

Materials:

- Products from the sea: pumice stone,

Procedure:

1. Bring to class various products that come from the sea, or visit a local store to investigate such products. Calcium pills (crushed oyster shells), toothpaste (carrageen seaweed), and aquarium filters (diatoms) are good examples.
2. Discuss with students how these products are harvested or produced. Are they harvested sustainably?
3. Challenge students to develop imaginary new products using the sea as a source. The products must be supported with a plan that details where the raw material will be found, how it will be harvested, how the marketing will be done, and scientific facts that support the notion that the product will actually do what it is advertised to do.
4. Review the products as a class. Were they harvested in a sustainable way? Is the resource inexhaustible?

FOOD FROM THE SEA

Grade(s): secondary

Subjects: social science, geography

Objectives

Observe what kinds of food are taken from the sea.

Measure how much food is taken from the sea.

Learn something about fishing techniques and the transport & marketing of seafood.

Understand the importance of the sea to local diets.

Curriculum links: Exploitation of natural resources, fishing.

Materials

- field notebooks and pencils
- balances or scales for weighing fish
- plastic bags or buckets
- hand lens or dissecting microscope (optional)
- knife
- forceps

Procedure

Time required: one or more visits to observe fishermen's landings & the marketing of fish.

1. Choose a site: any coastal marine habitat where fishing takes place, including if possible a fishing port and fish market.
2. Obtain any existing statistics on local fish catches. If possible obtain the co-operation of local fishermen in explaining their fishing techniques and showing their catch.
3. Visit the local landing place as the fishermen come in with their catches, and/or the local fish market. Observe the fishermen separate the marine animals into various groups: economic fish, trash fish, prawns, crabs, etc. Discuss with the fishermen what kind of habitats they fished in and what gear they used.
4. List the names or descriptions of all the different kinds of seafood brought in or available for sale. If some fisheries are seasonal, try to complete the class data from other sources. If possible take examples of the different animals and seaweeds back to the classroom for further examination and identification. (If the collections cannot be worked on immediately, they can be preserved in 10% formaldehyde, and then washed before student use.)
5. Each student should also make a list of the seafood eaten at home over a period of a week. If subsistence fisheries or gleaning by women and children are important, these also should be observed and recorded.
6. If weighing devices are available (the class can make simple balances), quantify the amount of seafood taken in a given time (say 1 week) by weighing fishermen's catches and determining where they came from and how long it took to catch them. Home consumption of seafood can also be weighed over a week.

7. On the basis of the figures collected, make simple estimates of the amount of food produced locally from the sea, perhaps measured per kilometer of coastline, on an annual basis. If the data are available, also determine the fishermen's catch per unit of effort (hours spent fishing per fisherman or per boat).

8. Compare the local catch or consumption of fresh seafood with that of imported seafood (canned, dried or frozen) using import statistics or students' reports of home consumption. Has the proportion of local and imported seafood eaten changed over the years?

9. If there has been a change in seafood consumption, is it due to a change in the local resources (i.e. from overfishing) or to consumer preferences (better taste, or the ease of opening a can).

10. Discuss the results of the class study in terms of the management of the coastal marine environment.

For Students:

review general information on fishing boats, fishing gear and fishing ports. The principles of harvesting a wild resource, and such measures as catch per unit effort, should be taught together with this activity.

Question: How important is food from the sea locally?

1. Many coastal communities depend on the resources of the sea to provide an important part of the local diet. This activity allows students to measure that importance for themselves.

FISHING FOR THE FUTURE

Grade(s): secondary

Subject(s): social studies, biology, geography

Objectives

Consider social, environmental, and economic impacts of overfishing.

Identify sustainable fishing practices.

Understand that fishing does not always remain within boundaries

Overview

Through a fishing simulation, students model several consecutive seasons of a fishery and explore how technology, population growth, and sustainable practices impact fish catch and fisheries management.

Materials

- Plain M&Ms, one 14-ounce bag for up to 30 students or beans
- Peanut M&Ms, one 14-ounce bag for up to 30 students or beans
- Small cups, 1 per student
- Serving bowls, medium size, 1 per group
- Spoons, 1 per group
- Straws, 1 per student
- Watch, for timing activity
- Handout *Fishing Log*, 1 per student
- Handout *Fishery Facts*, 1 per student

Preparation

1. Students will simulate fishery activity in different oceans. As the students progress through the fishing seasons, they will likely overfish their oceans and will have to migrate to other oceans to meet their basic needs. Most groups will eventually create a total crash of fish stocks in all the oceans.
2. *Check for peanut allergies in your class. You can do the activity using only plain M&Ms, if necessary.*
3. For a class of 20, you will have five or six groups of 3–4 students each. Each group will start with 20 plain and 10 peanut M&Ms. Count out the first round of M&Ms and place them in cups or bags. As a pre- or post-activity reference, have students read the handout *Fishery Facts*.

Introduction Discussion

1. Introduce and discuss the concept of sustainability using the following definition: “Sustainability is meeting the needs of the present without limiting the ability of people, other species, and future generations to survive.” Ask why sustainability might be an important goal for a society and what might be difficult about realizing this goal.

2. Tell students that today they’re going to go fishing and explore some of these sustainability concepts

Procedure

1. Explain the game rules:

Each student will be a “fisher” whose livelihood depends on catching fish. Peanut M&Ms represent the largest and most valuable fish (tuna, swordfish, et cetera).

Plain M&Ms represent the next most-valuable fish (cod, salmon, et cetera).

Each fisher must catch at least two fish (large or small) in each round to survive (i.e., get enough fish to either eat or sell).

When the fishing begins, students must hold their hands behind their backs and use the “fishing rod” (straw) to suck “fish” (M&Ms) from the “ocean” (bowl) and deposit them into their “boat” (cup).

The fish remaining in the ocean after each fishing season represent the breeding population, and thus one new fish will be added for every fish left in the ocean (bowl).

1. Divide the class into groups of 3 or 4 students and have each group choose an ocean name such as North Atlantic, North Pacific, Arctic, Mediterranean, et cetera.
2. Give each group one serving bowl and each student one cup, one straw, and one copy of the handout *Fishing Log*.
3. Put 20 plain and 10 peanut M&Ms in each group’s bowl.
4. Start fishing” and give the students 20 seconds for the first “season” of fishing.
5. Have each fisher count his or her catch (M&Ms in their cup) and record the data in their *Fishing Log*.
6. Fishers who did not catch the two-fish minimum must sit out for the following round.
7. Add one new fish for every fish left in the ocean (bowl).
8. Allow fishers to use their hands on the straws during the second session to represent “new technology.”
9. After the second fishing season, give one fisher from each group a spoon representing more new fishing technology such as trawl nets, sonar equipment, et cetera. Continue the game for round three.
10. Ask, “What happened when ocean group [name] ran out of fish? How are the fishers going to survive now?” (One option is to move to another ocean.) Allow students to “invade” other ocean groups when their ocean is depleted, but don’t tell them that they can do this beforehand. Fishers may either go as a group to another ocean or they may disperse to other oceans.
11. Repeat fishing, recording, and replenishing fish stocks until either sustainable fishing is achieved or until all (or most) groups fish out their ocean.

Inquiry/Critical Thinking Questions

- What happens when a commonly owned resource is overused?
- What are the impacts of overfishing or exploiting a natural resource?

- How can we establish and maintain the sustainable use of a resource?

Reflection

Use the following sample questions to lead a discussion about the activity:

- “How did you feel when you realized that you had depleted your fish stock?”
- “How did you feel when other fishers joined your ocean group?”
- “How does this activity relate to real ocean and fishery issues?”
- “What’s missing in this game?” (Impacts to nonhuman animals that rely on fish for their survival, population growth, et cetera.)
- “What happens to a resource when you have infinite population growth, growing technology, and a finite resource?”
- “Are there any commonly owned resources in our region or community? If so, what are some similar issues around them, and how can they best be managed?” (Air is a commonly used resource—how do we deal with air pollution? Forestry or animal grazing rights also sometimes create similar discussions. You might also talk about city, national parks, and other public lands, and the competing uses and needs.)

4. Have students brainstorm ways to have a sustainable fishery. What rules could be developed? (For example, limits on type of equipment allowed, amount and type of fish, shorter seasons.)

Class Projects/Action Ideas

- Students can research which fish are harvested in a sustainable manner and which are being depleted. Have them do an advertising campaign in their school promoting the consumption of sustainable fish and avoiding the consumption of threatened fish. (This might include researching the kind of fish served in your school cafeteria, developing a system that protects threatened fish, and presenting it to the principal.) For recommendations about which seafood to buy or avoid, check out the Monterey Bay Aquarium’s website “Seafood Watch” at www.montereybayaquarium.org or the Audubon website “What’s a Fish Lover to Eat?” at <http://magazine.audubon.org/seafood/guide/>.

Have students research a local fishery and include interviews with local fishers, biologists, and other people involved with the fishery.

- Have students investigate fish farming and its environmental and economic impacts.
- Have students research laws relating to economic use of public lands by private companies and individuals. Determine whether these laws balance environmental protection and economic development. If not, outline new laws to create such a balance.
- Visit the United Nations Food and Agriculture Organization Fisheries Resource website at www.fao.org/fi. For information and pictures about the state of the world’s fisheries, see the New International Magazine on-line issue on fishing at www.newint.org/issue325/facts.htm.
- Do a watershed planning/protection project to help protect fisheries from environmental damage.
- Participate in a beach or river cleanup project.

Variations

1. Use two types of dried beans instead of M&Ms. Be sure that the beans are large enough so that the students cannot suck them through the straws.

FISHING LOG

OCEAN

GROUP: _____ **FISHERS:** _____

Record your group's catch and fish left in ocean after each season:

SEASON	CATCH			FISH LEFT IN OCEAN
	High-Value Fish	Medium-Value Fish	Total Catch	
1				
2				

Write a brief description of the status/health of your fishery

SEASON	CATCH			FISH LEFT IN OCEAN
	High-Value Fish	Medium-Value Fish	Total Catch	
3				
4				

Discuss changes in fishing practices or regulations. Are any fisheries in trouble? What did they do and how did that impact your fishery?

SEASON	CATCH			FISH LEFT IN OCEAN
	High-Value Fish	Medium-Value Fish	Total Catch	
3				
4				

Write a brief description of the status or health of your fishery now:

How could you have made your fishing sustainable

FISHING FOR THE FUTURE—FISHERY FACTS

The world's fisheries are under more pressure than ever before. From 1950 to 1990, there was a fivefold increase in the world annual fish catch. The average yearly per-person fish consumption in the industrialized world (59 pounds) is three times that of people in the developing world (20 pounds). Fish demand remains high: An additional 15.5 million tons of fish will be required by 2010 just to maintain current rates of fish consumption. Today, 70 percent of the planet's marine stocks are fully exploited or overexploited.

The number of people fishing and practicing aquaculture worldwide has doubled since 1970. More than 21 million people are full-time fishers, and 200 million depend on fishing for their livelihood. Asia contains the vast majority of the world's fishers. In the early 1950s, developed countries took 80 percent of the world's fish catch. Today, they take only 36 percent of the catch, while developing countries take 64 percent.

The technology used to catch fish and the number of fish caught per fisher varies enormously. Modern fleets are the most environmentally destructive, as they use enhancements such as airplanes, radios, seafloor maps, and video sonar to track down fish schools. Once they have found the fish, these fleets use large nets to drag up not only the targeted fish but also coral, the seafloor, and around 27 million tons annually of "by-catch"—nonmarketable fish that are killed and thrown overboard.

To compensate for reduced wild fish stocks, more and more fish are being farmed. Nearly a third of all fish for food is harvested from aquaculture. For every 11 pounds of beef grown globally, there are now 4.5 pounds of farm-raised fish produced. Fish farming causes environmental destruction comparable to the replacement of rain forest with cattle ranches. About 11 pounds of wild ocean fish need to be caught to feed each pound of farmed species. Thailand, which has one of the biggest aquaculture industries, has lost half its mangrove forests due to shrimp farming. Densely stocked salmon farms in British Columbia, Canada, produce waste (including fertilizer, effluent, and fishmeal) equivalent to that generated by half a million people.

Despite these numbers, there is still hope for the world's fisheries. Fisheries can be restored through the adoption of sustainable fishing practices. With the proper incentives, fishers can be encouraged and rewarded in their effort to sustainably manage marine resources. For example, partnerships between local communities and scientists in the central islands of the Philippines resulted in the establishment of marine reserves to help manage overexploited fisheries. The establishment of no-fishing zones in the reserves has increased catches in adjacent fishing grounds. Another solution is to use the power of the market to encourage sustainable fishing practices. The Marine Stewardship Council together with the World Wildlife Federation and Unilever, one of the largest makers of fish products, has developed a certification process that includes a label telling consumers that fish products came from fisheries certified as sustainable.

References: *The New Internationalist* magazine issue 325, www.newint.org; The United Nations Food and Agriculture Organization, www.fao.org; Environmental News Service, February 2002, www.enn.com

DEPLETION OF MARINE RESOURCES

Grade(s): secondary
Subject(s): geography

Description

Through the following activity, students will hypothesize that as the next generation comes along, there will be fewer resources available to them and eventually, there could be nothing at all. In addition the number of people using a resource and the amount each person uses are critical in determining the rate at which resources, both renewable and non renewable, get used up.

Objectives

Understand that some resources like fishes can be depleted
Understand that the resources of the Mesoamerican Barrier Reef System have no boundaries and are shared among the various countries

Materials

- A large jar or other container filled with ready-to-eat popcorn
- Fourteen index cards labeled as follows; two cards that say *First Generation*, 4 cards that say *Second Generation*, and 8 cards that say *Third Generation*.
- A box or hat to hold the index cards
- Fifteen paper lunch bags for students
- A supply of extra popcorn (out of sight of the class) for those students who do not participate directly in the simulation

Procedure

1. Ask fourteen students to each draw one index card from the container.
2. Ask the students not to tell the others what the index card says.
3. Give these students each a lunch bag.
4. Explain to the class that the popcorn in the jar represents a fish population, the Nassau grouper, a renewable resource.
5. Ask the two students with the 1st generation index cards to come up to the big jar of popcorn. Tell them they can put as much of the popcorn as they want into their paper lunch bags while the rest of the class watches.
6. When the two 1st generation students have filled their bags, ask the 2nd generation students to come up and put as much of the remaining popcorn as they want into their lunch bags.
7. When they have finished, have the 3rd generation students come up and put whatever is left into their lunch bags.

After the 3rd generation takes their turn, begin the class discussion

Teacher Tip

Students will probably eat as much of the popcorn as they can without any thought as to who will come after them. By the time the 3rd generation students are finished,

there should be little or no popcorn left. Some of the generation coming next people will therefore have little or none at all.

Do not discuss what is happening to the popcorn until all the generations have gotten their popcorn. Some students will begin to realize what is happening. Some students in the 2nd generation may think of the 3rd generation and not take as much. The teacher should just watch and listen without making any comments.

Discussion Points

1. Discuss with the class what is happening to the world popcorn supply.
2. Hold up the empty fifteenth paper lunch bag and ask if anything was left for Generation Next.
3. Review the definitions of renewable resource, and non renewable resource.
4. Relate these definitions to the popcorn simulation.
5. Now tell the students that the popcorn represents the supply of fishes. The students work in groups of 4 and discuss the importance of individual responsibility in conserving resources and ways to involve others in conservation efforts.

The students should use these discussion points and write their answers in the form of a report. The report should include the following points.

- What happened to the total amount of the resources?
- How much was left for each successive generation?
- Did any of the students who were part of this simulation think about those who might be eating after them, or were they only trying to get as much popcorn as they could?
- What parallels do the students see between what happened in class and what occurs in the outside world?
- What are the critical factors in determining the rate at which resources, both renewable and non renewable get used up, including: the number of people using the resource and the amount each person uses.
- What is the individual responsibility for resource conservation?
- What steps could individuals take to advocate change in people treatment of natural resources such as fishes?
- If a resource is renewable, does that mean it will continue to exist no matter what people do?

Assessment

Each student will turn in their own report after they have gone over the discussion points. Each group of 4 will create a slogan that advocates personal responsibility for resource conservation

SAVE THE MANGROVES

Grade(s): secondary

Subject(s): science, social science

Take part in this fun role play and put your case to save or destroy the mangroves!

Objectives:

Examine issues related to the conservation of mangroves areas and the needs of different commercial and community groups.

Describe the values underlying personal and other people's actions regarding familiar places.

Make justifiable links between ecological and economic factors and the production and consumption of a familiar resource.

Predict the impact of changes on marine environments by comparing evidence.

Materials

- Role play cards (see following pages)

Procedure:

The game:

1. Each player or group of players, takes on the role of a particular interest group that will be involved in deciding the future of a given area of mangroves/foreshore in a local area. One group takes on the role of the local council which must decide the future of the mangrove area.
2. Each group follows the objectives outlined on their role card and bases their arguments around these points. These views are expressed firstly at a public meeting and then later in a spirit of compromise during the lobbying and decision-making process.
3. Finally the council brings down its decision—hopefully along the lines of protecting the mangroves for those interested groups. However the council should also make provisions for other groups to use nearby areas which are not as susceptible to environmental damage.

Examples of possible council decisions

- Area of mangroves protected because of arguments put forward by local birdwatchers, local fishers/crabbers, offshore fisher.
- An old dump - no longer in use - made available for trail bikers club.
- A cane farm - no longer needed to meet the local mill's requirements —made available for football club.

- Heavily logged forest made available for skirmish war games club on the provision that they undertake a replanting scheme of native plants to return forest to original condition.
- Developers passed on to a neighbouring council which has an area of land needed for development.

- Wastewater treatment plant implementing land disposal of sewerage effluent into cane farms with runoff to mangroves

Role Play Cards

Ecotourist association

We want:

1. Setting aside of mangrove area for mangrove canoe trips.
2. Establishment of a small store and landing for briefing tourists and storage of canoes.
3. Establishment of a toilet and shower block and car park.

Developers

We want:

1. Mangroves destroyed to enable filling and levelling of site.
2. Construction of four multistorey high-rise (ten floors max.) buildings, including one hotel.
3. Tennis courts and nine-hole golf course.

Offshore fishers (trawlers)

We want:

1. Preservation of mangroves so young fish and prawns will have a nursery in which to live and grow. Adult prawns and fish will still be able to be caught offshore.
2. Preservation of mangroves as the vital producers in the food chains upon which catches depend.

Local birdwatchers group

We want:

1. Mangrove area to be preserved so that birds will have a place to feed and live.
2. Banning of all fishing and other activities (apart from bird watching) in the area so birds are not scared away.
3. The erection of 'hides' from which to observe and film birds.

Local council

We want:

1. To reach a planning solution to cater for a majority of the rate payers.
2. To study the local area to find sites (eg, old farm areas no longer used) which could be put to use by the community.
3. To decide on a solution which is best for the long-term welfare of the community.
4. Establishment of a sewerage land disposal unit.

Local football club

We want:

1. Mangrove area to be filled (possibly using area as a dump) and then levelled and turfed as a new playing site.
2. Light towers for night football.
3. A grandstand with clubrooms.
4. Car parking facilities.

Local fishers/crabbers

We want:

1. Mangrove area to be left untouched so local fish and crabs will have a place to live.
2. Size limits and bag limits on fish and crabs to preserve numbers for the future.

Grade(s): secondary
Subject(s): science

Objectives

Observe and record the diversity and distribution of populations associated with gradients in physical factors.

Study interrelationships among organisms and between organisms and the physical environment.

Understand spatial relationships in the mangrove ecosystem.

Consider the effects of disturbing the mangrove ecosystem.

Understand the need for conservation of mangrove areas.

Curriculum links: Community, habitats, biological factors, physical factors.

Materials

- rope or string
- stakes
- plastic buckets (1 per group)
- plastic bags (5, 10, and 20 litres) and rubber
- bands/ties
- marking pen
- thermometer
- PH paper
- paper labels (3 x 5 cm)
- sieve or screen (1 mm gauge)
- jars (250 cc)
- scissors
- forceps
- small shovel
- quadrat sampling frame (25 cm square or larger)
- field notebooks and pencils
- level or long clear plastic tube filled with
- water
- measuring tape
- ethyl alcohol (optional)
- plant press (optional)

Time required: 2 - 3 hours of field work and a similar time for laboratory study of collections and data analysis.

Procedure

1. Choose a study site: a typical coastal mangrove area; if possible both undisturbed and disturbed mangrove areas can be studied and compared. An appropriate sites for the surveys is where the slope of the land can be measured in a straight line.

2. Divide students into small groups (up to 4 - 5), with one group to measure the slope of the shore while the others make records at each station.a general introduction to mangrove forests would be useful.

3. Make sure to tell students the special problems of working in mangroves, such as not walking in others tracks (because of the danger of sinking deeper in the mud) and keeping close to a supporting plant, should be understood.

Strategy

Question: How are mangrove ecosystems and the organisms that live within them different from other ecosystems?

1. Lay a straight transect line with rope or string from the water's edge to dry land above high tide level. Place stakes at 10 metre intervals along the line to mark a station for each group of students. Number the stations.

2. To sample the animals at each station, throw the quadrat at random in the vicinity of the stake. Observe and record the kinds and numbers of animals found on the surface or under-ground within each quadrat. Put examples of each animal in one plastic bag, and a soil sample in another, and label them with the station number. Also record the kinds and numbers of animals or plants (especially mangrove roots) nearby. Throw the quadrat again and make another count and sample of specimens.

3. For the plants, mark off squares 10 x 10 metres along one side of the transect. Within the square, count and record the names and heights of all plants with a diameter of 4 cm or more. Collect samples of each plant, including leaves, flowers and fruits if possible. Record the animals found on each part-of the plant.

4. Record the physical factors at the station:
characteristics of the soil (colour, odour, hard or soft)
light intensity (estimated qualitatively)
pH of the soil using pH paper
air temperature
soil temperature at 5 - 10 cm depth (allow 2 minutes)
slope or inclination (using tape measure and sight level or water level in transparent plastic tube).

5. After the field work or in the laboratory, wash the animals by running water over them in a sieve or screen. If a voucher collection is needed, preserve the animals in jars of alcohol; dry plant specimens in a plant press. Examine the plants and animals (with the help of a hand lens or microscope, if available), and identify them if possible

6. Prepare a table listing for each station the name, density (number per square metre), height (for plants) and observable characteristics of each animal and plant on the surface or underground.

7. Make a table for the physical factors, showing for each station the soil Characteristics (color, odor, soft or hard), soil temperature, air temperature, pH and light intensity.

8. Draw a diagram showing the slope of the area studied in cross-section, and enter the information from the table of plants and animals to show their distributions along the transect in order to demonstrate the spatial distributions in the ecosystem. (Figure 32)

If a disturbed mangrove site is available, do the same survey in the disturbed site and compare the two transects.

9. Discuss with the class what may happen with different kinds of mangrove disturbance (logging, filling, polluting, changing water circulation). Review with the class the values of mangroves and the importance of their conservation.

ZONATION ON MANGROVE TRUNKS

Grade(s): secondary

Subject(s): science

Objectives

Discover the organisms that live on mangrove trunks and prop roots.

Observe the relationship between environmental factors or gradients and organism distributions.

Observe how organisms can create an environment for other organisms.

Materials

- Knife or scraper for collecting
- bucket, plastic bags or small jars
- meter stick or 2m tape measure
- field notebooks and pencils
- hand lens or microscope

Procedure

Time required: 1 - 2 hours of field observations.

1. Choose a field site, mangroves with accessible trunks or prop roots well colonized by benthic organisms.
2. Select a good low tide when trunks will be accessible; obtain references to local marine life.
3. Measure the width of each zone or band of organism distribution relative to the tide level.
4. Collect samples of each organism or association for identification on the shore or in the laboratory. Examine the algae and small animals with a hand lens or microscope. Determine the names of as many organisms as possible.
5. Combine information on the levels of each zone and on the tidal cycle to calculate the frequency and duration of exposure for each zone.
6. Prepare a diagram showing the zonation of common organisms on a mangrove trunk relative to the tide levels.
7. Try to explain the distribution of organisms in terms of their resistance to exposure to air, their vulnerability to predation by animals in the water, or other factors.
8. If there are few or no organisms at certain levels, try to explain why (changing heights of the sediment, grazing, pollution, storm scour, sedimentation, turbidity, etc.).
9. If time permits, experiment with the effects of changes in level on organism distributions. Select three similar prop roots or small trunks with the same zonation patterns. Cut off two of them above and below the main intertidal zones, and reattach them to one side of the third (the control), displacing one 20 - 30 cm (or more if the

zones are wide) above its normal level, and the other the same distance below its normal level. The roots can be wired or nailed into place.

10. Return to examine the changes in organism distributions and zones on the two displaced roots relative to the control, after 1 day, 3 days, 1 week, etc. until the normal zonation is re-established. Measure and note the changes observed on each visit. How long does it take each organism to readjust to its normal zone? Do some move while others disappear and grow back again? Do some organisms persist outside of their usual zones? How do you explain these observations?

Question: What organisms live on mangrove trunks and how are they distributed relative to the tide level?

The soft, muddy bottoms of mangrove coastlines are not good places for many plants and animals to attach. Mangrove trunks and prop roots are often the only place where algae can stay in the light and animals keep out of the smothering mud. Such places are thus often crowded with life. However, the rise and fall of the tides covers and uncovers different levels of the trunks for different lengths of time, producing a vertical zonation of organisms.

SEAGRASS TURNOVER

Grade(s): secondary

Subject(s): science

Objectives

Observe primary production and loss (turnover) in seagrasses;

Use a field experiment to determine change over time.

Appreciate the importance of seagrasses in food production in coastal waters.

Curriculum links Primary productivity, herbivores, detritus, food chains.

Time required: two visits of 1 - 2 hours each one week apart.

Materials

- stiff wire stakes
- waterproof tags marked with group numbers or
- student names (can be cut from plastic food containers)
- 30 cm ruler or measured strings with loop at one end
- cheap staplers, paper punches or scissors (will rust)
- field notebooks or waterproof slates and pencils

Procedure

In preparation, choose an appropriate study site: shallow bottom with seagrass bed accessible to students.

Question: How much food is produced by seagrasses?

1. Each student or small student group should choose a small area of dense seagrass and mark it with a stiff wire stake and attach plastic label driven into the sand. These markers should be left in place for the return visit.

2. The area to be measured is determined by turning the ruler or measured string around the marker. A 30 cm radius is good, but this can be increased or decreased depending on the density of seagrass blades (leaves). There should be 20 to 50 blades in the area measured.

3. Every seagrass blade touched at its base by the string should be counted.

4. All the blades that are counted should be marked in the middle, either with a staple (from an ordinary paper stapler), by punching a small hole in the blade with a paper punch, or by cutting a small notch in one edge with scissors. This will allow the old leaves to be identified on the return visit.

5. The class should return about 1 week later and relocate their markers.

6. Using the same string, they should count both the number of marked seagrass blades remaining and the number of new leaves without marks.

7. From these data, the density of seagrass leaves should be calculated. The number of new leaves is a measure of primary productivity (new food being made). The number of leaves originally marked minus the number of marked leaves remaining after 1 week gives the number of leaves grazed off by herbivores or lost as detritus to supply the detritus food chain.

8. Discuss the significance of the class results for the ecology of the area.

Teacher

Students would have had a class on the introduction to the ecological importance of seagrasses.

SENSATIONAL SEAGRASS

Grade(s): secondary

Subject(s): science, geography

Introduction:

Seagrasses are flowering plants that grow underwater in marine environments. Generally they are restricted to shallow waters in bays and inlets. Seagrasses are valuable breeding and feeding grounds for large numbers of fish and invertebrate species. Some seagrass beds in the Mesoamerican Barrier Reef System may be under threat. For species such as the manatee (sea cow) that feeds only on seagrass, this is a major concern.

Objectives:

Research the role that seagrass plays in marine habitats
Identify locations where seagrass grows.

Classify values that underpin campaigns and organisations associated with human or environmental rights.

Predict the impact of changes on environments by comparing evidence.

Procedure:

Do some research on seagrasses

Questions for Research

1. Where is the Mesoamerican Barrier Reef?
2. Where are there some seagrass beds in the Mesoamerican Barrier Reef System?
 - Draw a map to show the location of seagrass beds in your state/district or local area.
 - Identify, if possible or visit this area or make some phone calls to organizations who may be monitoring it.
3. What type of seagrass is it?
4. Is seagrass found on the Barrier Reef? Why?
5. What sea creatures live amongst the seagrass?
6. Is this seagrass under any threat? If so what are they?
7. Make a brochure to distribute to the local community about the importance of seagrass in that area or design a poster to display.

Did you know?

The anchor from one cruise boat can destroy an area of seagrass the size of a football field! What can be done to limit the problem?

TREE VERSUS FISH - a management comparison

Grade(s): secondary

Subject(s): social studies, geography

Introduction:

Parts of Central America are considered important with old growth trees that should be set aside for future generations. In the MesoAmerican Reef System large numbers of fish that breed in nursery areas need to be managed.

Objectives:

Compare community and management issues involved with forests and fish nurseries.

Make justifiable links between ecological and economic factors and the production and consumption of a familiar resource.

Predict the impact of changes on environments by comparing evidence.

Procedure:

1. Form a group and study the table below and discuss the difference between (+) and (-) values and perceptions, and the management issues involves with each.
2. Write down your discussion notes in a table similar to the one below.
3. Discuss these with the whole class.

Community perceptions and values	Management issues
(-) Low value held for 'swamps' and marine wetlands which are used as dumps or filled.	The need to protect sensitive fish habitats by restricting development that damages fish habitats is supported by the community.
(+) New catchment management group members	Catchment groups need funds to promote education programs

2. As a class discuss some issues involved in developing mangrove or salt marsh areas for farming or housing development and compare these with the issues of using old growth forest timbers for furniture and wood chips.
Have students complete a table making sure that there are positive as well as negative

Perceptions and values of forests	Perceptions and values of nursery areas

Management issues of forests	Management issues of nursery areas

Source;VNature's Nautical Nurseries. The State of Queensland (Department of Primary Industries) [Queensland Government Gateway](#),2002.

DESIGN TASKS FOR A CORAL REEF MARINE RESERVE

Grade(s): secondary

Subject(s): social studies, geography

Objectives

Understand how human actions modify the physical environment

Explain how human actions affect coral reefs

Identify actions that can be taken to help coral reef environments

Procedure

Explain to the class that a coral reef can be legally protected by setting up a coral reef marine reserve. Specific rules and regulations will then govern the use of the reef and the waters surrounding it. Some countries such as New Zealand have enacted strict limitations to safeguard their marine reserves (e.g., **no** killing or removal of marine life, **no** construction or dumping nearby). Such tight controls have not yet been imposed in reserves in the U.S.A. or many other parts of the world where reefs are endangered.

Tell the students to ...

Imagine that the Department of Conservation decides to establish a coral reef marine reserve in your area. You accept the contract from the Department of Conservation or from regional authorities for the following design tasks:

(Each class member chooses **one** of the following:)

- a brochure or pamphlet advertising the coral reef marine reserve for local use
- a notice-board display that describes reef etiquette for visitors (e.g., snorkelers, divers)
- a brochure, describing the marine reserve, for oversea tourists
- a poster about the marine reserve for distribution in grade schools or high schools

The class as a whole may share ideas on what rules and practices will be enforced in the new reserve.

Post the accompanying examples in the classroom to assist students in coming up with ideas for their projects. Suggest that students use their *imagination* if they do not have facts.

Provide large sheets of newsprint, typing and ruled notebook paper, poster board, pens, markers and poster paint for the design tasks. Encourage the students to make their designs "user friendly," presenting important information, perhaps reducing the emphasis on what is not allowed and suggesting *positive* things to do in the marine reserve. Tell them to do their best to create designs with **impact**.

Display the best efforts around the school, in local shops, or send them to the local newspaper for publication.

Source: Dr. Sharon H. Walker, R. Amanda Newton, Dr. Alida Ortiz, Coral Reefs: An English/Spanish Compilation of Activities for Middle School Students, J.L. Scott Marine Education Center & Aquarium, 2001,



Because you are a diver, you're already more aware of and more alarmed by changes in our environment than most.

Living coral reefs attract millions of snorkelers and scuba divers each year. By the year 2000 there will be 10 million new divers in North America alone.

The dive operators who gave you [this bulletin] share an increasing awareness and growing concern for the protection and wise management of the coral reef ecosystem.

There is no question about divers causing damage. More than one million U.S. divers impact coral reefs 36 million times each year. Our coral reefs are being used up faster than they can replenish themselves.

Many divers still believe corals are an inexhaustible resource composed of an inanimate, indestructible rock.

A study by the University of South Florida has confirmed that divers can pose a serious threat to our coral reefs. The average scuba diver knocks, bumps into, pushes over, or kicks living corals an average of seven times for every 30 minutes under water. Snorkelers have at least one negative contact with the corals for every 30 minutes in the water.


Every diver, novice and expert alike, is a vital link in nature's complex eco-system.

Each of us can help protect the world's coral reefs. The problems are critical ... but not hopeless. **YOU CAN MAKE A DIFFERENCE!**

Source: Adapted from "Piggy Divers Wreck Our Reefs" produced by Dr. Joe Strykowski. The Star Thrower Foundation, P.O. Box 2200, Crystal Crystal River, Florida 34423 Tel: (352) 563-0022, Fax: (352)563-2064. Used with permission.

National Marine Sanctuary Program

Florida Keys




REEF ETIQUETTE


Your visit to the Florida Keys National Marine Sanctuary will delight you with beautiful coral formations and a variety of reef organisms in a tropical reef setting.

Please follow the guidelines and regulations below while in the Sanctuary:

Just touching coral may cause damage to this fragile animal, therefore, do not allow your hands, knees, fins, gauges or tank to contact the coral.




Marc Gill




When anchoring, the anchor, anchor chain or line should not be in contact with coral. Use mooring buoys that are provided. If one is not available, ask to tie off to another stem. If neither option is available carefully anchor in sand.

Corals, shells, sea biscuits and other animals, living or dead, cannot be removed from the Key Largo or Looe Key National Marine Sanctuaries.


The red and white divers down flag must be flown while SCUBA diving or snorkeling. Boats must slow to no-wake speed within 100 yards of a dive flag. Divers should stay within 100 yards of their dive flag.





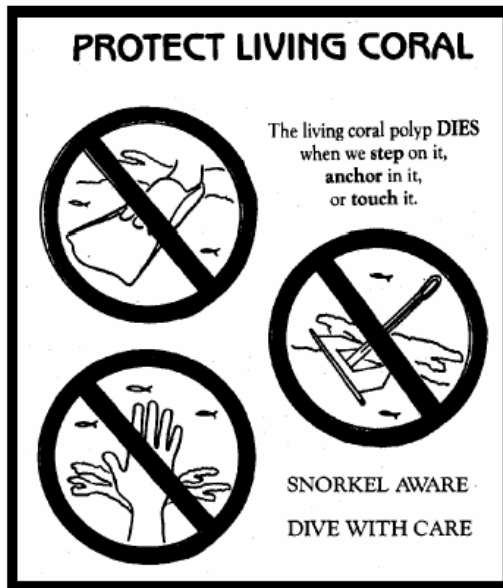
Spearfishing, possession of spearfishing equipment or of speared fish is not allowed within the boundaries of the Key Largo National Marine Sanctuary. Within the Looe Key National Marine Sanctuary, spearfishing is not allowed, however, equipment may be stowed and not readily available onboard. Call the Florida Marine Patrol concerning other closed areas.

Florida law requires a fishing license. Special stamps are required for lobster, snook and tarpon. Applicable size, bag limits and seasons must be observed when harvesting seafood products. Consult State and Federal authorities for current regulations.



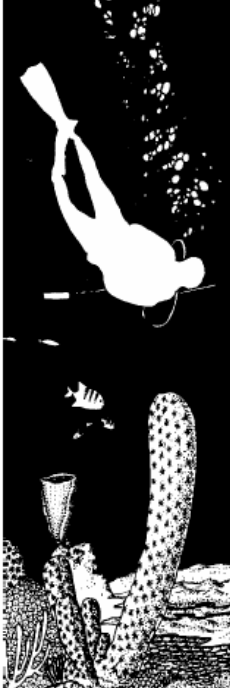
Marc Gill

Source: "Reef Etiquette/Safe Boating Tips." Florida Keys National Marine Sanctuary, Upper Keys Region, P.O. Box 1083, Key Largo, Florida 33037. Used with permission.



Source: (Figure at left) © Reef Relief, P.O. Box 430, Key West, Florida 33041 Tel: (305)294-3100 Fax: (305)293-9515 All rights reserved, reprinted with permission.

Source: (Figure below) Lynne Hinkey-Mac-Donald, "You can help protect our coral," **Coast Notes:** Fact sheet #28, A Virgin Islands Marine Advisory Services Publication, University of the Virgin Islands. University of Puerto Rico Sea Grant College Program. Used with permission.



You can help protect our corals

- 1. Never stand on or touch the coral reef.**
Coral is **not** a rock. Each coral colony is made up of tiny living animals called **polyps**, which are closely related to sea anemones. Touching, holding, standing on or kicking coral can crush and kill these animals. The coral polyps are connected and completely interdependent. **When you harm one, you hurt the entire colony.** It may take years for a coral to fully recover from an injury, and corals grow very slowly. Even small breakages can cause long-term or even irreparable damage. If you must stand while swimming, snorkeling or diving, please stand only on sandy-bottomed areas.
- 2. Don't feed the fish.**
Bread, cooked vegetables, cheese and other human foods are indigestible for fish. They may fill up on these foods, but they can't assimilate the nutrients so may easily become weakened or sick. In addition, these foods disturb the natural balance of ocean life and may contribute to harmful algae growth and the decline of other species.
- 3. Swim without stirring up the sand.**
Stirred up sand can cover corals, sponges and other animals and plants. This is called **siltation**, and it **can injure or even kill these organisms.** Besides, sand suspended in the water column interferes with our view of fish and other marine life. Keep track of where you kick your feet and flippers. Make sure they don't touch the coral or stir up the sand.
- 4. Pick up any trash you find in the water and place it in a garbage can.**
If no garbage cans are available, take trash home and dispose of it properly. Plastic bags and other litter in the water may be mistaken for food by turtles, sea birds and other organisms. If eaten, marine debris can suffocate and starve animals. Or it may entangle or otherwise fatally injure them.
- 5. Use only waterproof sunscreen.**
Some sunscreens wash off in the water and become a pollutant. At high-use beaches, washed off sunscreen can pose a real problem for marine plants and animals. Use only waterproof sunscreen or wear a t-shirt when you swim.
- 6. Use the restrooms.**
Urine adds unwanted nutrients to the water. These nutrients encourage algae growth, which can limit the amount of sunlight that reaches the reef. Corals depend on sunlight for energy. With insufficient light, reefs will die.
- 7. Take only photos. Leave only footprints.**
The health of our marine ecosystems depends upon a delicate balance of many natural processes. Removing organisms from the waters or beaches, or adding any new substances (trash, food, pollutants) can seriously disturb the balance Nature has created. To ensure the beauty and health of the Virgin Islands' environment for future visits and for future generations, please take only photos and leave only footprints.
- 8. Share this information with a friend.**
Teach others to care for the Virgin Islands' reefs and beaches for the enjoyment of all.

Grade(s): secondary

Subject(s): social studies, geography

Objectives:

Discuss management issues of ESD — Ecological sustainable development

Describe human actions on marine ecosystems.

Make inferences about interactions between people and environment.

Procedure:

Step 1 Form 4 class groups, study the table opposite and choose an activity that has impact on nursery areas. The diagram will have to be discussed before forming student groups.

Step 2 Study the chart below (see Figure 1). This is called a development - consequence chart and is used to identify issues involved in ecological sustainable development.

Step 3 Now select one impact and ask the question "What are the immediate effects or consequences?" Discuss what you think these might be and write them on the first line out from the centre. This shows that they are the first consequences to arise from this action or issue.

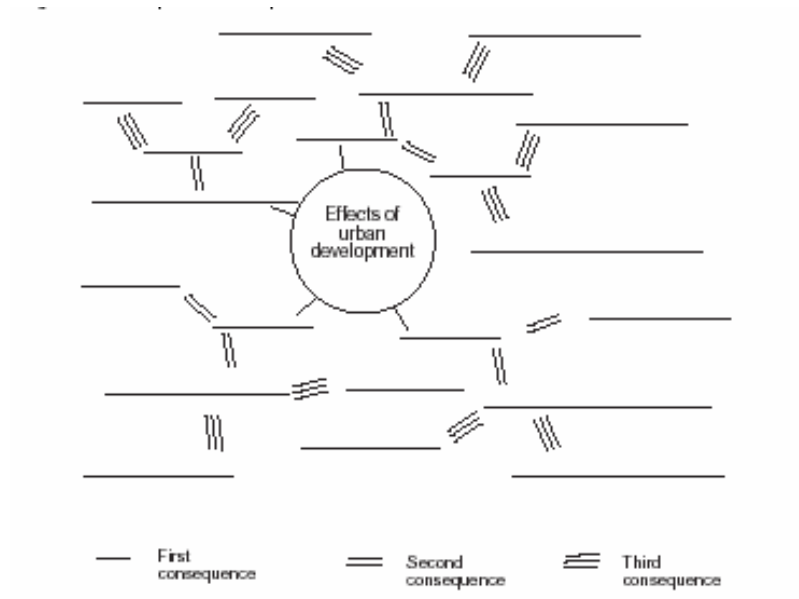
From these continue in small groups to discuss what consequences may follow on from the first ones. These second order consequences are then written on the next line and joined with a double line.

Third and fourth order consequences can be explored and written down in a similar way.

The result is a wheel of the future showing a range of possible consequences which might effect an ESD decision.

Step 4 Present the different consequences to others in the class.

Figure 1: Development/ consequences chart



Activity	Examples	Management Issues
1. Commercial fishing	<p>Taking too fish leads to fewer fish stocks.</p> <p>Jobs for fishing families.</p> <p>Damage to fish habitats because of fishing techniques.</p>	<p>Identify new ways of fishing that are passive, don't over fish stocks & fish to have low impact on habitats.</p> <p>Restocking of fisheries.</p> <p>Develop value (markets) for under utilized stocks & reduce waste of fish unsuitable for sale.</p>
2. Recreational fishing	<p>Unsustainable reduction in fish stocks.</p> <p>Enjoyment for people of all ages.</p> <p>Damage to fish habitats because of fishing techniques.</p> <p>Supplimentary food resource.</p>	<p>Encourage responsible / ethical fishing behaviors :</p> <ul style="list-style-type: none"> • Only take what you need. • Take legal sized fish. • Obey closed seasons. • Release protected species. • Retrieve broken fishing lines. • Use biodegradable bait bags.
3. Aquaculture	<p>Employment for families and development of a local industry.</p> <p>Damage to fish habitats through construction of ponds and inlet and outlet structures in sensitive habitats.</p> <p>Reduction in water quality from effluent disposal.</p>	<p>Strategic placement of aquaculture industries which adhere to standards for environmental protection and best management.</p> <p>Movement towards total reuse of water and treatment to maintain good water quality.</p>
4. Urban development	<p>Reclamation of sensitive fish habitats for development purposes.</p> <p>Placing developments too close to fish habitats causing 'edge effects' that may damage habitats.</p> <p>New affordable homes for young families.</p>	<p>Restrict any further development of wetlands and tidal lands – stop 'hardening' the catchment (eg, making large amounts of concrete and paved areas).</p> <p>Develop 'soft' engineering solutions for stormwater treatment and river bank stabilisation.</p> <p>Introduce 'buffer zones' to setback any developments from sensitive fish habitats (100m in marine areas and 50m in freshwater areas).</p>

PERSONAL ACTIONS

Grade(s): secondary
Subject(s): geography

Objectives

Investigate how different activities that have a negative impact on the environment
Identify positive activities to address the negative impacts.

Procedure:

Create a fish habitat certificate.

A certificate is awarded for completing any or all of the following suggested student activities:

- Wrote an essay on the importance of fish habitats to prawns
- Found a photograph of a mud crab
- Explained to the class why you can't collect seaweed or marine plants
- Watched seabirds on the shore and described how they fly, what they eat, how they behave towards each other
- Arranged a visit to the class by a local fisheries officer
- Carefully released undersized fish
- Caught fish for only one meal
- Cleaned up fishing line from the shoreline and put it in the bin
- Collected garbage from the foreshore
- Found a lure and brought it to class explaining what type of fish it was designed to catch
- Walked carefully through the mangroves
- Participated in building a mangrove boardwalk
- Identified two mangrove species
- Observed crabs come out of their holes at low tide and described them to the class
- Caught a legal sized fish and explained why it was legal to the class
- Found out about fishing ethics from Fisheries department or conservation organizations
- Explained how mangroves survive in mud and anaerobic soils
- Explained what acid sulfate soils are
- Explained fines, why we have them, who gets them, and why we do it
- Described a local fish habitat to the class
- Found out about a marine conservation volunteer program
- Studied media images as they relate to fishers of different ages, gender, disability and ethnicity
- Researched how native ethnic groups use fish habitats and mangroves
- Studied a religious or spiritual belief relating to fishing

Source: Nature's Nautical Nurseries - An educational module from the Queensland Fisheries Service. The State of Queensland (Department of Primary Industries) 2002.

Green Points Challenge!

The Challenge

Working in teams, your challenge is to earn the greatest number of Green Points. Green Points are actions that people can take that will have a positive effect on the environment. There are five different levels of these points: the higher the level, the greater the effect on the environment. Actions taken in higher levels earn more points.

Materials

- A Green Points Scorecard for each person in each team
- A tally sheet
- A Gould Green Points trophy

The Game

1. Form teams. Each team should give themselves a name. Teachers can form teams and compete if they wish. Just warn them that the competition will be stiff.
2. Use the *Green Points Scorecard* Study this scorecard carefully, and in the weeks before World Environment Day, plan out how your team can earn the most points. For each action in Level 1, you will earn one point; for each action in Level 2, you will earn two points, and so on. It is pretty obvious that you should spend more effort on actions in the higher levels if your team hopes to win this Challenge.
3. Hold a Gould Green Points Challenge for a 24 hour period. Each member of a team should use the Green Points Scorecard to record their actions. It is important that someone, who is not in your team, should witness each action and write their initials in the appropriate box. For example, if you turned off a tap properly, then ask a friend, who saw you do this, to sign their initials in the box under Level 1 for the Category of Water Conservation. Each person can only count one action for each box.
4. Use the tally sheet to work out the score for your team.

The Rules

1. Each person can only count one action for each box.
2. Each action can only be counted if a person from outside the team initials it. (This won't be necessary in the toilet action in Water Conservation.)
3. Actions can only be counted for a 24 hour period.

The Celebration

Make a Green Points trophy, using mainly reused or recycled materials. Present this to the winning Green Team.

The Gould Green Points Challenge, The [Gould League](#), Environment Australia

Green points Scorecard

CATEGORY	LEVEL 1 <i>Basic action</i> 1 Green Point	LEVEL 2 <i>Action involves a wise choice</i> 2 Green Points	LEVEL 3 <i>Action requires some effort</i> 3 Green Points	LEVEL 4 <i>Action requires greater effort</i> 4 Green Points	LEVEL 5 <i>Action involves persuading others</i> 5 Green Points
Water pollution/ Quality	Don't drop litter as it could end up in a water way	Pick up a plastic bag that is litter and place it in a rubbish bin	Pick up after your pet dog	Sweep a path instead of hosing it down	Put up a display in local shopping centre that shows the consequences of litter in waterways
Water conservation	Turn off a tap properly or Turn off a dripping tap	Use the half flush button in the toilet where appropriate	- Take a shorter shower or - Have shallower bath or Turn off a tap while brushing your teeth	Wash your bike or your parents' car on the lawn, using a bucket of water	Tell an adult about any leaking tap and urge them to have it fixed quickly
Litter	Put your litter in a rubbish bin	Pick up other people's litter	Use things that create less litter	Join in a clean-up event.	Encourage others not to drop litter
Waste	Put recyclable drink container into the correct recycling containers or Try to recycle cardboard.	Use a reusable lunch box and drink bottle for your lunch at school	- Use both sides of a sheet of paper or - Give old things away to charity or -Use rechargeable batteries	Fix a broken toy or pen rather than buy a new one	Encourage others to buy things made from recycled materials
Shopping	- Buy a drink in a packaging that can be recycled or - Buy fresh food that is made locally	Swap something instead of buying a new one	Buy something second-hand	Buy something that will last a long time	Put up a display to encourage others to use their own bags in supermarkets or Make recycled shopping bags and sell these to parents
Soil quality	Place fruit and vegie scraps into a compost bin or worm farm	Use home compost on the garden	Place mulch on garden beds	Plant trees and other plants in revegetation projects	Join a conservation group to help in environmental projects
Energy conservation (and greenhouse gases)	Turn off a light when no-one is in the room	Keep doors closed when rooms are heated or cooled or Keep the fridge door closed when it	Put on a jumper when it is cool, rather than turn on a heater or Use a personal fan in hot weather, instead of turning on the air	Help to hang the washing on the line, instead of using the clothes drier	Ask an adult to: - change a computer monitors to energy saving mode or - use cold water for washing clothes

CATEGORY	LEVEL 1 <i>Basic action</i> 1 Green Point	LEVEL 2 <i>Action involves a wise choice</i> 2 Green Points	LEVEL 3 <i>Action requires some effort</i> 3 Green Points	LEVEL 4 <i>Action requires greater effort</i> 4 Green Points	LEVEL 5 <i>Action involves persuading others</i> 5 Green Points
		is not being used	conditioner		
Transport (and greenhouse gases)	Walk short distances, instead of being driven there by car	For travelling longer distances, car pool with your friends	Ride a bike for a short trips	Use public transport for a longer journeys	Persuade your family to -- use public transport or - do things together locally, instead of driving long distances
Air pollution	Speak to a friend by phone or email, rather than travel to your friend's place by car	Get in the car promptly. Don't let the car idle for long periods	Offer to cut the grass using a hand lawn mower	If you can share a car for school or going out, do so.	Persuade your parents to use the gas / oil / electric heater, instead of burning wood or briquettes
Biodiversity	Protect all native plants and animals	- Keep your cat inside at night. or - Place a bell around its neck. or - Keep your dog under control when taken for a walk	Remove weeds from school gardens, so that they can't invade natural areas	Plant more native and indigenous plants and fewer introduced plants	- Create a habitat for creatures in the corner of your garden or - Join a group that cares for natural environments

Evaluation Methods

Not all the lessons have the provision for formal evaluation, but for those lessons that feature presentations, story, play, essay writing, or creative activities the generic rubric assessments are useful.

GENERAL SCORING RUBRIC

SCORE	DESCRIPTION
CATEGORY 4	<ul style="list-style-type: none"> The student completes all important components of the task and communicates ideas clearly. The student demonstrates in-depth understanding of the relevant concepts and/or process. Where appropriate, the student chooses more efficient and/or sophisticated processes. Where appropriate, the student offers insightful interpretations or extensions (generalizations, applications, analogies).
CATEGORY 3	<ul style="list-style-type: none"> The student completes most important components of the task and communicates clearly. The student demonstrates understanding of major concepts even though he/she overlooks or misunderstands some less important ideas or details.
CATEGORY 2	<ul style="list-style-type: none"> The student completes some important components of the task and communicates those clearly. The student demonstrates that there are gaps in his/her conceptual understanding.
CATEGORY 1	<ul style="list-style-type: none"> The student shows minimal understanding. The student addresses only a small portion of the required task(s).
CATEGORY 0	<ul style="list-style-type: none"> Response is totally incorrect or irrelevant.
BLANK	<ul style="list-style-type: none"> No response.

For evaluating presentations, a rubric has been designed to determine the students' abilities and efforts into developing their presentation.

Quality of Presentation	
4	<p>Topic is related to theme and is presented imaginatively. The presentation is extremely creative and effectively tells a clear, concise story that stands on its own. Project excellently flows logically from beginning to end. Physical appearance of project shows sophistication and attention to detail in terms of typing & proofreading, neatness, etc.</p>
3	<p>Topic is related to the theme. The exhibit is interesting and tells a clear story that stands on its own. The project adequately flows from beginning to end. Good physical appearance of project. Minor flaws in attention to detail in terms of typing, proofreading, neatness, etc</p>
2	<p>Topic shows vague references to the theme. The exhibit tells an unclear story and is missing vital elements. The project cannot stand on its own. Major errors in attention to detail.</p>
1	<p>Topic is not related to the theme. No exhibit. Overall project lacks clarity. Gross errors in attention to detail.</p>

GLOSSARY

Algae - Tiny, floating, aquatic plants that drift in the sunlit surface or of the ocean and often give water a greenish color. Scientifically known as phytoplankton, these plants exist as producers at the bottom of many food chains.

Asexual reproduction - a natural process by which some plants and animals produce offspring within themselves, without the production of eggs or without fertilization from another plant or animal.

Atoll - a type of coral reef that grows in the shape of a circle, enclosing or nearly enclosing a lagoon.

Barrier reef - a type of coral reef that lies parallel to a beach shoreline and protects a lagoon.

Brackish water: A mixture of sea water and fresh water (as occurs near the mouths of rivers).

Calcification - a process that takes place in the body of the coral polyp, with assistance from zooxanthellae algae, by which the dissolved limestone in ocean water is changed into solid limestone, and is laid down beneath the coral polyp in the species specific skeletal pattern. This accumulative process results in the building of coral reef structures.

Calcium carbonate: The white limestone material which makes up the skeletons of coral polyps and the shells of molluscs; the chalk used on blackboards is mostly calcium carbonate.

Carnivore: An organism which eats animals.

Catch Quota: The maximum catch permitted to be taken from a fishery; such a limit applied to the total catch from a fishery is often referred to as a global quota (as distinct from an individual quota).

Cnidae - stinging cells that exist on the tentacles of the coral polyp and assist the polyp in capturing zooplankton that are passing by in ocean currents.

Consumer - a plant or animal which gets its energy by consuming, or eating other living things.

Coral colony - a group of coral polyps that takes the specific shapes of that species of coral.

Coral polyp - a small aquatic animal with a tube-shaped body and a mouth surrounded by tentacles; coral polyps are responsible for the production of coral reefs.

Coral reef - a collective structure consisting of dead skeletal limestone that has accumulated over time and a result of the coral animals that cover the structure's surface. As a result of a series of ecological relationships, the coral reef structure is directly responsible for the production of much of the earth's fish and marine life.

Coral reef ecology - the study of the relationships between the living and non-living things that exist in and around the coral reef environment.

Deforestation - the removal of trees and vegetation from land; the most common cause of soil erosion.

Dependent relationship - a type of relationship in which one thing needs or relies on another for its continued existence.

Dissolved substance - a material that has been mixed in liquid to form a solution.

Ecology - the study of the relationships between living and non-living things in any environment.

Ecosystem - any environment where living and non-living things have relationships; the basic unit of study in ecology.

Ecologically Sustainable Development (ESD): Use of the environment which aims to meet present needs without compromising the ability of future generations to have the same privilege; development based on the sustainable use both of species and ecosystems, the maintenance of essential ecological processes, and the preservation of biological diversity.

Extinction: The total disappearance of a species.

Fisheries regulations: Controls designed to either restrict effective fishing effort (input controls), or to restrict the total catch (output controls) to predefined limits in a fishery.

Food web - an interdependent and interconnecting pattern of producer and consumers, predator and prey.

Fringing reef - a type of coral reef that grows parallel and near to a beach shoreline.

Habitat - the place or kind of place in which it is natural for an animal or plant to live or grow.

Hard coral - a group of coral species known as stony coral that forms the hard, calcium carbonate skeleton in several shapes; other include the brain corals, fungus or mushroom corals, staghorn and table corals, flower pot corals, bubble corals and lettuce corals.

Herbivore: An animal which eats plant material.

Inner reef - the part of a barrier reef or atoll that faces the lagoon.

Interaction - the result of one thing acting on another.

Interdependent relationship - a type of relationship wherein both or all members of a relationship are dependent on one another.

Invertebrate - an animal that does not have a backbone.

Lagoon - a shallow, pond-like body of water that is usually connected to a larger body of water, such as a river, lake or sea; the body of water between a barrier reef and a beach shoreline, or surrounded by an atoll.

Larvae: The young stages of many marine animals including corals; most larvae are small and drift in the sea before becoming adults.

Limestone - a common, naturally occurring form of calcium carbonate of which coral reef structures are made.

Mangroves ecosystem - the environment of saline-tolerant trees that live in the tidal zone of the ocean, and all the other non-living and living things that have relationships there.

marine biologists - persons who study the life and processes of the ocean.

Marine life - animals that live in the ocean including coral polyps, sea urchins, clams, shells, worms, crabs, octopuses, squid, etc.

Marine Protected Area (MPA): A marine reserve, park, or other area protected from uncontrolled human access and use by the application of various restrictions on activities, development and exploitation.

Overfishing - the harvest of fish or marine life at a rate and volume that destroys the ocean's ability to provide such harvest in the future; the unsustainable harvest of fish and marine life.

Partner ecosystems - ecosystems that work together to maintain the diversity, productivity and ecological balance of other, nearby or connected ecosystems, or of the broader ecosystem of which they are a part.

Photosynthesis - the process by which plant material is formed from water, nutrients and carbon dioxide using energy absorbed from sunlight.

Phytoplankton - small aquatic plants that drift in the sunlit surface of the ocean; commonly known as algae, these plants exist as producers at the bottom of many food chains.

Plankton - small aquatic plants and animals that drift in the ocean; types include algae, phytoplankton, zooplankton and zooxanthellae.

Predator - an animal that hunts for food, or otherwise eats another animal.

Prey - an animal that is hunted or consumed for food by another animal.

Producer - a plant that manufactures plant material from water and carbon dioxide using energy from sunlight and nutrients in a process known as photosynthesis.

Primary producers: Plants, including algae and phytoplankton, which use sunlight and nutrients.

Prop roots - roots of mangrove trees that are extended out of the muddy soils and submerged in sea water at high tide, but are exposed at low tide; assist in slowing wave action and protecting soft mangrove soils against erosion.

Quota: A limit on the weight of fish which may be caught in a particular stock or area; a bag limit is a quota (usually in numbers of fish caught) applied to recreational fishers.

Reef flat - the space between a fringing reef and the beach shoreline covered by water at high tide but has almost no water on it at low tide and where coral growth is minimal.

Reef front - the outside edge of all types of coral reefs; the side of a coral reef facing the open ocean, where coral growth is most extensive; also known as the reef face.

Seagrass ecosystem - the environment of aquatic plants called seagrasses that live in the tidal zone of the ocean, and all the other non-living and living things that have relationships there.

Sediment - sands, silts, or soil mixed into, carried by, or deposited from water.

Settled polyp - the larvae of a coral polyp that has come to attach itself to a clean, hard surface and begins to grow.

Sexual reproduction - a natural process by which some plants and animals produce offspring as a result of the production of eggs and the fertilization from another plant or animal. shallow - water that is not deep.

Silt - fine soil mixed into, carried by, or deposited from water as sediment.

Siltation - the accumulation of silt in the bottom of waterways or bodies of water.

Soft corals - a group of coral species that are thick and fleshy, and that move and wave in ocean water currents. These corals do not produce calcium carbonate

Species: A distinct group of animals or plants able to breed among themselves, but unable to breed with other groups.

Stinging cells - mechanisms located on the tentacles of coral polyps that enable them to capture passing zooplankton; similar in appearance to poison darts or recoiling darts; scientifically known as cnidae.

Subsistence fishing: The catching of fish to eat rather than to sell.

Symbiosis: A relationship between two different creatures which live together for the benefit of both. Plant cells (called zooxanthellae) have a symbiotic relationship with coral polyps.

Symbiotic relationship - a relationship between two living things that live together for the benefit of both.

Tentacle - the arms that surround the mouth of a coral polyp; the site of stinging cells called cnidae which enable the polyp to capture passing zooplankton.

Tidal zone - the area along the beach shoreline that is affected by the rise and fall of the tide.

Unsustainable - the present use, consumption or harvesting of natural resources that can not be continued into the future.

Vertebrates - animals that have backbones.

Waste water - water used in domestic or industrial process and as a result contains pollution that has potentially harmful substances.

Zooplankton - small animals, or larvae or larger animals, which drift in the ocean.

Zooxanthellae - small aquatic plants that live in symbiosis within coral polyps which allows it to manufacture its own food and the deposition of a calcium carbonate skeleton; a type of algae; a type of phytoplankton.

Additional Resources

abc teach –unit with activities, pictures on reefs

http://abcteach.com/directory/theme_units/habitats/coral_reef/

Bermuda Biological Station for Research & College of Exploration

www.coexploration.org/bbsr/coral/lessons/

Bridge Ocean Sciences Teachers Resource Centre

www.vims.edu/bridge/

Coral Reef Alliance – online catalog, photobank, lessons

www.coralreefalliance.org

CREST (Coral Reef Education for Students and Teachers) Manual

www.marine.org/content/CREST/CREST_manual.html

Discovery School

www.Discoveryschool.com

Endangered Reefs – information on reefs in danger

www.eco-pros.com/endangeredreefs.htm

International Coral Reef Information Network

www.coralreef.org/tools/teachers.html

KaAms Kids as Airborne Scientists

www.higp.hawaii.edu/kaams//prof/whatiscr/over.html

Nature's Nautical Nurseries – Fact and activity sheets on seagrasses & mangroves

www.dpi.qld.gov.au/extra/nnn/activity_home.html

Neptune's Web

<http://pao.cnmc.navy.mil/educate/neptune/teacher.htm>

Ocean Planet

http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/search_educational_materials.html

Reefbase –online information system with maps

www.Reefbase.org

Reef Education Network – Activities for students and teachers

www.reef.edu.au

Smithsonian Education

www.si.edu/resources/lessons/currkits/ocean/main.html

The Teachers Corner – online resource for educators

www.theteacherscorner.net

Terrax – hands on unit on coral reefs

<http://terrax.org/teacher/lessons/australia/reef/reefplan.aspx>

Under the Sea – Mrs. Seagrave's Quest Class – lessons, activities for teachers and students

www.geocities.com/Athens/Athrium/5924/underthesea.htm

Water Matters

www.watermatters.org

WWF Learning UK

www.wwflearning.co.uk/activities/

Year of the Ocean

www.yoto98.noaa.gov/kids

42explore

www.42explore.com/index.htm

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SECTION V

Annex

**Official Endorsement
of the**

MBRS Infusion Document

Endoso Oficial del Documento de Infusión de las Temáticas del Sistema Arrecifal Mesoamericano SAM, Julio del 2003



Infusión de Temáticas Sobre el Sistema Arrecifal Mesoamericano (SAM)

Dentro de las Currículas y sus Planes de Educación
en los Niveles de Primaria y Secundaria de Belice, Guatemala,
Honduras y el Estado de Quintana Roo, México

ENDOSO OFICIAL



[Handwritten signatures and initials]

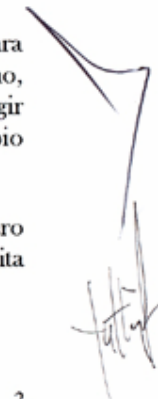
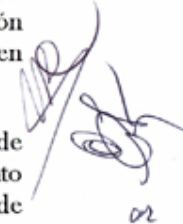
Endoso Oficial del Documento de Infusión de las Temáticas del Sistema Arrecifal Mesoamericano SAM, Julio del 2003

**Los Representantes de los Ministerios de Educación Pública de Belice,
Guatemala Honduras y del Estado de Quintana Roo, México**

**Reunidos en San Pedro Sula
El 14 de Julio del 2003**

Considerando

1. Que el Proyecto para el Sistema Arrecifal Mesoamericano (SAM) es un organismo internacional, cuyos objetivos se orientan a promover la conservación y el uso sostenible de los recursos del SAM en Belice, Guatemala, Honduras y México. Concebido como tal durante la "Declaración de Tulum" en junio de 1997 y dependiente de la Comisión Centroamericana de Ambiente y Desarrollo (CCAD).
2. Que el Proyecto SAM es parte esencial del proceso de integración entre los países del Istmo Centroamericano y México.
3. Que los países del SAM, a través de los compromisos adquiridos con el Proyecto, de manera conjunta se han propuesto impulsar la infusión de las temáticas del SAM dentro de la Curricula y Planes de Estudio en la región.
4. Que la Comisión de Areas Naturales Protegidas de la Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) como punto focal del Proyecto SAM en México, ha delegado a la Secretaría de Educación Publica del Estado de Quintana Roo, para el endoso del Documento de Infusión de Temáticas del SAM
5. Que la Educación para la Sostenibilidad Ambiental es beneficiosa para la conservación y el desarrollo del Sistema Arrecifal Mesoamericano, porque permitirá a los estudiantes comprender y, por ende dirigir eficientemente los temas costero marinos dentro de su propio ambiente.
6. Que el aprendizaje para responder a temas ambientales costero marinos es una parte importante de la formación integral y necesita formar parte de la Curricula y de los Planes de Estudio .



Endoso Oficial del Documento de Infusión de las Temáticas del Sistema Arrecifal Mesoamericano SAM, Julio del 2003

7. Que de los objetivos del Proyecto SAM, se crearon tres temas principales de educación, con veinte áreas temáticas, se relacionaron con los Planes de Estudio de los países del SAM, los cuales demostraron compatibilidad.
8. Que los principios generales de la conectividad transfronteriza se integrarán en la curricula a través de los Planes de Estudio.
9. Que la Guía de Maestros para la Infusión de Conceptos del SAM ayuda a los maestros a incorporar los principios transfronterizos en las lecciones, a través del entendimiento obtenido de la Guía sobre la forma de presentar estos principios dentro de los temas de objeto del aprendizaje.
10. Que los Planes Educativos de los países del SAM, ofrecen muchas oportunidades de introducir los temas relacionados con "La Gente y los Arrecifes, biología y ecología de comunidades coralinas relacionados con los conceptos del SAM.
11. Las asignaturas que facilitan la integración fácil de temas del SAM en escuelas primarias son los Estudios Sociales o Ciencias Sociales, la Geografía y las Ciencias Naturales. Las materias pertinentes en institutos de enseñanza secundaria son la biología, la geografía y los estudios sociales.
12. Que los planes para las lecciones incorporados a las Guías del Maestro conectan a las áreas temáticas con las asignaturas apropiadas, ofreciendo actividades para cumplir adecuadamente los objetivos del SAM y los Planes de Estudio vigentes en los países del SAM.

POR TANTO ACORDAMOS:

- a) Facilitar la infusión de las temáticas del SAM, contenidas en el Apéndice A del documento de Infusión de Conceptos, dentro de las curricula educativa, en los niveles primario y secundario de los respectivos países o estados.
- b) Completar la inclusión total de las temáticas del SAM, descritas en el Apéndice A del Documento de Infusión de Conceptos del SAM, dentro de las Curricula y sus Planes de Estudio en un plazo no mayor de dos años académicos.

Endoso Oficial del Documento de Infusión de las Temáticas del Sistema Arrecifal Mesoamericano SAM, Julio del 2003

- c) Encomendar esta adecuación de conceptos a las Unidades Curriculares Ministeriales o al organismo competente dentro del sistema educativo de cada uno de los países signatarios.
- d) Desarrollar las temáticas del SAM a través de las asignaturas de Estudios Sociales o Ciencias Sociales, Geografía y Ciencias Naturales para primaria y Biología y Geografía en institutos de enseñanza secundaria, haciendo la respectiva adecuación.
- e) Participar activamente en la planificación y el desarrollo de los talleres nacionales de capacitación sobre el uso de las Guías del Maestro, para los niveles de primaria y secundaria.
- f) Asegurar la implementación local de los conceptos del SAM, principalmente dentro del área de influencia del Proyecto SAM y evaluar su impacto.
- g) Hacer del conocimiento público el presente acuerdo de Infusión de Conceptos y su vigencia a partir de su suscripción.

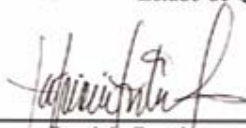
Dado en la Ciudad de San Pedro Sula, Departamento de Cortés, República de Honduras, a los catorce días del mes de Julio del 2003.


Armando Leiva
Ministerio de Educación de Belice


Elder Román León
Ministerio de Educación de Guatemala


Will Renan Díaz
Secretaría de Educación Pública de Honduras


Claudio Godda Medina
Secretaría de Educación Pública del Estado de Quintana Roo, México


Patricia Panting
Ministro de Recursos Naturales y Ambiente
SERNA, Honduras