GUAM

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TEACHERS EDITION

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Coastal Management Program

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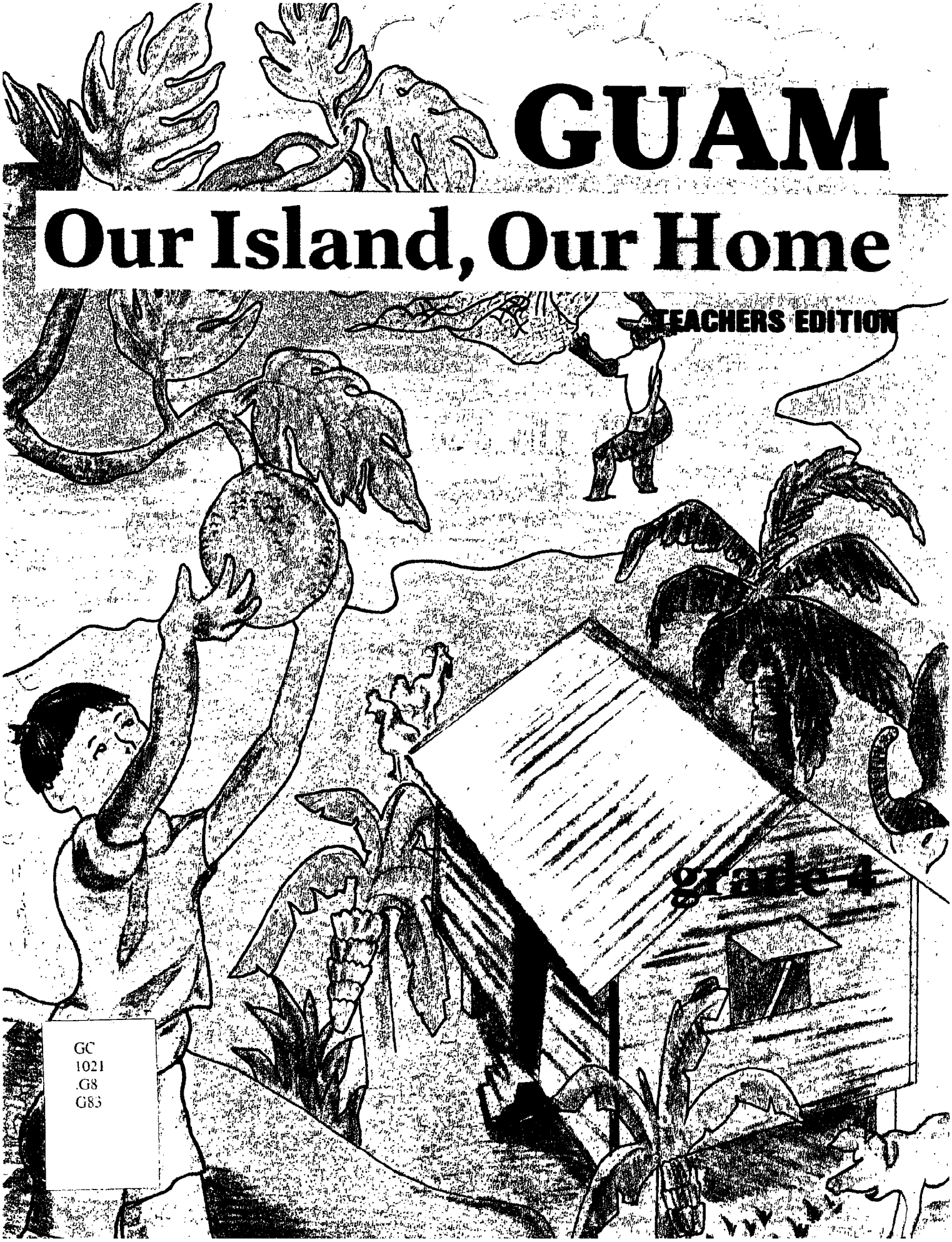
GUAM

Our Island, Our Home

TEACHERS EDITION



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4th Grade Glossary List

1. evaporation - when water turns into steam or vapor.
2. transpiration - when plants "swet" or give off moisture to the air.
3. precipitation - any form of water (rain/snow/sleet/hail) which falls from clouds.
4. infiltration - when water seeps down through limestone rock.
5. condensation - when steam or vapor turns into water.
6. humus - a layer of dead, decaying organic matter on top of the soil.
7. atmosphere - the collection of gases (air) which surrounds the earth.
8. granite - the oldest rock on earth, formed when the hot surface cooled.
9. glacier - a slowly-moving river of ice heading toward the ocean to accumulate (to pile up).
10. photosynthesize - to make food from minerals, water and sunlight.
11. photosynthesis - the making of food in the green parts of a plant.
12. algae - species of simple plants that live in water.
13. microscopic - so tiny you need a microscope to see it.
14. plankton - plants and animals that drift around in the ocean.
15. energy - the force that makes things live, move or work.
16. predator - animal that hunts and feeds on other animals.
17. prey - animals that are hunted and eaten by other animals.
18. population - the number of a species of animals living in one place.
19. decay - to rot away, to break down into tiny parts.
20. mangrove - several species of trees that grow in mud flats where the water is partly fresh and salty (brackish).
21. aquaculture - growing water animals in special ponds and tanks for food.
22. staple - important for everyday use.
23. diet - everything a person eats and drinks.
24. brackish - water which is a mixture of fresh and salty.
25. cargo - items and goods transported in ships and airplanes.
26. fertilizer - something to put into soil to make plants grow better.

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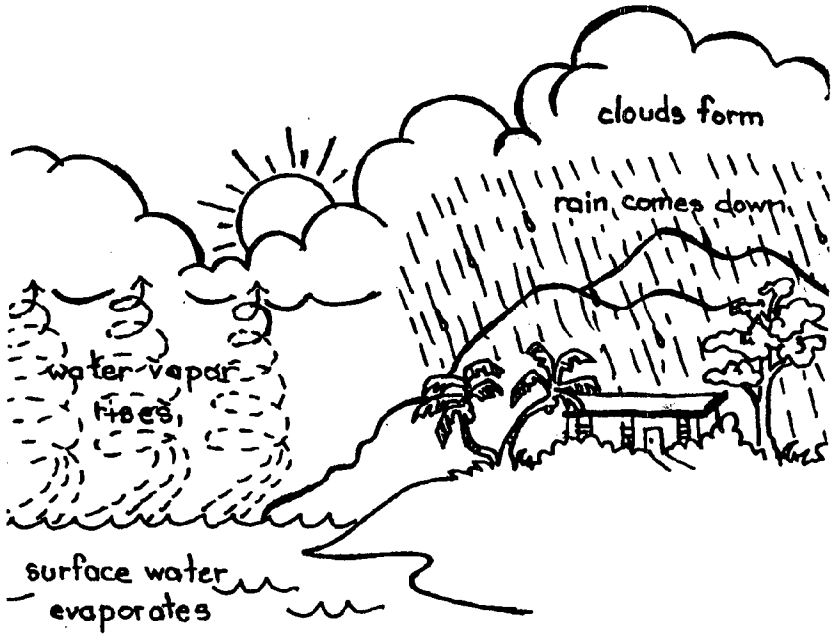
T.E.
The Water Cycle



Earth's Water (H_2O)

Two atoms of hydrogen and one atom of oxygen make one molecule of water.

When Earth was first forming, 4 ½ billion years ago, various gases escaped through cracks in the cooling, granite crust. These gases formed clouds above the surface and became Earth's first atmosphere. As the clouds cooled, they condensed and the first rain fell. When it hit the hot granite crust it immediately evaporated, rose again as steam, cooled, condensed, fell again as rain. So the cycle went on for millions of years, until Earth was cool enough to let water collect in the low places, and the firs oceans were formed. *The very same water* still goes through its cycle today, but much more slowly.

About 97% of all earth's water is salt water in the oceans.

About 3% of all earth's water is fresh water in rivers and lakes.

About 75% of earth's fresh water is locked as ice in glaciers and ice-caps in the polar and cold regions of earth.

Water, fresh or salt, covers about 70% of earth's surface.

A mammal's body is about 65% water!

Teaching Strategies:

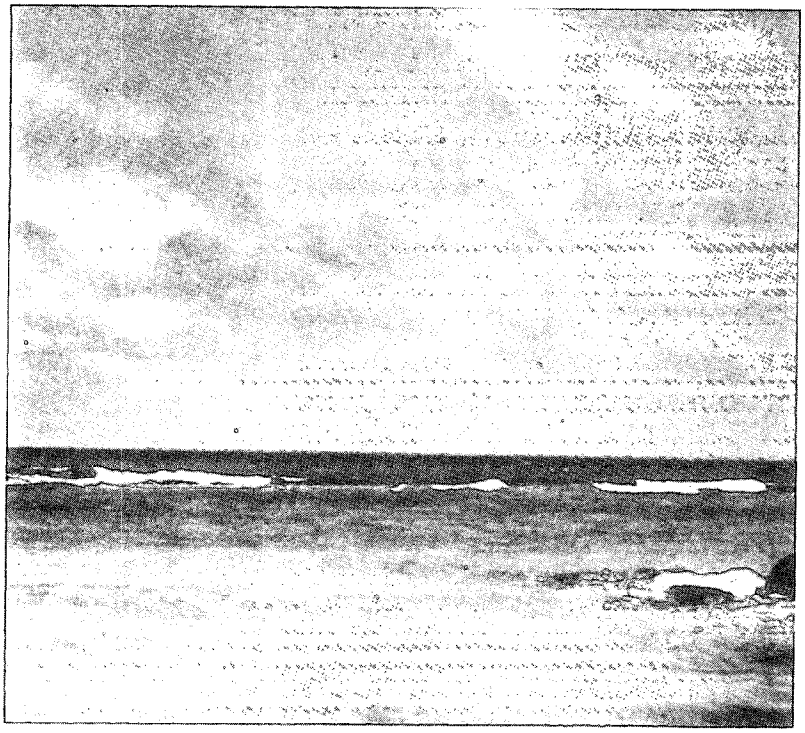
1. This page shows the water cycle and give a number of basic facts about water.

2. Have the students study and discuss the diagram. Ask them about snow and hail on Guam. Try to make the students understand how water goes up as vapor and down as rain in a never ending cycle.

3. Discuss the Polar ice caps. Ask the students what they think might happen if this ice ever melted. (sea levels would rise all over the world and all low places would be flooded)

4. Have the students look up glacier in the glossary. Ask them what they think happens when glaciers reach the sea. (chunks break off and form ice-bergs)

Our Ocean



As we have seen, most of Earth's surface is covered with water, and nearly all that water is salty. The ocean's water gets more salty as time goes by. Rivers flow into the ocean and wash into it all kinds of minerals from the land. These minerals stay in the ocean. They do not evaporate with the surface water, so the minerals *accumulate* and make the water saltier all the time.

We cannot drink salty water We cannot use it for cooking, washing clothes, doing household chores, watering the garden or even for putting out wildfires. So, if the water itself is not really much use to us, why is the ocean so important?

Teaching Strategies:

1. This chapter can be tied in with Chapter 10, page 196 in the Silver Burdett 4th grade Science Book. This chapter gives information about the importance of the ocean to Guam.

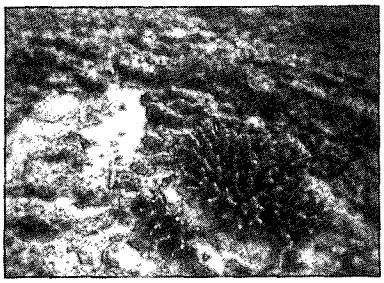
2. Make sure the students understand why the ocean is salty. (Silver Burdett, page 199)

3. Discuss the recreational uses of ocean water. Brainstorm (on the chalkborad) for all the fun things people can do in or on the ocean.

4. Address the question at the bottom of the page and see if the students can suggest any importances of the ocean (food, shipping)

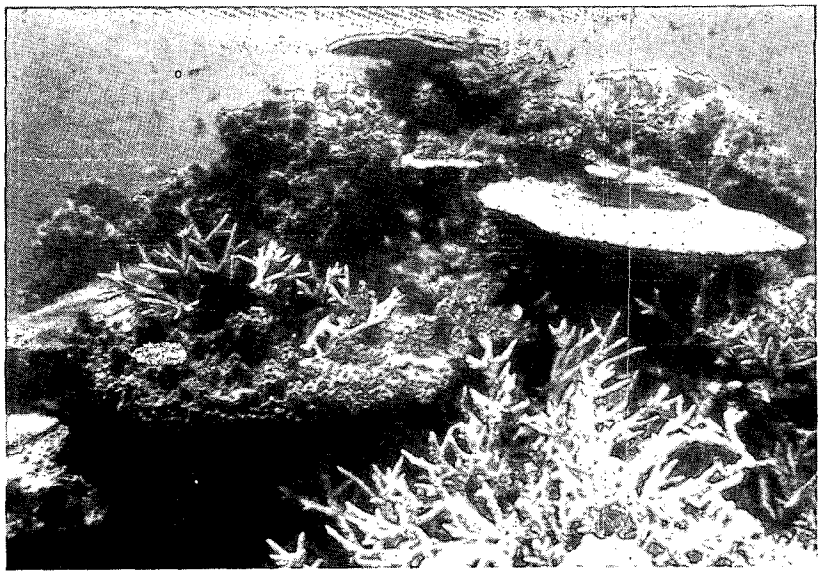
5. See if the children can suggest why salty water can't be used for cooking etc. (clean, makes things sticky, would kill plants in the garden, would ruin fire-fighting equipment, how do you get the water from the sea to the fire, etc.)

The Coral Reef



The most important part of the ocean for Guam is the coral reef, it protects the island's coast from pounding ocean waves. You can see the waves breaking on the reef, especially during and after storms.

But the reef is also important because of all the plants and animals that live in and around it A reef is built mainly of the limy outer skeletons of tiny coral animals. The living build on top of the dead, over and over, as hundreds of years pass. Only the top layer of coral is alive. There are hard corals and soft corals of many shapes and colors. They form a kind of undersea garden which becomes the habitat of more kinds of organisms that can't be found anywhere else in the ocean. Large fish come to the reef to feed. These fish are a good food source for people.



Teaching Strategies:

1. Study and discuss the pictures on this page. Ask the children what dead coral looks like. (no color) Ask the children what they think the coral animals are eating. (tiny organisms, plankton, in the water)

2. Discuss how the reef protects the island. Guam's reef is a "fringing" reef quite close to and attached directly to the land. "Barrier" reefs are separated by a lagoon.

3. Brainstorm for all the kinds of organisms that may be found in, on or around the coral reef. Then have the children organize them into two groups, those that are fixed to the reef (coral animals, mussels, clams, seaweed etc.) and those that can move around (fish, snails, octopus, squid etc.)

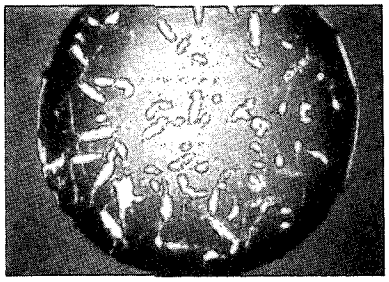
4. See if you can get students to bring in shells, corals etc., and make a display. Using library or other resources, try to have the students identify the items in the display.

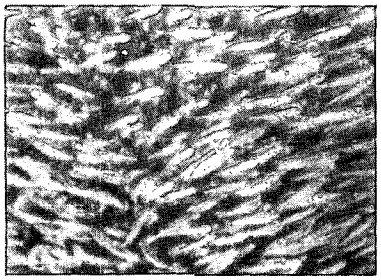
Ocean Food Chains

Just as on land, ocean fool chains begin with plants. Like land plants, sea plants *photosynthesize* and for this they need sunlight. Sea plants grow in shallow seas, especially around corals reefs. Like land plants they provide shelter and food for animals. As they carry on *photosynthesis*, sea plants make over 40% of the oxygen that is in the air we breath.

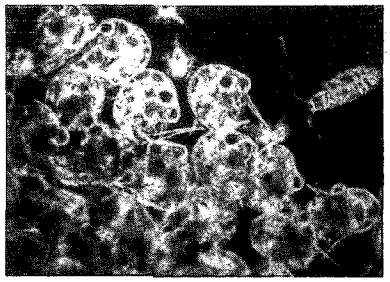
Most sea plants are called seaweed by many people, but scientists call the *algae*. The other kinds of sea plants are sea grasses.

The surface waters of the ocean teem with *microscopic* plants and animals called *plankton*. They feed on each other and on algae. They also form the food for countless varieties of small animals such as crabs, shrimps, snails and tiny fish.





In turn these small creatures are eaten by larger ones which are eaten by even large ones. So it goes on. Food gives *energy* to living things, and energy is passed from one animal to another as it gets eaten.



Animals which hunt and eat other animals are called *predators*. The animals they hunt and eat are called *prey*. Most creatures in the sea are both predator and prey. Only the largest predators have no enemies to hunt them.

Teaching Strategies:

1. Supporting information on food chains can be found in Silver Burdett Science, 4th grade, pp. T45-63.

2. Have the students examine the pictures and see what they can identify.

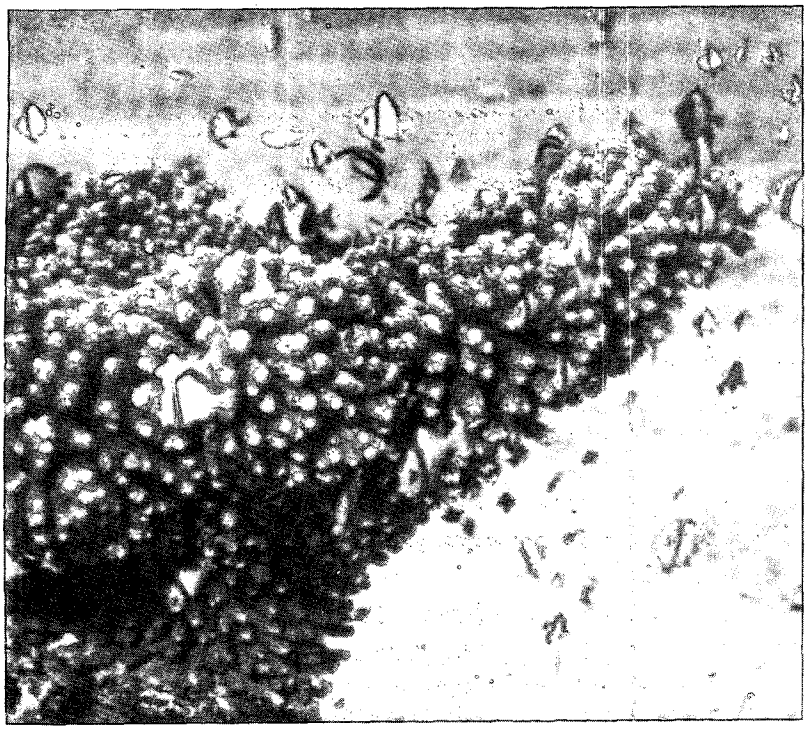
3. Discuss photosynthesis and its importance to the earth. Ask the students what would happen if algae stopped photosynthesizing. (not enough oxygen in the air; many people and animals would die)

4. Have the students make up some coral reef food chains. What would eat what? Try to get pictures and books on coral reefs for classroom resources.

5. Discuss ocean pre dators. Brainstorm for large ocean predators on the board (remember that the largest whales and sharks eat only very small creatures)

6. Ask the students what animal is the ultimate predator. (man)

Ocean Resources



The human population of the earth today is so large that it's hard to feed them all. More and more land is taken over to grow crops and raise food animals, but it's still not enough. So people are turning to the ocean to provide food for hungry people.

Many kinds of ocean fish make good eating. Fish provides a lot of protein and very little fat, so it is very healthy food. Crabs, shrimp, prawns and lobsters are delicious. Many people eat octopus, squid and cuttlefish; oysters, clams, mussels and many kinds of sea snails are included in *staple diets* in many parts of the world. Even some kinds of seaweed are used as food, as well as for medicine, *fertilizer* and paper. Seaweed is rich in vitamins and minerals.

Teaching Strategies:

1. Study the picture and discuss the food items shown. See how many the students can identify.

2. Discuss human population. Ask the students if they know why there are more and more people in the World (*not* because women have more babies, but because modern medicine and health care make people live longer and fever babies die)

3. Ask the students what seafood they have eaten. Have they eaten seaweed? (think of sushi)

4. Discuss how we get fish and other food from the sea. Different kinds of fishing. Ask them what might happen if we turn more and more to the sea for food (over-fishing and over use of the ocean's resources-there will be less and less until there are none)

5. Try to get a speaker with slide-show or film from Aquatics and Wildlife to show Guam's reefs.

The Mangrove Flat

A mangrove flat is a very special enviroment found on protected coasts. Guam's mangrove flat is on the eastern side of Apra Harbor. It is protected to the north and west by Cabras Island and the Glass Breakwater, and to the south by Orote Point. Several small rivers flow into Apra Harbor, bringing fresh water and lots of nutrients from *decaying* vegetation inland. The ocean tides bring in salty water and different nutrients from the sea.

Specially adapted plants and animals live in this rich muddy mixture of fresh and salty water known as blackish water. Trees called mangroves with special root systems grow very well in these muddy flats. Hundreds of species of microscopic and small animals live among the mangrove roots. Mangrove flats are often called "nurseries of the sea," because fish and other sea animals come in to feed and lay their eggs. Because of this, mangrove flats are a very important part of the ocean food chains.

Teaching Strategies:

1. Try to get a copy of "Mangrove Flat" in the Life on Guam series put out some years ago by Guam Science Teachers and Department of Education. It gives a lot of detailed information about mangrove flat ecology.

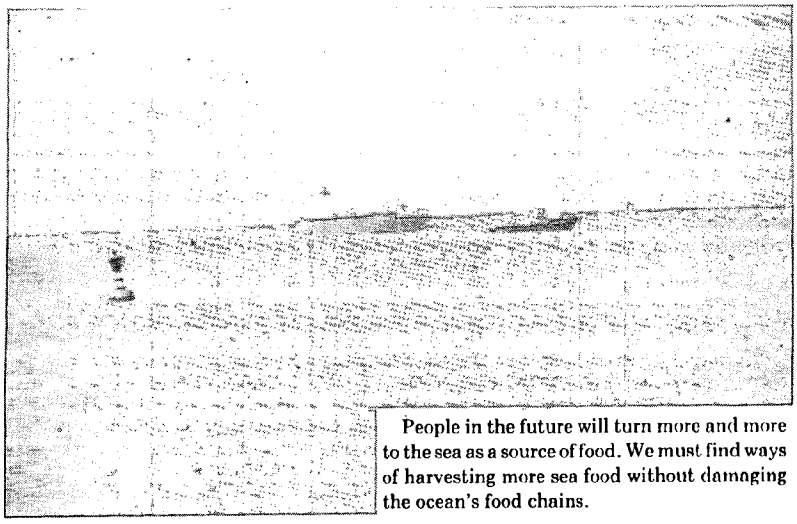
2. See if in the library, the students can find out anything about a) mudskippers, b) fiddler crabs. These are two of the most interesting inhabitants of the mangrove flat.

3. Ask the students to watch out for the mangroves if they're every driving past Apra Harbor.

4. Make sure the students understand how important a mangrove flat is, because of all the animals that live and breed there.

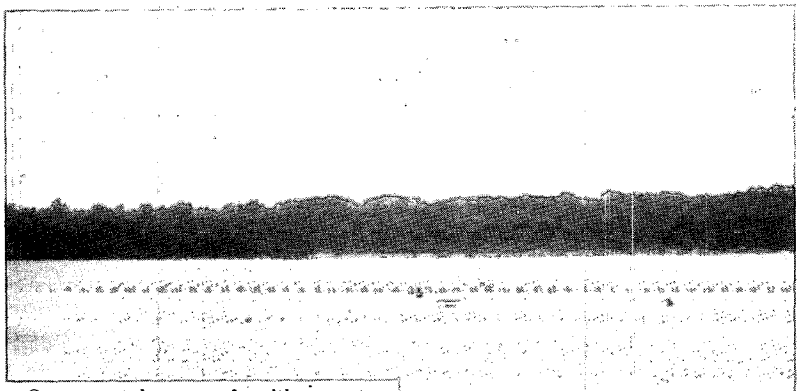
5. Try to get a presentation from Guam Environmental Protection Agency or Fish and Wildlife.

Farming the Ocean



People in the future will turn more and more to the sea as a source of food. We must find ways of harvesting more sea food without damaging the ocean's food chains.

One way to farm the resources of the ocean is aquaculture Large tanks or ponds are built, usually close to the ocean, or even in the ocean, so that sea water can flow in and out. These ponds are stocked with whatever kind of animal you want to grow. Predators are kept out and lots of food is supplied so that the animals grow fast and big. When they are right for eating they are easily gathered up and taken to market. The best part of this is that the ocean is not harmed.



Oysters can be grown for either meat or pearls in protected places in the ocean. Guam would be a good place for all kinds of aquaculture We could have plenty of fish and other seafood to improve our diet.

Teaching Strategies:

1. Ask the children what they think of when they think of farming.

2. What sort of "crops" might we farm in the ocean? (seaweed) See if they can remember why seaweed is useful.

3. What animals can we farm in the ocean (Almost any animal we can eat) Ask them to name some that are not mentioned on this page (turtles, crabs, lobsters, etc.)

4. Make sure the students understand why we will need to farm the ocean in the future.

5. Try to find newspaper cutting or information from Department of Agriculture and Wildlife about aquaculture projects on Guam.

Chapter Review

A) Rewrite these sentences, choosing the correct word from the parenthese ().

1. Most of Earth's water is (fresh,salty).
2. Granite is the oldest form of (rock, water, gas) on Earth.
3. The ocean is getting (more and more, less and less) salty.
4. Only the (top, bottom) layer of coral contains living animals.
5. Plants in the ocean produce (some, most, a little) of the oxygen we breath.
6. Food provides (energy, photosynthesis) for living things.
7. Most animals in the ocean are (predators, prey, both predators and prey).
8. Earth's human population is getting (bigger, smaller).
9. Mangrove trees like to grow in and near (fresh, salty, brackish) water.
10. We can get more food from the ocean by using (aquaculture, agriculture).

B) Answer the following questions in your own words using whole sentences. Use the information in this chapter to help you.

1. Why is the ocean salty?
2. Why is the coral reef so important?
3. Why are sea-plants so important to people?
4. How is energy passed among living things?
5. Why do *you* think human beings are the top predators on earth?

C) Write a paragraph called "Why the ocean is Important." Be sure to give as much information as you can.

Teaching Strategies:

1. Select a number of glossary words for this chapter. Assign them for study of spelling and/or meaning and give a test.

2. Use A and B for oral or written work, as you please. Use C for individual written work or small group work, or as a whole class project constructing it on the board.

KEY:

A - 1. salty, 2. rock, 3. more and more, 4. top, 5. most, 6. energy, 7. both, 8. bigger, 9. brackish, 10. aquaculture

B -1. Rivers bring minerals, accumulate in ocean, do not evaporate. 2. Protects shores from waves, great source of food from reef animals. 3. Provide most of our oxygen. Useful for food, medicine, fertilizer and paper. 4. In the food chain when one animal eats a plant or another animal. 5. We can kill anything we want with weapons. We are not the natural prey for any animal (though people can be killed by animals)

C - Look for reasons called from the chapter, written expression etc.

Glossary Words

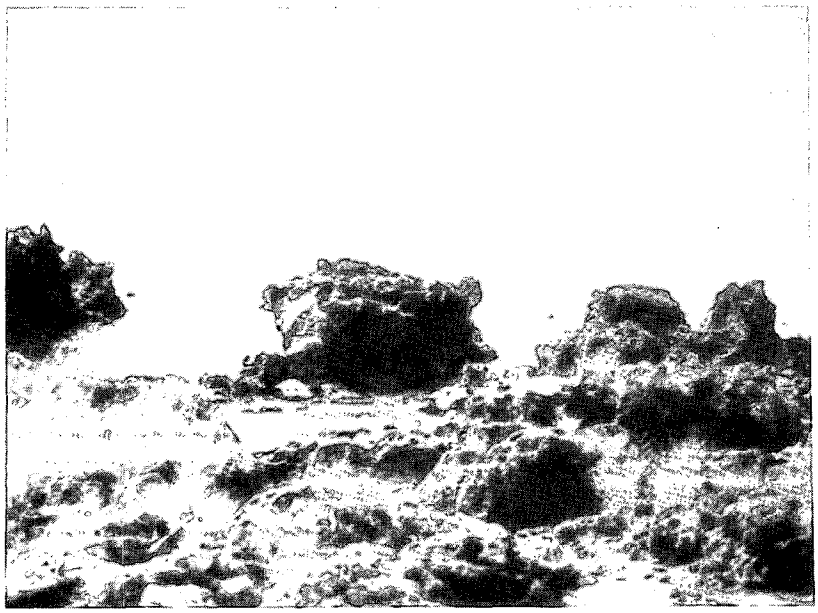
1. ecosystem	-	a) an area within which all the organisms depend upon each other and upon their environment.
or		b) an area within which all the living and non-living things are dependent upon each other.
2. toxic	-	poisonous.
3. non-degradable	-	something that will not break up and rot away.
4. productive	-	having all the healthy plants and animals it's supposed to have.
5. nuclear	-	something made by splitting atoms.
6. marine	-	belonging to the ocean.
7. indigestable	-	something that an animal's body can't digest.
8. tradition	-	a practice handed on from father to son over many years.
9. ancestors	-	members of your family who lived before you in the past.

T.E.
Our Misuse of the Ocean

Even though we know how important the ocean and its resources are, we still find many ways to misuse them.

1. Reef destruction: It takes hundreds of years for a reef *ecosystem* to form. Every plant and animal, every rock and coral formation is important, providing either food or shelter for the animals. When collectors break off pieces of coral they are damaging the reef. When they take living sea shells to decorate their house, they are interfering with food chains. If enough people do this for long enough the reef ecosystem breaks down and the reef begins to die.

We learned in Chapter 1 how a reef can be destroyed when soil from run-off settles on it and suffocates all the living things. Guam's reefs are often damaged when people illegally dynamite them or pure chlorox in the water for quick fish kills. Everything is killed by these destructive fishing methods, including seaplants and the coral animals themselves. We are left with a section of dead reef which will take years to grow again.



Teaching Strategies:

1. Study and discuss the photos. Talk about shells and shell collecting. Ask the students how they feel about killing and animal so you can have its beautiful shell.

2. See if you can get pieces of coral to see the holes where the animals lived. Discuss how that piece of coral may have been broken off.

3. Discuss dynamiting. What would this do to everything in the area? (coral would be blown apart, animals blasted, plants destroyed etc.)

4. Discuss pouring chlorox in the water. Everything would be poisoned.

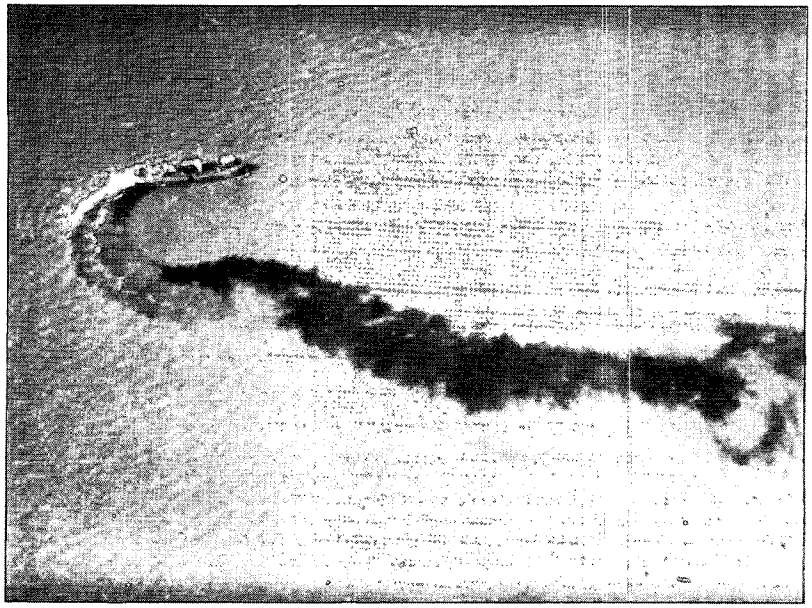
5. Try to get someone from Aquatic and Wildlife to talk about the difficulties of protecting the reef; laws and punishments, the importance of the reef to the island and so on.

6. Have the children design a poster appealing to people not to destroy the reef.

2. Pollution - Oil Spills:

2. Pollution - Oil Spills:

Some people seem to think that the ocean is so big it can take care of any amount of pollution we choose to dump into it. This is far from true. The ocean is certainly very big. It can cope very well with the waste products of all the creatures that live in it, but people pollute the ocean in ways that really damage it.



In 19 , a pip-line taking oil to GORCO leaked hundreds of gallons of crude oil into Guam's mangrove flat in Apra Harbor. Even though the spill was cleaned up as quickly as possible, *most* of the red mangrove trees were killed. Millions of small organisms that lived among their roots either died or had to go away. These organisms were important links in the ocean food chain and it is hard to measure the damage that resulted. It took years for the trees to recover and may take many more years for the mud-flat ecosystem to be full *productive* again. Oil spills, whether close to shore or out in the open ocean, kill sea birds, turtles and fish, as well as smaller organisms. Sometimes oil is dumped deliberately into the sea by ships wanting to get rid of it!

Teaching Strategies:

1. Study the picture. Ask the students if they've seen the mangrove flat. Discuss the strange roots - called prop roots - see if students can suggest why red mangroves have such roots. (to hold it down against the waves and tides) Refer to the "Life on Guam" series "Mangrove Flat" pg 4. Tell the students about its special kind of seeds.

2. Ask the students if they can figure out why the oil spill killed trees and other things. (it choked them, cut off air, poisoned them when it got inside them)

3. Ask the students who had to clean up the mess? (GORCO)

4. Ask the students if they think people who cause oil spills should be punished - why? What sort of punishment would be good (clean-up, replant, re-stock, take care of the area for a specified length of time, be fined, be made to do environmental work.)

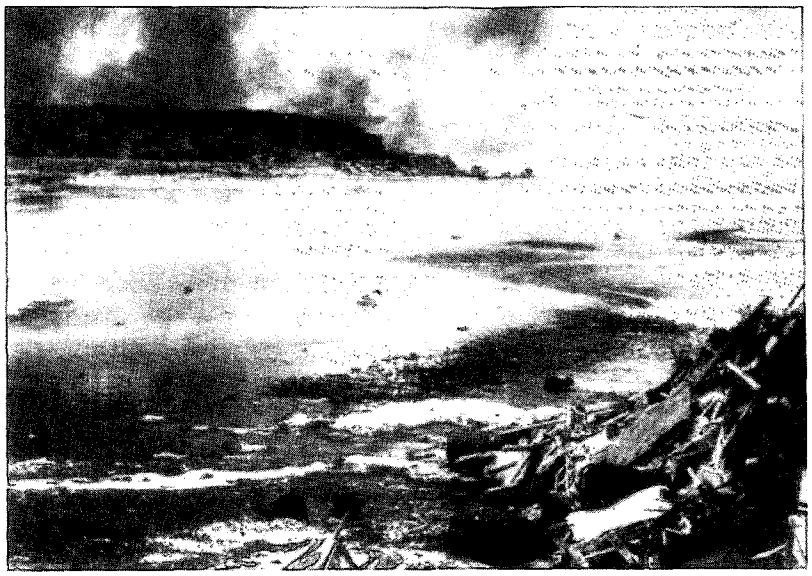
5. Try to get a presentation on the Mangrove Flat from Department of Agriculture or the Environmental Protection Agency.

3. Pollution - Dumping of Wastes:

3. Pollution - Dumping of Wastes:

There was a time when sewage (kitchen and bathroom wastes) were piped out into the ocean. People thought all that ocean water could deal with the poisons in the raw sewage. Now we know better. Poison gets into plankton which is eaten by small fish which are eaten by bigger fish. When people eat these bigger fish they get poisoned. All sewage on Guam is taken to sewage treatment plants which remove all the poisons. Only harmless water is emptied into the sea. The rest is turned into useful fertilizer.

Because the ocean off Guam is so deep, some people want to dump *nuclear* waste into it. Nuclear waste is what is left over when electricity is made in atomic power plants. It is very, very toxic. Scientists believe such wastes can stay dangerously toxic for thousands of years. They say the poison would seep out of whatever it was stored in, and poison everything in the ocean. Sooner or later we would all get poisoned. Nuclear wastes must never be allowed to be dumped in our ocean.



Teaching Strategies:

1. Study and discuss the picture. Ask the students to picture these wastes (urine and feces, not just dishwater and laundry water). Explain that harmful bacteria breeds in human and animal wastes that can give people diseases.

2. See if you can arrange a field trip to one of Guam's sewage treatment plant so they can find out how it is treated. Ask the students why the problem is worse now than 50 years ago (more people).

3. Discuss radioactive wastes. Ask if the students know why scientists are turning to nuclear power to make electricity? (Oil is getting scarce, nuclear power plants make a lot of inexpensive electricity once they have been built, big problem of what to do with the wastes because they are so toxic for so long) Ask students for ways of disposing of nuclear waste. (Not one good way has ever been found. Shooting it into outer space is too expensive - one lift-off costs billions of dollars)

Try to find simple books on nuclear energy and its problems. Have students design a poster or a T-shirt to protect our ocean from nuclear waste dumping.

4. Pollution - Trash and Litter:

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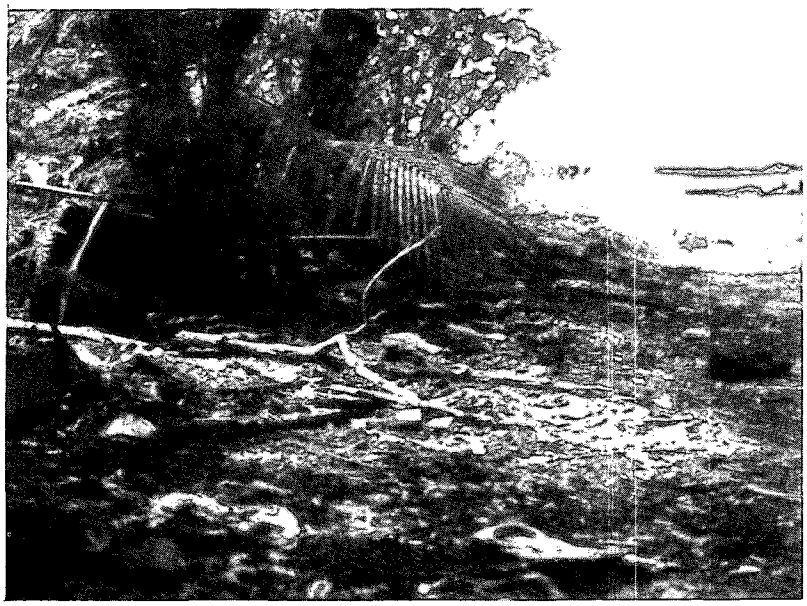


You have all seen the assorted rubbish left on the beach by people - bottles, cans, plastic bags, pampers and so on. Much of this gets swept into the sea when the tide comes up. Some of it, the plastic stuff, can cause unbelievable damage. Scientists say it takes 450 years for most plastics to break up and rot away.

The following is a May 1987 report from Defenders of Wildlife:

Millions of sea animals every year suffer tragic deaths to non-degradable plastics. In fact, the plastics problem is almost as bad as oil spills and toxic-waste discharges in overall destruction of *marine* birds and animals.

It is estimated that every year plastic kills:

- Northern fur seals -- 50,000 in Alaska waters alone
- Dall's porpoises -- 8,3000 in the North Pacific
- seabirds -- more than 1 million of U.S. and Canadian shores
- sea otters -- nearly 7 percent of California's total population
- sea turtles -- untold thousands in the Atlantic & Pacific Oceans

Plastic -- the synthetic, durable, non-destructible wonder of the modern world -- is destroying nature.

Here's how. Seals, sea lions, porpoises and sea otters become entangled in submerged, almost invisible plastic fishing nets and lines and mistaken for jellyfish and die of intestinal blockage or suffocation...turtles drown when caught in the plastic nets of shrimp fishermen...seabirds strangle in plastic six-pack rings or become trapped in old fishing nets...birds eat *indigestible* plastic pellets, mistaking them for floating fish eggs, and then suffer damage to their stomachs, starvation and death.

Teaching Strategies:

1. Study the picture and ask the students if it looks familiar. Ask them if they ever have family picnics at the beach. Do they pick up all their trash? What can they do if the trash cans are already full? (Bring all their trash home)

2. Study the information in the report and discuss all the ways plastic items can harm marine animals.

3. Ask the children how they think people can be stopped from throwing trash in the ocean. (they may suggest fines and punishments, stress that people have to understand what damage they do, so that they will be willing themselves to stop doing it.)

4. Have the children write a letter (to the local paper) explaining the problem and asking for public education to stop it. Don't forget the sheer unpleasantness of a filthy, littered beach!!

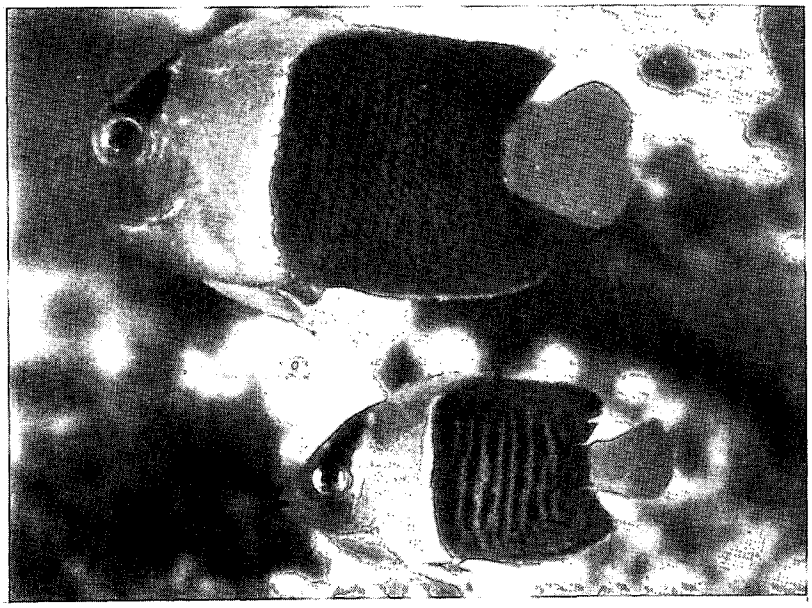
Other Harmful Practices:

5. Other Harmful Practics:

Out in the open ocean where commercial fishing is carried o, fishing boats use huge nets called seine nets to catch tuna fish. unfortunately many dolphins also get caught in these nets and can't come to the surface to breath. They drown just as you would.

Some people who depend on fish for the greater part of their diet, think dolphins eat too many fish. So they kill the dolphins. In other parts of the world people kill hundreds of pilot whales every year, not because they need the meat, but because they're just following the *traditions* of their *ancestors*. Elsewhere thousands of baby harp seals are clubbed to death so that coats for rich women can be made from their lovely white fur. How long will it be before there are no harp seals left?

Shrimp fishermen use special nets to catch huge quantities of shrimp. Hundreds of endangered sea-turtles get caught in these nets by accident. Because they're reptiles and must breathe air, they drown before they can be set free. Sea-turtles come ashore in the same beaches every year to lay their eggs. in some countries ignorant people gather turtle eggs by the thousands, just to feed to their pigs! In other places the turtles' nesting beaches have been taken over by huge hotels and beach resorts. Some sea-turtles swim in Guam's ocean and all species are endangered. Soon, if we are not more careful, there will be none left anywhere in the world.



Teaching Strategies:

1. Study the pictures and ask the students if they have ever seen a dolphin or a turtle.

2. Ask them if there are any seals around Guam. (no, but there are a few monk seals around Hawaii) Try to get pictures of baby harp seals to show the white fur.

3. Ask the students for suggestions of what can be done to protect the animals discussed on this page. (In fact, special nets are now being used so that dolphins and turtles do not get trapped. Conservation movements like Greenpeace are trying to stop the slaughter of baby harp seals and pilot whales. Turtle nesting sites are protected from development)

4. Have students design a poster or a T-shirt for "Save the Turtles."

5. Remind the students that every animal is important in an ecosystem. If one species is wiped out, the balance of nature is upset.

Chapter Review

A) Choose the correct ending for each sentence beginning and write the complete sentences on your activity paper.

Beginning	Ending
1. Every plant and animal	a. when people dynamite them
2. People who take sea-shells	b. must be piped to a sewage treatment plant
3. Guam's reefs are damaged	c. can strangle marine animals
4. Oil spills	d. often get swept out to sea
5. Kitchen and abthroom wastes	e. is important in an ecosystem
6. Nuclear wastes	f. protected nesting beaches
7. Plastic six-pack rings	g. get caught in tuna fishing nets
8. Trash and litter left on a beach	h. are toxic for thousands of years
9. Often, many dolphins	i. kill everything they touch
10. Sea turtles need	j. are interfering with food chains

B) Have you understood? Answer the following questions in whole sentences.

1. In what ways can snorkelers damage the reef?
2. What lazy fishing practices can damage parts of the reef?
3. Why are oil spills so destructive?
4. What is the biggest problem with nuclear power?
5. How is plastic trash dangerous to marine wildlife?
6. Why do fishermen in some places kill dolphins on purposes?

C) Write a paragraph explaining why sewage should not be dumped into the ocean.

Teaching Strategies:

1. Select 10 words from this chapter and have them study for a spelling and/or vocabulary test.

2. Use A and B as oral or written exercises with your students, whichever best suits your purpose.

3. Key to A:

1e; 2j; 3a; 4i; 5b; 6h; 7e; 8d; 9g; 10f.

Key to B:

1. Breaking off pieces of coral. Collecting living seashells etc.

2. Dynamiting and pouring chlorox.

3. They choke and poison everything they touch.

4. The wastes are poisonous for thousands of years and nobody knows how to get rid of them.

5. Marine wildlife can be strangled, trapped, choked by plastic trash.

6. They think the dolphins eat the fish they ought to have.

Key to C

Accept all sensible suggestions. Ocean can't deal with it, poisons plants and animals, stinks, poisons people etc.

Guam's Landforms
Vocabulary Words

1. Landform - a natural feature of the earth's surface.
2. Limestone - a rock formed by accumulation of organic remains like shells.
3. Plateau - a large level area raised above next to another land.
4. Mountain - high land pushed up by pressure or volcanic activity.
5. Hill - high land smaller than mountain.
6. Eruption - to force out suddenly and violently something as lava and steam.
7. Poacher - hunter illegally in pursue of forest animals.
8. Erosion - soil gradually worn away by wind and water.
9. Valley - low land between hills.
10. Fertile - productive, fruitful.
11. Vegetation - plant life in an area.
12. Savannah - vast land covered by plants.
13. Reef - ridge of rock near the sea.
14. Cliff - high face of rock on the side of a mountain.
15. Sea Level - level of the surface of the sea.
16. Beach - sand and rock fragments found in the sea, lake or river.
17. Reservoir - a place where something is stored.
18. Coral - stony or thorny material that forms the skeleton of colonies of tiny sea animals.
19. Algae - water plant used as food by water animals.
20. Calcareous - containing calcium or calcium carbonate.
21. Calcium - soft metallic chemical element found in bones, limestone, shells or plant ashes.
22. Spring - source of supply of water from the ground.
23. River - natural stream bigger than a brook.
24. Igneous Rock - a hard rock formed by fire. It doesn't absorb water easily.
25. Silt - small particles of matter like soil and mud and other things that float on water.
26. Cave - a small hollowed chamber on earth.
27. Mangrove Flat - swampy meeting place of fresh and salt water where plants and animals live.
28. Swamp - a marsh, a wet spongy low-lying ground.
29. River - natural stream of water flowing in a channel.
30. Lake - a large body of water within land.
31. Shore - land joining sea or large lake.
32. Brook - a small stream, a small flowing body of water.
33. Stream - a small flowing body of water.
34. Elevate - to raise up.

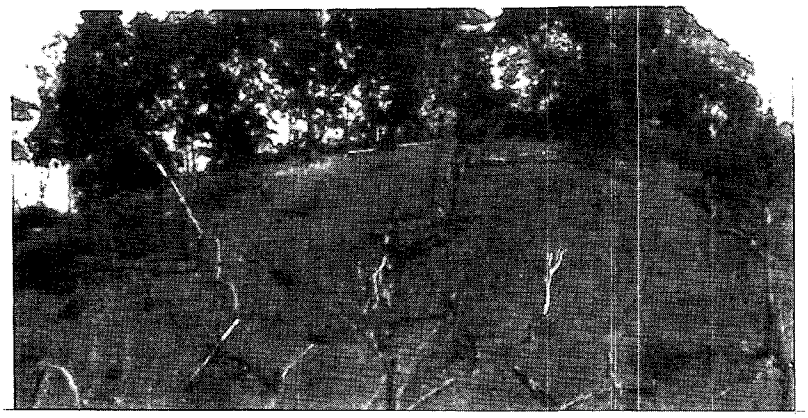
Loss Of Habitat

Guam is the southernmost and largest of the fifteen islands that form the Mariana Islands chain. It is approximately 45 kilometers (km) long and 6 to 13 km wide. The northern *limestone* plateau while the southern half is largely of volcanic origin. Mixed evergreens grow on the northern plateau and the southern half is largely savannah with ravine forest in river valleys. A series of volcanic hills up to 390 miles extend along the west side of the island in the south. A coral reef nearly surrounds the island. The *climate* is tropical with a dry and wet season.

Strategically located, Guam is an important military base, communications center, and stopover for several airlines. It has become a major center of activity for the Pacific. Concurrently, Guam's wildlife has declined. Loss of *habitat* is a growing problem on Guam. Habitat is used to describe the home for a *species*. It is an area that supplies everything an animal needs to survive. The following are components of habitat:

1. Food is necessary for any form of life. The greater its supply the more kinds of wild animals can live.

2. Water is essential too. Water supports the vegetation needed for food and cover. It's absolutely necessary for fish and other aquatic species.



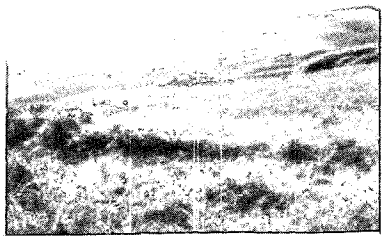
3. Cover can be any material that gives wildlife a place to hide from enemies or a place that offers shelter from the weather. It might be a patch for shelter, mass of aquatic plants or coral for a fish, a brushpile or thicket for a rabbit, or a forest for a herd of deer. The same vegetation often serves as both food and cover for wildlife.

Location of the three (3) elements is very important. They must be properly located for each kind of species. What might be too far for a gecko might not be too far for a deer.

Guam is a small island so you wouldn't expect many different kinds of habitat. There are four primary habitat types on Guam:

1. the limestone forest
2. savannah
3. strand
4. reef

The pictures below show the four primary habitat types on Guam:



Teaching Strategies:

1. Discuss vocabulary words. Use glossary. Use each word in a sentence.

2. Brainstorm why wildlife on Guam has declined.

3. Discuss 3 components of habitat. Review or name animals found in our habitat.

4. Discuss each of the 4 habitats shown.

5. Discuss how each of the habitat changed through the years.

6. Draw some limestone forest turned into housing areas. Discuss the effect on wildland plants and animals.

7. Make a poster on how to conserve our wildland. Display posters at school, commerical areas like Agana Shopping Center and Gibson's.

8. Discuss how students can help conserve the habitat left for wildlife.

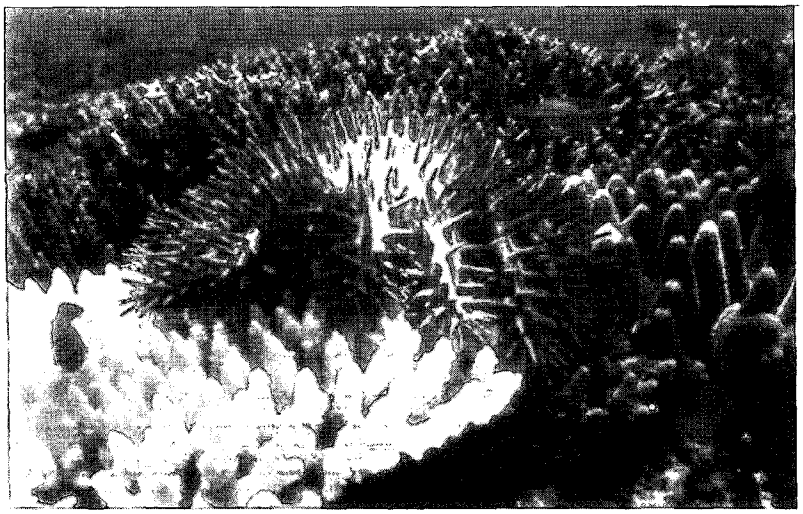
Types of Habitat:

The *limestone forest* used to be the predominant habitat type on the island but now there are only small patches of forests left, mostly on military reservations like the Northwest Field at the Naval Communications Center (NCS) and the forests at Andersen Air Force Base (AAFB). Common plants in the forest include breadfruit, banyan chopak, pandanus and hibiscus. Because there is a wide variety of food plants and cover, most of our native wildlife prefers to live in limestone forests.

Grassland or *savannah* cover most of the southern hills. Most of the vegetation is the razor-edged swordgrass. The savannah grows each year as fires race across the dry grass killing trees on the border. Introduced species such as quail and deer can utilize the grasslands but the savannah is not very suitable to our wildlife.

The land bordering the beach is called a *strand*. The strand on Guam supports a variety of plant life including coconut palm, puting, nonnak, beach morning glory, ironwood and sea beans. There are also different kinds of algae growing in the shallow waters next to the shore. Some common beach animals are hermit crabs, starfish, clams, worms, and birds.

Guam's richest habitat is the *coral reef*. Over 600 different species of fish are found near our reef plus thousand of mollusks (shells), echinoderms (urchins and starfish), sponges, crustaceans (crabs and shrimp), and many other animals.



There are over 350 species of coral forming the base of our reef. Their growth provides food and homes for many of the other reef creatures.

Some other less common types of habitat include the ravine forest, wetlands, agricultural lands, and some mangrove flats or swamps. Another type overrunning the others is human habitat. Villages, housing tracts, highways, shopping and commercial areas compose this habitat. Some animals like the gecko, rat, sparrow, and pigeon find human habitat suitable to their needs, but most wildlife cannot survive in human habitats.

Wildlife problems on the island are due to increased human population demanding more commercialization and over-development. *Predators* like snakes, rats, cats, dogs, pigs, and disease, habitat destruction through fire, littering illegal dumping, erosion, improper farming and construction methods, overhunting and poaching, have rapidly destroyed needed habitats.

Teaching Strategies:

1. Discuss meanings of vocabulary words. Check the glossary. Use them in sentences.

2. Discuss the types of habitat found on Guam.

3. Name other types of habitat not mentioned in student book. (ocean, farmland)

4. Discuss the list of endangered and threatened species on Guam.

5. Try to remember the Chamorro common and scientific names of 5 species and have a contest by groups.

6. Discuss the plight of the endangered species.

7. Name what people can do to protect these species. (educate the public, enforce laws)

8. Have a field trip in one or two of the types of habitat and list all plants and animals one can find.

9. Discuss the causes of loss of habitat.

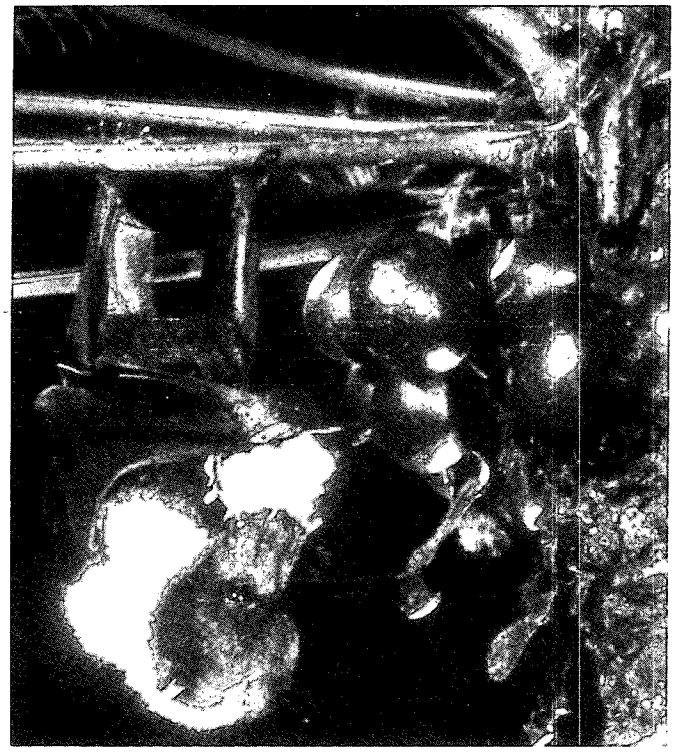
Guam's Endangered Species:

Many of Guam's plants and animals are *endangered* species. The only native Guam mammal, the fruit bat, is but one of the endangered. Endangered means that the population is threatened with *extinction* and may not survive without help. Extinction is a sad situation. It means all of the population is dead and will be gone forever. A great majority of species that have become extinct are known to have disappeared because of man's ignorance or thoughtlessness. We are responsible for the welfare of plants and animals to make the world a brighter and better place to live. We all depend on the stability of the *environment* so we must take care of it.

Mammals:

Guam's Fanihi or fruit-eating bats are becoming rare. There were three different species of these bats but two of these may be extinct as the chart shows. All the species are on the U. S. Endangered Species List. The Mariana fruit bat is estimated of about 50 in 1978. Currently the species is estimated at about 800. The increase due to bats immigrating from Rota, an island north of Guam.

Overhunting and loss of habitat appear to be responsible for the decline. Fruit bats are known to a popular item on Guam.



Teaching Strategies:

1. Discuss vocabulary words. Check in the glossary. Use the sentences.

2. Discuss endangered and extinction in length.

3. Name some species threatened, endangered or maybe extinct on Guam.

4. Compare Guam's list with the U. S. list and make a class chart.

5. Discuss about the Fanihi. Show a picture of the fruit eating bat.

6. Discuss how the fruit bat became extinct.

7. Draw the fruit bat and display poster urging the public to protect the only native mammal on Guam.

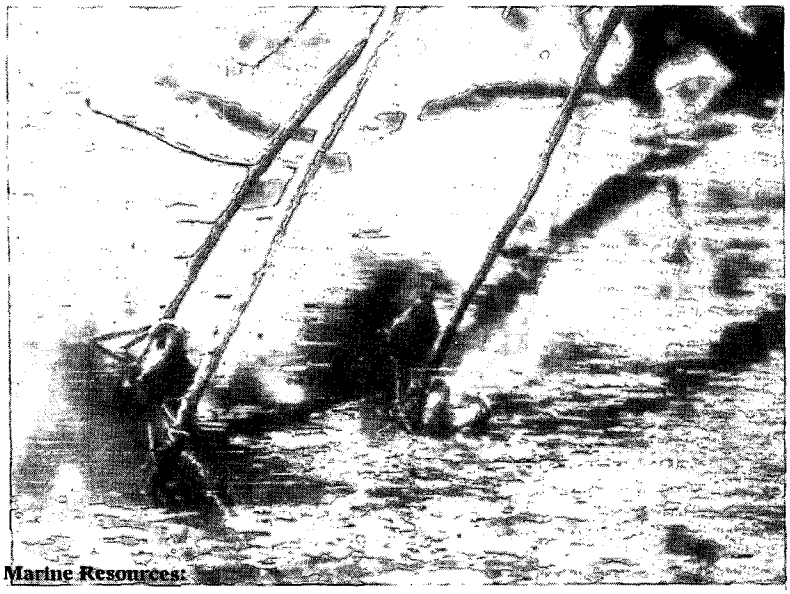
8. Discuss how people try to get fruit bats even if there are laws prohibiting hunting.

9. Name ways how to protect the Fanihi.

The fruit bat is a traditional entree at fiestas——the entire bat cooked in coconut milk. The bats are protected by law since 1973 but illegal hunting still continues. *Importation* of bats became a practice, but in 1981, importing from any island was prohibited. Populations of fruit bats must be closely monitored on other islands to prevent over *exploitation.*

Birds:

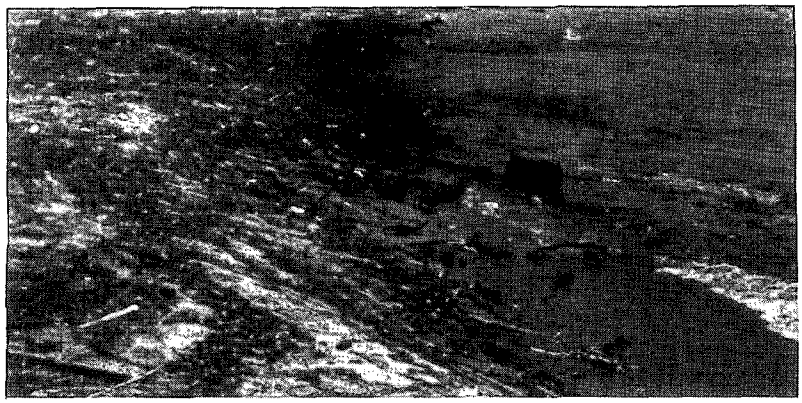
Guam's birds have declined sharply in recent decades. Four species have become extinct and all ten species are endangered. The wetland drainage and clearing, overhunting disease and predators like the brown free snake adversely affected the species. The Guam rail is vanishing. It needs alot of help to protect its population. Forest birds are now largely restricted to the limestone forest in the far north and some species occupy the northern plateau. Once some native land birds occupied the south but at present none of them can be seen in the southern part of Guam.



Marine Resources:

Sea food has always been an important source of protein for the people of Guam. Many of Guam's reef flats are currently being overfished, resulting in a decline in reef flat fish. Some people are using poisons and explosives to kill fish. Chlorine, the most common poison used, not only kills fish but also all other life in the area including *invertebrates*, coral and *algae*. It is also used in streams and rivers thus killing freshwater fish and shrimp. Dynamiting is another non-selective and wasteful practice. Many fish may not be recovered due to ruptures and subsequent sinking. Dynamite is used near the reefs, thus habitat essential for reef productivity is destroyed.

Because islands develop in isolation, their flora and fauna are usually limited, and their ecosystems are simplier. This makes them more vulnerable to disruption by man. Island species are confined and cannot seek new habitat. Continental animals usually have broad selections of food and cover resources. For these reasons and others already mentioned, islands have many endangered species. Changes wrought by people like overhunting, illegal setting of wildland fires, illegal dumping of trash, over-development, illegal fishing, and other careless environmental change will result in loss of habitat and eventual extinction of wildlife.



Teaching Strategies:

1. Discuss vocabulary words. Check meanings in the glossary. Use them in sentences.

2. Discuss about Guam's endangered bird species. Check the chart for the names.

3. Compare Guam & U.S. list and discuss how each became endangered.

4. Discuss the habitat of the birds. Discuss where these birds can be found based on the maps.

5. Draw some posters of the birds to be displayed urging the public to protect the species.

6. Look at the photographs and discuss how each can be protected.

Habitat alteration by people is a primary reason why our wildland animals and plants are endangered. Many of our wildlife losses can by prevented without disrupting our economic growth. It's simply a matter of planning and foresight. We should take into consideration the plight of our endangered species when we build projects such as housing developments and dams. Law should be passed and put into effect. All people who don't abide by the law should by properly punished. The public must be involved and out laws must be enforced.

Teaching Strategies: (Page 8)

1. Discuss vocabulary words. Check in the glossary.

2. Name some animals threatened because of the destruction of our reefs.

3. Discuss how people destroy our coral reefs.

4. Discuss why flora and fauna of islands can easily be endangered.

5. Compare how species on islands and continental land survive.

6. Discuss how man's role in changing the environment play a vital role in the decline of wildlife.

7. Draw all the causes of wildlife decline. Display all posters for public awareness.

Guam's Landforms
Vocabulary Words

1. Landform - a natural feature of the earth's surface.
2. Limestone - a rock formed by accumulation of organic remains like shells.
3. Plateau - a large level area raised above next to another land.
4. Mountain - high land pushed up by pressure or volcanic activity.
5. Hill - high land smaller than mountain.
6. Eruption - to force out suddenly and violently something as lava and steam.
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32. Brook - a small stream, a small flowing body of water.
33. Stream - a small flowing body of water.
34. Elevate - to raise up.

GUAM'S LANDFORMS

1. The Different Landforms

Look at the map of Guam. Guam is an island having different *landforms*. The northern part of the island is a vast *limestone plateau* with thick limestone forests. Mt. Sta. Rosa is located in the north - the only mountain found in the north. We find the numerous *hills* and *mountains*, *river valleys* with massed vegetation, savannahs, *mangrove flats* or *saltmarsh*, and *freshwater wetlands* in the south. Cliffs, *fringing reefs* and *beaches* surround the island. The map shows where to find the landforms.

Key:

1. _____limestone forest
2. _____river valley
3. _____mountain & hill
4. _____savannah
5. _____mangrove flat
6. _____freshwater wetland
7. _____cliff
8. _____beach
9. _____reef

Teaching Strategies:

1. Discuss the underlined vocabulary words. Check in the glossary.

2. Ask what children see in the picture.

3. Show map of Guam and ask students to show the different landforms found on Guam.

4. Brainstorm how the north became a limestone plateau.

5. Brainstorm how the south became fertile valleys between hills and mountains.

6. Discuss the location of Guam in the Pacific and illicit the idea that neighboring islands have the same landforms, plants and animals as Guam.

7. Do the writing activity-match the numbers to the landforms found on Guam.

2. Limestone Plateau

The northern part of Guam is an *elevated* large flat land called a *limestone plateau*. The plateau emerged as a result of a long process of the change the island had from the volcanic *eruptions* under the sea to the present landform. Limestone forests can be found in Dededo, Yigo and the military bases in the north. *Poachers* still roam the forests to hunt wild deer and wild pigs. Most of the flat lands in Tamuning, Dededo and Yigo are coverted to commercial and residential areas. Mt. Santa Rosa is the only mountain located in the north. Rain water easily soaks into limestone that's why there are no major streams in the north.

Teaching Strategies:

1. Brainstorm the meaning of the underlined vocabulary words and check in the glossary.

2. Discuss what the picture shows.

3. Discuss how the northern part of Guam is mostly a large limestone plateau.

4. Brainstorm ideas why Mt. Sta. Rosa is the only high land in the north. (It's a block between two rock formation and is thrown up. Limestone has been deposited around the "horst" - Mt. Sta. Rosa since its upheaval).

5. Brainstorm what poachers hunt besides pigs and deers.
6. Discuss the legal ways of hunting.
7. Draw some limestone forests and the animals found in them.
8. Draw other things found in the north.

3. Hills and Mountains

Mountains are elevated lands pushed up under pressure or formed by volcanic activity. Mountains are the highest lands on earth. *Hills* are high lands too. They dwindle by *erosion*. We find mountains and hills in the south. Mt. Lamlam is the highest mountain on the island. Some of our mountains are sites for hunting. Most of them are good for boonie stomping. Mountains in the south are habitats of plants and animals. We can see deep *ravines* and steep *slopes* in the south. We find rivers, brooks, swamps, lakes and waterfalls in the south too.

Teaching Strategies:

1. Discuss the vocabulary words. Check in the glossary.

2. Ask students what they see in the picture.

3. Brainstorm the different mountains and hills found in the south. (Mt. Lamlam, Mt. Jumulong, Nimitz Hill). Name the only one mountain found in the north. (Mt. Sta. Rosa)

4. Discuss some animals found in southern forests.

5. Name some crops found in the south.

6. Ask the places where freshwater can be found.
7. Draw a tourist spot found in the south.
8. Draw some mountains and hills.
9. Ask what other interesting things or places can be found in the south.

4. Savannahs

A *savannah* is a vast land covered by unique plants adapted to Guam's volcanic soil. Tall grasses or sword-grasses, soft low grasses, dense tall reeds and a mixed shrub community are the most common vegetation on Guam's savannahs. Generally, the term savannah is used for flat plains with scattered trees, but on Guam, the savannahs are the bare country-side or hillsides covered with *vegetation*. We find savannahs in the south. Burning happens on the savannah. Fire doesn't harm the swordgrass. It sprouts again, but fire harms other trees and plants that cannot grow again after an area is burnt. Growth of trees should be encouraged in the savannahs to protect our land and animals. The koko bird lives by the savannahs and roadsides. It is an *endangered* animal. Some animals living on savannahs are rodents.

Teaching Strategies:

1. Discuss meanings of vocabulary words. Check in the glossary.

2. Discuss the picture.

3. Ask students whether they've played in a savannah.

4. Illicit ideas why savannahs easily get burned.

5. Ask for solutions on how to prevent savannah fires.

6. Ask what other animals can be found in a savannah. (toads, snails, lizards, snakes, rodents and the koko birds)

7. Discuss endangered animals like koko and fruit bats. Ask for some ways on how to protect Guam's endangered animals.
8. Make a poster of endangered animals and write the title: "Help Protect Our Endangered Animals".
9. Draw a savannah with plants and animals.

5. **Beaches**

Beaches are an accumulation of *sand* and *rock fragments* affected by ordinary wave action. They come in many sizes and shapes, from little pockets of sand fathered between cliffs and water's edge, to wide expanses of sand like Tumon and Tarague. Cocos Island has beaches too. Beaches are always in motion. Large stable beaches have an inland *reservoir* of sand. Sand consists of loose particles of hard broken rock or of broken shells and skeletons of plants and animals.

Teaching Strategies:

1. Discuss the meanings of vocabulary words.

2. Ask what students see in the picture.

3. Ask students their experiences in the beach.

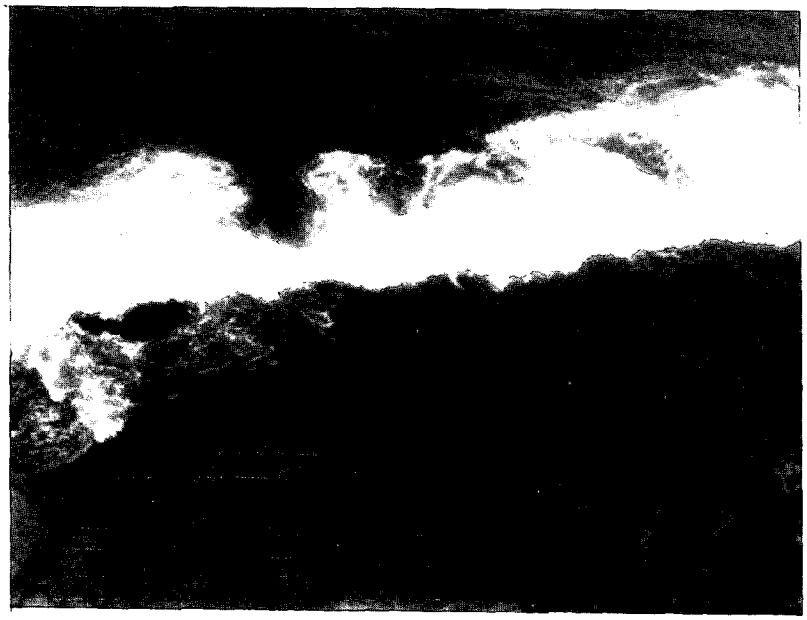
4. Ask what they find in the beach. (plants and animals) plants: beach morning glory, sea beans, puting, hunek, nigas, coconut tree) animals: fish, mollusks, crabs, birds, turtles, geckos, etc.)

5. Discuss in what areas on Guam one can find beaches.

6. Discuss the development going on in some areas for tourism.
7. Ask how beaches can be kept clean.
8. Draw a beach on a poster board.
9. Draw some activities done in beaches.

6. Fringing Reefs

The *shore* around Guam is half *fringing reefs*. Reefs are ridges of rocks near the sea. The island is surrounded by the sea so we find shallow reefs in the northern, central and southern parts of the island. Some reefs are narrow and some are wide. Guam's first coral reefs grew around in the volcanic central part of the island. Reefs are built 2 kinds of organisms: *corals*, which are animals, and *calcareous algae*, calcium containing plants. There are many little plants and animals that live in reefs. Some animals are coral fireworms, coneshells, starfish, eels, crabs, shrimps, lobsters and many others. Some plants found in reefs are algae, seaweeds and others.



6. Draw some fringing reefs.
7. Draw a poster on how to enjoy a day by the reefs.
8. Draw some plants and animals found in the reefs.

Teaching Strategies:

1. Discuss meanings of underlined vocabulary words. Check in the glossary.

2. Discuss what students see in the picture.

3. Ask students what they do at the reefs when they go to the beach. What do they see?

4. Ask students where on Guam they can find reefs.

5. Ask students some animals and plants they can find in reefs.

7. **Cliffs**

Cliffs are high rocks on the sides of mountains. The cliffs of Mt. Lamlam in the south and at Two Lovers Point in Harmon add to the awesome beauty of the mountains. There are cliffs along Marine Drive in East Agana and Tamuning, too. These rocky sides are dangerous to climb. Waves wear away the rock where water meets a cliff. If we look up the face of some cliffs, we can see several "*nips*" where the rock has been worn away. These nips indicate former higher *sea levels*. At some places more prominent features such as sea level benches and terraces are cut into rocky shorelines.

Teaching Strategies:

1. Discuss meaning of underlined words. Check in the glossary.

2. Ask students what other mountains they can name.

3. Illicit ideas what people do in mountains.

4. Discuss how people can protect mountains.

5. Name some ways mountains can be useful.

6. Explain how mountains can have nips.

7. Draw a poster of a mountain showing a cliff.

8. Draw some animals and plants found in mountains.

8. River Valleys

Some people live in river valleys. *Valleys* are low lands between hills. We find river valleys in Agat and Umatac in the South. A river flows from the hills or mountains through the valley.

A valley is a very *fertile* land so we find massed vegetation in the south. People grow different crops like watermelon, bananas, vegetables and fruit trees. Animals like pigs and chicken are raised there too. The south is an interesting place to live and visit. There are plenty of tourist spots to visit like the Inarajan pool, the Talofofo Falls, Namo Falls, Cocos Island, Umatac Village, Golf Courses and others.

6. Draw any tourist spot found in the south.
7. Draw any valley with the plants and animals.

Teaching Strategies:

1. Discuss the meaning of the vocabulary words. Check in the glossary.

2. Discuss how valleys become very fertile and a good place to raise animals and plants.

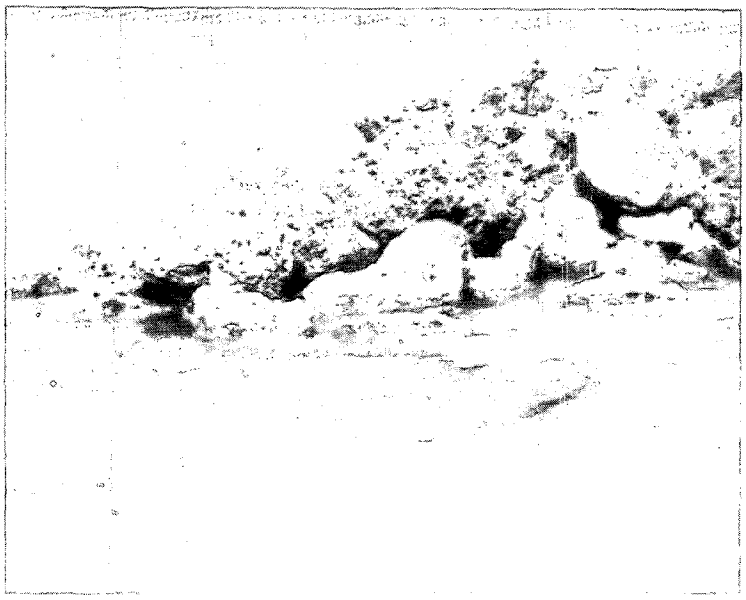
3. Ask students where they can find valleys on Guam.

4. Discuss the life in the valley-name some plants and animals found in the valley.

5. Discuss the places often visited in the south, how they help tourism.

9. **Freshwater Wetlands**

Freshwater wetlands can be found from the north to the south of Guam. These abound in the south. The north being mostly limestone doesn't have plenty of wetlands because limestone absorbs water easily. The south has *igneous* rocks that don't absorb water fast so some freshwater collect in pools or run downhill. In the north, we can find some freshwater in the Ritidian *Cave*, a small spring near Yigo called the Japanese War Memorial *Spring*. Agana Springs can be found in Sinajana hill and Agana swamp is near NAS Barrigada. There are plenty freshwater wetlands in the south. Some of them are the Pago River, Talofofo River, Talofofo Falls, Malojloj stream, Inarajan River, Padre pools in Merizo, Umatac River, Namo River, Rizal Beach, *swamp* and *marsh* in Naval Station, Atantano *River* in Apra Harbor, Laguas River in Piti, and Fena *Lake* at Naval Magazine.



Teaching Strategies:

1. Discuss meanings of underlined words. Check in the glossary.

2. Ask students what they see in the picture.

3. Discuss how small pools of water collect on the ground to form springs, brooks, swamps or rivers.

4. Discuss the difference of limestone and igneous rocks.

5. Show map of Guam and ask students names of villages where they can find limestone rocks. (All northern villages)

6. Ask students names of villages where they can find igneous rocks. (All southern villages).
7. Draw some fresh water wetlands found on Guam by groups. Each group can be assigned one or two to draw.
8. Name some fresh water wetlands that become tourists attractions.

10. Mangrove Flats

Land and sea meet at three different shores: muddy, sandy and rocky. Muddy shores develop where water is calm and currents are slow, behind some rocks or little islands. Small rivers bring some water and *silt* to this meeting place. Silt is a combinations of soil, mud and other particles. We find plants and animals in mangrove flat. A *mangrove flat* is the meeting places of fresh and salt water where plants and animals live. Some animals found in mangrove flats are crabs, mudskipper fish, lizards and others. Some plants found are tall grasses, beach morning glory, shrubs, ferns and some trees.

7. Draw a mangrove flat with plants and animals.
8. Make a short test on the chapter.

Teaching Strategies:

1. Discuss meanings of vocabulary words. Check in the glossary.

2. Ask students what they see in the picture.

3. Discuss the difference of mangrove flat and freshwater wetland.

4. Ask the different plants found in a mangrove flat.

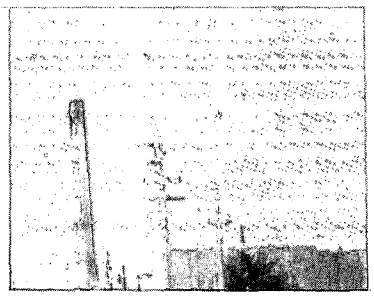
5. Ask the different animals found in mangrove flats.

6. Make a list of the same plants or animals found in both freshwater wetland and mangrove flat.

Glossary

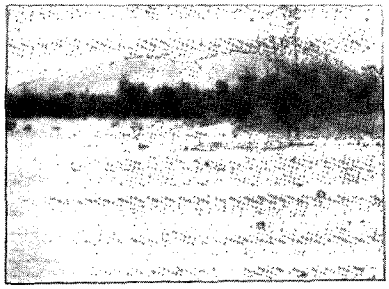
1. nitrogen	-	a nonmetallic colorless, odorless gas (78% of air).
2. oxygen	-	a colorless, odorless, tasteless gas (21% of air).
3. exhaust	-	gaseous fumes from a car or bus.
4. noxious	-	harmful
5. open burning	-	burning outside so smoke goes into the open air. The burning does not take place inside a closed container.
6. noise pollution	-	excess noise or very loud noise that is unpleasant to the ear.

Air Pollution



We cannot waste air, but we can pollute it.

What do jets flying low overhead, radios blasting, fires burning and cars and buses with excess exhaust all have in common? They are all contributing to the pollution of our air. Air carries things such as noise, smoke and small solid particles.



The dictionary defines air as an odorless, colorless, tasteless gaseous mixture of nitrogen (78%) and oxygen (21%) plus varying amounts of moisture, low altitude pollutants and particles of matter. Sky and atmosphere are other names for air.

If we can smell air, see black smoke or exhaust in the air, or if it tastes smoky or scratches our throat when we breath it, or it hurts our eyes, then we know our air is not pure but polluted. People in Tokyo, Japan wear masks over their nose and mouth to filter the air so it does not hurt them to breath. People, plants and animals cannot live without clean air.

Teaching Strategies:

1. Discuss the dictionaries definition of air. Explain what nitrogen and oxygen are.

nitrogen - a non-metallic colorless, odorless gas making up 4/5 of our air.

oxygen - a colorless, odorless, tasteless gas making up 21% of our air.

Stress the other synonyms for air - sky and atmosphere.

2. Stress that all plants, animals and people need air for breathing. If the air is dirty, it can cause breathing problems and such illnesses as asthma and emphysema

3. If you can find a picture of someone in Tokyo wearing a breathing mask, show it to the class and discuss the situations that would cause someone to wear such a mask. Where does this pollution come from? (mostly vehicle exhaust) Would we need to wear such a mask on Guam? This could be a lead into the rest of the air pollution discussion for Guam.

Guam's location as an island in the Pacific helps it to be almost free from air pollution as the trade winds blow across the island carrying any polluted air with it. Therefore; we experience clear, blue skies almost every day.

Guam does experience some problems with air pollution however. One of these problems is motor vehicle *exhaust* which occurs most often during rush hour traffic. Even though cars that are *imported* to Guam must be equipped with pollution controls, some exhaust still escapes. As of January 1, 1988, cars will be inspected for exhaust safety as well as a regular safety inspection.

If a car or bus is seen to have excess exhaust fumes, the person who notices it can report there findings to the Environmental Protection Agency (EPA), and they will call the owner in and require him to have the vehicle repaired and inspected. This is one way of solving the air pollution problem.

Teaching Strategies:

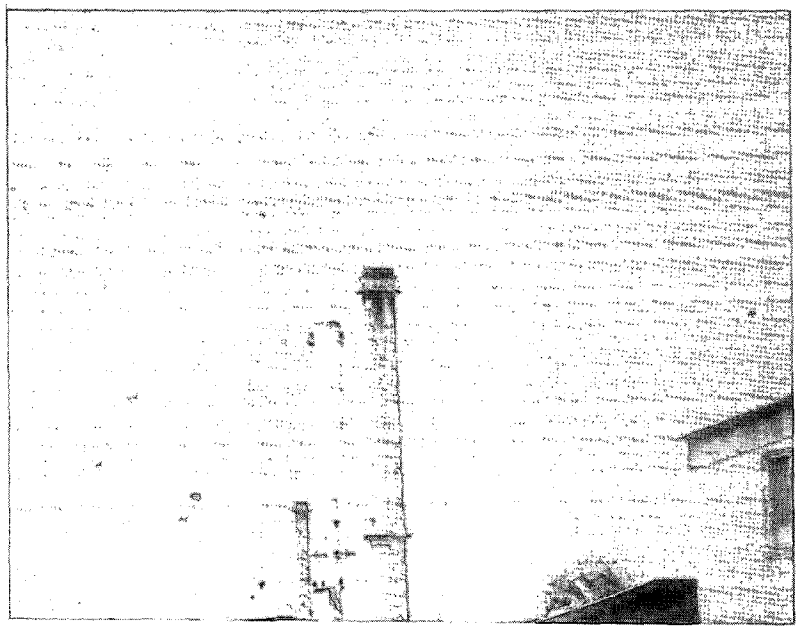
1. Discuss with your students the harmful effects of exhaust fumes. (difficulty with breathing, eyes hurt and become red, throat feels scratchy) Many suicides have taken place by breathing exhaust fumes, so they can be deadly.

2. Let the students discuss a time when they were behind a bus or car with excess exhaust fumes. How did they feel? Did they want to tell the driver to get the automobile fixed?

3. Discuss reasons why the exhaust fumes do not create a pollution problem the magnitude of Tokyo or Los Angeles. We have the trade winds, and also we don't have as many cars. Impress on them that it is still a problem to be reckoned with as our population grows and the number of cars on Guam increase.

Because Guam is an isolated island, we have no fuel source for our power so we must import oil. This oil is burned in the power plants at Piti and Tanguissen. Any unburned oil escapes as smoke and *noxious* fumes. Usually, the winds carry the smoke out to sea and our air remains clean. The Environmental Protection Agency (EPA) monitors the level of air pollution from these power plants and requires a low sulfur fuel to be burned during the rainy season when the trade winds cease. Because of this, we experience clean air most of the time.

We cannot take that clean air for granted and the government and EPA must continually research and implement methods of pollution control as our island continues to progress and to demand more power. Maybe new sources of power will have to be tried which will not pollute the air at all.



Teaching Strategies:

1. Discuss and make a list of all the ways your students use electricity in their homes and in school. Discuss where this power comes from, and how it gets to their homes. How do you feel when there is a power outage? (can't watch TV, play the stereo, no lights, can't cook etc.) Electricity has become a very important part of our lives. Therefore, we need the power plants, but we also need our clean air.

2. Discuss alternate sources of power such as windmills. Would windmills pollute the air? Would they be efficient in supplying enough power? What about solar power? Who has solar hot water heaters? Do they work? Is it hot all the time? Do we have enough sunshine to keep the heater working?

The biggest contributor to air pollution is *open burning*. There are still many people on Guam who burn there trash and garbage and clear land by burning even though it is against the law. If a farmer wants to clean his land for planting, he can get a burning permit from EPA. This fire will then be watched to keep it under control.

However; many people do not obey these laws because they have always burned their trash and land and can see no reason to stop now. Therefore; much of our land is lost to fires which also creates much pollution (smoke and particles of matter) into the air. This makes it difficult to breath, our eyes water and our throats feel scratchy as we breath this polluted air. These fires, big or small, are a major contributor to air pollution.

We can best find a solution to this problem in changing attitudes toward burning, and to get in the habit of taking trash to the dump or let the garbage trucks pick it up. We do not live in isolation, but everything we do, like open burning, affects others. It destroys land and pollutes the air.

Teaching Strategies:

1. Ask the students if they burn their trash at home. Discuss how bad it smells if their neighbors burn their trash and it blows over into your yard and through the windows of you house. Does this make them want to go over and ask the neighbor to please stop? It should and the neighbor should do so.

2. Discuss the alternatives to burning the trash. (take it to the dump or have the garbage truck pick it up)

3. Invite a person from the Environmental Protection Agency or the Department of Foresty to speak to your students on the loss of land and thus habitats for plants and animals due to uncontrolled fires which often begin with open burning.

Planes cannot fly in or out of the Narita airport in Tokyo, Japan or the National airport in Washington, DC after 10:00 p.m. Why should such a restriction be placed on these airports? The reason is noise pollution because airplanes do make a lot of noise.

Guam has no noise pollution laws, but we are concerned with the loud noises that the air carries. Every now and then the Navy carries on "tough and go" operations in which the planes fly from the aircraft carriers out in the ocean to the airport and back causing very loud noises as these planes fly low.

If this were a daily activity we would be concerned and consider limiting this activity in some way. Noise bothers us and interrupts our regular activities such as sleeping and talking.

If you play your radio or stereo at the highest volume, or if a band plays so loud you can't talk to the person next to you, that is a form of air pollution. You must be considerate of your neighbor when you play your music because not everyone likes the same music and volume level that you do. Be considerate and we will never need laws to control noise pollution.

With Guam's population increasing and houses being built closer together and more apartment living taking place, it becomes very important for us to be considerate of those living close to us. We can't be as loud as we once were when we were the only ones living on the street.

Teaching Strategies:

1. Discuss what noises the students consider too loud or too excessive in their home or around their neighborhood. What could be done to lessen these noises? Can you make a dog bark softer or a rooster crow softer? Are these air pollution noises? Is it being considerate of your neighbor if you have many dogs that bark or roosters that crow? Would it be better to move these animals out to a ranch somewhere?

2. Experiment with noise levels in your classroom. Use the stero, talking, shouting, closing of the door etc. at different volumes. Check with the class next door if they were disturbed. Ask each student at what point these sounds became noisy and thus offensive to them. Use this to impress upon your students the importance of noise control for living a comfortable life, and for making the work place a more pleasant place to be.

T.E. (Review Questions)

Comprehension:

1. Name 3 forms of air pollution.

   a. open burning
   b. motor vehicle exhaust
   c. power plant fumes
   d. noise pollution

2. Does Guam have any laws regarding air pollution?

   It is illegal to burn trash openly.

3. Why does Guam experience little air pollution?

   The trade winds below across the island and carry most polluted air out to sea.

4. Is there such a thing as noise pollution? Yes-Any reasonable answer.

5. What is the most serious air pollution on Guam? Open burning

   Don't burn trash at all. Any reasonable solution.

Thought Question:

Hawaii has a law somewhat like this. Let the students discuss their answers together.

They should conclude that is would be a difficult law to enforce, but should also realize that all these activities to bother some people, and we must be considerate of those around us.

T.E.

A. Definitions:

After your students have written their definitions, compare them to the definitions in the glossary. Discuss each definition and how it relates to land pollution.

B. Critical Thinking:

These statements can be answered orally or written. After the students have answered the questions, try changing each statement or situation into a positive statement as a solution to land pollution.

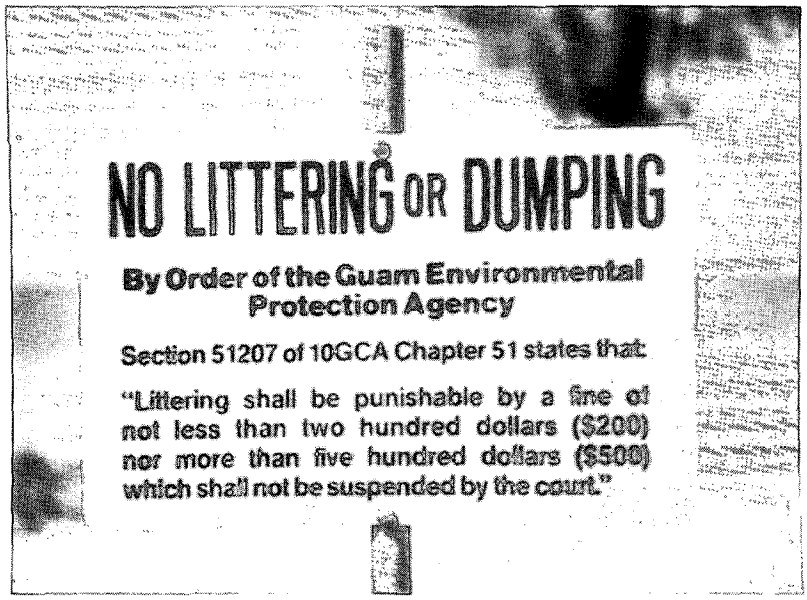
Example:

Johnny, take this pamper and throw it in the trash can over there.

Glossary

1. scenery - that which our eyes see surrounding us.
2. natural resources - air, land, water (those resources not created by man).
3. wants - anything our heart desires.
4. needs - things we need to stay alive.
5. consumer porducts - anything we can buy in the stores.
6. importation - the means of bringing goods into Guam.
7. solid waste - trash, garbage, rubbish which is thrown away.
8. toxic waste - harmful poisonous substance created by the solid waste at the landfill.
9. recycling - to use again.
10. transfer stations - places where trash can be brought and from there it will be brought to the landfill.
11. illegal dumping - dumping trash anywhere but at the Landfill or legal dumps.
12. incinerator - a machine to burn trash.
13. leaching - to dissolve and wash out or remove by means of draining through the soil or rocks.
14. attitudes - a feeling toward something.
15. GEPA - Guam Environmental Protection Agency.
16. public - all people living on Guam.
17. capacity - how much something can hold.
18. legal dumping - dumping trash in approved places.
19. littering - throwing things outside of trash containers.

Legal and Illegal Dumping



Guam as a beautiful island on which to live. It has some of the most beautiful *scenery* in the world from the southern mountains to the limestone flats and breathtaking cliffs in the north. The ocean sparkles, the air is clean, and the beauty and fragrance of flowers can be experienced all over the island.

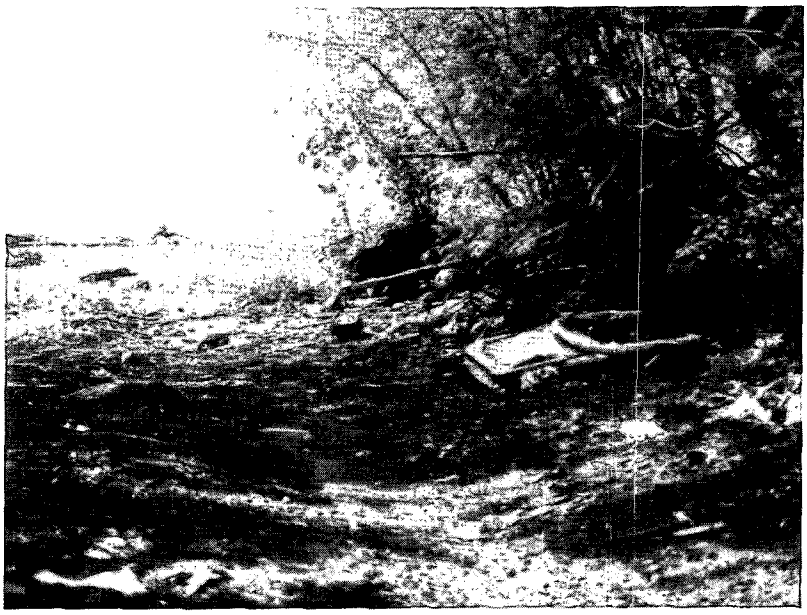
Living on an island should make us very aware of how precious our limited *natural resources* are. Salt water surrounds us, both the land stops at the waters edge. Each square inch of our 38 mile long island, whether it be hills, valleys, mountains, flatlands, beaches, farms or parks, is important for food, housings, recreation, business, tourism and is a habitat for numerous plant animals and birds.

Teaching Strategies:

1. Discuss uses of Guam's land. Write these uses on the board. What is most of the land used for? (housing and business) How do 4th graders use the land?

2. Discuss what our natural resources are. (air, land, water, resources that are not created by man) List the natural resources on Guam. Discuss what limited resources mean (can use them up and then there will be no more) What resources could we use up? (land, water)

3. Discuss what reasons a tourist might have for coming to Guam? (tropical island, warm, beautiful beaches, friendly people, beautiful scenery etc.) Does he find these things when he gets here? Why or why not?



The Guam Environmental Protection Agency has estimated that each person on Guam produces approximately 2.5 pounds of *solid waste*, such as trash, garbage and rubbish every day. This means that YOU could be responsible for producing 895 pounds of waste products each year. Given the population of 1986, approximately 100 million pounds of solid waste are produced each year.

As in may states in the United States *recycling* is one answer to disposing of solid waste, but on Guam it is not the answer because we are so far from recycling centers and it would cost too much to ship it off island. Therefore, most solid waste must be disposed of on island. There are places to recycle aluminum cans, but that's only a small part of the total solid waste problem.

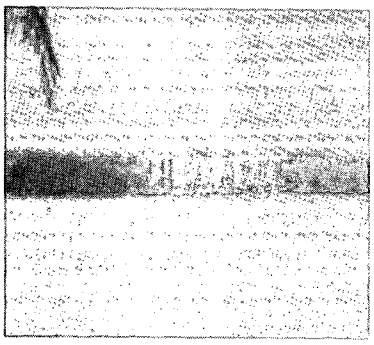
Teaching Strategies:

1. Discuss the difference between *wants* and *needs*.

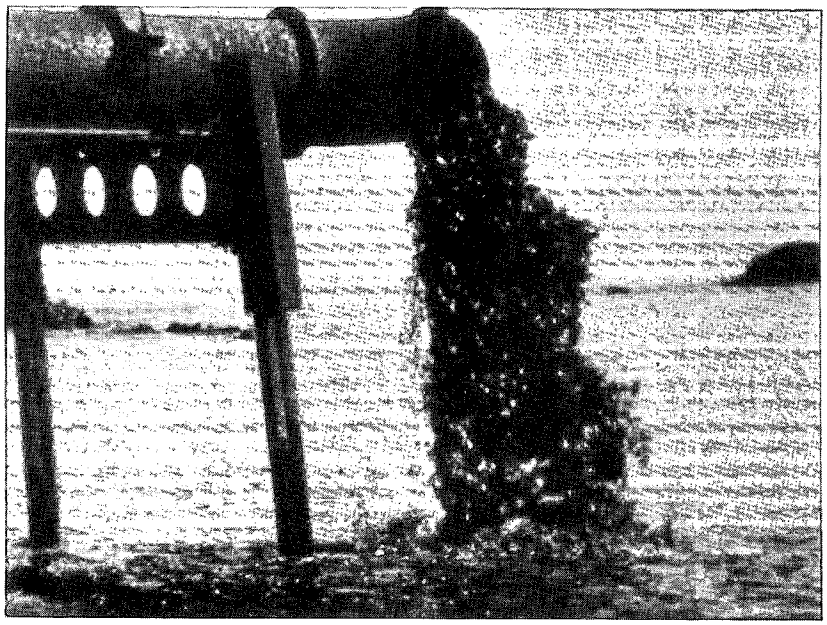
2. How do our wants create throw away products and disposal problems? (eventually, everything is thrown away)

3. Make two lists. One for wants and the other for needs. Have the children think about what is in their house and place the things under wants or needs. Discuss things we absolutely must have to survive and those we can get along without.

4. Take a field trip to commercial port and see first hand how all our goods are brought to Guam and then to our stores.



Guam has changed rapidly over the last twenty years and will continue to do so. The population has increased and so has tourism thus creating a demand for more housing units and more hotels. Land has been cleared and house and hotels have been built along with roads and recreation areas, thus replacing grass, trees and jungle with cement and buildings. The monitor lizards and kako bird have been replaced by houses, cars and buses.



As our island developed, the *wants* and *needs* of the people increased the demands for better and wider variety of *consumer products*. These needs have been met by the *importation* of thousands of different products from the United States, Australia, Asia and other countries. Nearly all these products eventually become waste of one type or another to be thrown away.

Teaching Strategies:

1. Discuss with your students how they dispose of the trash at their home. Encourage them to be honest. Make a chart listing dump, burn, trash pick-up, leave in yard. Check off the various ways homes represented take care of their trash. Then point out that if this chart were multiplied by how many classes there were in your school, and by how many schools there are on the island, it would show the magnitude of our solid waste disposal problem.

2. Discuss the ever present problem of littering and dumping all over the island. Discuss ways each child could help rid Guam of this problem. List them on the chalkboard, and stress if we each do only one thing on the list it will be a start in solving the problem.

The Ordot Landfill is the only approved solid waste dumping site on Guam. There are also *transfer stations* in Dededo, Malojloj and Agat where people can bring their trash for free. These stations are open six days a week.

Even though these facilities are available, there are still *illegal dumping* problems. Sometimes it seems as if there is more trash and garbage right outside the dump than is brought inside.

To help reduce the illegal dumping of solid waste around the island, the guam Envornmental Protection Agency has strict litter control laws. They have the authority to issue litter tickets or fine and in 1986 they issued 73 tickets. The money collected is used to clean up dump sites and to educate the *public* concerning the problems of solid waste and litter.

"No place to put the garbage" is a problem experienced by almost every state in the United States. 95% of that garbage is buried in landfills, and so is ours on Guam. However, the Ordot Landfill has just reached its *capacity* or will do so soon and attempts are being made to keep it open.

Teaching Strategies:

1. Ask if anyone has ever been to the Ordot Landfill or to one of the transfer stations. Maybe you could take a field trip to one of them.

2. You could bring in someone from EPA to discuss the illegal dumping problem.

3. Discuss the difference between legal and illegal dumping. Go over the legal sites, and then discuss reasons why someone would not use those sites and dump their trash in the boonies or alongside the road.

4. Discuss the Environmental Protection Agency's role in dumping and littering, the governments role (operates the landfill and transfer stations and finances each projects) and the publics role. Write these on the board, and write down each agency's job and then discuss who is doing their job and who is not. (The public is failing as people dump their trash right next to a container or outside the dump) It should be noted that people and their practices are the main problem.

Solutions to this problem must not only meet today's needs, but also those of the future. Proposals have been made to buy more land next to the landfill so it can expand. Another proposal would be to move to a new site in Asan. A third proposal is to build an *incinerator* to burn the excess garbage. Each of these proposals is very costly to the Government of Guam.

Besides being almost full, the Ordot Landfill has another potential problem and that is a possibility of *toxic waste* not being *leached* out as the liquid runoff from the garbage goes down through the soil and into the water lens. If this should prove to be happening, the site would have to be closed and a new site opened.

These are serious *legel* dumping problems, but *illegal dumping* is considered one of the more serious and difficult environmental problems to correct. The real answers will involve changing the *attitudes* and practices of those responsible for illegal dumping.

Teaching Strategies:

1. Discuss what attitudes are. Discuss peoples attitudes toward littering and dumping. Are the attitudes good and healthy? If not, how can we change our attitudes toward littering? (take pride in our island and make a *conscious effort* to not litter and to pick up litter we see)

2. Have your students write anti-littering slogans, and design to be placed around the school, the home and around the island.

3. Have your students develop a "Keep Guam Clean" advertisement for TV or a local magazine or newspaper. They could make a video and share it with the rest of the school.

4. Your students could set up a mock trial for someone accused of littering.

5. Your students could hold a debate on the pros and cons of keeping our island clean for the present and the future.

Yes, changing our *attitudes* toward *littering* and dumping is the only real solution to keeping our island from being known as "trash island." The state of Michigan passed a law giving a ten cent refund for every bottle and can returned. Oregon has forbidden the useof pampers. Both of these have helped to keep the roadside cleaner. What can we do on Guam?

Essentially, litter stays right where people put it until someone picks it up. Our beaches are littered with cans, bottles, and trash. Our roadsides are littered with fast food containers, bottles, cans and sacks of garbage thrown out of cars. Almost every place you look you see garbage and litter.

Teaching Strategies:

1. Discuss the pros and cons of each solution to the dumping problem given in the text:

a) buy more land

b) move to a new site

c) build an incinerator

What might the best solution be?

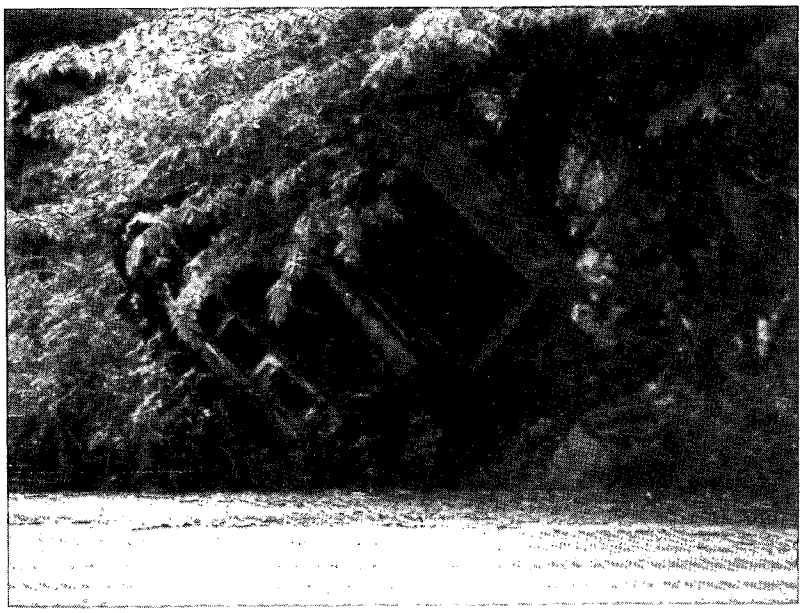
2. Discuss the leaching process by which liquids percolate down through the limestone and coral and in the process impurities and wastes are dissolved or gotten rid of. This keeps our water clean and pure. However; if the toxic wastes from the Ordot Landfill are not leached out, and they end up in the water supply the dump must be closed or the runoff diverted in a new direction and area.

But, trashy problems can be found right in your own back yard. If you keep your own home and yard free from trash, you will want to keep Guam clean too.

More trash cans can be placed around the island, but unless we each take pride in Guam and make sure we don't litter, trash cans won't do any good. People sit trash right next to the cans instead of in them!

Not only does litter and illegal dumping hide Guam's beauty, it is also bad for health reasons. Trash and garbage lying around and open dump site are breeding grounds for flies, mosquitoes and rats, all of which can carry and cause diseases. We must get rid of these health hazards.

What can YOU do to solve this problem? YOU can say "This is my island, my home and I'm proud of it. I will make sure I don't litter, I'll pick up after others, and I'll tell my family and friends that littering is definitely not cool." I want other people to see Guam's real beauty the moment they set foot on Guam and not after they dig through the trash to find it.



Teaching Strategies:

1. Just as there are groups against alcohol (SADD, Just Say No) you could start a group in your school against litter. Give it you own names such as (SALT - Students Against Litter & Trash) and give it the authority to fine those caught littering and the fines could be use to beautify the school.

2. Make a pledge card to fill out as a member that pledges each member to take pride in Guam and to do everything in their power to keep it clean.

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