

Dear Teacher,

Six years ago, I founded Ocean Challenge, Inc. to link classrooms around the world to adventures.

Adventures are potent teaching tools. They are personal in nature, thus promoting a bond between adventurers and classroom students; uncertain in outcome, thus dramatic and engaging; and multi-disciplinary in content, thus meeting curriculum requirements in all subjects. Because adventures are real people doing real things in real time with real consequences, they demonstrate the active application of subjects that are often dry and passive on a textbook page.

Our first project linked thousands of classrooms to the voyage of *Great American II* in her quest to break the sailing record set in 1853 by the clipper *Northern Light* from San Francisco to Boston around treacherous Cape Horn. I was privileged to be the skipper of *GA II* for the record run of 69 days and 20 hours.

It was our hope that the adventure for us would become an adventure for students. And in visiting dozens of classrooms afterward, I was amazed at how they took our voyage to heart and learned from it. The response was beyond our wildest dreams. We resolved to produce further programs focusing on marvelous learning adventures.

Continuing with our mission, over the past three years, we have linked thousands of classrooms to the voyage of a tall ship sailing around the world. The success of this program, called Class Afloat, prompted us to develop the sites *ALIVE!* series.

Recently, we joined forces with The School for Field Studies (SFS), an organization dedicated to offering college-level environmental field courses at research sites around the world. Together with SFS, we developed two new science programs as part of the sites *ALIVE!* series: Oceans Live and Rainforest Live. Through these programs, classroom students are linked to SFS student researchers living, working, and studying on the shores of South Caicos Island and in the rainforest of Queensland, Australia.

We look forward to marveling at their remarkable learning adventure with you and your students this semester.

Sincerely,



Rich Wilson
President
Ocean Challenge, Inc.



Table of Contents

Program Overview	4-7	<i>Newsletter</i>
Why are rainforests important?	4	
Why study rainforests?	4	
How do I use Rainforest Live?	5	
What are the components?	5	
Getting Started	8-9	
<i>Part I</i>		
Plant Life of the Rainforest	10	1
Animals of the Rainforest	12	2
Commercial Uses of the Rainforest	14	3
Case Study: An Ecotour	17	4
<i>Part II</i>		
The Rainforest Community	19	5
Food Webs	22	6
Animal Adaptations	24	7
Case Study: In Your Own Backyard	27	8
<i>Part III</i>		
The Nitrogen Cycle	30	9
Soil, Forest, and Land Exploitation	32	10
Soil, Forest, and Land Conservation	34	11
Case Study: Waste Management	36	12
Careers in Science	39	
Map of Queensland, Australia	40	
Resources	41	
Glossary	43	

Why are rainforests important?

Tropical rainforests are the most complex and biologically diverse natural communities on Earth. Although they cover less than five percent of the planet's land area, tropical forests support at least half, and possibly more than 90 percent, of the earth's species. A single square kilometer of primary, lowland rainforest often contains as many tree species as the entire continental United States.

In the past century, nearly half of the world's stock of these forests has been lost or drastically altered by agriculture, ranching, logging, mining, and hydroelectric schemes. Today, an acre of rainforest is destroyed every second! This equates to a yearly loss of area exceeding the size of Switzerland. As the world's human population swells, the pace of destruction accelerates. Many conservationists fear that little will remain of the rainforests by the year 2025, when the population of the human species reaches a population size of approximately nine billion.

Why is the deforestation cause for alarm? Many scientists think that destroying tropical rainforests could drastically change world weather patterns. The loss of thousands of acres is already causing serious local problems, including increased soil erosion and water pollution. In addition, tropical rainforests supply the world with many foods and products: coffee and chocolate; fruits, such as bananas and avocados; and paints, gums, and glues. Even more important are the medicines derived from tropical plants. Preliminary screenings have found cancer-combating properties in more than 2,000 tropical plants. It is clear that many potentially life-saving drugs are to be found in the tropical forests. Most of the practical uses of tropical plants were first identified by indigenous peoples who have lived in the forests for centuries. As rainforests disappear, so will their knowledge.

Why study rainforests?

The rainforests are a great subject for teaching a wide variety of science topics—everything from chemistry and food chains to animal classification and environmental protection. Rainforests appeal to students because they are exotic, unfamiliar yet fascinating environments. These distant environments can be used to teach scientific methods and principles that are also applicable in our own backyards.

The rainforests are also a timely topic in this era of increased environmental awareness. As we become more aware of the responsibility we have to take care of the earth, we understand that this includes taking care of the world's rainforests. Students are never too young to begin to learn this lesson. The children of today will be the decision makers for tomorrow. Soon the future of this planet will be in their hands.

How do I use Rainforest Live?

Rainforest Live provides a link between your students and college-age student researchers at The School for Field Studies (SFS) Center for Rainforest Studies in Queensland, Australia. Through journals and interactive questions and answers, SFS students share the experience of living, researching, and working in the last remaining rainforest of Australia. While SFS students are conducting their directed research projects, classroom students participate in hands-on activities and team projects that have been specially created to reflect experiences in the field.

By the end of the program, both groups will gain an in-depth understanding of the ecology of the Australian rainforest, a knowledge of the successes, failures, and challenges to their wise use, and insight into the role that indigenous and Euro-Australian cultures have played and can play in rainforest landscapes. They will also be familiar with many new species and environmental systems, and most importantly, they will have first-person familiarity with real and current field research.

What are the components?

Queensland News: Links you and your class to SFS students as they investigate the last remaining rainforest of Australia.

Teacher's Guide: Provides everything you need to integrate Rainforest Live into your science curriculum.

World Wide Web site: Provides a multi-media platform which captures students' interest through photographs of animals and plants that inhabit the Australian rainforest, interactive activities for home and school, and sounds of the rainforest at <http://www.sitesalive.com>

Rainforest Live Video: Introduces your students to the rainforest and its inhabitants.

How do I use the newsletters?

Every week for 12 weeks, you and your class will receive *Queensland News*. Your students will enjoy reading:

Journals: Essays written by SFS students focusing on their experience.

Research Updates: Updates on the latest research at the site, includes research methods used, data collected and solutions found.

Extra!Extra! Highlights of the learning adventure.

Q&As: SFS students' answers to questions asked by your students.

Home-School Connection: Hands-on activities or field trip suggestions for students to do at home with family members.

How do I use the guide?

The guide provides everything you need to use Rainforest Live successfully with your class. You'll find the following information and classroom activities:

Getting Started: Includes information on the Australian rainforest. Also provides an introduction to the SFS research site and students.

Classroom Activities: Provides detailed lesson plans on a wide variety of science topics which relate to the rainforest.

Case Studies: Details hands-on and cooperative learning projects that parallel case studies being done by SFS students at the site. Emphasizes the scientific methods and processes that they utilize.

Careers in Science: Designed to introduce students to exciting careers that relate to the rainforest.

Resources: Lists literature, reference books, videotapes, and web sites that are useful for student research projects.

How do I use the World Wide Web site?

The sites *ALIVE!* web site at <http://www.sitesalive.com> is designed to make your Rainforest Live curriculum “come alive” via regular and timely updates from the field, personalization by Q&A and Journal communication from the field, and interactive learning activities which complement those in this guide. In essence, the site is a “live” documentary.

What is online for students?

- ▶ Photos and bios of the students in the field, and pictures and sounds of the site itself.
- ▶ Extra!Extra!, Research Updates, Journals, Q&A from the students in the field; send a question to the field.
- ▶ Topic-relevant interactive learning activities.

What is online for teachers?

You may explore the site on your own, so that its navigation and content will be familiar. Also, visit the Teacher-to-Teacher area to see how other teachers are using the site and program; and, when you're ready, contribute your own ideas! Here are some further ideas:

- ▶ have the students login individually or in small groups to explore the site.
- ▶ assign small groups of students to check the site on a regular schedule to gain updated information, such as Q&A, Journals, Extra!Extra!, Sites Log, etc. Either print these for posting on your bulletin board, or have that student group report to your class and lead a discussion.
- ▶ assign projects related to the weekly topic which require researching particular information on the site or elsewhere on the web.
- ▶ assign students to do the special interactive learning activities on the site.

How do I log on to the web site?

You have two options:

1. On the site, go to the Rainforest Live title page and click on Teacher Subscription. You will be asked to enter the information that you sent when you ordered the program. When you are “recognized” by the database, you will be asked to select your own Username and Password. When you enter these into the login area, the private section of the site will be available to you.
2. Call Ocean Challenge at 1-800-890-3049 and we will enter your selected Username and Password for you.

Introduction to SFS Research Site and Students

Where is The School for Field Studies (SFS) Center for Rainforest Studies located?

The SFS Center for Rainforest Studies is located in Australia's tropical North Queensland. Here, cradled in a narrow, broken belt along the northeast coast, lies the country's only remaining rainforest. The research site lies at 800 meters elevation in the northern foothills of Atherton Tableland. The 153-acre site—called “Warrawee”—aboriginal for “You are welcome here,” is surrounded by World Heritage forests.

What problems does the rainforest face? What actions has the Australian government taken to preserve this fragile ecosystem?

The Australian rainforest has suffered the same fate as most other rainforests around the world. Agriculture, ranching, mining, and logging have destroyed and disrupted habitat. Unlike most tropical countries, however, Australia moved quickly to confront the threats to its rainforest. In 1988, most were declared protected under World Heritage designation. The decision was very controversial, and is still not accepted by some Queensland residents.

How's the weather in the Australian rainforest?

At 17 degrees south latitude, the area has two seasons: wet and hot, or cool and relatively dry. The Australian summer stretches from November to March, and can produce heavy rains and soggy roads. The dry season arrives in April, along with night temperatures that can sink as low as freezing.

Who are the student researchers? What are they doing while living in the rainforest?

The student researchers are college students selected by SFS who have come to the Australian rainforest to get involved in real research projects. They take courses, write papers and collaborate with scientists to collect data about the rainforest. Working with the people who live there, the students use their research results to develop programs that will help protect the animal and plant life that live in the rainforest.

What types of animals do SFS students see at the research site?

SFS students see a variety of vertebrates at the research site, including marsupials (musky rat kangaroo, Lumholtz's tree kangaroo, red legged pademelons, bandicoots, and several species of possums), reptiles (at least 10 species of snakes, leaf-tailed gecko, and forest dragons), several species of frogs, and many species of birds (brush turkeys, sulfur-crested cockatoos, rainbow lorikeets, and cassowaries).

Where do the SFS students live?

The SFS students live in dormitory rooms in Warrawee which is secluded and relatively remote. The nearest town is Yungaburra (population 500), a twenty minute ride by car.

It is not luxury living. All SFS students are expected to share in cooking, cleaning, and other chores. They eat breakfasts of cereal and fruit; lunches of peanut butter, cheese, and meat sandwiches; and hot suppers of vegetarian and meat dishes.

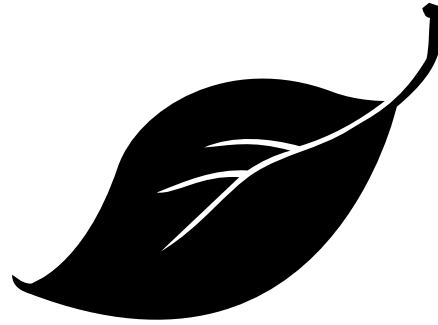
What is a typical day like for SFS students?

Students are expected to be physically fit and are busy from morning to night. A typical schedule is:

0730. Breakfast
0830 to 1200 . Lectures
1200. Lunch
1300. Field work (lecture, field work, research)
1830. Dinner
2000. Guest lecture, meetings (when required)

In addition to the above, each SFS student must serve on a four-person cooking crew with meal and clean-up responsibilities about once a week. Each person also serves on a committee; committees are responsible for recycling glass and aluminum, maintaining the compost pile, or helping to organize field trips. Finally, each week SFS students participate in a "Warrawork" session, in which students and staff clean dormitories, wash vehicles, and plant trees.

Plant Life of the Rainforest



Objectives

- ▶ describe the characteristics of a rainforest
- ▶ create a scale drawing of the rainforest strata

Vocabulary

canopy
emergent

epiphytes
strata

understory

Background

The trees of the tropical rainforest grow in fairly consistent layers, or strata. The highest level of the tropical rainforest is the height reached by the tallest trees, the emergents, which usually top 150 feet and occasionally reach 200. Only one or two of them can be found per acre. Below the emergents is the forest canopy, a mesh of leaves, branches, and tangling vines. The canopy, which catches most of the sunlight, tends to be composed of trees that are 60 to 90 feet tall. Sunlight that filters down below the canopy falls mostly on the forest understory, a layer of tree crowns between 15 and 45 feet tall. Seedlings, herbs, and ferns grow on the forest floor. The lateral branches of trees are colonized by populations of ferns, mosses, orchids, and bromeliads, called epiphytes. These plants depend on other plants for their structural support.

Materials

graph paper

pencils

rulers

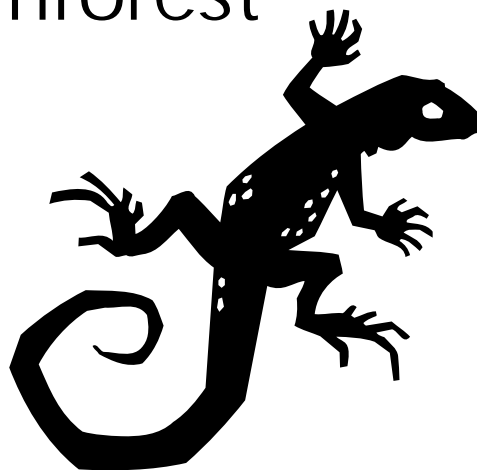
Activity

1. Display pictures of tropical rainforests. Have students describe the landscape. As they respond, create a word map on chart paper.
2. Tell students that if they looked at the forest from within, they would not notice the stratified character of the woods, because one layer tends to obscure the next. Help students understand the stratified character of the rainforest.
3. Explain that SFS students are obtaining a detailed picture of the vegetation types at the site. They note tree sizes and species diversity and map these characteristics on a topographic chart.
4. Have students work with partners to make a scale drawing of the rainforest strata. Help them decide what scale to use. (Have students compare the dimensions of the tallest tree to those of the paper to get a rough idea of an appropriate scale.) Have them write the scale they use on their drawings.

Extend the Activity

Explain that the canopy is home to many of the plants and animals that live in the rainforest. Because the highest branches of the canopy can be more than 100 feet above the ground, scientists find it difficult to conduct research in the canopy. Have students devise safe ways to reach and explore the treetops.

Animals of the Rainforest



Objectives

- ▶ appreciate the species diversity of the rainforest
- ▶ use library resources to identify animals of the rainforest
- ▶ classify the animals of the rainforest

Vocabulary

amphibian
bird

invertebrate
mammal

reptile
vertebrate

Background

Although rainforests cover only about one percent of the Australian continent, they are home to a wide variety of animal life. A typical 2,500-acre patch of rainforest contains as many as 1500 species of flowering plants, up to 750 species of trees, 400 species of birds, 150 kinds of butterflies, and insects too numerous to count.

Australia has 230 species of native mammals, half of which are marsupials—animals that develop their young in a pouch. This group includes such rainforest dwellers as koalas, possums, wombats, and bandicoots. In addition, many of the 700 species of birds that are native to Australia live in rainforests. The bird population includes cockatoos and a variety of parrots and parakeets.

Materials

reference books, such as encyclopedias and books about animals
list of animals of the Australian rainforest
computer/access to on-line resources (optional)

Activity

1. Discuss with students the importance of the rainforest as a wildlife habitat. Ask: Why do you think scientists want to know the types of animals that live in the rainforest? Why are rainforests suitable habitats for these animals?
2. Explain that SFS students are aiding in the conservation of the cassowary, a large flightless bird related to emus and ostriches. Tell students that the conservation and management of the species has been hindered by a lack of data. Ask: Why do scientists need information about an animal, especially one they want to conserve? What kinds of information do they need?
3. Give each student a copy of the following list. Explain that these animals live in the Australian rainforest.

striped possum

northern brown bandicoot

grey teal

honeyeater

ring-tailed dragon

gecko

giant tree frog

kowari

cassowary

tropical scrubwren

wallaroo

koala

red-winged parrot

wombat

wallaby

palm cockatoo

marsupial mole

yellow-bellied glider

woodswallow

dragon lizard

northern tree snake

tree-kangaroo

hopping mouse

double banded plover

Atherton antechinus

white footed dunnart

coral snake

gecko

eastern banjo frog

eastern froglet

red goshawk

amethystine python

4. Help students define the terms vertebrate and invertebrate. Have them classify each animal in the list as a vertebrate or invertebrate. Students may need to use library resources to find out more about each animal.
5. Help students define the terms mammal, amphibian, reptile, and bird. Write the definitions on chart paper. Then have students work together to group the animals by categories.
6. Have students find out which animals are considered rare and endangered. Suggest that they use library resources or visit related sites on the Internet. (See Resources.) Discuss the importance of conserving these species.

Extend the Activity

Suggest that students work in pairs to list the animals that live in their community and classify each animal. Have students compare their list with the list of rainforest animals. Ask: What do the differences in animal species tell you about the climate of each place?



Objectives

- ▶ understand the value of the rainforest
- ▶ appreciate the variety and importance of rainforest products
- ▶ develop consumer awareness

Vocabulary

fruit

medicine

vegetable

Background

Think of many of the things we take for granted: hot chocolate, a banana for lunch, an apple pie fragrant with cinnamon and nutmeg, a chocolate candy bar, a rubber ball, latex paint to touch up the walls, or anesthesia to ease the pain of surgery. Ingredients in all of these come originally from tropical forests. Indeed, the array of everyday products for which tropical forests are still an important source is astonishing.

Activity

1. Distribute copies of the Commercial Uses of the Rainforest Fact Sheet to students. Ask: Which products are you familiar with? Which do you use? What does the variety of products tell you about the value of the rainforests?
2. Have each student choose a partner. Direct the pairs to go on a scavenger hunt in the school or at home to find each product. Suggest that they check the ingredients in perfumes, dyes, soaps, paints, varnishes, and cosmetics to find the listed products. They can also visit a pharmacy, supermarket, or natural food store.
3. For each product, have students note its name, the manufacturer, and the specific ingredients that come from the rainforest.
4. Have students assess each product. Ask: Is it a good product? Is it something that people need or want?
5. Suggest that students set up a display of rainforest products. Have them invite other classes to visit the display.

Extend the Activity

Have students research other cultures and find out how they have used plants for medicinal and ceremonial purposes. For example, what kinds of plants did various Native American tribes use in ceremonies and for healing?

Commercial Uses of the Rainforest Fact Sheet

Name: _____

Woods	Houseplants	Spices	Fruits	Vegetables	Fibers	Pharmaceuticals	Oils	Gums/Resins
teak	Anthurium	allspice	avocado	Brazil nuts	bamboo	annatto	camphor oil	chicle latex
mahogany	Croton	black pepper	banana	cane sugar	jute/kenaf	curare	coconut oil	copaiba
rosewood	Dracaena	cayenne	coconut	chocolate	kapok	quassia	eucalyptus oil	copal
balsa	Parlor ivy	chili	grapefruit	coffee	raffia	quinine	palm oil	gutta percha
sandalwood	Philodendron	cinnamon	lemon	cucumber	ramie	reserpine	rosewood oil	rubber latex
	Schefflera	cloves	lime	tapioca	rattan	yang-yiang	tolu balsam oil	tung oil
	Zebra plant	ginger	mango	okra				
		nutmeg	orange	peanuts				
		paprika	papaya	peppers				
		turmeric	pineapple	tea				
		vanilla	plantain	hearts of palm				
		cardamom		cashew nuts				

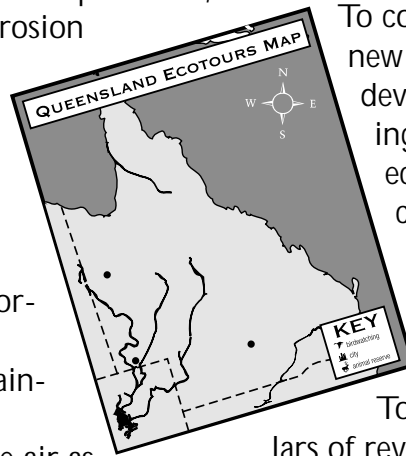
Objectives

- ▶ plan an ecotour of the Australian rainforest
- ▶ enhance research, writing, and presentation skills

Background

Agriculture, ranching, mining, and logging are destroying thousands of acres of rainforest everyday. The loss of rainforest is already causing serious local problems, including increased soil erosion and water pollution. Additionally, rainforest destruction may deprive everyone of potential food sources, medicines, and other products. Scientists warn that rainforest destruction may even affect the weather. The rainforest adds a tremendous amount of moisture to the air as excess water evaporates from leaves. The moisture eventually becomes rain. Some

areas of the world have already experienced droughts attributed to the loss of rainforest.



To counteract this devastation, a new rainforest-based industry has developed. Ecotourism is becoming an important part of the economy of many rainforest countries, including Australia. Government officials are beginning to realize that preserving the rainforest makes good economic sense.

Tourists bring in millions of dollars of revenue. The money can be used for economic development.

Materials

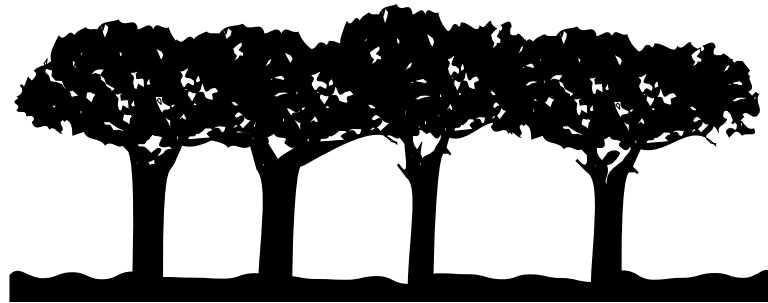
mural paper
tempera paint and paintbrushes
construction paper (for brochures)

pens
pencils
felt-tip markers
colored pencils

Activity

1. Divide students into teams.
2. Explain that in addition to their research projects, SFS students are building trails, giving presentations at local high schools, and meeting with local conservation groups. Ask: What is the value of these activities? Why do you think SFS students are building trails? Who will use these trails? Explain that tourists can use the trails. Discuss with students the meaning of ecotourism. Ask: What do you think are the benefits of ecotourism? What effect do you think ecotourism will have on the rainforest?
3. Tell students that they will be planning an ecotour of the Australian rainforest. Divide the class into groups. Have each group choose one of these tasks:
 - prepare fact sheets about animals of the Australian rainforest
 - create a mural
 - prepare an advertising brochure
 - prepare a guided tour of the rainforest
4. Students in Group #1 will prepare fact sheets about rainforest animals. The fact sheets should contain answers to the following questions:
 - What are its habits?
 - What does it eat?
 - How does it reproduce?
 - How does it differ from other animals?
 - What other facts do you find interesting about the animal?
5. Students in Group #2 will create a rainforest mural on mural paper depicting plants and animals of the Australian rainforest.
6. Students Group #3 will create an advertising brochure for travel agencies. The brochure should highlight the sights travelers can expect to see on their rainforest tour. Other information should include pictures and maps, as well as estimates of cost and a description of accommodations. The brochures will be distributed to parents or students in another class.
7. Students in Group #4 will take visitors on a "tour" of the rainforest. The tour guide will give a description of each animal based on information in the fact sheets. Other members of the group will take turns presenting information about the resources of the rainforests that they have discovered.
8. After the ecotour, ask students to assess the activity. Ask: What did you learn from this project? How could it be improved? What contributions do you think SFS students can make in the development of ecotourism in the Australian rainforest?

The Rainforest Community



Objectives

- ▶ design a self-sustaining, miniature ecosystem
- ▶ explore the principles and processes that occur in all ecosystems

Vocabulary

biome

community

population

biosphere

ecosystem

Background

Ecology is the study of the relationships of living organisms to each other and to their environment. In ecology, organisms can be classified into categories such as population, community, biome, and biosphere.

Population refers to a group of the same organisms living in a common environment, such as the rainforest. Several populations coexisting in that environment are referred to as a community. Communities coexisting in that environment form a biome or ecosystem. Though the terms biome and ecosystem are often used interchangeably, scientists generally use biome when they classify communities according to the plant and animal life within them. They use ecosystem when they classify areas by how living organisms and their environment function as a unit.

The Australian rainforest is a terrestrial ecosystem. When scientists study the ecosystem, they examine the interrelationships of its soil, climate, water, plants, insects, birds, and other animals. All ecosystems together make up the biosphere, those parts of the earth where life exists. These include the atmosphere, lithosphere (the solid outer part of the earth), and hydrosphere (the earth's water).

Materials

2 or 3 liter clean plastic soda bottle
charcoal
sand or gravel
small rocks
potting soil
masking tape

neotropical rainforest plants, such as:
Dracaena, Philodendron, ferns,
liverworts, mosses, prayer plants,
and bromeliads (from local nursery)

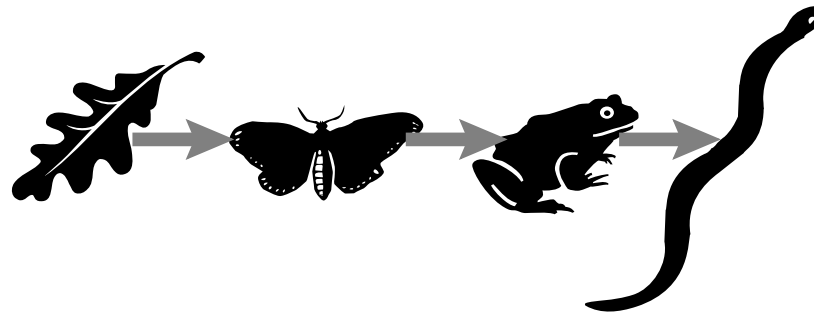
Activity

1. Discuss with students the meaning of the term ecosystem. Make sure they understand that an ecosystem is a balanced arrangement of plants, animals, soil, and climate and that it is a stable unit, with the decay of dead organisms providing the food for those that are growing.
2. Tell students that they will be creating a miniature rainforest ecosystem, a terrarium, that should require relatively little care. Ask: What materials will you need to create your ecosystem? (soil, plants, animals)
3. Have students work in pairs to create an ecosystem. Follow these steps:
 - a. Cut off the tops from the plastic soda bottles. (Save the tops.)
 - b. Cover the bottom of the bottle with two inches of sand.
 - c. Cover the sand with a thin layer of charcoal or gravel.
 - d. Cover the charcoal with two inches of potting soil.
 - e. Place rainforest plants in small, pre-moistened holes, leaving enough room for them to grow.
 - f. Water the plants. (The soil should be moist, not soggy.)
 - g. Cover the terrarium with the top of the bottle and tape to make a nearly airtight seal.
 - h. Place the terrarium where it will receive morning sunlight.

4. Explain that the system will need a source of nitrogen. Ask students what they can add to supply that source (example: plant-eating insects, such as ladybugs). Balance their plant-eating by introducing some insects or other small animals that eat the plant-eaters.
5. Have students explain how the continuous flow of energy and food in the ecosystem allows it to sustain itself. Ask: Is the ecosystem self-sustaining, or does it get energy from outside? Is this a balanced system? What is the energy source? (sunlight) Why is an energy source necessary? (allows plants to take in carbon dioxide to grow and produce oxygen) How are the organisms interdependent? How do insects get the oxygen? How do plants get the nutrients they need?

Extend the Activity

Have students design a zoo exhibit to house plants and animals from the rainforest ecosystem.



Objectives

- ▶ define food chain and food web
- ▶ understand how organisms in an ecosystem are interrelated
- ▶ create a food chain for rainforest organisms

Vocabulary

consumers
decomposers

food chain
food web

producers

Background

A food chain is a feeding pattern in which energy from food passes from one level to the next in a sequence. All living things are linked in food chains. The sun is the principal source of energy for all of them.

One common food pattern is called the grazing food chain. Grasses and other green plants (the producers) using solar energy are the base of this food chain. They are eaten by herbivores (the consumers). Herbivores are consumed by carnivores or by omnivores.

Another common food chain, called the detritus food chain, begins with the remains of plants and animals. These remains are slowly broken down by organisms, such as bacteria and fungi—the decomposers. In this process, nutrients are returned to the soil and then used again by plants.

Most organisms eat several kinds of food and therefore belong to more than one chain. Because of this, scientists refer to connecting food chains as food webs, networks that transfer energy within an ecosystem.

Materials

reference books, such as an encyclopedia and books on plants and animals of the rainforest
large pieces of poster board or oak tag
markers and felt-tip pens

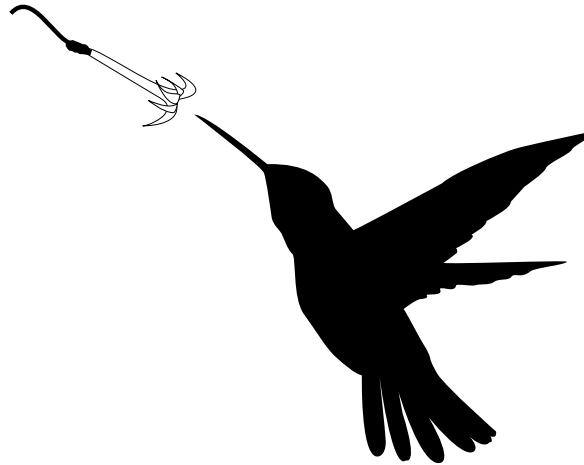
Activity

1. Explain the term food chain using the background information. Tell students that all living organisms in a food chain can be classified as a producer, a consumer, or a decomposer. Producers consist mainly of plants. Most consumers are herbivorous, omnivorous, and carnivorous animals. Decomposers, mainly bacteria and fungi, break down dead plants and animals to make nutrients in the soil.
2. Refer to the list of rainforest animals on page 13. An example of a food chain of the Australian rainforest is: a coral snake is a consumer that eats a tree frog; the tree frog is a consumer that feeds on a butterfly; the butterfly is a consumer that feeds on nectar in a flower; the flower is a producer; bacteria and fungi are decomposers—they make nutrients in the soil to feed the flower.
3. Remind students of the plight of the cassowary. Explain that a lack of data on its habitat needs and food sources have frustrated conservation and management efforts. Discuss why it is important for scientists to understand food chains.
5. Divide the class into cooperative groups. Distribute copies of the list of rainforest animals. Suggest that students use library resources to find information about the animals and the foods they eat. Have students make a flow chart to show the order in which energy is transferred through several organisms. Tell them to label producers, consumers, and decomposers in their chart.

Extend the Activity

Explain to students that a series of interconnecting food chains make up a food web. Have students diagram a food web based on their research of plants and animals of the rainforest.

Animal Adaptations



Objectives

- ▶ identify different types of bird beaks
- ▶ demonstrate ways in which different beaks are adapted to feed on different foods

Vocabulary

adaptations

Background

Living organisms adjust or change to help them survive the conditions particular to their rainforest ecosystem. Extreme environmental conditions, such as deforestation, strongly influence the changes animals experience. These changes are known as adaptations. Some adaptations help organisms adjust to changes in water and temperature. Other adaptations help organisms obtain food from particular sources. Camouflages and certain body structures protect organisms from becoming prey. As an ecosystem changes, organisms either adapt or migrate in order to survive.

Materials

"bird foods," *i.e., rice, styrofoam chunks, nuts, puffed rice*

"bird beaks," *i.e., tweezers, chopsticks, pliers, eyedropper, slotted scoop*

small log

vase

Activity

1. Discuss examples of physical features animals have that assist them in finding food, moving around, or staying alive. Point out that these characteristics are adaptations.
2. Explain that one of the best ways to see how animals adapt to their habitats is to examine bird beaks. Beaks come in all shapes and sizes and each is specially suited for finding and eating the type of food its owner needs.
3. Have students review the list of rainforest animals on page 13. Ask them to identify the birds on the list.
4. If possible, display photographs of each bird. Discuss the different bird beaks and how beaks help birds survive. (The woodswallow has a large, gaping mouth that acts like a net to catch insects by the wing; the cassowary has a long, thick beak for picking up fallen fruit.)
5. Explain the different classifications of bird beaks: chisel (for plucking insects from cracks in barks of trees), spear (for catching fish), cracker (for cracking shells of seeds), prober (for sucking nectar), or strainer (for gathering tiny aquatic plants and animals).
6. Set up stations, each with a different type of food: rice spread on a log (to represent insects), styrofoam chunks floating in water (to represent fish), nuts or seeds, water in a tall, thin vase (to represent nectar), and puffed rice floating in water (to represent tiny aquatic plants and animals).
7. Place tools to represent bird beaks at each station: tweezers (chisel), chopsticks (spear), pliers (cracker), eyedropper (prober), and slotted scoop (spoon).
8. Invite students to take turns picking up the foods with the various beaks (tools). Have them note the results on the Animal Adaptations Worksheet. Have them decide which beak is best for getting each food.
9. Conclude the activity by discussing beak adaptations in general. Ask: How can specialized beaks help some birds stay alive? How might a specialized beak hurt a bird?

Extend the Activity

Have students identify different types of bird feet and explain how each helps a bird survive in its habitat.

Animal Adaptations Worksheet

Name: _____

Type of Beak	insects (rice)	fish (styrofoam)	nuts/ seeds	nectar (water)	aquatic plants (puffed rice)
chisel (tweezers)					
spear (chopsticks)					
cracker (pliers)					
prober (eyedropper)					
spoon (slotted spoon)					

Objectives

- ▶ gather data about an animal in the community through observation
- ▶ explore how living and nonliving things are interdependent
- ▶ observe how living things must adapt in order to survive

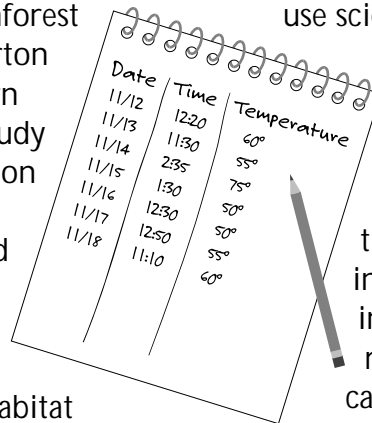
Vocabulary

habitat

organism

Background

SFS students participate in case studies that focus on rainforest issues affecting the Atherton Tablelands of far northern Queensland. One case study focuses on the conservation and management of the cassowary, an endangered species. Students conduct field surveys to get an accurate estimate of the population and the habitat quality available to these birds. Throughout their field work, the SFS



Date	Time	Temperature
11/12		
11/13	12:20	60°
11/14	11:30	60°
11/15	2:35	55°
11/16	1:30	75°
11/17	12:30	50°
11/18	12:50	50°
	11:10	55°
		60°

students record and reflect on how they use scientific processes to reach their conclusions.

Classroom students will have the same opportunity to use the scientific processes while they conduct their own case study of an organism in their community. These processes include observing, communicating, making comparisons, ordering data, categorizing and relating information, making inferences, and applying what they have learned.

Materials

In Your Own Backyard Worksheet

clip board

Activity

1. Have students recall that SFS students are participating in a case study on the cassowary. Ask: Why is the cassowary the focus of the case study? What kinds of information about cassowaries are SFS students collecting? (range, habitat needs, food sources, population density and distribution) How will they use the information? (plan management and conservation strategies) What scientific processes will SFS students use in conducting their research?
2. Explain that students will be collecting information about an organism in their locale. Have groups of students observe organisms in an area such as on a tree, on a rotting log, on grass, or under a rock.
3. Suggest that students record their observations on the In Your Own Backyard Worksheet. Tell them to make notes about the living and nonliving components of the community.
4. Have students use the information on the fact sheet to draw conclusions about the organism's habitat needs and food sources. Their conclusions should include answers to the following questions: How much water does the organism need? What is the availability of food sources? What temperatures does the organism need to survive? What other animals and plants does the organism need to survive?
5. Provide time for students to share their observations and conclusions with classmates.

Extend the Activity

Work with students to create a nature trail to highlight habitats, plants and animals on school grounds. Or get permission for the class to visit another site and map out possible trail stations.

Field Trip

As a class, visit a local park or nature center and walk one of their nature trails. Have each student bring a field journal. Ask them to sketch their favorite trail station and answer these questions: What plants and animals are supposed to live here? Which ones can you see? Are there any rules posted to protect animals and plants along the trail?

In Your Own Backyard Worksheet

Name: _____

Organism's name: _____

Describe the organism. _____

Draw a picture of the organism on the back of this sheet.

Describe the organism's habitat. _____

Record the air temperature on the observation days.

Date	Time	Temperature

What other animals occupy the organism's habitat? Estimate the population of each species in the habitat.

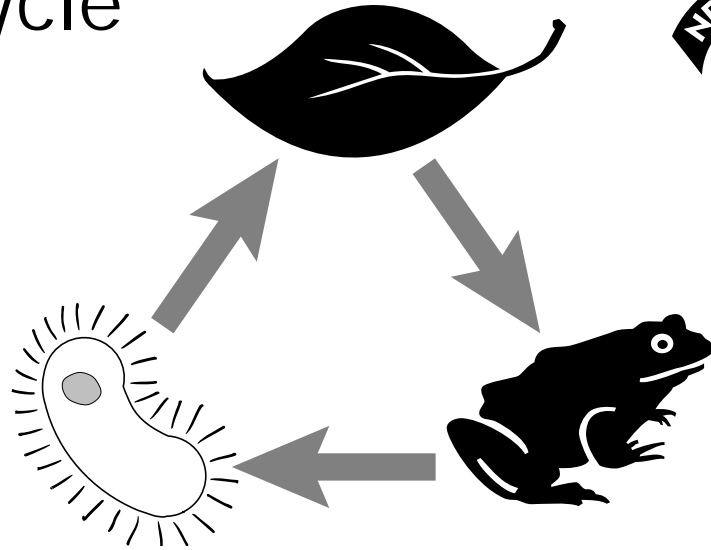
Animal	Est. population

What does the organism eat? _____

How plentiful is the food supply? _____

Observe the organism over a period of time. Describe the animal's habits. _____

The Nitrogen Cycle



Objectives

- ▶ understand the nitrogen cycle
- ▶ create a compost pile
- ▶ demonstrate how soil can be enriched to promote plant growth

Vocabulary

compound

decompose

nitrogen cycle

Background

All living organisms participate in the nitrogen cycle, which encompasses the processes and chemical reactions involved in producing organic nitrogen from inorganic nitrogen and subsequently breaking down organic nitrogen back to the inorganic form.

Nitrogen circulates through the atmosphere as an element and through the earth as a compound. Plants absorb nitrogen compounds from the soil. Animals then eat the nitrogen-rich plants, passing nitrogen along the food chain. When plants and animals die, they decompose and react with nitrifying bacteria to make nitrogen compounds in the soil that are used by plants. The nitrogen cycle ensures rich soil, a stable atmosphere, and life for plants and animals.

Materials

containers for compost pile and for planting seeds

fruit and vegetable waste; potting soil; leaves and grass clippings

craft sticks

different types of seeds, such as a legume, a gourd, and a flowering plant

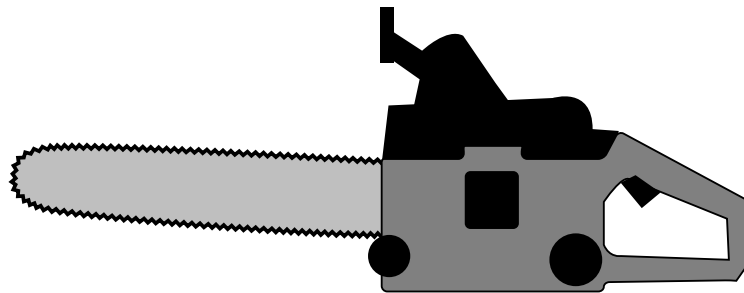
Activity

1. In a container, make a mini compost pile by layering fruit and vegetable waste with potting soil, leaves, and grass clippings.
2. Cover the container and place it in a sunny, outdoor location.
3. Shake the container every other day to add air to the mixture. Add enough water to keep the material moist. The compost will be ready for use in two weeks.
4. Fill two containers with an equal mixture of sand and clay.
5. Add organic matter from the compost pile to one of the containers.
6. Plant two seeds of each type in each container. Place a craft stick with the seed name written on it next to the seeds. Water every other day.
7. Observe the plants each day for two to three weeks. Compare each plant's germination and growth. Describe the results of the experiment.

Extend the Activity

Have students devise an experiment to test which type of soil is best for supporting plant life—sand, clay, or a mixture of sand and clay. Also have them test whether or not compost can be used to promote plant growth in each type of soil.

Soil, Forest, and Land Exploitation



Objectives

- ▶ understand the reasons why tropical deforestation is occurring
- ▶ understand the controversies surrounding preservation of the rainforest
- ▶ develop critical thinking skills

Vocabulary

deforestation

Background

Forests in the tropics are being cleared for many of the same reasons that the eastern United States was deforested early in its development: to accommodate a growing population and for short-term profit.

Tropical forests are, for the most part, located in developing countries, and the \$1 trillion foreign debt borne by these developing countries has fueled deforestation. To relieve some of the debt, large tracts of tropical forest have been logged to produce timber for export. Forestland has also been converted to plantations for growing export crops such as coffee, cacao, or rice.

Many poor countries also have burgeoning populations that seek out land for farms and wood for fuel. In many places, people with no land follow the logging roads into the forests to find farmland. But these new farms carved out of the rainforest rarely remain productive. The topsoil becomes depleted after a few years of cultivation and farmers must often then abandon them and clear new forest for crops.

Activity

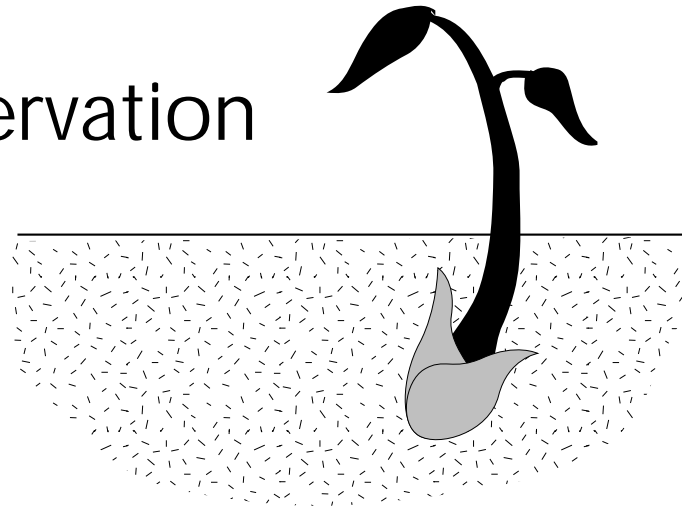
1. Discuss with students the reasons why rainforests are disappearing and why the deforestation is a cause for concern. Refer to the information in Background and the Overview. Make sure that the students understand that the Australian rainforest has suffered the same fate as most other rainforests and that agriculture, ranching, mining, and logging have destroyed and disrupted habitat.
2. Remind students of the importance of the rainforest by having them recall the names of foods and medicines derived from the rainforest plants. As students respond, create a concept web on chart paper.
3. Divide the students into two groups. Choose a volunteer to moderate the debate. Explain that one group will present arguments in support of cutting the rainforests in order to put people to work, improve the standard of living, and generate money for the economy. The other group will present arguments in favor of preserving the rainforest.
4. Conclude the debate by having students brainstorm ways it may be possible to provide food and jobs for people and to preserve the rainforest, such as by creating extracted reserves. The reserves are protected forests that allow traditional harvesting of rubber, nuts, and other forest products.

Extend the Activity

Have students examine the exploitation of a resource in their area. Have them explain why the resource is being exploited and the long-range effects of the exploitation on the environment and the local inhabitants.

Soil, Forest, and Land Conservation

NEWSLETTER
11



Objectives

- ▶ understand the principles of forest management
- ▶ devise a forest management plan
- ▶ create a diorama

Vocabulary

reforestation
management

Background

Designation as a World Heritage Site did not eliminate local pressures on the Australian rainforest. Struggles continue over how to manage the multi-use forests. Restoration of degraded areas which were cleared for farming may ease the problem, particularly in creating wildlife corridors to reduce fragmentation and extinction effects.

To investigate the dynamics of reforestation, SFS students will develop and implement a plan to convert a stretch of farmland between two protected rainforest areas into a reforested habitat corridor. This will involve designing and assessing specific reforesting and management strategies.

Materials

plaster of paris
tempera paint and paintbrushes

pipe cleaners
craft sticks

Activity

1. Have students discuss the demands on the rainforest from agricultural, ranching, mining, logging, and recreational interests. Create a concept map on chart paper.
2. Have students work in groups. Each student will represent one of the following: forest manager, commercial forester, wildlife biologist, recreation planner, farmer, rancher, or miner.
3. Explain to students that their task is to devise a management plan for the rainforest that satisfies competing uses. This can mean coming up with the most efficient way to grow timber trees while doing the least harm to the forest community; providing for recreational facilities in some parts of the forest; and managing for specific types of wildlife throughout the forest.
4. Suggest that each group construct a diorama to show the location of the various sites.

Extend the Activity

Have students explain why a forest is a renewable resource and examine the role that reforestation can play in restoration, wildlife conservation, and watershed protection.

Objectives

- ▶ estimate the kinds and amounts of trash generated by the school
- ▶ start a recycling program at the school
- ▶ devise ways to use recyclables

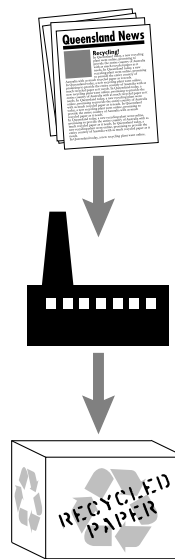
Vocabulary

recycle
precycle

Background

Today, the increased demand for wood products is, in part, fueling the drive to cut down the forests. For example, experts have estimated that the average American uses seven trees a year, in paper, wood, and other products made from trees. That's over one-and-a-half billion trees a year!

One of the best ways to reduce the destruction of forests is to recycle. Rather than taking more new materials from the earth, people use the same materials over and over again.



Recycling means less digging and drilling, less cutting and dumping, and less destruction of forests, rivers, and fields.

In devising the recycling program, classroom students will be using the same scientific processes—observing, communicating, comparing, ordering, categorizing, relating, inferring, and applying—as the students at the SFS rainforest site.

Materials

bins for recyclables
poster board
paint and paintbrushes

Activity

1. Have students estimate the kinds and amounts of trash generated by their school each day, week, and school year. This can be done by weighing trash material, such as paper, from one classroom and multiplying the amount by the number of classrooms in the school. Repeat the procedure for other materials. Record the results on the chart.
2. Brainstorm ways to reuse the recyclables. Record the information on the chart. Share the information with other classes.
3. Create a flyer explaining how recycling will work at the school. Distribute the flyer to students, teachers, and other school employees.
4. Place recycling bins in classrooms, offices, the cafeteria, and other strategic locations. Place instructions for their use near the recycling bins.
5. Appoint recycling monitors to see that recyclables are being deposited in the correct bins and to note when the bins are full.
6. Appoint a team of students who will be responsible for taking the bins to a recycling center.
7. Have students present the results of the recycling program to the school.

WASTE MANAGEMENT WORKSHEET

Name: _____

Material	Amount of trash generated before recycling	% of total	Amount of trash generated after recycling	% of total	Possible in-school uses of recycled material
paper and cardboard					
books					
magazines					
glass					
aluminum cans					
metals					
plastics					
styrofoam trays & cups					
food wastes					
yard wastes					

Careers in Science

Objectives

- ▶ investigate careers in science
- ▶ practice interviewing skills

Vocabulary

ethnobiologist
taxonomist

environmental specialist
ecologist

Background

Due to greater ecological concern, there is a growing demand for environmentally-conscious professionals. Some professions, such as an ethnobiologist, ecologist, botanist, forester, or biologist, are in the field of science. Other careers include environmental protection specialist, toxicologist, and hazardous waste manager.

Successful practitioners in the careers SFS and classroom students may be considering are a source of information and advice.

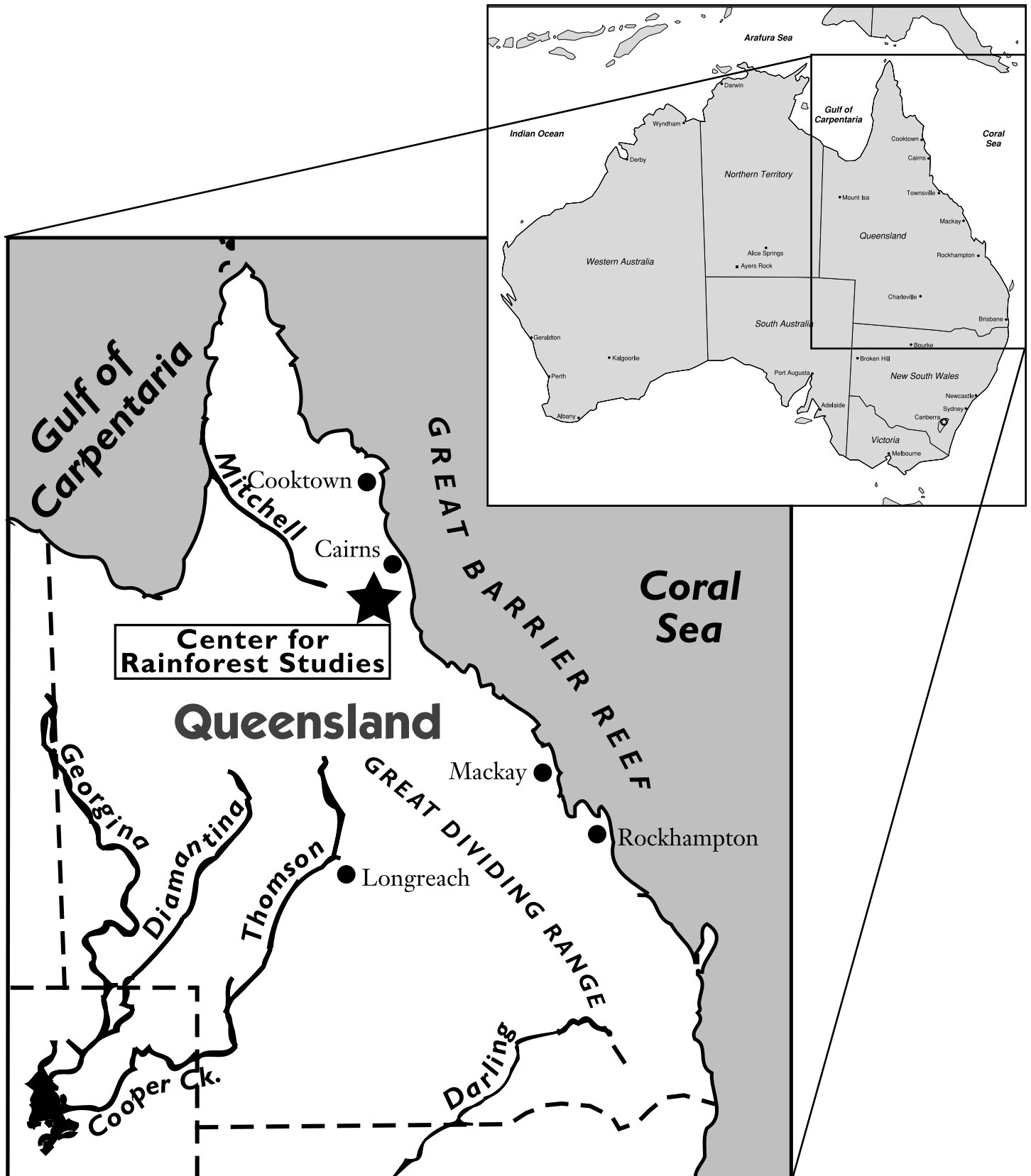
Activity

1. Have students write to selected professionals and invite them to speak to the class. (Contact faculty members of a local university or employees of a government agency, such as the Environmental Protection Agency and the U.S. Fish and Wildlife Service, or employees of organizations such as the World Wildlife Fund, the National Solid Waste Management Association, Greenpeace and the Cousteau Society.)
2. Divide the class into groups. Ask each group to do research about the profession of one invited guest speaker. Have students use this research to formulate interview questions.
3. After the guests have completed their presentations, have each group meet with the speaker who has the profession they studied. Have students use their questions to interview the speakers.
4. When the interviews are complete, invite each group to report their findings to the class.
5. You may wish to invite other classes to listen to the speakers and participate in the discussions.

Extend the Activity

Have students examine the role each professional would play in the study of the soil, forest, and land in the Australian rainforest. Suggest that they create an organizational flow chart that outlines the responsibilities of each professional.

Map of Queensland, Australia



RESOURCES

Reference Books

Baker, Lucy. *Life in the Rainforests*. New York, NY: Scholastic, 1993.

Caufield, Catherine. *In the Rainforest*. Chicago, IL: University of Chicago Press, 1991.

DePauw, Debby. *A Unit About Tropical Rainforests*. Monterey, CA: Evan-Moor, 1993.

Gay, Kathlyn. *Rainforests of the World: a reference handbook*. Santa Barbara, CA: ABC-CLIO, 1993.

Hare, Tony. *Rainforest Destruction*. New York: Gloucester Press, 1990.

Jennings, Terry J. *Tropical Forests*. Danbury, CT: Grolier Educational Corporation, 1992.

The Last Rain Forests: a world conservation atlas. New York: Oxford University Press, 1990.

Lessons of the Rainforest. San Francisco: Sierra Club Books, 1990.

Lewis, Scott. *The Rainforest Book: how you can save the world's rainforests*. Los Angeles: Living Planet Press, 1990.

Myers, Norman. *The Primary Source: tropical forests and our future*. New York: Norton, 1992.

People of the Tropical Rain Forest. Berkeley: University of California Press, 1988.

The Rainforests: a celebration. San Francisco: Chronicle Books, 1992.

Motion Picture

A Walk in the Forest. Randall Hood. Released by Pyramid Films, 1975.

Sound Recordings

Jungle Journey. Salem, MA: Ryko, 1990.

Rain Forest Retreat. Plymouth, MN: Metacom, Inc., 1993.

Videorecordings

Animals of the Rainforest. Bala Cynwyd, PA: Schlessinger Video Productions, 1996.

Plants of the Rainforest. Bala Cynwyd, PA: Schlessinger Video Productions, 1996.

Can Tropical Rainforests be Saved? PBS Home Video: Distributed by Pacific Arts, 1992.

Totally Tropical Rainforest. Burbank, CA: Distributed by Columbia Tristar Home Video, 1994

RESOURCES

Organizations

Cousteau Society, 930 West 21st St., Norfolk, VA 23517

Department of the Interior, U.S. Fish and Wildlife Service, National Ecology Center, Leetown, Box 705, Kearneysville, WV 25430

Greenpeace USA, 1436 U St., NW, Washington, DC 20009

National Solid Waste Management Association, 1120 Connecticut Ave., NW, Washington, DC 20036

National Wildlife Federation, 1412 16th St., NW, Washington, DC 20036

Rain Forest Action Network, 301 Broadway, Suite A, San Francisco, CA 94133

World Wildlife Fund, 1250 24th St., NW, Washington, DC 20037

Internet

<http://fig.cox.miami.edu/Faculty/NickCarter/mainlinks.html>

A well-organized general list of links to rainforest web sites.

Rainforest Action Network

<http://www.ran.org/ran/>

A site maintained by the environmental group that includes information about their organization, Action Alerts, general rainforest information, descriptions of their current campaigns and demonstrations, a Kid's Corner, and ideas on what you can do to help preserve the world's rainforests.

Earthwatch

<http://gaia.earthwatch.org/>

Earthwatch is a non-profit organization that has mobilized more than 40,000 people since 1972 to spend from one to three weeks assisting noted scientists and scholars on projects ranging from the coral reef to public health studies.

GLOSSARY

adaptation: a characteristic, like a body part or behavior, that helps a plant or animal survive in its environment

abundance: the quantity, or number, of a particular species or type of animal or plant

amphibian: animals that live on land and lay their eggs in water, includes frogs, toads and salamanders

biome: communities coexisting in an environment, examples include grassland, desert, rainforest, temperate forest, and tundra

biosphere: those parts of the earth where life exists

bird: common name for member of the vertebrate class *Aves*, includes any animal with feathers

canopy: the strata of trees that are 60 to 90 feet tall in the rainforest

carnivore: an animal that eats other animals

community: several populations of plants and animals coexisting in a common environment

compound: a substance that is made up of two or more chemical elements

conservation: the act of saving something from harm

consumer: an organism that eats other organisms

decomposer: bacteria or fungus that breaks down the remains of dead animals and plants

deforestation: clearing land of trees

diversity: the number of different species or types of animals

ecosystem: communities of organisms that coexist and are self-sustaining

population: group of the same organism living in a common environment

emergents: the tallest trees of the rainforest which usually top 150 feet and occasionally reach 200 feet

epiphyte: a plant that grows on another plant

food web: a feeding pattern in which energy in food passes from one animal or plant to the next

food chain: connections between food chains

habitat: the place where a plant or animal lives

invertebrate: an animal that lacks a backbone

mammal: the common name for the warm-blooded animals of the *Mammalia* class, includes humans and any other animal that nourishes its young with milk, has hair, and has a muscular diaphragm

nature trail: a marked trail designed to lead people through a natural environment which highlights and protects resources

nitrogen cycle: a process in which atmospheric nitrogen enters the soil and becomes part of living organisms, and then returns to the atmosphere

non-renewable resources: a resource that can not be replaced after harvesting

organism: a living entity composed of one or more cells

phylum: major scientific groups used to classify animals

predator: an animal that hunts and eats other animals

producer: an organism that produces food

renewable resource: a resource that replaces itself after harvesting so that it can be harvested again

reptile: common name for members of the cold-blooded vertebrate class *Reptilia*, includes snakes, lizards, turtles, and crocodiles

strata: consistent layers of rainforest trees

understory: a strata of rainforest trees that are 15 to 45 feet tall

vertebrate: an animal with a backbone