“Tropical Rain Forest”
Suitcase Science Kit

Curriculum Guide
For Grades 5-8

Developed by:

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TROPICAL RAINFOREST KIT
INVENTORY
FOR GRADES 5-8

Curriculum

- "Tropical Rain Forest" Suitcase Science Kit Binder

Lesson 1 Folder

- "Tropical Jungle" Music CD
- "Rescuing the Rainforest: A KMOV-TV Ch. 4 Production" DVD
- "Children's Eternal Rainforest" CD
- "Children's Eternal Rainforest" CD Script

Lesson 2 Folder

- 47 Laminated Tropical Rainforest Plant and Animal Pictures

Lesson 3 Folder

- 4 Ziploc Bags Containing 4 Different Tropical Rainforest Food Chains

Lesson 4

- One plastic container of "Tropical Rainforest" beans
- One plastic container of "Temperate Forest" beans
- Metal scooper

Lesson 5

- One plastic container of:
    - Allspice
    - Black Pepper
    - Brazil Nut
    - Cardamom
    - Chili Pepper
    - Cinnamon
    - Clove
    - Ginger
    - Nutmeg
    - Sugar Cane
    - Tapioca
    - Turmeric
    - Vanilla Bean
    - White Pepper
- Nutmeg Grater
- Two Different Sets of "Tropical Feast Cards"

Lesson 6 Folder

- 13 Yanomami Laminated Tribe Pictures
- 12 Pygmy Laminated Tribe Pictures
- 12 Huli Laminated Tribe Pictures
- Tribe Information Card for Teacher
- Tribe Matching Game Set A
- Tribe Matching Game Set B
- Tribe Matching Game Set C
- Tribe Matching Game Set D
- Tribe Matching Game Set E

Lesson 7 Folder

- No. 1 Transparency – Decision: "Choose your choice of action"
- No. 2 Transparency – Decision: "Now hear from the people"
- No. 3 Transparency – Decision: "Now you've heard other points of view, choose the best course of action"
- Map Transparency
- 20 Role Play Cards

Student Literature

- When the Monkeys Came Back by Kristine L. Franklin
- A Walk in the Rainforest by Kristin Joy Pratt
- Flute's Journey: The Life of a Wood Thrush by Lynne Cherry
- Vanishing Peoples: Yanomami People of the Amazon by David M. Schwartz
- The Forever Forest: Kids Save a Tropical Treasure by Kristin Joy Pratt-Serafini with Rachel Crandell
- Spices & Natural Flavorings by Jennifer Mulherin

Additional Teacher Resources Folder

- Tropical Trees by Dorothy and Bob Hargreaves
- Exploring the Tropics by Missouri Botanical Garden
- Ranger Rick's Nature Scope - Rainforests: Tropical Treasures by the National Wildlife Foundation
- Vanishing Rain Forests" Teacher's Manual by World Wildlife Fund
- Monteverde: Science and Scientists in a Costa Rican Cloud Forest by Sneed B. Collard III
- Plants of the Tropics by Susan Reading
- 3-2-1 Contact Extra Teacher's Guide by Children's Television Workshop
- We're Killing Our World: The Global Ecosystem in Crisis by Dr. Peter H. Raven

Multi-Media Materials

- "3-2-1 Contact Extra: You Can't Grow Home Again" DVD by the Children's Television Workshop
- "Amazonia: A Celebration of Life Rain Forest Rap" DVD by Andrew Young
- "Tropical Rainforest" IMAZ DVD by Science Museum of Minnesota

Games

- Rain Forest Card Games

Rainforest Products Bag

- 9 Product Information Cards
- Giant Bamboo Leaf
- Bamboo Section
- Chopsticks (Bamboo)
- Chiclets Gum
- Quinine Sulfate Bottle
- Caning for Chair Seat (Rattan)
- 100% Rubber (Latex) Object
- Rubber Eraser
- Sandalwood Chips
- Tropical Wood Product
- Kapok Fiber Sample and Information Card

Pamplets & Posters

- Laminated Monteverde Conservation League, US Pamphlet
- "The Tropical Rain Forest" Poster by the World Wildlife Fund

Tropical Wood Sample Kit

- 2 Introduction Cards
- 13 Descriptive Cards
- 13 Wood Samples
    - Granadillo
    - Honduras Mahogany
    - Billy Webb
    - Ziricote
    - Santa Maria
    - Balsa
    - Goncalo Alves
    - Belizean Redwood
    - Primavera
    - Honduras Rosewood
    - Philippine Mahogany
    - Macassar Ebony
    - Teak

Lesson Title:
Lesson 1 - Introduction to the Rainforest

Grade Level:
5th – 8th Grade

Missouri Science GLE's:

VII-IB(5th)a	Make qualitative observations using the five senses
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)c	Evaluate the reasonableness of an explanation
VII-IC(5th)d	Analyze whether evidence supports proposed explanations
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(6th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-IB(8th)a	Make qualitative observations using the five senses
VII-IC(8th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8th)c	Evaluate the reasonableness of an explanation (conclusion)

Objectives:
- To introduce students to the rainforest ecosystem.

Key Terms:
Tropical Rainforest, Tropic of Cancer, Tropic of Capricorn, Equator

Materials:
- Tropical Jungle CD with sounds from nature
- Markers
- Chart Paper for Teacher (provided by the school)
- Paper for Students
- DVD (KMOV Channel 4)
- Children's Eternal Rainforest CD and script
- World map without outline of location of forests
- Colored pencils
- Computer and/or Smartboard to show pictures (provided by school)
- List of websites for students to use to research

Teacher Background Information:

Types of Rainforests

There are two types of rainforests -- tropical and temperate. Tropical and temperate rainforests share certain characteristics. For example, most trees flare at the base. Vegetation is dense, tall and very green. Both types of rainforests are rich in plant and animal species, although the diversity is greater in the tropical rainforest.

Montane forests are found in mountainous areas and may contain plants such as oaks, rhododendrons, and pines, which are characteristic of temperate deciduous forests. At higher altitudes, temperatures are cooler. Even close to the equator, frost and snow can occur.

Precipitation and Climate
Both tropical and temperate rainforests are very lush and wet. Rainfall falls regularly throughout the year. The tropical rainforest receives 80-400 inches of rainfall per year. It rains a lot in the temperate rainforest, too -- about 100 inches per year. And even more moisture comes from the coastal fog that hovers among the trees.

Tropical rainforests are warm and moist; while temperate rainforests are cool.

	Tropical	Temperate
Temperatures	warm	cool
Number of tree species	many (hundreds)	few (10-20)
Types of leaves	broadleaf	needles
Age of trees	50-100 years	500-1000 years
Epiphytes	lots of different kinds including orchids and bromeliads	mostly mosses and ferns
Decomposition rate	rapid	slow

Are all Tropical Forests, Rainforests?
Only a small percentage of the tropical forests are rainforests. To be a tropical rainforest, forested areas must:

- Lie between the Tropic of Cancer and the Tropic of Capricorn.
- Receive rainfall regularly throughout the year (80-400 inches per year).
- Remain warm and frost free all year long (mean temperatures are between 70° and 85°F) with very little daily fluctuation.

Consequently, many forested areas in the tropics are not rainforests. Forests that receive irregular rainfall (monsoons followed by a dry season) are moist deciduous forests. Trees in these forests may drop their leaves in the dry season.

Procedure:

Hearing the Rainforest (15 minutes)

The teacher will introduce the rainforest unit with his/her students by playing the "Tropical Jungle" CD. The students will be instructed to close their eyes and listen to the sounds of the rainforest. Once ample listening time has been given, the teacher will challenge the students to write down at least ten different sounds that they heard from the rainforest CD. The students will be encouraged to share what they heard, and the teacher will write down their findings onto chart paper.

Learning about the Rainforest (45 minutes)

The teacher will play the KMOV Channel 4 DVD for his/her students. The students will be instructed to jot down at least ten different newly learned facts while they watch the DVD. Once the program is finished, the teacher will ask the students to share a few of the things that they have learned about the rainforest. The teacher will write down their findings onto chart paper.

Seeing the Rainforest (15 minutes)

The teacher will show the Children's Eternal Rainforest CD of rainforest plants and animals with the use of a classroom computer or Smartboard. While the pictures are scrolling on the screen, the teacher will read the accompanying script to his/her students. The students will be encouraged to jot down any new facts or information that they might want to add to the class chart paper about the rainforest. The teacher will stop the photo CD and ask the students to share any new facts that they would like to include onto their class chart paper about the rainforest. The teacher will write down their findings onto the chart paper.

Mapping the Rainforest (30 minutes)

The teacher will pass out colored pencils to each student, along with world map outline. The students will be instructed to use the designated websites below to research and record where the world's rainforests are located. Once the students have had the chance to color in where rainforests can be found in the world, they will be encouraged to share their findings with the class.

Rainforest Websites for Students

http://www.mbgnet.net/sets/rforest/index.htm
http://www.mobot.org/hort/gardens/CLtropfor.shtml
http://www.hesd.k12.ca.us/resource/biomes/rain.htm
http://www.enchantedlearning.com/subjects/rainforest/Where.shtml
http://www.rainforestlive.org.uk/index.cfm?Articleid=369

Lesson Title:
Lesson 2 – Layers of the Rainforest

Grade Level:
5th – 8th Grade

Missouri Science GLE's:

VII-IB(5th)a	Make qualitative observations using the five senses
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)c	Evaluate the reasonableness of an explanation
VII-IC(5th)d	Analyze whether evidence supports proposed explanations
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(6th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)
III-IA(8th)a	Recognize that most plants and animals require food and oxygen (needed to release the energy from that food)
VII-IB(8th)a	Make qualitative observations using the five senses
VII-IC(8th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8th)c	Evaluate the reasonableness of an explanation (conclusion)

Objectives:
- To introduce students to the four layers of the rainforest.
- To identify several kinds of plants and animals that live in the rainforest layers.

Key Terms:
Forest floor, understory, canopy, emergent layer

Materials:
- Laminated animal and plant pictures
- Paper
- Butcher paper (Optional)
- Computer and Printer (provided by school)
- Colored Pencils
- List of websites for students to use to research
- Books to use for research

Teacher Background Information:

What is a tropical rainforest?

Many forested areas in the tropics are not rainforests. In fact, tropical rainforests comprise only 40% of the world's tropical forests and only 20% of the world's total forests. Other kinds of forests include tropical dry forests, seasonally dry rainforest, and tropical montane forest. Here are the characteristics of the average tropical rainforest:

- Lies between the Tropic of Cancer and the Tropic of Capricorn, or 1,400 miles north and south of the Equator.
- Receives rainfall distributed regularly throughout the year, about 6-33 feet a year.
- Remains frost free and warm all year long, with temperatures between 70° and 85°F with very little daily fluctuation.

Special Rainforest Characteristics

Species diversity: The tropics do not contain the largest plants, or even necessarily the most unusual plants, but they do contain a greater number of different kinds of plants than all the other areas of the world put together! The contrasting figures for tropical animals, especially insects, are even greater. Among this great diversity are plants that have medicinal potential that could benefit many people.

Structure: The tropical rainforest is composed of three layers: the canopy, the understory, and the forest floor. The canopy is formed from the large trees whose crowns form a tight, continuous layer above the ground. The canopy is home to 90% of organisms found in the rainforest! In the wild, most animals spend their entire lives in the canopy, never touching the ground. The understory tends to be dark and relatively open, and contains smaller trees and shrubs. The forest floor receives only what little sunlight escapes through both the canopy and the understory, so not many plants grow here. The ones that do are well adapted to a very low level of light.

Soil: Many tropical rainforest soils are very poor and infertile. Millions of years of weathering have washed most of the nutrients out of the soil. Despite the amount of vegetation in the rainforest, the soil contains less organic matter than that of temperate forests, because the warm humid conditions encourage faster decay and recycling of nutrients back into living forest.

Forest Floor: The rainforest floor receives less than 2% of the sunlight and consequently, little grows here except plants adapted to very low light. Although the ground is covered by a layer of decomposing vegetation, the top soil is surprisingly poor in nutrients. The floor is very humid due to the evaporation of water from the leaves and shrubs that are found in this layer. This humidity will help speed up the process of decomposition of the matter. A wide variety of life including insects and larger animals inhabits the rainforest floor. (Bengal Tigers, Giant Anteaters, Gorillas)

Understory: Receiving only 2 - 15% of the sunlight that falls on the canopy, the understory is a dark place. It is relatively open and contains young trees and leafy herbaceous plants that tolerate low light. Many popular house plants come from this layer. Only along rivers and roadways and in treefall and cut areas is sunlight sufficient to allow growth to become thick and impenetrable. The understory has a large amount of insect life. (Jaguars, Queen Alexandra's Birdwing Butterflies, Rhinoceros Beetles)

Canopy: The broad, irregular crowns of these trees form a tight, continuous canopy 60 to 90 feet above the ground. The branches are often densely covered with other plants (epiphytes) and tied together with vines (lianas). The canopy is home to 90% of the organisms found in the rainforest; many seeking the brighter light in the treetops. Some of these animals never touch the rainforest floor. The canopy also acts as a reverse umbrella for the rainforest. It traps moisture and humidity underneath the leaves of its trees and also blocks out sunlight. (Cobras, Orangutans, Sloths)

Emergent Layer: These giant trees thrust above the dense canopy layer, sometimes at heights of 200 feet, and have huge mushroom-shaped crowns. These trees enjoy the greatest amount of sunlight but also must endure high temperatures, low humidity and strong winds. This layer of the rainforest is **not** represented in the Climatron ®. (Bats, Harpy Eagles, Howler Monkeys)

Procedure:

Sorting the Rainforest (15 minutes)

The teacher will distribute laminated pictures of rainforest animals and plants to each student. The students will be instructed to sort the pictures based on where they think the plants and animals live in the rainforest. The teacher will allow time for the students to explain where they placed their pictures and why they believe that they live there.

Learning the Layers (30 minutes)

The teacher will discuss the four layers of the rainforest and the properties of each layer with his/her students (see Teacher Background Information). After the teacher has finished explaining the layers of the rainforest, the students will be given an opportunity to change where they placed their rainforest plants and animals.

Building a Class Rainforest (45 minutes)

Now that the students have an understanding of the layers of the rainforest, along with what kinds of plants and animals live in it, the teacher will encourage his/her students to create a classroom rainforest display.

The students will be instructed to choose a rainforest plant and animal to research and study. They will be expected to use the approved rainforest websites and the resource books to conduct their research. Once the students have had ample time to learn about their chosen plant and animal, the teacher will provide paper and colored pencils so that the students may create them. The students might also want to add fun facts next to their researched plant and animal on the mural so that other students in their class may learn about what lives in the different layers of the rainforest.

The teacher will also provide a large sheet of butcher paper so that the students can have the opportunity to make the background for their class rainforest.

Rainforest Websites

http://www.mbgnet.net/
http://kids.mongabay.com/
http://www.kathimitchell.com/rainfor.html
http://www.rainforestanimals.net/index.html
http://www.enchantedlearning.com/subjects/rainforest/animals/

Teacher Rainforest Plant and Animal Answer Key

Harpy Eagle – Emergent Layer
Massena Trogon – Emergent Layer
Kapok Tree – Emergent Layer and/or Canopy
Lemur – Emergent Layer and/or Canopy
Black Spider Monkey – Emergent Layer and/or Canopy
Iridescent Butterfly – Emergent Layer and/or Canopy
Tropical Butterfly– Emergent Layer and/or Canopy
Kinkajou (Honey Bear) – Emergent Layer and/or Canopy
Clear-wing Satyr Butterfly – Emergent Layer and/or Canopy
Malachite Butterfly – Emergent Layer and/or Canopy
Bromeliad – Canopy, Understory, and/or Forest Floor
Mahogany Tree – Canopy
Strangler Fig – Canopy
Hyacinth Macaw – Canopy
Howler Monkey – Canopy
Spiderwort – Canopy
Bamboo – Canopy
Coconut Tree - Canopy
Orchid – Canopy
Iguana – Canopy
Fruit Bat – Canopy
Python – Canopy
Sloth – Canopy
Toucan – Canopy
Arrow Poison Frog – Canopy and/or Understory
Arrowroot – Canopy and/or Understory
Red-eyed Tree Frog – Canopy and/or Understory
Philodendron – Understory
Heliconia – Understory
Banana Plant - Understory
Ocelot - Understory
Rainbow Lizard - Understory
Cacao – Understory
Sugar Cane – Understory
Taro – Understory
Cassava – Understory
Rubber Plant – Understory
Chameleon – Understory
Fig Wasp – Understory
Gecko – Understory
Jaguar – Understory and/or Forest Floor
Tarantula – Understory and/or Forest Floor
Caiman – Forest Floor
Leaf Cutter Ant – Forest Floor
Tapir – Forest Floor
Piranha – River/Creek

Lesson Title:
Lesson 3 – Food Chains of the Rainforest

Grade Level:
5th - 8th Grade

Missouri Science GLE's:

III-IE(5th)b	Distinguish between plants (which use sunlight to make their own food) and animals (which must consume energy-rich food)
VII-IB(5th)a	Make qualitative observations using the five senses
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)c	Evaluate the reasonableness of an explanation
VII-IC(5th)d	Analyze whether evidence supports proposed explanations
I-IIC(6th)b	Recognize and apply the fact that energy from the Sun is the source of almost all energy used to produce the food for living organisms
III-IA(6th)a	Describe the common life processes necessary to the survival of organisms (i.e., growth, reproduction, life span, response to stimuli, exchange of gases, use of water, elimination of waste)
III-IIB(6th)a	Describe how plants use energy from the Sun to produce food and oxygen through the process of photosynthesis
IV-IB(6th)a	Identify populations within a community that are in competition with one another for resources
IV-IB(6th)b	Identify the factors that affect the number of and types of organisms in an ecosystem can support (e.g., food availability, abiotic factors such as quantity of light and water, temperature and temperature range, soil composition, disease, competitions from other organisms, predation)
IV-IB(6th)c	Predict the possible effects of changes in the number and types of organisms in an ecosystem on the populations of other organisms within that ecosystem
IV-IIA(6th)a	Diagram and describe the transfer of energy in an aquatic food web and a land food web with reference to producers, consumers, decomposers, scavengers, and predator/prey relationships
IV-IIA(6th)b	Classify populations of unicellular and multicellular organisms as producers, consumers, and decomposers by the role they serve in the ecosystem
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(6th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)

I-II(8^{th})c	Explain that the amount of matter remains constant while being recycled through food chains and food webs
III-IA(8^{th})a	Recognize that most plants and animals require food and oxygen (needed to release the energy from that food)
III-IIB(8^{th})a	Describe photosynthesis is a chemical change with reactants (water and carbon dioxide) and products (energy-rich sugar molecules and oxygen) that takes the place in the presences of light and chlorophyll
VII-IB(8^{th})a	Make qualitative observations using the five senses
VII-IC(8^{th})a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8^{th})c	Evaluate the reasonableness of an explanation (conclusion)

Objectives:

- To learn about the food chains that exist in a tropical rainforest.
- To classify populations of organisms as producers, consumers, or decomposers by the role they serve in the ecosystem.

Teacher Background Information:

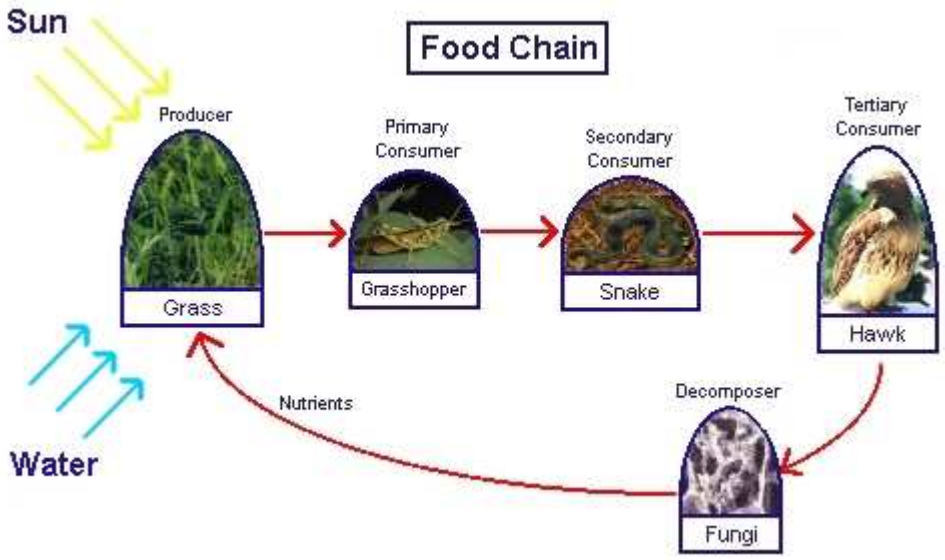
(from http://www.arcytech.org/java/population/facts_foodchain.html)

In an ecosystem, plants capture the sun's energy and use it to convert inorganic compounds into energy-rich organic compounds[1]. This process of using the sun's energy to convert minerals (such as magnesium or nitrogen) in the soil into green leaves, or carrots, or strawberries, is called photosynthesis.

Photosynthesis is only the beginning of a chain of energy conversions. There are many types of animals that will eat the products of the photosynthesis process. Examples are deer eating shrub leaves, rabbits eating carrots, or worms eating grass. When these animals eat these plant products, food energy and organic compounds are transferred from the plants to the animals. These animals are in turn eaten by other animals, again transferring energy and organic compounds from one animal to another. Examples would be lions eating deer, foxes eating rabbits, or birds eating worms.

This chain of energy transferring from one species to another can continue several more times, but it eventually ends. It ends with the dead animals that are broken down and used as food or nutrition by bacteria and fungi. As these organisms, referred to as decomposers, feed from the dead animals, they break down the complex organic compounds into simple nutrients. Decomposers play a very important role in this world because they take care of breaking down (cleaning) many dead material. There are more than 100,000 different types of decomposer organisms! These simpler nutrients are returned to the soil and can be used again by the plants. The energy transformation chain starts all over again.

Here is a figure showing one such food and energy chain:



Producers. Organisms, such as plants, that produce their own food are called autotrophs.The autotrophs, as mentioned before, convert inorganic compounds into organic compounds. They are called producers because all of the species of the ecosystem depend on them.

Consumers. All the organisms that can not make their own food (and need producers) are called heterotrophs. In an ecosystem heterotrophs are called consumers because they depend on others. They obtain food by eating other organisms. There are different levels of consumers. Those that feed directly from producers, i.e. organisms that eat plant or plant products are called primary consumers. In the figure above the grasshopper is a primary consumer.

Organisms that feed on primary consumers are called secondary consumers. Those who feed on secondary consumers are tertiary consumers. In the figure above the snake acts as a secondary consumer and the hawk as a tertiary consumer. Some organisms, like the squirrel are at different levels. When the squirrel eats acorns or fruits (which are plant product), it is a primary consumer; however, when it eats insects or nestling birds, is it is a tertiary consumer.

Consumers are also classified depending on what they eat.

Herbivores are those that eat only plants or plant products. Example are grasshoppers, mice, rabbits, deer, beavers, moose, cows, sheep, goats and groundhogs.

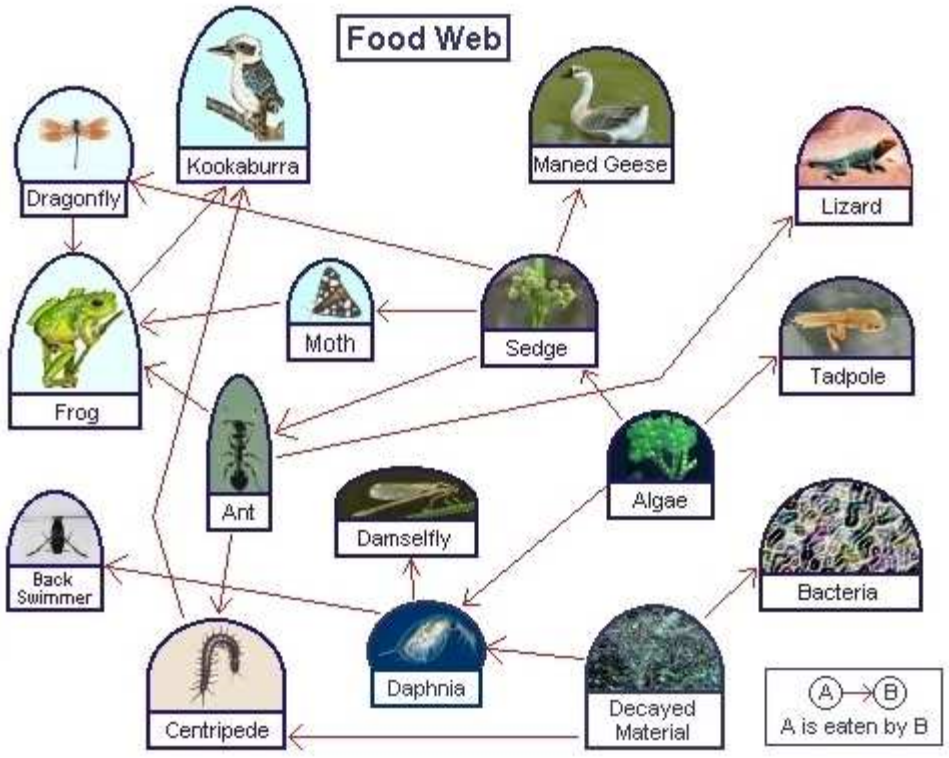
Carnivores, on the other hand, are those that eat only other animals. Examples of carnivores are foxes, frogs, snakes, hawks, and spiders.

Omnivores are the last type and eat both plants (acting a primary consumers) and meat (acting as secondary or tertiary consumers). Examples of omnivores are:

- Bears --They eat insects, fish, moose, elk, deer, sheep as well as honey, grass, and sedges.
- Turtles -- They eat snails, crayfish, crickets, earthworms, but also lettuce, small plants, and algae.
- Monkeys -- They eat frogs and lizards as well as fruits, flowers, and leaves.
- Squirrels -- They eat insects, moths, bird eggs and nestling birds and also seeds, fruits, acorns, and nuts.

Food Webs

In looking at the previous picture, the concept of food chain looks very simple, but in reality it is more complex. Think about it. How many different animals eat grass? And from the Facts about Red-tailed Hawks page, how many different foods does the hawk eat? One doesn't find simple independent food chains in an ecosystem, but many interdependent and complex food chains that look more like a web and are therefore called food webs. A food web that shows the energy transformations in an ecosystem looks like this[2]:



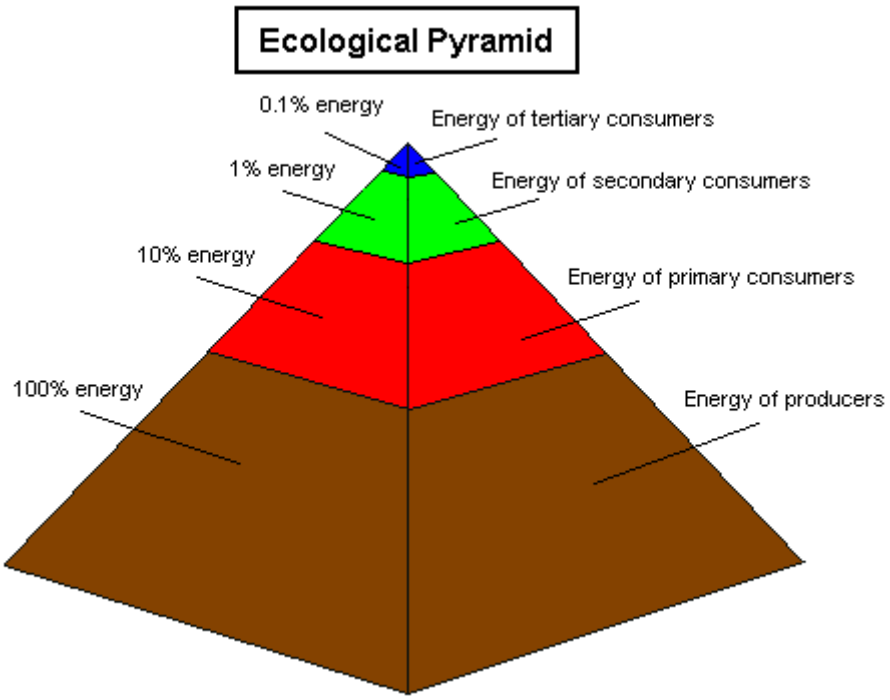
As you can see from this picture, food webs, with all their dependencies, can be very complex, but somehow nature balances things out so that food webs last a long time.

Many species share the same habitat, their populations survive for many years, and they all live *happily* together.

The Ecological Pyramid

We described in the previous sections how energy and organic compounds are passed from one trophic level to the next. What was not mentioned is the efficiency of the transfer. In a highly efficient transfer almost all of the energy would be transferred -- 80% or more. In a low efficiency transfer very little energy would be transferred -- less than 20%. In a typical food chain, not all animals or plants are eaten by the next trophic level. In addition, there are portions or materials (such as beaks, shells, bones, etc.) that are also not eaten. That is why the transfer of matter and energy from one trophic level to the next is not an efficient one.

One way to calculate the energy transfer is by measuring or sizing the energy at one trophic level and then at the next. Calorie is a unit of measure used for energy. The energy transfer from one trophic level to the next is about 10%. For example, if there are 10,000 calories at one level, only 1,000 are transferred to the next. This 10% energy and material transfer rule can be depicted with an ecological pyramid that looks like this:



This pyramid helps one visualize the fact that in an ecological system there need to be many producing organisms at the bottom of the pyramid to be able to sustain just a couple of organisms at the top. In looking at the pyramid, can you guess how much larger the volume of each layer is as compared to the one just above it? Take a guess. It might not look like it but they are close to 10 times larger.

Key Terms:
Food chain, food web, producer, consumer, decomposer, sun, energy

Materials:
- Laminated rainforest animal and plant pictures
- Paper
- Pencils

Procedure:

Rainforest Food Chain (20 minutes)

The teacher will divide the class into four groups. Each group will get a set of laminated pictures of rainforest animals and plants. The teacher will explain to the students that their challenge is to create a rainforest food chain. The teacher will explain what a food chain is to the students, along with definitions and examples of a producer, consumer, and decomposer (see Teacher Background Information below). Once the students have had ample time to sequence their food chain, the teacher will check each group's answers.

Next, the teacher will instruct each group to mix up their pictures. The teacher will then give each group a new set of pictures to put in order.

Rainforest Food Chain Answers

Food Chain #1

The Sierra Palm Tree is alive and provides food for many species. In this case, the lizard consumes the fruit of the Sierra Palm Tree. The lizard is in turn food for the Pearly-Eyed Thrasher, which in turn is food for the Screech Owl.

Food Chain #2

The Sierra Palm Tree is decomposing. After the palm dies, various decomposing organisms, such as the Oyster Mushroom, facilitate the decomposition. During this process, the Oyster Mushroom obtains its food while at the same time it returns nutrients to the soil. The Oyster Mushroom is consumed by the snail, who is eaten by the Fresh Water Crab, which in turn is eaten by the Mongoose. The mongoose is food for the Boa and for the Broad-Winged Hawk.

Food Chain #3

The Fungus Gnat is eaten by the Coqui. The juvenile coquis are food for the Tailless Whip Scorpion, and simultaneously the coquis can eat juvenile scorpions. The Coqui and the Tailless Whip Scorpion are food for the Puerto Rican Tarantula, while the tarantula is food for the Tarantula Hawk Wasp. We usually think that predators are larger than the prey. In reality, this is not always the case; some organisms have developed various mechanisms that permit them to prey upon larger creatures. This is the case with the Tarantula Hawk Wasp; it paralyzes its prey with venom and then lays its eggs on the tarantula in order for its larvae to have a ready food source.

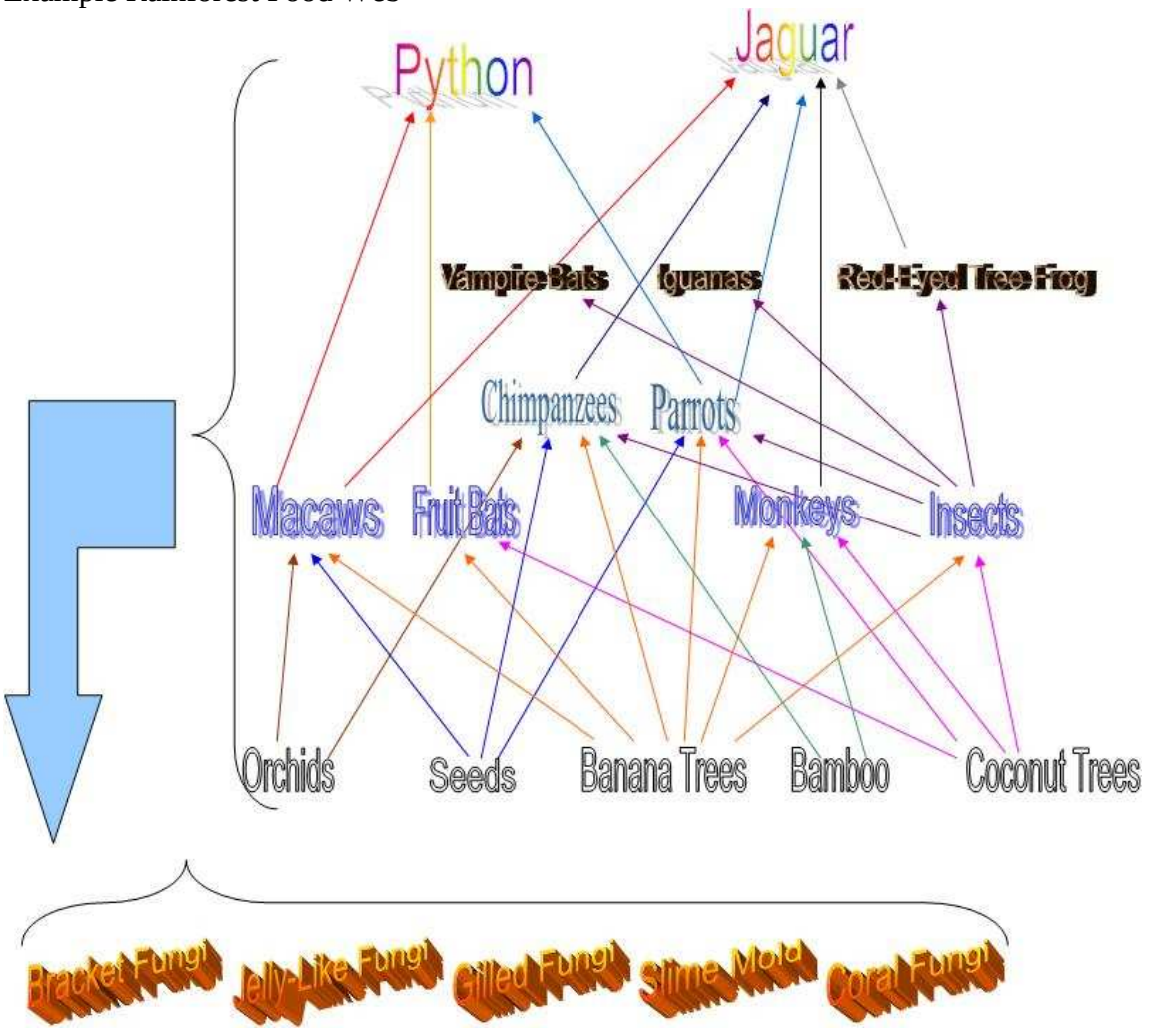
Food Chain #4

The plants that make their own food are eaten by Crickets. The cricket is eaten by the White-Lipped Frog, who in turn is eaten by the Boa, who is a food source for the Broad-Winged Hawk.

Rainforest Food Web (15 minutes)

The teacher will now collect all of the food chain cards and instruct the students to work as a class to create a rainforest food web. The teacher will explain what a food web is to the students (see Teacher Background Information above). The teacher will tape up and draw how each rainforest plant and animal is connected based on the suggestions from the students.

Example Rainforest Food Web



Rainforest Story (40 minutes)

Once the students have had ample time to practice putting the plants and animals into a rainforest food chain in order and into a food web, the teacher will pass out paper and a pencil to each student. The teacher will instruct the students to create a detailed story describing a day in the life of a rainforest food chain and/or food web. After the students have had time to create their descriptive stories, the teacher will allow time for each student to share their story with the class.

Lesson Title:
Lesson 4 – Biodiversity Endangered

Grade Level:
5th – 8th Grade

Missouri Science GLE's:

VII-IB(5th)a	Make qualitative observations using the five senses
VII-IB(5th)e	Compare amounts/measurements
VII-IB(5th)f	Judge whether measurements and computation of quantities are reasonable
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)c	Evaluate the reasonableness of an explanation
VII-IC(5th)d	Analyze whether evidence supports proposed explanations
VII-ID(5th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or writings
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IB(6th)e	Compare amounts/measurements
VII-IB(6th)f	Judge whether measurements and computation of quantities are reasonable
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(6th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-ID(6th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or writings
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IB(7th)e	Compare amounts/measurements
VII-IB(7th)f	Judge whether measurements and computation of quantities are reasonable
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-ID(7th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or equations and writings
VII-IB(8th)a	Make qualitative observations using the five senses
VII-IB(8th)e	Compare amounts/measurements
VII-IB(8th)f	Judge whether measurements and computation of quantities are reasonable
VII-IC(8th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8th)c	Evaluate the reasonableness of an explanation (conclusion)

VII-ID(8^{th})a Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or equations and writings

Objectives:

- To define biodiversity
- To compare the levels of biodiversity in the tropical rainforest to that found in a temperate rainforest
- To understand how greater biodiversity benefits rainforests
- To recognize how biodiversity benefits humans

Key Terms:

Biodiversity, tropical rainforest, temperate forest, benefits

Materials:

- 2 containers of dried beans
- One coffee scoop
- Biodiversity worksheet

Teacher Background Information:

In this activity, students will learn about biodiversity. Using beans to represent trees, the students will compare a tropical rainforest to a Missouri temperate forest. The container with only red, black, and white beans represents a Missouri temperate forest. The container with many colored beans represents the tropical rainforest. Each different color, size, or shape of bean represents a different species of tree or other plant in the forest.

Tropical Rainforests are Diverse: Biodiversity is a term biologists and ecologists use to describe biotic variety - numbers of animal and plant species, the richness of gene pools and living ecosystems. Plants, mammals, birds, reptiles, amphibians, fish, invertebrates, bacteria and fungi live together with non-living elements like soil, water and air to make a functioning ecosystem. A tropical rainforest is the world's most spectacular example of a living ecosystem and the ultimate in biodiversity.

Just How Diverse are Tropical Rainforests?: Rainforests have been around a long time. Some existing rainforests have evolved over 65 million years. This time-enhanced stability has allowed these forests greater opportunities for biological perfection. Rainforests harbor the greatest gene pool in the world. The gene is a basic building block of living things and every species is evolved by various combinations of these blocks. The rainforest has nurtured this "pool" to become home for 170,000 of the world's 250,000 known plant species.

Fantastic Rainforest Comparisons: To comprehend just how marvelous this biodiversity is you have to make a comparison or two:

One study in a Brazilian rainforest found 487 tree species growing on a single hectare (2.5 acres), while the US and Canada combined only have 700 species on millions of acres.

There are approximately 320 butterfly species in all of Europe. Just one park in a Peruvian rainforest, The Manu National Park, has 1300 species.

THE BIODIVERSITY OF THE RAINFOREST

Why should the loss of tropical forests be of any concern to us in light of our own poor management of natural resources? The loss of tropical rainforests has a profound and devastating impact on the world because rainforests are so biologically diverse, more so than other ecosystems (e.g., temperate forests) on Earth.

Consider these facts:

- A single pond in Brazil can sustain a greater variety of fish than is found in all of Europe's rivers.
- A 25-acre plot of rainforest in Borneo may contain more than 700 species of trees - a number equal to the total tree diversity of North America.
- A single rainforest reserve in Peru is home to more species of birds than are found in the entire United States.
- One single tree in Peru was found to harbor forty-three different species of ants - a total that approximates the entire number of ant species in the British Isles.
- The number of species of fish in the Amazon exceeds the number found in the entire Atlantic Ocean.

The biodiversity of the tropical rainforest is so immense that less than 1 percent of its millions of species have been studied by scientists for their active constituents and their possible uses. When an acre of topical rainforest is lost, the impact on the number of plant and animal species lost and their possible uses is staggering. Scientists estimate that we are losing more than 137 species of plants and animals every single day because of rainforest deforestation.

Surprisingly, scientists have a better understanding of how many stars there are in the galaxy than they have of how many species there are on Earth. Estimates vary from 2 million to 100 million species, with a best estimate of somewhere near 10 million; only 1.4 million of these species have actually been named. Today, rainforests occupy only 2 percent of the entire Earth's surface and 6 percent of the world's land surface, yet these remaining lush rainforests support over half of our planet's wild plants and trees and one-half of the world's wildlife. Hundreds and thousands of these rainforest species are being extinguished before they have even been identified, much less catalogued and studied. The magnitude of this loss to the world was most poignantly described by Harvard's Pulitzer Prize-winning biologist Edward O. Wilson over a decade ago:

"The worst thing that can happen during the 1980s is not energy depletion, economic collapses, limited nuclear war, or conquest by a totalitarian government. As terrible as these catastrophes would be for us, they can be repaired within a few generations. The one process ongoing in the 1980s that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly that our descendants are least likely to forgive us for."

Yet still the destruction continues. If deforestation continues at current rates, scientists estimate nearly 80 to 90 percent of tropical rainforest ecosystems will be destroyed by the year 2020. This destruction is the main force driving a species extinction rate unmatched in 65 million years.

Procedure:

Biodiversity Activity (30 minutes)

The teacher will divide the students into groups of four. The students will be instructed to act as scientists who are sampling the forest. The teacher will explain that scientists can get a fairly accurate idea of what species living the forest by taking a sampling.

The teacher will instruct two team members of the group to take a sample of the "tropical rainforest" by using a level coffee scoopful from the correct container. The other two team members from the group will take a level scoopful sample of the "temperate forest." The students will be instructed to pour the "plants" onto the table in front of them, being very careful to keep their samples separate.

The students will separate their samples by "species" color and shape. Then, they will count and record the numbers of each type using the biodiversity worksheet.

After all have completed the sorting and counting, the groups will share what they found with the class. The class can make a group chart and graph of their information.

Team Member
Names_____

Biodiversity Worksheet

1. Sort samples into piles by color and shape. Assign each pile a letter.
2. Record how many beans are in each pile onto the chart below.

Missouri Temperate Forest Sample

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____

Tropical Rainforest Sample

A. _____	I. _____
B. _____	J. _____
C. _____	K. _____
D. _____	L. _____
E. _____	M. _____
F. _____	N. _____
G. _____	O. _____
H. _____	P. _____

3. Which sample has more different kinds of trees?
   a. Temperate Forest b. Tropical Rainforest

4. Which forest has the largest number of trees all the same kind?
   a. Temperate Forest b. Tropical Rainforest

5. Which forest has the second largest number of trees all one kind?
   a. Temperate Forest b. Tropical Rainforest

6. Is the forest that has the most different kinds of trees the forest that has the most trees of one kind? (HINT: Compare the answers of questions 3 and 4)
   a. Yes b. No

7. Suppose insects invade both forests. The insects kill five of the plants represented by red beans. How will the loss of these plants effect the survival of the species? Explain.

8. Which forest would you expect to be a better place to look for plants with chemicals for curing illnesses?
   a. Temperate Forest b. Tropical Rainforest
   Why?

9. In which forest would you expect to see more kinds of pollinators and nut-eaters?
   a. Temperate Forest b. Tropical Rainforest
   Why?

Lesson Title:
Lesson 5 – Visit the Tropical Rainforest

Grade Level:
5th – 8th Grade

Missouri Science GLE's:

VII-IB(5th)a	Make qualitative observations using the five senses
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)c	Evaluate the reasonableness of an explanation
VII-IC(5th)d	Analyze whether evidence supports proposed explanations
VII-ID(5th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or writings
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(6th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-ID(6th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or writings
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-ID(7th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or equations and writings
VII-IB(8th)a	Make qualitative observations using the five senses
VII-IC(8th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-ID(8th)a	Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables, graphs (bar, single line, pictograph), and/or equations and writings

Objectives:
- To learn about the products that come from the tropical rainforest.

Key Terms:
Specialization, environment, organs, organism, biodiversity

Materials:

- Coconut seed
- Variety of spices
- Tropical feast cards
- Food for tasting (provided to students and/or teacher)

Teacher Background Information:

Missouri Botanical Garden Climatron Information

The Climatron simulates a tropical lowland rainforest. In the Climatron there are about 1,200 species of the total estimated 160,000 species of tropical plants. It is an introduction to tropical plants and gives a good glimpse of a warm moist forest. No building can begin to house all of the diverse plant forms found in the tropics, but the Climatron illustrates the structure of the rainforest and many of its special characteristics.

About half of the plants in the Climatron were collected in the field, which gives them more scientific value than plants raised in a greenhouse. The Climatron is also home to representatives of numerous endangered species. Just preserving single specimens of endangered plants cannot save a species. It can help to save a species, however, if these plants are where visitors can see them, learn about them and appreciate them.

History and Architecture

Overview

The Climatron conservatory at first glimpse is a striking sight. The geodesic dome rises out of the surrounding greenery, a feat of architectural technology. The Climatron was built in 1960 to replace the crumbling Palm House, which had housed the Garden's palm and cycad collection since 1914.

The conservatory incorporates the principles of R. Buckminster Fuller, the inventor of the geodesic system. A geodesic dome is a type of structure shaped like a piece of a sphere and built of a network of triangles. When the Climatron opened, it was one of the world's most advanced display-research greenhouses. Developed by St. Louis architects Murphy and Mackey, it won the 1961 Reynolds Award for architectural excellence in aluminum. In 1976 it was named one of the 100 most significant architectural achievements in United States history.

The Structure

The Climatron, named for its climate-control technology, stands 70 feet high and 175 feet in diameter. It encompasses a volume of 1.3 million cubic feet, and a ground surface of about 24,000 square feet (more than half an acre). The form of the building was chosen to fit the specific demands of a greenhouse. The Climatron has no interior support and no columns from floor to ceiling, allowing more light and space for plants. Instead, the weight of the dome is carried to the ground on five piers around the perimeter of the circle. The interlocking triangle design helps to distribute weight throughout the dome, allowing it to be lightweight but strong. The original outer structure was made of lightweight aluminum, which resists corrosion, lined by a plastic Plexiglas "skin" suspended below the aluminum framework.

Renovation

In 1988 the greenhouse was closed for renovation. The original discolored and leaking Plexiglas skin was removed and a new aluminum and glass geodesic dome was built in its place.Each of the 2,425 panes that make up the new glass dome is made of a Saflex® plastic interlayer, manufactured by Monsanto Company, sandwiched between heat-strengthened glass. The panes are also coated with low-e film, or low-emissivity, which helps conserve energy by retaining the solar heat collected during the day for use at night.

With the new dome in place, the old aluminum structure was no longer necessary. It was retained, however, for its historical value. Today the Climatron is actually a dome within a dome, the new dome standing just within the original aluminum framework. During the renovation, new heating, cooling, and ventilating systems were installed. Paths were made accessible to the disabled, and the adjacent Shoenberg Temperate House was added.

During the 22 month-long renovation, the interior of the Climatron also underwent extensive landscaping changes. Major features were added, including two large waterfalls, rock and cliff landscaping, and tropical theme areas. The original clay-based soil was removed and an improved mixture ideal for tropical horticulture was put in its place. It took six hours with a bulldozer just to mix the batch of new soil. Only a few of the most important plants remained in the building during the renovation. The rest were transplanted either to holding facilities or to other botanical gardens. Replanting was finished, and a dramatically changed Climatron was re-opened in 1990.

Procedure:

Missouri Botanical Garden Field Trip (2 hours)

The teacher will go online (http://www.mobot.org/education/classes.asp) to register a "Rainforest Rendezvous" field trip at the Missouri Botanical Garden. Students will have the opportunity to escape to the Climatron to learn how plants cope with over 80 inches of rain each year and compete for light in a dense forest. Giant leaves, climbing vines, and epiphytes are just a few of the features of the rainforest your students will observe as they research the ways in which this productive biome is unique and important. Rainforest products and conservation will also be explored. Each student will plant a house plant from the tropics to take home.

Tropical Rainforest Taste Test (30 minutes)

Once the students have had an opportunity to visit a real tropical rainforest, the teacher will display several items and products that we get from the rainforest. The students will have an opportunity to observe a coconut seed, lots of spices, and several tropical feast cards.

After the students have had plenty of time to look at different tropical rainforest products, the teacher will invite the students to participate in a taste testing of many products that come from the rainforest. (The teacher may choose to bring in items on their own or they may ask students to help contribute to the tasting.)

Possible products that may be used for the tasting could include:

Vanilla ice cream (vanilla orchid is used to flavor the ice cream)

Bananas	Peppers	Black Pepper
Chocolate	Tomatoes	Cardamom
Avocadoes	Winged Beans	Cinnamon
Citrus	Cassava	Cloves
Guava	Rice	Coffee
Jackfruit	Sweet Potatoes	Ginger
Mangoes	Water Chestnuts	Nutmeg
Papayas	Yams	Mace
Passion Fruit	Cashews	Sugar Cane
Pineapple	Brazil Nuts	Turmeric
Plantain	Coconut	
Eggplant	Allspice	

Lesson Title:
Lesson 6 – People of the Rainforest

Grade Level:
5th – 8th Grade

Missouri GLE's:

VII-IB(5th)a	Make qualitative observations using the five senses
VII-IC(5th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(5th)b	Use data as support for observed patters and relationships, and to make predictions to be tested
VII-ID(5th)a	Evaluate the reasonableness of an explanation
VII-IC(5th)b	Analyze whether evidence supports proposed explanations
VIII-IA(5th)a	Identify a question that was asked, or could be asked, or a problem that needed to be solved when given a brief scenario (fiction or nonfiction of individuals solving everyday problems or learning through discovery)
VIII-3A(5th)b	Work with a group to solve a problem, giving due credit to the ideas and contributions of each group member
VII-IB(6th)a	Make qualitative observations using the five senses
VII-IC(6th)a	Use quantitative and qualitative data as support for reasonable explanations
VII-IC(6th)b	Use data as support for observed patters and relationships, and to make predictions to be tested
VII-ID(6th)a	Evaluate the reasonableness of an explanation
VII-IC(6th)b	Analyze whether evidence supports proposed explanations
VII-IB(7th)a	Make qualitative observations using the five senses
VII-IC(7th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(7th)c	Evaluate the reasonableness of an explanation (conclusion)
VII-IB(8th)a	Make qualitative observations using the five senses
VII-IC(8th)a	Use quantitative and qualitative data as support for reasonable explanations (conclusions)
VII-IC(8th)c	Evaluate the reasonableness of an explanation (conclusion)

Objectives:

- To observe and ask questions about the groups of people who live in the rainforest.
- To match the details of each rainforest group to the tribe's name.
- To compare and contrast how each rainforest group lives.
- To compare and contrast each rainforest group lives to the way we live.
- To write a diary entry of a rainforest group.

Key Terms:
The Huli, The Pygmies, The Yanomami, Tropical rainforest

Materials:

- 10 laminated pictures of The Huli
- 10 laminated pictures of The Pygmies
- 10 laminated pictures of The Yanomami
- Chalk and/or dry-erase markers (provided by school)
- 1 teacher card with tribe information
- 5 student envelopes (each envelope contains laminated information about each tribe along with the tribe names)
- 1 laminated teacher answer key for the student envelopes
- 1 stopwatch

Teacher Background Information:

Why are Forest People Well-Adapted to Living in the Tropical Rainforest?

Through thousands of years of natural selection, forest people have evolved to be smaller than people who do not live in the rainforest. They also sweat less because the forest's high humidity means that sweat cannot evaporate, making sweating a poor way to cool off. Forest people also drink less water because their food contains a lot of water.

Forest people have accumulated a great wealth of knowledge about the forest and have learned how to live in the forest without damaging it. They know how to use thousands of edible, medicinal, and poisonous plants and how to grow crops in the forest's poor soil. They also know how to hunt and fish without driving the animals to extinction.

The Huli

The Huli are one of the many tribes that live in the remote highland forests of Papua New Guinea. They live by hunting, gathering plants, and growing crops. Men and women live separately, in large group houses. The men decorate their bodies with colored clay and wear elaborate headdresses for ceremonies.

Location:
The Huli live in the Tari Basin in the highlands of Papua New Guinea (PNG). The region had little outside influence before the 1940s when plane travel allowed Westerners to bypass the nearly impenetrable coastal swamps and rugged inland mountains.
PNG is a country located in the western half of the world's second largest island, New Guinea. The island is situated just south of the equator and due north of Australia. Its name comes from Spanish explorer Inigo Ortiz de Retes who believed that the people resembled the inhabitants of Guinea in western Africa. The island is divided into two nations. The eastern half is known as Irian Jaya, which was annexed by Indonesia in 1963. The western half was granted full independence from Australia in 1975 under the name "Papua New Guinea".

People:
It is believed that the first Papuans migrated to the island over 45,000 years ago. The stocky, bearded highland people are closely related to the lowland Papuans and more distantly to the Melanesian populations of the Solomon islands. Today, over three million people live in the highlands of New Guinea. The harsh terrain and traditional inter-tribal warfare has lead to village isolation and the proliferation of distinct languages. Over 750 languages are spoken in New Guinea!

Diet:
The Huli subsist primarily on a diet of yams, manioc (also known as "cassava", a plant with a large starchy root) and on occasion meat from village raised pigs, wild cassowary (a large flightless bird related to the emu) or other forest game (such as tree kangaroos and cuscus - a marsupial with a yellow nose and prehensile tail). The first Westerners to visit the highlands in the 1920s were astounded to see vast valleys of carefully planned gardens and irrigation ditches.

Housing:
The Huli live in rounded grass huts; the two to four huts in each community are surrounded by split-wood and mud walls. The compound walls serve a dual purpose of keeping domesticated pigs in the compound and away from the gardens while keeping enemies and evil spirits out. Traditionally, the men sleep in one hut while the women and pigs (both considered the property of the men) sleep in a another. This practice has been discouraged by western missionaries, and today most villages keep pigs in a third hut. Villagers cover their bodies with pig-fat grease and ash to keep warm during the cold mountain mornings. At night, a small fire is kept inside the hut so that the heat - and smoke - fills the hut and keeps the occupants warm.

Clothing:
Westerners are often surprised by the traditional highland apparel. While women wear grass skirts, men wear nothing but a koteka, or "penis gourd." The gourd is tied under the man's genitals and around his waist with two pieces of string. While very few villagers in PNG still wear traditional clothing, many inhabitants of the Balem Valley in Irian Jaya proudly maintain this custom.

Religion:
Traditionally, the Huli are animists who abide by strict ritualized offerings to appease the spirits of their ancestors. Sickness and misfortune are thought to be the work of witchcraft and sorcery. Today, the PNG government states that 66% of residents are Christian and 34% "pantheist," though most village "Christians" who attend Sunday church services maintain a strong respect for resident spirits.

The Pygmies

Mbuti and Baka Pygmies live in the rainforests of Central Africa. Traditionally they live by hunting and gathering food.

Who are they?

There are many different 'Pygmy' peoples – for example, the Bambuti, the Batwa, the Bayaka and the Bagyeli ('Ba -' means 'people') – who live scattered over a huge area in central and western Africa, in the Democratic Republic of Congo (DRC), Congo (Brazzaville), Cameroon, Gabon, Central African Republic, Rwanda, Burundi and Uganda. In many places they are recognised as being the first inhabitants of the region. The different Pygmy groups speak different languages, mostly related to those of neighbouring non-Pygmy peoples. However there are a few words which are shared between even widely separated Pygmy tribes, suggesting they may have shared a language in the past. One of these shared words is the name of the forest spirit, Jengi.

How do they live?

The 'Pygmy' peoples are forest dwellers, and know the forest, its plants and its animals intimately. They live by hunting animals such as antelopes, pigs and monkeys, fishing, and gathering honey, wild yams, berries and other plants. For them, the forest is a kindly personal god, who provides for their needs. All Pygmy groups have close ties to neighbouring farming villagers, and work for them or exchange forest produce for crops and other goods. At its best this is a fair exchange, but it can involve exploitation of the Pygmies, especially where they have lost control of the forest and its resources.

What problems do they face?

'Pygmy' peoples see their rainforest homes threatened by logging, and are driven out by settlers. In some places they have been evicted and their land has been designated as national parks. They are routinely deprived of their rights by governments, which do not see these forest-dwellers as equal citizens. In Cameroon, the life of the Bagyeli is being disrupted by a World Bank-sponsored oil pipeline which is to be built through their land. The Batwa of eastern DRC, Rwanda, Burundi and Uganda have seen nearly all their forest destroyed, and barely survive as labourers and beggars.

The Yanomami

The Yanomami are an indigenous tribe (also called Yanamamo, Yanomam, and Sanuma) made up of four subdivisions of Indians which live in the tropical rain forest of Southern Venezuela and Northern Brazil. Each subdivision has its own language. They include the Sanema which live in the Northern Sector, the Ninam which live in the southeastern sector, the Yanomam which live in the southeastern part and the Yanomamo which live in the southwestern part of Yanomami area.

Of the approximately 20,000 Yanomami alive today, about 12,000 of these are Yanomamo.

Villages

The Yanomami live in about hundreds of small villages, grouped by families in one large communal dwelling called a Shabono or Yano; this disc-shaped structure with an open-air central plaza is an earthly version of their gods' abode. They hunt and fish over a wide range and tend gardens in harmony with the forest. Villages are autonomous but constantly will interact with each other. The villages, which contain between 40 and 300 individuals, are scattered thinly throughout the Amazon Forest. The distance between villages may vary from a few hours walk to a ten day walk.

Warriors

Though many Yanomami are peace, many are fierce warriors. Sometimes their warring is to capture women, so that their best warriors can maximize their reproductive success. In general, warring villages are usually several days walk from each other, where as tranquil ones may be less than a day. Villages will usually fission when the population reaches 100 to 150 people but in times of warfare villages will not split before they reach a population of around 300 individuals. Villages may go to war for a number of reasons and warfare makes up a large part of Yanomami life.

About 40% of adult males have killed another person and about 25% of adult males will die from some form of violence. Violence will vary from chest pounding, in which opponents take turns hitting each others on the chest, to club fights, to raids which may involve the killing of individuals and abducting the women, to all out warfare.

Spiritual Beliefs

The Yanomami people's traditions are shaped by the belief that the natural and spiritual world are a unified force; nature creates everything, and is sacred.
They believe that their fate, and the fate of all people, is inescapably linked to the fate of the environment; with its destruction, humanity is committing suicide.
Their spiritual leader is a shaman.

Trade

Trade also is another important aspect of Yanomami life and helps to reduce the chances of warfare between villages. Often one village will have manufactured goods that are badly needed by an other village. The village that depends on these goods will give the other village wives in return for the goods

Marriage

Marriage arrangements are not only vital in forging alliances but keeping the peace between families as well. Most women have prearranged marriages and marry at a young age. The preferred marriage is the "bilateral cross-cousin marriage" which helps produce strong relationships between families and villages.

Forest People (Hunters) - River People (Fishing)

Today about 95% of the Yanomami live deep within the Amazon forest as compared to the 5% who live along the major rivers. Compared to the "forest people," the "river people" are much more sedentary and subsist by fishing and trading goods such as canoes and hooks with other villages. The "forest people" are horticulturists as well as hunters and gathers.They will spend up to two hours of their day "garden farming" which is quite a labor intensive process. Some of the crops grown include sweet potatoes, bananas, sugar cane and tobacco. However as horticulturists the Yanomami do not get sufficient protein from their crops. Therefore the Yanomami will spend as much as 60% of their time trekking. Men usually make up the hunters and the women the gathers. Men will go on long distant hunts that may last up to a week. The fact that just about all of the Yanomami live deep within the forest has been quite significant for their survival. Since most outsiders have invaded the Amazon via the large rivers, the Yanomami have been able to live in isolation until very recently. Because of this they have been able to retain their culture and their identity which many Indians of the Amazon have lost.

Procedure:

Explore the People of the Rainforest (20 minutes)

The teacher will divide the students into groups of two to four. The teacher will then distribute three laminated pictures of people who live in the rainforest to each group. (The name of each group will be written on the back of each picture.) The students will be given ample time to write down what they notice about each picture. They should be encouraged to compare and to contrast the three different rainforest people pictures. Students should also be invited to write down any questions that they might have about the people in their pictures.

Once each group has had enough time to record their observations and their questions, the teacher will ask each group to share what they noticed. The teacher will write down the students' observations and questions on the board for each rainforest group. The teacher will also encourage the students to compare and contrast the people in the pictures to themselves.

Listen to the People of the Rainforest (15 minutes)

Once all of the students have had the chance to share their observations, the teacher will tell the students that they are going to compete in a listening challenge. The teacher will explain to the students that he/she will read a little bit of information about each group of people who live in the rainforest. The teacher will also emphasize the importance of listening very carefully to the details of each tribe because the information will be used to play a game.

After the students show that they understand the importance of listening, the teacher will show a picture of each group of people and read an information card about each group. The students should use their listening skills to absorb as many details about each group as possible.

Match the People of the Rainforest – Individual Group Activity (10 minutes)

The teacher will divide the students into five groups. The teacher will then distribute an envelope (that contains information about all three tribes) to each group. The students will be told not to open the envelope until the teacher tells them that it is time to open it. The teacher will explain to the students that in each of their envelopes are laminated cards of information for each tribe. The goal of the game is to be the first group to place all of the information cards with the right group of people. Once the students show that they understand how to play the game, the teacher will signal for the students to open their envelope. The teacher will walk around the room to monitor how each group is doing.

When a group believes that their answers are correct, they should raise their hand to signal for the teacher. In turn, the teacher will check the group's answers for accuracy. The first group to get all of their information correct will win the game.

Match the People of the Rainforest – Whole Class Activity (15 minutes)

Once the groups have had a chance to put the cards in the correct order, the teacher will tell the students to mix up their information cards and to put them back into the envelope. The teacher will explain to the students that now it is time for part two of this game.

For the second part, the class is challenged to complete the same matching task as a whole group. The competition is now to complete the activity with accuracy and speed as an entire class. The teacher will time the class three times. When the signal is given, the students will open their envelope and match their information cards to the proper rainforest group. When all of the class has accurately finished the task, the teacher will write their time on the board. The students will be given two more chances to better their class time. (The purpose of this completing this activity as a whole group is to encourage teamwork and to serve as a way to help drill the facts of the rainforest people into the students.)

Diary of a Person Who Lives in the Rainforest (30 minutes)

Students will be asked to put themselves in the shoes of one of the rainforest groups that they have just learned about. The teacher will ask the students to write a diary entry to describe a typical day for them. Students should focus on every detail from the time they wake up to the time they go to sleep. The more details they include the more realistic their story will sound.

Once the students have completed their diary entries, the teacher will encourage the students to share their stories with the rest of the class.

Possible Lesson Extensions

- Have the students research the answers to the questions they generated at the beginning of the lesson and report their answers to the class.
- Create a poster about a rainforest group.
- Create a diorama about a rainforest group.
- Create a song about a rainforest group.
- Create a play about a “day in the life” of a rainforest group.
- Create a board game about a rainforest group.
- Create a newspaper about a rainforest group.
- Use the diary entries of the class to create an entire Huli, Pygmy, or Yanomami diary.

Tribe Information Card

The Huli

Where do they live?

- They are one of many tribes that live in the remote highland forests of Papua New Guinea (which is an island situated south of the equator and north of Australia).

How do they survive?

- They live by hunting, gathering plants, and growing crops.

What kind of houses do they live in?

- The men and women live separately in large rounded grass huts.

What do they wear?

- The women wear grass skirts, and the men wear a gourd. The men decorate their bodies with colored clay and wear elaborate headdresses for ceremonies.

The Pygmies

Where do they live?

- They are one of many tribes that live in central and western Africa.

How do they survive?

- They live by hunting, gathering plants, and fishing.

What kind of houses do they live in?

- They live in dome-shaped huts made from leaves. Their mattresses are also made from leaves.

What do they wear?

- The women wear one or two bunches of green leaves, and the men wear a small piece of deer skin.

The Yanomami

Where do they live?

- They are one of many tribes that live South America.

How do they survive?

- They live by hunting, fishing, and farming.

What kind of houses do they live in?

- They live in a communal house called the yano. It is a large, circular building made out of vine and leaf thatch with a living space in the middle.

What do they wear?

- The women use cotton yarn to make their clothing and decorative waistbands, and the men wear cotton strings.

Student Game Card Information

The Huli

- **They are one of many tribes that live in the remote highland forests of Papua New Guinea (which is an island situated south of the equator and north of Australia).**

- **They live by hunting, gathering plants, and growing crops.**

- **The men and women live separately in large rounded grass huts.**

- **The women wear grass skirts, and the men wear a gourd.**

The Pygmies

- **They are one of many tribes that live in central and western Africa.**
- **They live by hunting, gathering plants, and fishing.**
- **They live in dome-shaped huts made from leaves. Their mattresses are also made from leaves.**
- **The women wear one or two bunches of green leaves, and the men wear a small piece of deer skin.**

The Yanomami

- **They are one of many tribes that live South America.**

- **They live by hunting, fishing, and farming.**

- **They live in a communal house called the yano. It is a large, circular building made out of vine and leaf thatch with a living space in the middle.**

- **The women use cotton yarn to make their clothing and decorative waistbands, and the men wear cotton strings.**

Lesson Title:
Lesson 7 – To Manage the Tropical Rainforest

Grade Level:
5th-8th Grade (Can be adapted for 2nd-4th Grade)

Objectives:
- To introduce students to individuals and groups that use the rainforest.
- To involve students in the decision-making process.
- To discover the merits of opposing viewpoints.
- To recognize the complexity of the deforestation issue, including environmental, social, economic, anthropological, and technological factors

Materials:
- "To Manage the Tropical Rainforest" Packet
    - 4 Transparencies
        - No. 1 "Decision: Choose Your Choice of Action:"
        - No. 2 "Decision: Now Hear From the People:"
        - No. 3 "Decision: Now You've Heard Other Points…:"
        - "To Manage the Tropical Rainforest" area map
- 20 Laminated Role Play Cards
- Overhead Projector (provided by school)

Procedure:

Section I

The teacher will distribute the laminated role play cards to the students. (The teacher should play the role of the narrator.) The teacher will use the map to explain that each student will have a role to play, and that the class as a whole will be called upon to make decisions regarding this particular rainforest area. (Note: For the roles of Arturo and Miguel, give two students these roles ahead of time so that they will be prepared for their presentations.)

The teacher will point out the following areas on the map transparency:
Capital City
Indian Village
River Settlement
Frontier Town
Wilderness
Road
River

Section I: Continued

The teacher will need to refer to the map during the role play activity. Be sure to organize the other transparencies near the overhead projector for use during the role play. After the class has begun the role play with Arturo and Miguel's introduction, place transparency No. 1 on the overhead and refer to it as you read the narration – "It's time to choose your course of action…" The teacher will see which choice the majority of the class would like to take by asking for a show of hands. The choices are: Stop the road; Build the road as planned;Further study needed. Read the consequences for the majority's decision, and for a balanced understanding of the situation, read to the consequences to the other decisions also. Make sure and read Further study last so that you can enter into Section II of the activity.

Section II

"Further study is the key to forming a workable plan of action." The teacher will read the narration, "For other points of view on the road building issue, you may choose business interests in the city, etc…."

The teacher will now ask the group as a whole which groups of people they would like to hear from:

- Business interests in the city
- Scientists in the wilderness
- Indians
- River settlers
- Colonists in the frontier town

The teacher will place transparency number 2 on the overhead projector. As the students choose which group they would like to hear from, the teacher will let them decide if they would like to hear that groups opinion on either or all of the following:

a. Build the road as planned
b. Build the road and declare a park
c. Build the road at another place
d. Stop the road
e. Talk to another group

NOTE: Referring to the transparency will clarify this situation for you. Use it to lead the discussion. As particular students' roles come up, ask them to read their role card or ad lib if possible.

Section III

After the students have heard other points of view and feel ready to make a decision, place transparency number 3 on the overhead projector. The teacher will ask the students for their decision. Read and discuss the consequences of their decision. Then, read the consequences of the other decisions. Discuss the complexity of the rainforest issue and let students air their opinions.

"To Manage the Rainforest"

A Role Play Activity

Adapted from the
Interactive Video Program by Crawford Communications in the SITES Exhibition:

Tropical Rainforests: A Disappearing Treasure

Section I

Narrator:

Glad you decided to take this assignment. Congratulations on your new job as Manager of Resources for a state in Amazonia. From the air, you can see the state is made up mostly of tropical rainforest, much of it, as yet, untouched by developers.

On your first day, you've journeyed by plane to the government's regional office in a boom town on the edge of the frontier. From here, you can get a first hand look at the state's rainforest and the people who want to colonize it. After all, its future is now in your hands. First, meet your two key advisors.

Arturo:

"Hello, I'm Arturo Mendez."

Miguel:

"And I'm Miguel Oeste. Welcome. We have been awaiting your arrival. The state needs your foresight more than every before. Come, sit down."

Arturo:

(looking concerned) Yes, we have our hands full, it is true. Past regimes have left us with policies that don't work, and YOU must act NOW to insure our country's future. Time you see, is a great enemy of ours.

Miguel:

Indeed. And your first decision must be what to do about the road that's being build. Look…the state has long been the home of native Indian tribes who hunt and farm deep in the Western forest, and set up their villages near the river. Other river settlements, established by non-Indians, have grown up along major tributaries, the largest one here on the southern fork. They make a living by tapping rubber, and selling other forest products like their grandparents did.

Section I - Continued

Arturo:

Yes, but those groups now have visitors, our countrymen who gather in frontier towns, waiting for their chance to homestead a piece of the forest. They, of course, want to be connected to our capital city, where many of them used to live. And, of course, there are the scientists who want to study our forests before they are changed by civilization.

Miguel:

So, you see, the previous administration began to build a road. It is completed up to this point, and construction continues each day. Unless something is done, the proposed route will cut right across our state.

Narrator:

It's time to choose your course of action…to build the road as planned, to stop the road, or to begin further study. You may review the map, if needed.

CONSEQUENCES OF STOPPING THE ROAD

Narrator:

The consequences of your abrupt stopping of the road may surprise you. The large international bank financing the project was bound by some environmental safeguards, while the local developers that later took over the project were not.

And, while the virgin forest was saved from immediate colonization, within five years poachers and settlers brought widespread destruction to much of the rainforest and disease to the Indians. Your countrymen protested the delays in getting the road built. They blamed you for taking away their hope, and you were fired from the office. While your intentions were good, further research was actually needed to form a workable plan of action.

Miguel:

Won't you reconsider your decision? I think there's some information you are overlooking.

CONSEQUENCES OF BUILDING THE ROAD

Narrator:

Building the road as planned was not a wise decision. While your country did export timber, rice, and cacao along the new truck route, environmentalists say the nation's number one export was topsoil. Within five years, nearly all of the virgin forest lands were cleared by colonists. Much of them are now covered with scrub and failing cattle ranches. Violent clashes between Indians and colonists became a regular occurrence, making the frontier too dangerous for families who had wanted to homestead. Efforts were made to regenerate some forest by planting pine trees but scientists estimate it will take hundreds of years to regrow the rainforest. And even though this will help stem erosion, some ten thousand species of plants and animals can never be brought back from extinction. Although your intent was progress for your country, further research was actually needed to form a workable plan of action.

Section II

FURTHER STUDY OPTION

Narrator:

Congratulations…further study is indeed the key to forming a workable plan of action.

Miguel:

There are many ways to look at this, but I think I have come up with an alternative that will solve all of our problems. Take a look. We build a road along the same proposed route, but we declare the land around it a park. That way we can control what goes on there.

Arturo:

No, there is a better plan. Here I'll show you. We stop the road as planned and reroute it so it doesn't cut through this part of the rainforest. That solves the Indian question and lets our people still colonize other parts of the forest.

Miguel:

But, you have heard enough from us. Now, we must go to the people. Time allows you to hear from only five of our countrymen. So, please select them carefully.

Narrator:

For other points of view on the road building issue, you may choose business interests in the city, scientists in the wilderness, Indians, river settlers, or colonists in a frontier town.

CITY/BUILD THE ROAD

Banker No. 1:

The road is needed and should be built. Sure, we in the international banking community have made some mistakes in the past, but we've learned from them. We've set up safeguards for conservation and we are confident the needs of the Indians and the environmentalists will be dealt with.

CITY/BUILD ROAD/DECLARE A PARK

Mining Company Executive:

Make a park out of the forest? We're sitting on a fortune in gold, iron, and tin. And you expect my company and others to sit by while we waste those valuable resources?

CITY/BUILD ROAD ANOTHER PLACE

Agribusiness Executive:

To reroute the road would simply take too much time. Our nations agribusiness cannot grow without access to new markets and with the rainy season starting in less than three months we must finish the current road as quickly as possible.

CITY/STOP THE ROAD

Banker No. 2:

As a banker, I can tell you that to stop the road would be foolish. It will provide badly needed social services to the river settlers and the Indians and besides, too much money is tied up in the project already. Rerouting it would another expensive waste of time.

WILDNERNESS/BUILD THE ROAD

Soil Expert:

Build this road and the area will be exploited and abandoned within five years. Without strict safeguards, this pattern of clearing the forest, trying to farm it, logging it at random, and eventually cattle ranching will just plain destroy the soil. The people the government is trying to help will actually be worse off than before they came.

WILDERNESS/BUILD ROAD/DECLARE A PARK

Botanist:

Creating a multiple-use park is the wisest choice for everyone concerned. It's been done successfully in places like Panama, where the Kuna Indians have title to their native lands, and use their knowledge to help manage the forests' resources.

WILDERNESS/BUILD ROAD ANOTHER PLACE

Biologist No. 1:

Rerouting the road is curing the symptom, not the disease. You must realize that a road project will cause similar environmental problems wherever it crosses the rainforest. We are talking about the greatest evolutionary theater in the world!

WILDERNESS/STOP THE ROAD

Biologist No. 2:

We must stop the road now, before any further damage is done. We've seen projects like this result in disastrous levels of deforestation in a very short time. And, of course, we've just begun to document even the species we'd be losing.

INDIAN VILLAGE/BUILD THE ROAD

Indian Leader No. 1:

If the road is built, we will lose the land that has been our home since ancient memory. Colonists, miners, and ranchers will destroy our livelihood. They will tear down trees that give us food, medicine, and shelter. Our people will become beggars in your cities.

INDIAN VILLAGE/ BUILD ROAD/DECLARE A PARK

Indian Leader No. 2:

We would welcome a reserve, as long as we secure legal title to our land, and have control of the park. We have lived in harmony with the forest for as long as we have existed, and we would share our knowledge with those who want to save it.

INDIAN VILLAGE/BUILD ROAD ANOTHER PLACE

Indian Leader No. 3:

Wherever you try to build a road, native people will be displaced. Other tribes may have to hunt in our hunting grounds and we will have to defend our livelihood from them. No, cutting open our neighbors' forests is not the answer.

INDIAN VILLAGE/STOP THE ROAD

Indian Leader No. 4:

The road will cut through our home like a knife. We will lose our hunting grounds, our pharmacy, the burial grounds of our ancestors…and for no reason. Settlers should use the river as their highway, as our people always have. Besides, the river is free and it never turns to mud in the tropical rains.

RIVER SETTLEMENT/ BUILD THE ROAD

Hunter/Gatherer:

We use the river to ship our product to market, just the way our grandparents did. But building a road would allow us to ship greater quantities, and that would be progress, I guess. Just as long as we don't lose the forest---because without trees, we have nothing.

RIVER SETTLEMENT/ BUILD ROAD/ DECLARE A PARK

Rubber Tapper No. 1:

A park sounds like a good idea to me, as long as we rubber trappers fit into the picture. We would cooperate if we could continue to grow gardens, and hunt and collect plants in the forest. With a park, at least the speculators and poachers might be kept out.

RIVER SETTLEMENT/ BUILD ROAD ANOTHER PLACE

Rubber Tapper No. 2:

Yes, build the road someplace else. We need the trees and the river for our very livelihood, and we can't risk throwing all that away---not for someone else's idea of progress.

RIVER SETTLEMENT/ STOP THE ROAD

Rubber Tapper No. 3:

We make a decent living now, though we could do a bit better with a truck rout to the capital. But a road would bring in settlers and spectators, and they might destroy the forest we depend upon for rubber, wood, and of course, hunting.

FRONTIER TOWN/ BUILD THE ROAD

Urban Migrant:

We have a deed for a five hectare homestead – just enough land to grow food for our family and maybe keep a cow. Please – we need the road to start our new life.

FRONTIER TOWN/ BUILD ROAD/ DECLARE A PARK

Farmer:

A park wouldn't be fair. We need to grow food for our families and hunt in the forest. We're trying to make the forests productive for people. How can you put plants and animals ahead of our children?

FRONTIER TOWN/ BUILD ROAD ANOTHER PLACE

Merchant in Frontier Town:

I am a merchant, a businessman. I ask you, what good is a road some place else? Our town would dry up. No, we must not move the road to protect some Indians and animals. They don't need all that land, we do.

FRONTIER TOWN/ STOP THE ROAD

Subsistence Farmer from Temperate Zone:

You can't stop the road…it's our only hope! We were driven off our land in the south, and now my family must settle here and make a go of it. We don't want trouble with the Indians; if they leave us alone, we'll leave them alone.

Section III – MAKE A DECISION

Narrator:

Now that you've heard other points of view, please choose the best course of action: Build the road as planned, stop the road, build the road and declare a park, or build the road another place.

CONSEQUENCES/STOP THE ROAD

Narrator:

Stopping the road was a short-tem solution to a long-term problem. The committee you set up to heal the wound of the unfinished road was met with widespread protest – from colonists, industrialists, and even other government officials. They made the road a national referendum, and when it passed, your resigned your position in defeat.

The Indians were temporarily spared from clashes with colonists, but were forced to deal with a more dangerous foe – the poacher and the speculator. Violence increased, and within five years, a third of the Indians were wiped out.

Scientists were able to document thousands of new plant species, and discovered a potential new drug treatment for leukemia. But, in just ten years after your successor built the road, massive deforestation took place, and the species that provided the drug was all but extinct.

Choosing a more diverse group of viewpoints would have alerted you to potential drawbacks of simply stopping the road. So, while your intent was admirable, your plan was not a workable solution to the state's complex problems.

CONSEQUENCES/BUILD THE ROAD

(Good or Inadequate Research)

Narrator:

Although your intent was progress for your country, recognition of the complexity of this issue was needed to insure a successful outcome.

CONSEQUENCES/BUILD ROAD/ DECLARE A PARK

(Good Research)

Narrator:

You have made a careful and wise decision. With the creation of a park the Indians and river settlers were trained as park guards, and have since earned a respectable income. They formed a cooperative to increase the efficiency of their export business, and used the extra income to build a schoolhouse and pay a doctor to come more often, using the road.

A new plant species with anti-cancer properties was discovered by scientists working in the park. And the Indians worked with anthropologists to document and save their oral tradition.

The colonists remained on the boundary of the park and were taught methods of sustainable agriculture. Recognizing these successes, the government and the international banking community declared the park a model for development.

They granted the Indians and river settlers legal title to their lands, and started plants for similar parks in other forested parts of the country.

Your extensive research paid off. Thanks to you, your state's people and resources were benefitting from a plan that protects both.

CONSEQUENCES/BUILD ROAD/DECLARE A PARK

(Inadequate Research)

Narrator:

Your plan to continue the road and create a park around it was basically sound. However, inadequate planning led to some unfortunate consequences. The park was declared hastily, but no provisions wee made for training or equipping guards. The wilderness area was quickly invaded by colonists, who cleared it, and by cattle ranchers, when attempts to farm it failed. Your office knew this was happening, but was powerless to stop it.

The Indians were not included in the planning of the park, and were angered to learn that their traditional hunting grounds were made off limits to them. They defied the rule and hunted in the park anyway.

The river settlement became a boom town for illegal miners who clashed with the Indians, tore up surrounding forest, and polluted the river with silt and chemicals. Within ten years, the river settlers' way of life was destroyed.

Politicians and businessmen saw the failure of this park as justification for abandoning other park projects. They decided to continue building the road beyond the river settlement into unoccupied areas of the frontier.

While your intentions were good, further study was actually needed to insure your park's success. But at least you tried, and your efforts came close to a workable solution.

CONSEQUENCES/ BUILD ROAD ANOTHER PLACE

(Good or Inadequate Research)

Narrator:

Re-routing the road was not the answer. Colonists still invaded the wilderness area, claiming their homesteads despite you having stopped the original road.

The Indian territory was invaded by nomadic tribes who were displaced by the new land. This forced the Indians to fight each other, as well as speculators, for the right to hunting grounds.

Poachers destroyed the forest around the river settlement, which ruined the livelihood of rubber tappers and plant gatherers.

And along the new road, wilderness areas were slashed and burned at an alarming rate. Scientists estimate several hundred potentially useful plant species became locally extinct.

The re-routed road was a disaster, extremely expensive, and still was not finished three years later. Politicians and bankers blamed it all on the factions that opposed the original road. They vowed they'd never again be duped into a compromise on any development project.

While your intention to protect the Indians was admirable, your solution to the road-building question was far from effective.

Though you tried to solve a few problems, you invited many more.