

## Rainforest Worksheet

**Please state whether these questions are true or false and then please state why you came to this decision.**

1. The Amazon River has more species of fish than the entire North American continent.
2. The tropical rainforests of Southeast Asia have more mammal species than the United States, an area twice as large.
3. Citizens of developed countries have enormous power that can be put to work to save the forest.

**Questions to think about:**

1. What accounts for the biodiversity of the rainforest?
2. Why have the numbers of indigenous tribes dropped so drastically?
3. What percentage of the earth's surface do rainforests cover? What percentage is that down from?
4. How many plants have the U.S. National Cancer Institute identified that are active against cancer cells. What percentage grows in the rainforest?
5. Why has the Amazon Rainforest been described as the "Lung of our planet"?
6. What does one hectare contain?
7. Why has the scale of human pressure on ecosystems everywhere increased?
8. How many acres of rainforest are burned every day?

9. What consequences does deforestation bring?
10. Name five reasons why rainforest ecosystems are so biologically diverse, and has such an impact on the world?
11. What percentage of the rainforests species have been studied by scientists?
12. In what nine countries is the Amazon rainforest located?
13. What are the four layers of the rainforest? Describe each one.
14. What is the major limiting factor of the rainforest?  
Sunlight
15. How can you be an eco-consumer?
16. Name five products found in the rainforest.
17. Over how many inches of rainfall can rainforests receive each year?
18. What are the three major rainforest zones?
19. What prevents the accumulation of humus in the rainforest?
20. Name and describe the five growth formations of plants in the rainforest.



# Rainforest



- I. Rainforest General Information
  - a. Very dense, warm, wet forests
  - b. Harbor at least half of the world's life forms
  - c. Location of rainforests is influenced by global climate
  - d. Humid tropics around the equator
  - e. It is almost always raining in the rainforest. Rainforests can get over 80 inches of rain each year.
  - f. The soil of a tropical rainforest is only about 3 - 4 inches thick and is ancient. Thick clay lies underneath the soil. Temperate rainforests have soil that is richer in nutrients, relatively young and less prone to damage.
  - g. There are tropical rainforest and temperate rainforests.
    - i. Tropical rainforest are found in South America, Central America, Africa, Southeast Asia and Australia
    - ii. Temperate rainforests have wet and dry seasons. In a dry season, coastal fog helps supply moisture to the forest. They are found in New Zealand, Tasmania, Chile, Ireland, Scotland and Norway.
- II. Protecting the Planet
  - a. Help maintain climatic conditions necessary for their own survival
  - b. Protect watersheds upon which millions of depend
  - c. Forest vegetation acts like a sponge
  - d. Where forests have been cut down heavy rainfall compacts and erodes the soil
  - e. The plants of the rainforest generate much of the Earth's oxygen. These plants are also very important to people in other ways; many are used in new drugs that fight disease and illness.
- III. Rainforests and Greenhouse Warming
  - a. Loss of rainforest is recognized as a factor in global warming, as excess "greenhouse" gases build up in the atmosphere
    - i. Example of greenhouse gas, carbon dioxide, admit sunlight but trap heat that is radiated from the Earth's surface
  - b. Through a process called photosynthesis plants absorb carbon dioxide and store carbon as living tissue giving off oxygen.
- IV. Layers of a Rainforest
  - a. The Forest Floor
    - i. Fairly open area, carpeted with moss and decaying leaves
    - ii. Higher up there is a dense ceiling of leaves and branches that blocks out most of the sunlight

- iii. Layer is dark and wet and very green
  - iv. Inhabitants are decomposers that live on leaf litter and other debris. Termites, giant earthworms, millipedes, and beetles that eat decaying plants and animals
  - v. In Central America you might see an anaconda, jaguar, caiman, armadillo, a poison arrow frog, army ants, leafcutter ants, and flightless birds.
- b. The Understory
- i. Upper parts of the trees
  - ii. Tangle of shrubs, young trees, palms, and woody plants that can grow in the shade of taller trees
  - iii. Leaves of many of the plants are large so they can absorb as much sunlight as possible
  - iv. Full of life and you can find animals like bats, snakes, birds, red-eyed tree frog, iguana, tarantula, spider monkeys, and jaguar
- c. The Canopy
- i. Trees get as high as 100 feet tall form a green roof over the forest below
  - ii. Gets much of the rainfall, but it keeps the rain from falling on the understory
  - iii. The leaves on the plants in the canopy are pointed, so that the rain can run off the tips of the leaves. These "drip tips" keep the leaves dry and free from mold.
  - iv. There is abundant food and sunlight for thousands of animals and plants.
  - v. Most of the animal and plant species in the rainforest live in the canopy
  - vi. Find animals like three-toed sloth, toucans, parrots, macaws, spider monkeys, butterflies, snakes
- d. The Emergent Layer
- i. Trees grow as tall as 250 feet
  - ii. Trees here receive the hot sun, wind, and rain
  - iii. Houses many birds and insects
  - iv. Have thick, waxy leaves to help them retain water and protect themselves from the sun and wind
- V. Animals of the rainforest
- a. Millions of mammals, birds, insects, amphibians and reptiles call the rainforest home.
  - b. Insects are the most numerous animals in the rainforest
  - c. Tropical rainforest have a greater diversity of plants and animals than temperate rainforest.
  - d. In temperate rainforest, most of the animals are ground dwellers and there are fewer animals living in the forest canopy.
- VI. People of the rainforest

- a. There are many indigenous groups of people who have lived in the tropical rainforests.
- b. Many groups like the Yanomamo tribe of the Amazon rainforest in Brazil and Venezuela have lived in scattered villages in the rainforests for thousands of years.
- c. These tribes get their food, clothing, and housing mainly from materials they obtain in the forest

VII. Products from the rainforest

a. BEDROOM

- i. MATTRESS: Contains kapok fibers taken from pods found in one of the tallest trees in the forest.
- ii. LEATHER: Tannins, used to treat leather goods so they won't decompose, come from chemical compounds found in seeds, roots, leaves and the bark of certain tropical trees, such as mangroves and quebrachos.
- iii. CLOTHES: Many clothes, including some jeans, contain hemp. Many clothes get their color from dyes made from rainforest plants.

b. HOME OFFICE

- i. DOLLAR BILL: "Paper" money is made with abaca fibers, a material similar to hemp.
- ii. STAMP AND ENVELOPES: The sticky stuff on stamps and envelopes is produced with oil from the sassafras plant.

c. BATHROOM

- i. TISSUES: Gum karaka, a tropical rainforest gum, helps hold together the fibers in light papers such as tissue.
- ii. TOOTHBRUSH: The bristles in your toothbrush may be made from fibers found in certain varieties of palm trees.
- iii. DEODERANT: It often contains Brazilian sassafras oil, which provides the odor-inhibiting substance called saffrole.
- iv. MOUTHWASH: It is often enhanced with the antiseptic properties of resins or saps from tropical trees.

d. LIVING ROOM

- i. HOUSE PLANTS: Many plants in our homes and nurseries are imported from rainforests, including orchids, African violets and philodendrons.
- ii. MUSICAL INSTRUMENTS: Many wooden instruments, including guitars and pianos, are made with rainforest woods.

e. KITCHEN

- i. NUTS: Brazil nuts grow in trees that produce up to 300 pods full of nuts in a single tree.
- ii. VITAMINS: The smooth capsules that encase many vitamins are made with lac resin, secreted by a tiny insect that lives in the tropical forests of India and Thailand.
- iii. BEVERAGES: One of the major ingredients in cola is derived from the kola nut, a distant relative of the cocoa bean.

- iv. FRUITS: Many fruits grow in the rainforest, including mangoes, kiwis and papayas.
- v. CHOCOLATE: It is made from the tropical cocoa bean.
- vi. SPICES: Almost every spice we use comes from rainforests, including cinnamon, nutmeg, allspice and the vanilla bean.

f. GARAGE

- i. AUTO PARTS: Natural rubber from the rainforest is used in windshield wipers, transmission belts and tires. Natural rubber from Brazil and Southeast Asia provides one-third of the world's total rubber supply.
- ii. LIFE VESTS AND SLEEPING BAGS: These insulated items often contain kapok, which comes from the forests of Thailand, Brazil and India.
- iii. ATHLETIC SHOES: The rubber soles on athletic shoes are made with natural rubber, tapped from an Amazon tree called *Hevea brasiliensis*.

VIII. How You Can Help

a. Be an Eco-Consumer

- i. Know that it is a fragile ecosystem
- ii. Avoid products that come from regions where there are rainforests
- iii. In the case of rainforest beef, consumer awareness has led fast food franchises like McDonalds and Burger King to stop buying beef raised to cleared tropical rainforest land.
- iv. Timber is another problem. Over half of the hardwood timber cut down from tropical forests is destined for foreign markets with Japan, Europe, and the United States the top importers.



## The Disappearing Rainforests

- We are losing Earth's greatest biological treasures just as we are beginning to appreciate their true value. Rainforests once covered 14% of the earth's land surface; now they cover a mere 6% and experts estimate that the last remaining rainforests could be consumed in less than 40 years.
- One and one-half acres of rainforest are lost every second with tragic consequences for both developing and industrial countries.
- Rainforests are being destroyed because the value of rainforest land is perceived as only the value of its timber by short-sighted governments, multi-national logging companies, and land owners.
- Nearly half of the world's species of plants, animals and microorganisms will be destroyed or severely threatened over the next quarter century due to rainforest deforestation.
- Experts estimates that we are losing 137 plant, animal and insect species every single day due to rainforest deforestation. That equates to 50,000 species a year. As the rainforest species disappear, so do many possible cures for life-threatening diseases. Currently, 121 prescription drugs sold worldwide come from plant-derived sources. While 25% of Western pharmaceuticals are derived from rainforest ingredients, less than 1% of these tropical trees and plants have been tested by scientists.
- Most rainforests are cleared by chainsaws, bulldozers and fires for its timber value and then are followed by farming and ranching operations, even by world giants like Mitsubishi Corporation, Georgia Pacific, Texaco and Unocal.
- There were an estimated ten million Indians living in the Amazonian Rainforest five centuries ago. Today there are less than 200,000.
- In Brazil alone, European colonists have destroyed more than 90 indigenous tribes since the 1900's. With them have gone centuries of accumulated knowledge of the medicinal value of rainforest species. As their homelands continue to be destroyed by deforestation, rainforest peoples are also disappearing.
- Most medicine men and shamans remaining in the Rainforests today are 70 years old or more. Each time a rainforest medicine man dies, it is as if a library has burned down.
- When a medicine man dies without passing his arts on to the next generation, the tribe and the world loses thousands of years of irreplaceable knowledge about medicinal plants.

## Rainforest Action

- Experts agree that by leaving the rainforests intact and harvesting its many nuts, fruits, oil-producing plants, and medicinal plants, the rainforest has more economic value than if they were cut down to make grazing land for cattle or for timber.
- The latest statistics show that rainforest land converted to cattle operations yields the land owner \$60 per acre and if timber is harvested, the land is worth \$400 per acre. However, if these renewable and sustainable resources are harvested, the land will yield the land owner \$2,400 per acre.
- If managed properly, the rainforest can provide the world's need for these natural resources on a perpetual basis.
- Promoting the use of these sustainable and renewable sources could stop the destruction of the rainforests. By creating a new source of income harvesting the medicinal plants, fruits nuts, oil and other sustainable resources, the rainforests is be more valuable alive than cut and burned.
- Sufficient demand of sustainable and ecologically harvested rainforest products is necessary for preservation efforts to succeed. Purchasing sustainable rainforest products can effect positive change by creating a market for these products while supporting the native people's economy and provides the economic solution and alternative to cutting the forest just for the value of its timber.

### THE IMPORTANCE OF THE RAINFOREST

The beauty, majesty, and timelessness of a primary rainforest are indescribable. It is impossible to capture on film, to describe in words, or to explain to those who have never had the awe-inspiring experience of standing in the heart of a primary rainforest.

Rainforests have evolved over millions of years to turn into the incredibly complex environments they are today. Rainforests represent a store of living and breathing renewable natural resources that for eons, by virtue of their richness in both animal and plant species, have contributed a wealth of resources for the survival and well-being of humankind. These resources have included basic food supplies, clothing, shelter, fuel, spices, industrial raw materials, and medicine for all those who have lived in the majesty of the forest. However, the inner dynamics of a tropical rainforest is an intricate and fragile system. Everything is so interdependent that upsetting one part can lead to unknown damage or even destruction of the whole. Sadly, it has taken only a century of human intervention to destroy what nature designed to last forever.

The scale of human pressures on ecosystems everywhere has increased enormously in the last few decades. Since 1980 the global economy has tripled in size and the world population has increased by 30 percent. Consumption of everything on the planet has risen- at a cost to our ecosystems. In 2001, The World Resources Institute estimated that the demand for rice, wheat, and corn is



expected to grow by 40% by 2020, increasing irrigation water demands by 50% or more. They further reported that the demand for wood could double by the year 2050; unfortunately, it is still the tropical forests of the world that supply the bulk of the world's demand for wood.

In 1950, about 15 percent of the Earth's land surface was covered by rainforest. Today, more than half has already gone up in smoke. In fewer than fifty years, more than half of the world's tropical rainforests have fallen victim to fire and the chain saw, and the rate of destruction is still accelerating. Unbelievably, more than 200,000 acres of rainforest are burned every day. That is more than 150 acres lost every minute of every day, and 78 million acres lost every year! More than 20 percent of the Amazon rainforest is already gone, and much more is severely threatened as the destruction continues. It is estimated that the Amazon alone is vanishing at a rate of 20,000 square miles a year. If nothing is done to curb this trend, the entire Amazon could well be gone within fifty years.

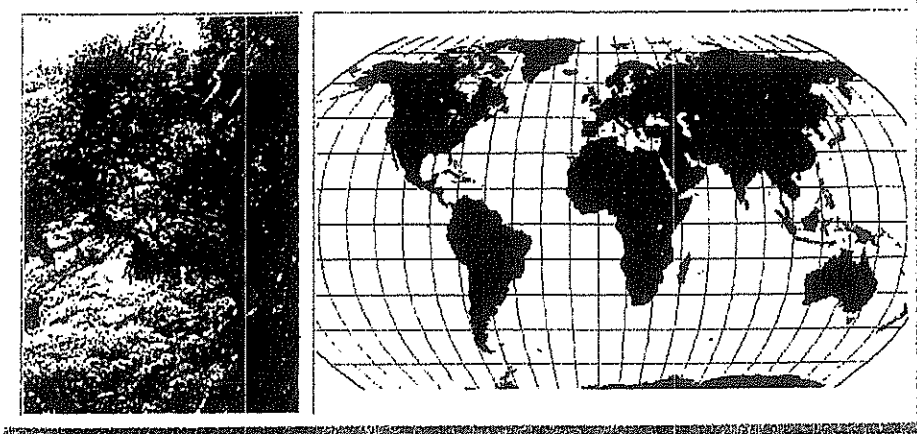
Massive deforestation brings with it many ugly consequences-air and water pollution, soil erosion, malaria epidemics, the release of carbon dioxide into the atmosphere, the eviction and decimation of indigenous Indian tribes, and the loss of biodiversity through extinction of plants and animals. Fewer rainforests mean less rain, less oxygen for us to breathe, and an increased threat from global warming. (a)

But who is really to blame? Consider what we industrialized Americans have done to our own homeland. We converted 90 percent of North America's virgin forests into firewood, shingles, furniture, railroad ties, and paper. Other industrialized countries have done no better. Malaysia, Indonesia, Brazil, and other tropical countries with rainforests are often branded as "environmental villains" of the world, mainly because of their reported levels of destruction of their rainforests. But despite the levels of deforestation, up to 60 percent of their territory is still covered by natural tropical forests. In fact, today, much of the pressures on their remaining rainforests comes from servicing the needs and markets for wood products in industrialized countries that have already depleted their own natural resources. Industrial countries would not be buying rainforest hardwoods and timber had we not cut down our own trees long ago, nor would poachers in the Amazon jungle be slaughtering jaguar, ocelot, caiman, and otter if we did not provide lucrative markets for their skins in Berlin, Paris, and Tokyo.

## **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.

## Tropical Broadleaf Evergreen Forest: The Rainforest



**Introduction.** The tropical rainforest is earth's most complex biome in terms of both structure and species diversity. It occurs under optimal growing conditions: abundant precipitation and year round warmth. There is no annual rhythm to the forest; rather each species has evolved its own flowering and fruiting seasons. Sunlight is a major limiting factor. A variety of strategies have been successful in the struggle to reach light or to adapt to the low intensity of light beneath the canopy.

**Climate:** (Koeppen's Af and Am climate types.) Mean monthly temperatures are above 64 ° F; precipitation is often in excess of 100 inches a year. There is usually a brief season of reduced precipitation. In monsoonal areas, there is a real dry season, but that is more than compensated for with abundant precipitation the rest of the year.

**Vegetation:** A vertical stratification of three layer of trees is apparent.. These layers have been identified as A, B, and C layers:

- A layer: the emergents. Widely spaced trees 100 to 120 feet tall and with umbrella-shaped canopies extend above the general canopy of the forest. Since they must contend with drying winds, they tend to have small leaves and some species are deciduous during the brief dry season.
- B layer: a closed canopy of 80 foot trees. Light is readily available at the top of this layer, but greatly reduced below it.
- C layer: a closed canopy of 60 foot trees. There is little air movement in this zone and consequently humidity is constantly high.
- Shrub/sapling layer: Less than 3 percent of the light intercepted at the top of the forest canopy passes to this layer. Arrested growth is characteristic of young trees capable of a rapid surge of growth when a gap in canopy above them opens.
- Ground layer: sparse plant growth. Less than 1 percent of the light that strikes the top of the forest penetrates to the forest floor. In such darkness few green plants grow. Moisture is also reduced by the canopy above: one third of the precipitation is intercepted before it reaches the ground.

- 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 tropical 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. 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.

## **THE AMAZON RAINFOREST . . . THE LAST FRONTIER ON EARTH**

If Amazonia were a country, it would be the ninth largest in the world. The Amazon rainforest, the world's greatest remaining natural resource, is the most powerful and bioactively diverse natural phenomenon on the planet. It has been described as the "lungs of our planet" because it provides the essential service of continuously recycling carbon dioxide into oxygen. It is estimated that more than 20 percent of Earth's oxygen is produced in this area.

The Amazon covers more than 1.2 billion acres, representing two-fifths of the enormous South American continent, and is found in nine South American countries: Brazil, Colombia, Peru, Venezuela, Ecuador, Bolivia, Guyana, French

Guiana, and Suriname. With 2.5 million square miles of rainforest, the Amazon rainforest represents 54 percent of the total rainforests left on Earth.

# The Wealth of the Rainforests

- The Amazon Rainforest covers over a billion acres, encompassing areas in Brazil, Venezuela, Colombia and the Eastern Andean region of Ecuador and Peru. If Amazonia were a country, it would be the ninth largest in the world.
- The Amazon Rainforest has been described as the "Lungs of our Planet" because it provides the essential environmental world service of continuously recycling carbon dioxide into oxygen. More than 20 percent of the world oxygen is produced in the Amazon Rainforest.
- More than half of the world's estimated 10 million species of plants, animals and insects live in the tropical rainforests. One-fifth of the world's fresh water is in the Amazon Basin.
- One hectare (2.47 acres) may contain over 750 types of trees and 1500 species of higher plants.
- At least 80% of the developed world's diet originated in the tropical rainforest. Its bountiful gifts to the world include fruits like avocados, coconuts, figs, oranges, lemons, grapefruit, bananas, guavas, pineapples, mangos and tomatoes; vegetables including corn, potatoes, rice, winter squash and yams; spices like black pepper, cayenne, chocolate, cinnamon, cloves, ginger, sugar cane, tumeric, coffee and vanilla and nuts including Brazil nuts and cashews.
- At least 3000 fruits are found in the rainforests; of these only 200 are now in use in the Western World. The Indians of the rainforest use over 2,000.
- Rainforest plants are rich in secondary metabolites, particularly alkaloids. Biochemists believe alkaloids protect plants from disease and insect attacks. Many alkaloids from higher plants have proven to be of medicinal value and benefit.
- Currently, 121 prescription drugs currently sold worldwide come from plant-derived sources. And while 25% of Western pharmaceuticals are derived from rainforest ingredients, less than 1% of these tropical trees and plants have been tested by scientists.
- The U.S. National Cancer Institute has identified 3000 plants that are active against cancer cells. 70% of these plants are found in the rainforest. Twenty-five percent of the active ingredients in today's cancer-fighting drugs come from organisms found only in the rainforest.
- Vincristine, extracted from the rainforest plant, periwinkle, is one of the world's most powerful anticancer drugs. It has dramatically increased the survival rate for acute childhood leukemia since its discovery.
- In 1983, there were no U.S. pharmaceutical manufacturers involved in research programs to discover new drugs or cures from plants. Today, over 100 pharmaceutical companies and several branches of the US government, including giants like Merck and The National Cancer Institute, are engaged in plant research projects for possible drugs and cures for viruses, infections, cancer, and even AIDS.

- **Cauliflory**, the development of flowers (and hence fruits) directly from the trunk, rather than at the tips of branches.
- **Large fleshy fruits** attract birds, mammals, and even fish as dispersal agents.

**Soil: Oxisols**, infertile, deeply weathered and severely leached, have developed on the ancient Gondwanan shields. Rapid bacterial decay prevents the accumulation of humus. The concentration of iron and aluminum oxides by the laterization process gives the oxisols a bright red color and sometimes produces minable deposits (e.g., bauxite). On younger substrates, especially of volcanic origin, tropical soils may be quite fertile.

**Subclimaxes:** Distinct communities (varzea) develop on floodplains. Jungles may line rivers where sunlight penetrates all layers of the forest. Where forests have long been cleared and laterites have developed to cause season waterlogging of the substrate, tropical grasslands and palm savannas occur.

**Fauna:** Animal life is highly diverse. Common characteristics found among mammals and birds (and reptiles and amphibians, too) include adaptations to an arboreal life (for example, the prehensile tails of New World monkeys), bright colors and sharp patterns, loud vocalizations, and diets heavy on fruits.

**Distribution of biome:** The tropical rainforest is found between 10 ° N and 10 ° S latitude at elevations below 3,000 feet. There are three major, disjunct formations:

- Neotropical (Amazonia into Central America)
- African (Zaire Basin with an outlier in West Africa; also eastern Madagascar)
- Indo-Malaysian (west coast of India, Assam, southeast Asia, New Guinea and Queensland, Australia).

The species composition and even genera and families are distinct in each. They also differ from species of temperate forests. Species diversity is highest in the extensive neotropical forest; second in the highly fragmented Indo-Malaysian formation; and lowest in Africa. Where 5 to a maximum of 30 species of tree share dominance in the Temperate Broadleaf Deciduous Forest, there may be 40 to 100 different species in one hectare of tropical rainforest. Tropical species of both plants and animals often have very restricted distribution areas:

**Alpine expressions of the biome:** A simplification of the tropical rainforest in species composition and in stratification occurs as elevation exceeds 3000 ft. Distinct communities are found at higher elevations, communities that do *not* replicate latitudinal changes in vegetation as do alpine communities in temperate zones. For more information, see Tropical Life Zones.