The Amazon Rainforest Experience

Objective:

1. Students will demonstrate an understanding of the interdependence of organisms with the environment.
2. Students will demonstrate a general knowledge of energy flow in an ecosystem.
3. Students will demonstrate an understanding of conservation, urban development, populations, climate change and natural resources in the rainforest environment.

Grades: 9-12

Related Literature:

The Forest Unseen
David G. Haskell

Rainforest (Biomes)
Tony Allen

No Where Else on Earth
Caitlyn Vernon

The Rainforest (Earth at Risk)
Laura Tangley

Performance Objectives:

High School: Strand 3- Concept 1: PO 1, 4 & 5
Strand 4 – Concept 3: PO 1; Concept 4: PO 4
Concept 5: PO 4
NGSS: HS – LS2; LS 4
CCSS 9-10. W. 2; 11-12. W. 1

Background Information:

The tropical rainforest of South America covers an area over 2 million miles of underdeveloped land. The Amazon River, which begins high in the Andes Mountains of Peru, is the life source that flows through the rainforest. The Amazon River is the second largest in the world and contains more fresh water than any river on Earth. The Amazon River and its tributaries supply most of the ground-level water of the rainforest.

A tropical rainforest is a lush forest of trees and plants that live in a warm, humid climate. The tropical rainforest receives an average of 160 inches of rain a year and maintains an air temperature of 75 to 80 degrees. Regulating temperatures and weather patterns, the rainforests are considered the world's thermostat. The plants in rainforests produce about 20% of the oxygen on Earth and play a vital role in the survival of all living organisms. The Amazon Rainforest is filled with an abundance of living organisms that exist in the ecosystems unique to the region. Scientists reveal that in a four-square-mile section of the rainforest, as many as 1500 flowering plants, 750 species of trees, 400 species of birds and 150 species of butterflies live and contribute to the ecosystem. It is believed that within the dense foliage and diverse populations of animals and insects, there are many species that have not yet been discovered. The remote location of some habitats may be the cause of species remaining unknown. For example, many species live at the top of the tallest trees where they are not seen from the ground and are extremely difficult to reach.

The Amazon Rainforest is comprised of four layers and filled from top to bottom with living organisms. The upper most part of the rainforest is referred to as the **emergent layer**. The name, emergent, describes the manner in which the tallest trees "emerge" some 200 feet from the dense forest below. The crowns (tops) of the trees fan out like umbrellas over the trees below. This layer receives the most sunlight but must survive strong winds and high temperatures. The trees in the emergent layer are the home for creatures such as the Harpy Eagle, Howler Monkey and other raptors and animals capable of living high in the treetops.

The Amazon Rainforest Emergent Layer (Photo by Keri Granado)

Harpy Eagle (Public domain photo)

The **canopy layer** is below the emergent layer. This dense layer is crowded with trees that form a continuous canopy approximately 60 to 90 feet above the ground. The upper part of the canopy captures about 90% of the sunlight and is where most of the photosynthesis takes place. Trees in the canopy layer are often covered with vines and other plants that live attached to the trunks or branches of the trees. Plants such as ferns and bromeliads attach themselves to the trees in the canopy layer. The canopy layer is the most populated, making it the home for 90% of the living organisms in the rainforest. The beautiful Morpho Butterfly, Scarlet Macaw and Squirrel Monkey live in the canopy layer of the rainforest. Animals such as the Three-toed Sloth, the Kinkajou and the Iguana find that the canopy layer offers them the most secure habitat with a wealth of branches to call home. Jaguars, poison dart frogs and snakes find that the lower part of the canopy is a suitable habitat providing food, shelter and a place to rest.

The Amazon Rainforest Canopy Layer is the most densely populated with plants and animal life.

(Photo by Keri Granado)

Many of the species living in the Amazon Rainforest are considered endangered. For most of these species, the loss of habitat has contributed to the decrease in numbers and ability to survive. For example, the Golden Lion Tamarin has found its way to the endangered list of monkeys. Deforestation has severely impacted the survival of the tiny creature.

The Golden Lion Tamarin is an **omnivore** who prefers to eat fruit, insects, spiders and lizards. This little monkey can grow up to 12 inches long and weigh about 2 pounds. These tamarins are known for their brightly colored golden hair and charming faces.

(Public domain photo)

The environment in the canopy is very different from that of the rainforest floor. During the day, the canopy area is dryer than the rainforest floor, and due to the denseness of the leaves, it is difficult to see the floor below. Some animals living in the canopy rely on loud noises and calls to alert others as a means of communication. Many animals in the canopy layer move about by swinging from branch to branch, flying from tree to tree and jumping from limb to limb. Animals also make use of the vines that grow and hang from the branches on the trees.

(Photo by Keri Granado)

The vine snake can appear to be just another thin branch, especially in the dark of night.

Because the canopy layer is very high, scientists have difficulty studying some of the animals. Rope bridges have been constructed in the canopy area to help people study the native species.

(Photo by Keri Granado)

This rope bridge in the rainforest canopy was built to study living organisms in the preserve at Jatun Sacha, Ecuador. The bridge allows scientists to cross treetop areas as they investigate the habitats of various animals. (Photo by Keri Granado)

The **understory layer** is closer to the rainforest floor and only receives 2 – 15% of the sunlight. The air is cooler under the leafy plants with smaller shrubs, ferns and vines that have adapted to the understory's filtered light and soil conditions. Some of the plants in the understory are orchids, ginger plants, and bromeliads, which have become home to small birds, insects and amphibians. Poison dart frogs, vine snakes, sloths and jaguars enjoy life in the understory layer of the rainforest. Heliconia, sulpher, malachite and glasswing butterflies float among the plants in the understory, and the shade and humidity provide a perfect environment for a vast diversity of insects.

The rainforest floor is where **decomposition** takes place and vital nutrients are produced. The process of decomposition is breaking down decaying materials and recycling them back into the forest ecosystem. While this area receives approximately 1- 2% of the sunlight, the top soil is rich in nutrients and filled with dead leaves, twigs and ground-cover plants. The humidity, temperature and shade allows for an environment crowded with moss, ferns, vines, insects, arachnids,

snakes and large ground-loving animals. Birds, beetles, lizards, Goliath tarantulas, funnel-web spiders, termites and Conga ants are only a few of the creatures that inhabit the rainforest floor. Larger animals like the jaguar roam the forest in search of food. The agile jaguar is one of the most dangerous animals in the rainforest because of its size and ability to climb trees or run quickly after its prey. Equally dangerous is the poison dart frog with the most powerful poison known to man. Generally harmless if left alone, the poison dart frog produces enough poison in its glands to kill up to 100 people. This tiny amphibian is on the endangered list and is only found in tropical forests. Most poison dart frogs have brightly colored skin used as a warning to predators. South American indigenous tribes have used the poison from the dart frogs to tip their arrows before hunting prey.

(Yellow-banded poison dart frog. Public domain photo)

The poison dart frog is very small, only about an inch in length. The brightly colored skin is a warning to predators to “back off.” These tiny creatures capture their food with a sticky tongue that darts out and grabs the prey. Poison dart frogs like to eat small insects such as flies, ants and termites. There are several species of poison dart frogs, but all of them live in the tropical forests of Central and South America.

One of the more docile animals on the rainforest floor is the Capybara. The capybara is the world's largest rodent and is considered a semi-water animal. With its slightly webbed feet and shaggy, rough coat, the capybara can spend a great deal of time in water and wallowing in the mud. The capybara stands about 1.5 feet high and weighs 75 to 100 or more pounds, depending on age, with males being larger. The capy is well adapted to life in and around water. Capys can submerge in water for up to 5 minutes at a time and swim as well as they can walk. The capybara's ears, eyes and nostrils are located high on the head so that the capy can swim with those body parts out of the water to view its surroundings.

Capybaras are very social animals living in groups of 10 to 20. Eating 6 to 8 pounds of vegetation a day, the capy enjoys grass, water plants, reeds and roots.

(Photo by Keri Granado - Pictured)

This friendly Capybara is a large rodent that behaves like a pet. The Capybara is the largest rodent in the world. Native to South America, the capybara inhabits dense forests and lives near bodies of water. It is a highly social species and can be found in large groups. Generally the capybaras live in groups of 10 to 20. They are not an endangered species.

Many rainforest creatures use a disguise to keep them safe from predators. Blending in with the surroundings is one way creatures can **camouflage** themselves out in the open. Some reptiles using this adaptation can change color to blend in with the plants around them. Using **mimicry** is another way creatures have adapted to their need for survival in an environment. Katydids can mimic twigs, leaves and bark while some butterflies shut their wings to look like leaves. Algae growing on the three-toed sloth's hair allow it to blend in with the leaves as it hangs from branches.

The stick bug can appear to be just another twig on a branch.

(Photo by Keri Granado)

The rainforest is the most diverse ecosystem on Earth with enormous numbers of plant and animal species who rely on their particular habitat to survive and reproduce. The relationships within the rainforest range from interdependence to competition and can be observed in all living organisms. Leaf cutter ants and fungus are an example of a mutualism. Their relationship is one in which the ants protect the fungi from harmful insects while nourishing it with small pieces of leaf matter. Bromeliad plants grow on high branches of trees. They do not do damage to the branches and they supply water to insects and birds that have adapted to the structure of the plant. The relationship between the bromeliad and tree is called commensalisms. An example of a symbiotic relationship in which two or more species interact very closely, would be ants and aphids. Aphids produce and excrete a sweet liquid which is a good food source for ants. Ants protect the aphids from predators and extract the liquid for nourishment. Ants have been known to herd aphids and take them along when moving the ant colony. The rainforest community is made up of all of the populations that live in the habitat of the area.

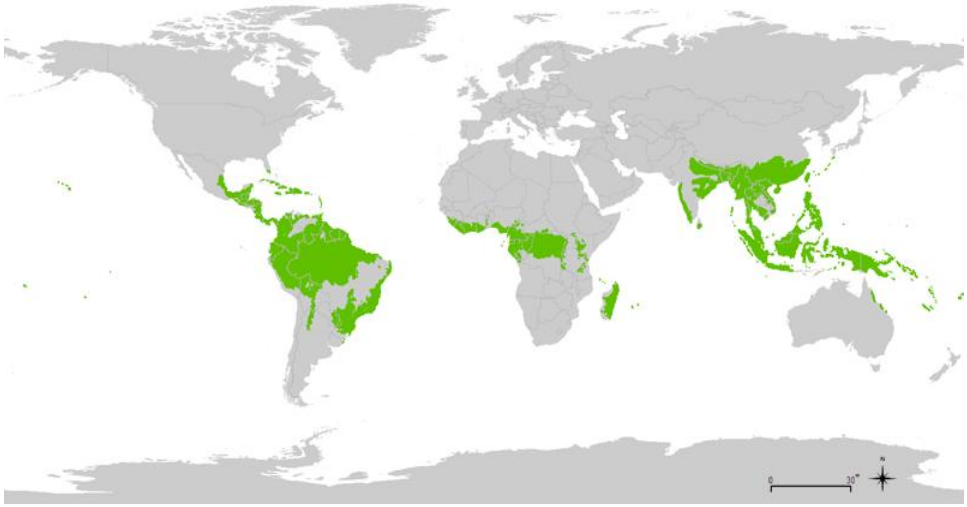
In addition to plants and animals, humans play a role in the balance of nature within the rainforest region. Indigenous people, native people to the area, have lived in the rainforest for many thousands of years. The Yanomami are the longest

surviving group of indigenous people in the Amazon rainforest. They raise crops of plantain, hunt for food and live somewhat isolated in the forest. The traditional past continues to be a part of the lifestyle of the Yanomami people. Many other native people live in the vast region of the rainforest and continue to live much like their ancestors did a thousand years before them. Many of these people rely on the Amazon River for food and other resources. Indigenous people live a sustainable life and use the land without doing harm to the plants and animals in the environment.

People outside the rainforest rely on the immense resources that stem from the Amazon region. Much of the food that we consume today originated in the rainforest. Coffee, cocoa, spices, fruits and nuts are only a few of the foods produced in the rainforest. Products such as rubber, gum, resins and dyes also come from the region and are important in the various products derived from them. Medicinal plants and herbs from the Amazon rainforest have made a significant impact on world health and the advancement in curing some diseases and fighting certain types of cancer. The rainforest has a bounty of resources for both indigenous people and people around the world. However, the balance of nature can be fragile and conservation of the natural resources in the rainforest continues to be of great concern to many.

The rainforests of the world have been a focus for the scientific community for many years. Scientists believe that conservation of the rainforest regions is critical to the balance of life on Earth. Often referred to as the "Lungs of the Earth" tropical rainforests are important because they provide oxygen to the planet and take in carbon dioxide as a part of the natural cycle. Without the vegetation of the rainforests, the carbon dioxide would be released into the atmosphere causing significant damage. Rainforest plants and trees also protect the underground water supplies and help stop erosion that could take place during climate changes. When deforestation takes place the water cycle is disrupted in the region causing temperatures to increase and drought conditions can be more common. Significant changes in rainforest conditions are likely to affect the region's vegetation, water supply, biodiversity, agriculture and human health worldwide.

The world map shows rainforests that are located in the central regions of the Earth. Rainforests are disappearing rapidly as a result of logging, cattle ranching, removal of natural resources, and human encroachment on the environment. While deforestation meets the needs of some, it has an enormous impact on the plants and animal life in the region. Scientists have suggested that the devastating effect of deforestation results in extinction of plant and animal species, climate change and social conflict.



(Picture: Wikipedia Commons)

While tropical rainforests cover approximately 7% of the Earth's dry land, they are home to 50% or more of the plant and animal species on Earth. Some of the most specialized species live in microhabitats that are found in very small areas and are extremely vulnerable to extinction. The issues related to loss of habitats and extinction of species is controversial, however, the concern continues to pose a number of problems.

Global markets rely on products originating in the rainforests. For example, fruit, nuts, timber, fibers, natural oils, resins and medicines are important products for consumers in all regions of the world. The genetic makeup of the native plants in the rainforests is considered to be at the deepest end of the planetary gene pool. New discoveries related to medicines may rely on the conservation of these native species. It is believed that the loss of rainforests has a direct impact on climate change and managing the aftermath of harsh weather conditions in the region. Flooding is a significant concern when forests have been removed. Drought conditions are imminent when the water cycle is eliminated along with the

vegetation in a large area of rainforest. Once the rainforest is burned and removed, the nutrient cycle is disrupted in the area. Factors related to sustaining life in the rainforests extend beyond the indigenous people and becomes a worldwide concern.

Removal of the rainforest. (Public domain photo)

Sources: The Nature Conservancy; Oldfield, Sara. *Rainforest*, London: New Holland Publishing 2002; World Wildlife Federation; Wikipedia; NOVA; Discovery Kids; The Rainforest Alliance; Physical Anthropologist Keri Granado; National Geographic; San Diego Zoo; Animal Fact Guide; Earth Observatory/NASA.

Procedures and Pre-Activities:

1. State the learning objective.

2. Read related literature and discuss the rainforest facts.

3. Locate the rainforest on the world map and hand out the map of the Amazon Rainforest Region map.

4. Conduct a general discussion related to the living organisms in the Amazon tropical rainforest. Discuss the interdependence of plants and animals in the region.

Activity: The Ecosystem: The objective of the activity is to allow students to demonstrate their understanding of the interdependence of living organisms in the ecosystem. Students follow directions on the worksheet. (See Food Chain Handout.)

5. Discuss the general facts related to climate in the region, how energy is produced and consumed in the rainforest and the importance of the vegetation in each layer of the rainforest.

Activity: The Amazon Rainforest Layers: The objective of this activity is to reinforce the students' understanding of the rainforest layers, function, environmental features and description of living organisms.

6. Prepare students to visit **Butterfly Wonderland**. Explain that the environment in the atrium is a managed ecosystem with regulated temperature and humidity to create a beneficial environment for the plants and butterflies. Ask students to observe how the temperature and humidity is maintained and compare the ecosystem to the outside desert area. Draw attention to how the living organisms are housed, protected and monitored.

Reflection and Assessment:

After visiting **Butterfly Wonderland**, discuss the experience in the atrium and how the atmosphere relates to the rainforest. Discuss the necessity for the controlled environment with regards to the plants, soil and water pond.

Activity: Build a rainforest in a jar. The objective of this activity is to give students an opportunity to be creative and apply their knowledge in formulation of a rainforest environment in a contained location. (See attached worksheet for instructions.)

Optional Activity: Students create a chart or graph related to any of the suggested topics:

- Sources and percentages of green house gas emissions
- Estimate future deforestation by type of forest and time period
- Causes and percentages of deforestation in the rainforests

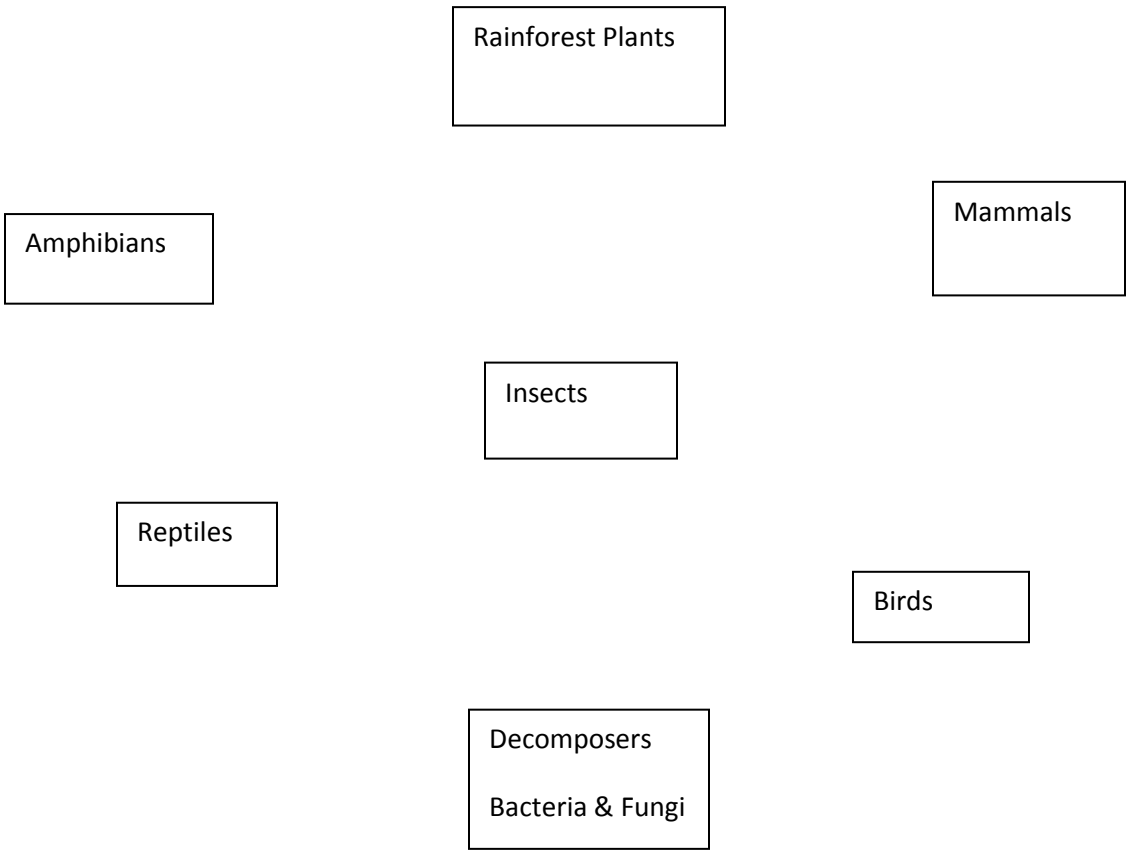
Activity/Assessment: Write an argumentative essay. (See outline)

Suggested topic: Conservation of the rainforests

Amazon Rainforest Region

(Rainforest in yellow)

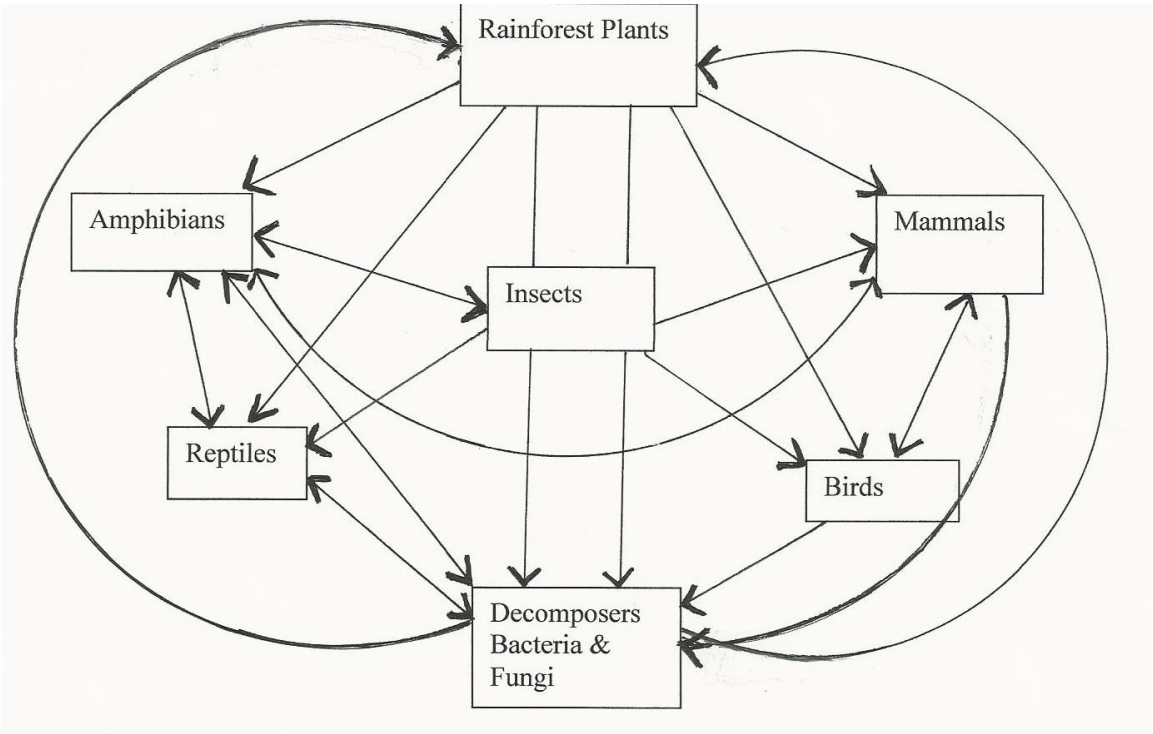
THE ECOSYSTEM



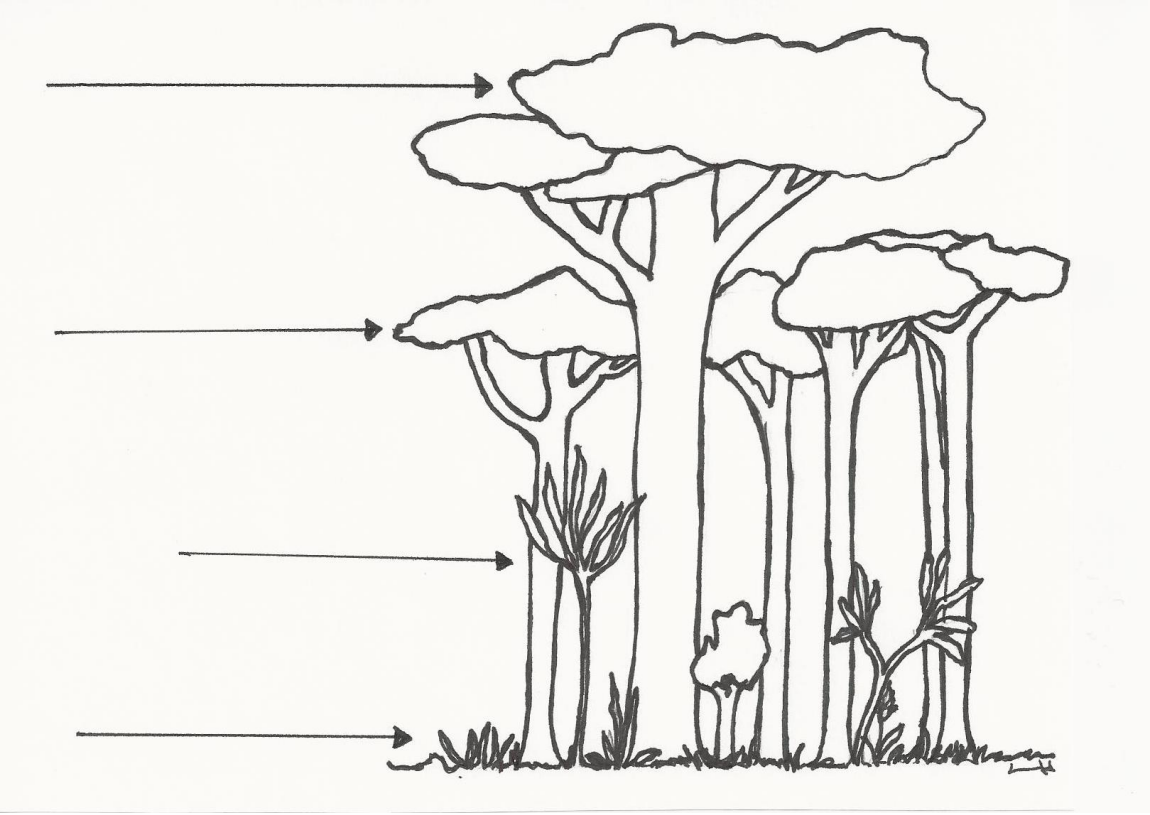
The rainforest ecosystem has several components. Each component has a specific purpose in the balance of life. In the example above, connect the components of the ecosystem in all of the directions in which they contribute to the balance of life in the rainforest.

In essay form, explain how the rainforest ecosystem functions.

Ecosystem Key



The Amazon Rainforest Layers



Label the rainforest layers and give a description of each layer with an example of one species of animal living in each layer.

Top Layer #1: _____

Description: _____

_____

Animal: _____

Layer # 2: _____

Description: _____

_____

Animal: _____

Layer # 3: _____

Description: _____

_____

Animal: _____

Layer # 4: _____

Description: _____

_____

Animal: _____

Explain the importance of plant decomposition and the rainforest floor.

_____

_____

_____

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_____

Explain what would happen if the rainforest no longer existed. (Consider the impact on the world.)

_____

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_____

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_____

_____

Build a rainforest in a jar

Students can apply knowledge, participate in the activity and record data as the living organisms change during the process. Building a rainforest terrarium can be done in small groups or as a class project. Small groups allow more students to be creative and take a hands-on role in the project.

Materials:

- Glass jars with a lid (Any size will work though it is suggested that containers the size of a large mason jar may work best.)
- Potting soil
- Rocks (very small and clean)
- Small tropical plants (ferns and moss work well. 1-2 plants in a jar)
- Note- plastic cling wrap can be used if a jar lid is not available.

Procedure:

Clean the glass container, lid and small rocks. Be sure that there is no soap or any residue on the container or rocks.

Fill the bottom of the container with a layer of small rocks (about an inch deep). The rocks will help balance the moisture and drainage.

Add a layer of potting soil on top of the rocks. The soil should fill about 1/3 of the jar.

It is time to add small plants. Gently plant them in the soil, lightly patting the soil around the base of the plant.

Water the plants gently so the soil is not disturbed.

Place the lid on the terrarium and put the mini rainforest in a warm place with indirect sunlight.

The warmth and sunlight causes water vapor inside the jar. You can see the precipitation process begin inside the mini rainforest. The lid should be opened about every two weeks to allow fresh air to circulate. Monitor the moisture in the jar so plants do not get too dry.

Assigning students in a rotating manner to adjust the lid, monitor the moisture, measure the growth of plants, etc. is a way to enhance the project.

Argumentative Essay

I. Broad theme and catchy hook (to get reader's attention)

A. Identify how topic relates to argument

B. List reasons why topic is important

C. Identify the topic's place in history

D. What are the general aspects of the topic

E. State the various positions (for and against)

THESIS statement: Focus your argument and clearly present your position on the topic

II. Background information about the topic

A. What it is
B. Beginning history
    1. when it first became an issue
    2. how the issue has evolved
    3. where does it stand today
C. Why is it a controversial topic

III. State the position opposite of yours in a clear topic sentence

A. First reason people have this opinion
    1. specific evidence or example
    2. explain why this may be true
B. Second reason people have this opinion
    1. specific evidence or example
    2. explain why this may be true
C. Analysis of the contrary position – transitions to your position

IV. State your position as fact (clear topic sentence)

A. First reason people have this opinion
    1. specific evidence or example
    2. explain why this may be true
B. Second reason people have this opinion
    1. specific evidence or example
    2. explain why this may be true

V. Your synthesizing statement/conclusion (no new details)

A. Synthesize specific causes of controversy (overview)

B. Transition from specific to general – how this topic has lasting effects

C. Give your opinion about how general effects impact injustice/justice

D. Consider – concluding with your opinion - action

THE FOOD CHAIN

Living organisms must have energy to survive. Plants rely on the sun, soil and water for the energy to grow. Animals rely on the sun, water and plants as a source of energy. Animals also may rely on other animals as a source of food, which produces energy. This interdependence is called a "food chain."

A food chain shows how different living organisms consume each other to survive in the environment. For example, grass receives energy from the sun, soil and water. Plants are producers because they produce energy for the ecosystem. The grass grows and supplies food for the katydid that eats the grass.

The frog eats the katydid as a source of food and energy. The frog is called a consumer because the frog "consumes" energy.

As the food chain continues, the tree snake eats the frog. The tree snake is also a consumer.

Animals that eat other animals are called secondary consumers or carnivores. Some animals eat both plants and animals; they are called omnivores. The eagle, considered a predator, eats the snake as part of the food chain. The final link in the food chain is the decomposer. Decomposers eat decaying matter such as dead plants and animal remains. Decomposers are organisms such as bacteria, fungi and worms. Decomposers contribute to the food chain by putting nutrients back into the soil for the plants to consume. All living organisms are a part of the food chain. (Public domain photos)