MARIE SELBY
BOTANICAL
GARDENS

Selby Gardens Rainforest Field Studies

Grades 9-12

Photo: Mike Trenerry

Curricular units designed and prepared by Andy Harshman

Curriculum Guide Titles

- Exploring Rainforests: What are they Made Of?
- Biodiversity: The Value of a Rainforest
- Human Impacts: What has been done, and what can be done to fix it?

Sources listed with each activity

9-12 NGSSS Benchmarks/IFC

SC.912.L.14.53, SC.912.L.17.4, SC.912.L.17.5, SC.912.L.17.6, SC.912.L.17.7, SC.912.L.17.8 SC.912.L.17.9, SC.912.L.17.12, SC.912.L.17.13, SC.912.L.17.15, SC.912.L.17.16, SC.912.L.17.17, SC.912.L.17.18, SC.912.L.17.19, SC.912.L.17.20

9-12 CC Benchmarks

CCSS.ELA-Literacy.RST.9-10.1/CCSS.ELA-Literacy.RST.11-12.1
CCSS.ELA-Literacy.RST.9-10.2/CCSS.ELA-Literacy.RST.11-12.2
CCSS.ELA-Literacy.RST.9-10.3/CCSS.ELA-Literacy.RST.11-12.3
CCSS.ELA-Literacy.RST.9-10.4/CCSS.ELA-Literacy.RST.11-12.4
CCSS.ELA-Literacy.RST.9-10.5/CCSS.ELA-Literacy.RST.11-12.5
CCSS.ELA-Literacy.RST.9-10.6/CCSS.ELA-Literacy.RST.11-12.6
CCSS.ELA-Literacy.RST.9-10.7/CCSS.ELA-Literacy.RST.11-12.7
CCSS.ELA-Literacy.RST.9-10.8/CCSS.ELA-Literacy.RST.11-12.8
CCSS.ELA-Literacy.RST.9-10.9/CCSS.ELA-Literacy.RST.11-12.9

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Pre-Visit Activity for Rainforest Exploration: Rainforest Structure and Function WebQuest

Objectives
Students will:

- Understand the structure of the rainforest (layers)
- Explore the distribution and various biota of the rainforest
- Study the climate of a rainforest, and how it predicts the structure, distribution, and biota within
- Use a WebQuest to research answers to topic

NGSSS: SC.912.L.14.53; SC.912.L.17.4; SC.912.L.17.5; SC.912.L.17.6; SC.912.L.17.7

CCSS: CCSS.ELA-Literacy.RST.9-10.1; CCSS.ELA-Literacy.RST.9-10.2; CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.5; CCSS.ELA-Literacy.RST.11-12.1; CCSS.ELA-Literacy.RST.11-12.2; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.5

Materials:

- Internet Access
- WebQuest Worksheets

Vocabulary: *Rainforest, Climate, Biota (Flora, Fauna, Animals), Precipitation, Temperature, Layers*

Procedure:

1. This activity can be completed as a group or individually, depending on availability of computers
2. Hand out a worksheet to each group or individual
3. Have students complete WebQuest worksheet
4. Review worksheet with class upon completion

Extension:

5. Students use a Venn diagram to compare and contrast rainforest structure, biota, distribution, and climate with other biomes around the world (tundra, deciduous forest, desert, etc.)

Sources:

- WebQuest Worksheet Questions: Andy Harshman
- WebQuest Websites: (students may also find others on their own)
  http://environment.nationalgeographic.com/environment/habitats/rainforest-profile/
  http://www.bbc.co.uk/learningzone/clips/rainforest-structure-layering/3092.html (video on structure)
  http://www.britannica.com/EBchecked/media/42/Worldwide-distribution-of-tropical-rainforests (diagram of distribution)
  http://library.thinkquest.org/C0113340/text/biomes/biomes.rainforest.animals.html# (animals)
  http://www.srl.caltech.edu/personnel/krubal/rainforest/Edit560s6/www/plants.html (plants)
  http://library.thinkquest.org/C0113340/text/biomes/biomes.rainforest.climate.html (climate)

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Pre Visit Activity for Rainforest Biodiversity: Food Web of the Rainforest

Objectives:

- Students will organize biota of a tropical rainforest into a pictorial food web, showing the movement of food and energy between organisms
- Students will hypothesize about the impact of removal of organisms from the food web of the remaining organisms

NGSSS: SC.912.L.17.4; SC.912.L.17.6; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.9; SC.912.L.17.13

CCSS: CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.7; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.7

Materials:

- Internet Access
- Access to word processing software (needs to be able to accept pictures from internet)
- Printer
- Alternate to printing- students may draw organisms they find

Vocabulary: *Biodiversity, Food Web, Food Chain, Keystone Species, Trophic Level, Producer, Consumer, Decomposer*

Procedure:

1. Teacher will give sheet of instructions to students, which include:
    a. Each student must research 10 species that live in a tropical rainforest. Of the 10, there must be AT LEAST one example of a member of each of the following groups:
        i. Primary Producers
        ii. Primary Consumers
        iii. Secondary Consumers
        iv. Decomposers
    b. Organize pictures of the organisms into a food web, with arrows indicating the direction of food/energy flow
    c. Next to each species, list the species name and trophic level…the species should be arranged vertically as well (Producers on bottom, decomposers next, etc.)
    d. A series of questions will follow, asking students to remove organisms from their webs, and to hypothesize the impact on the species that remain

<u>Extension:</u>

2. Teacher breaks students into groups and groups combine food webs to create much larger
3. Class discussion on the hypotheses. Which animals were most connected? Which removals had the most impact? This leads into a discussion of keystone species.

Sources:

- Food Web Activity Instructions: Andy Harshman
- Students will use search engines to find biota

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Pre-Visit Activity for Human Impacts: Tragedy of the Commons

Objectives
Students will:

- be introduced to the dangers of open use without regulation
- learn that by working together, all can benefit from a commons, such as an open rainforest and keep it running long-term (sustainability)
- learn that overuse of a commons can lead to the depletion of that resource without chance of reemergence (unsustainability)

NGSSS: SC.912.L.17.4; SC.912.L.17.5; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.12; SC.912.L.17.13; SC.912.L.17.16; SC.912.L.17.17; SC.912.L.17.18; SC.912.L.17.20; SC.912.L.17.19

CCSS: CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.6; CCSS.ELA-Literacy.RST.9-10.7; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.6; CCSS.ELA-Literacy.RST.11-12.7

Materials:

- One of the "Big Boxes" of Goldfish Crackers
- Straws, for 1 per student
- 1 Bowl Per 4 Students
- Instruction/Data Sheets
- Some sort of reward for the group who makes the most "money" (ex. Extra credit, homework pass, sticker, etc.)

Vocabulary: *Commons, Tragedy of the Commons, Sustainability, Unsustainability, Overuse, Conservation, Carrying Capacity*

Procedure:

1. Divide students into groups of no more than 4
2. Have each group gather around 1 bowl filled with 16 fish…the "carrying capacity" of the bowl (the lake may never have more than 16 goldfish)
3. Explain that each fish harvested by a student will result in $10 profit! They will go through 3 cycles of harvesting, where students will remove fish by sucking on one end of a straw.
4. Explain that only one student may remove fish at a time and the time limit per cycle is 1 minute…students must rotate, no hogging the bowl!
5. At the end of each cycle, each fish left will "spawn" 2 additional fish, up to the carrying capacity of the lake.
6. Students MAY NOT talk or communicate during the 3 cycles, but they must take turns.
7. Teacher starts timing, and adds fish at the end of each cycle.
8. At the end of each cycle, students fill in a data sheet given to them, which records the amount of fish harvested and income made individually and by the group as a whole.
9. The activity is repeated, except that groups may plan for 5 minutes prior to the activity and talk throughout. At this point, students are enticed with the reward for the group with highest income.

Extensions:

1. Students will answer questions following the activity that lead them to discover how a commons, such as the rainforest, can be overused and depleted.
2. Students will write a conclusion essay that debates the best way to use a commons and how much regulation should be put in place.

Sources:

- Tragedy of the Commons Activity Instructions: Andy Harshman adapted from Gayle Evans, former AP Environmental Teacher, Gainesville High School

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Pre-Visit Activity for Entire Unit: Rainforest Vocabulary Introduction

Objective:

- Students will be introduced to terms associated with the rainforest structure, biodiversity, and human impacts through a vocabulary crossword puzzle.

NGSSS: SC.912.L.14.53; SC.912.L.17.4; SC.912.L.17.5; SC.912.L.17.6; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.9; SC.912.L.17.12; SC.912.L.17.13; SC.912.L.17.15; SC.912.L.17.16; SC.912.L.17.17; SC.912.L.17.18; SC.912.L.17.19; SC.912.L.17.20

CCSS: CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.5; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.5

Materials:

- Crossword Puzzle pages (below)

Vocabulary: *Rainforest, Climate, Biota (Flora, Fauna, Animals), Precipitation, Temperature, Layers (Emergent, Canopy, Understory, Forest Floor), Biodiversity, Food Web, Food Chain, Keystone Species, Trophic Level, Producer, Consumer, Decomposer, Commons, Tragedy of the Commons, Sustainability, Unsustainability, Overuse, Conservation, Carrying Capacity*

Procedure:

1. Students will complete the crossword puzzle activity that introduces them to terms they will see and need to understand in the rainforest unit.

Extensions:

1. Have students give a pictorial representation of each term
2. Have students separate terms into which section of unit to which they below (structure/function, biodiversity, and/or human impacts)

Sources:

- Crossword puzzle developed by Andy Harshman

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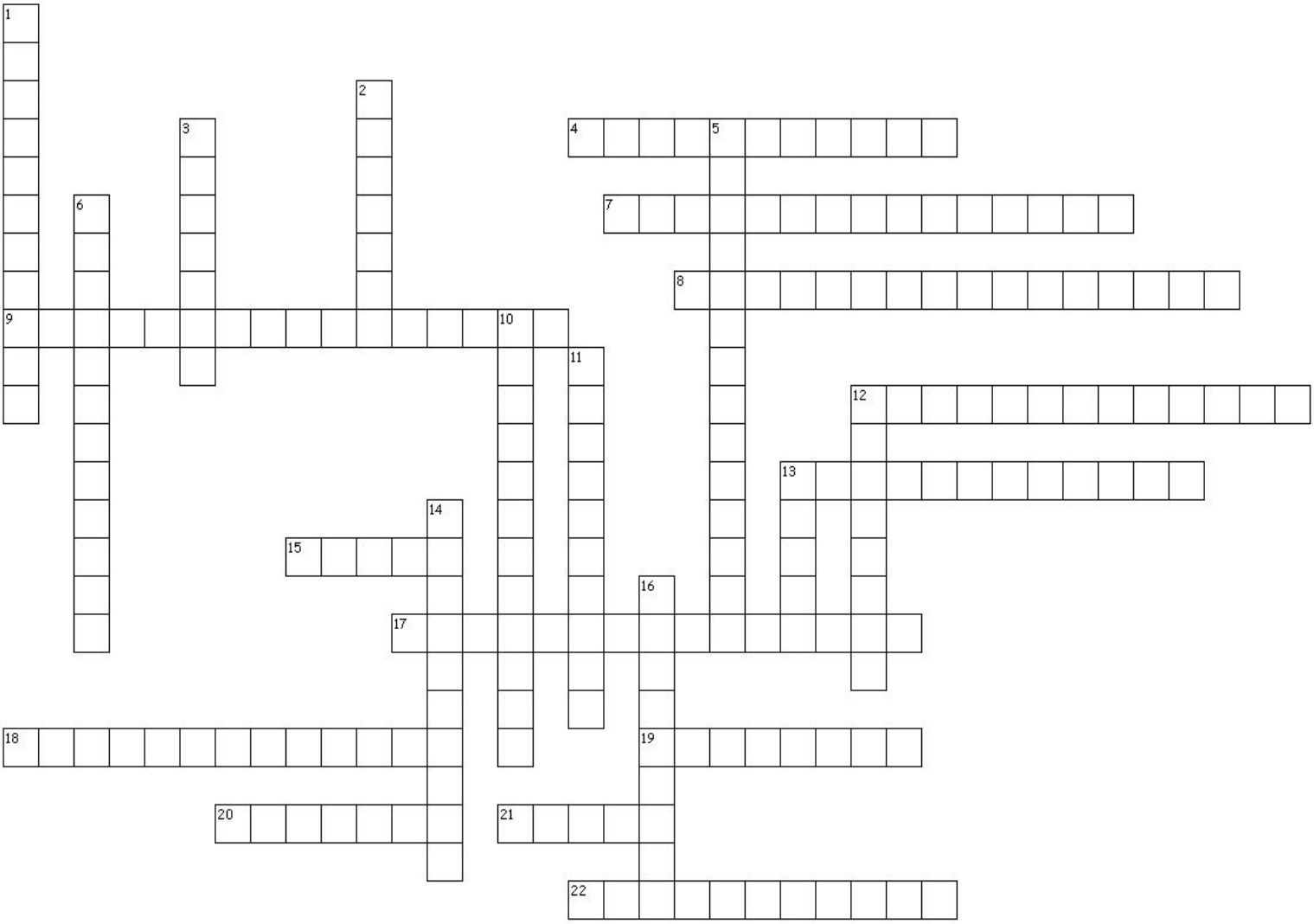
Rainforest Terms Crossword Puzzle



Word Bank

Rainforest
Climate
Biota
Flora
Fauna
Precipitation
Temperature
EmergentLayer
CanopyLayer
UnderstoryLayer
ForestFloor
Producer
Consumer
KeystoneSpecies
TrophicLevel
Decomposer
Commons
Sustainability
Unsustainability
Conservation
CarryingCapacity
FoodWeb
FoodChain

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Rainforest Terms Crossword Puzzle Clues

Across

4. Almost no plants grow in this area, as a result things begin to decay quickly
7. a species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically
8. the number or quantity of people or things that can be conveyed or held by a vehicle or container
9. not able to be maintained at the current rate or level
12. rain, snow, sleet, or hail that falls to the ground
13. the variety of life in the world or in a particular habitat or ecosystem
15. the animals of a particular region, habitat, or geological period
17. Layer where little sunshine reaches so the plants have to grow larger leaves to reach the sunlight and the plants in this area seldom grow to 12 feet
18. layer containing the tallest trees which are towering as much as 200 feet above the forest floor with trunks that measure up to 16 feet around
19. An organism that generally obtains food by feeding on other organisms or organic matter
20. land or resources belonging to or affecting the whole of a community
21. the plants of a particular region, habitat, or geological period
22. the primary layer of the forest and forms a roof over the two remaining layers

Down

1. the degree or intensity of heat present in a substance or object
2. a system of interlocking and interdependent food chains
3. the weather conditions prevailing in an area in general or over a long period
5. able to be maintained at a certain rate or level
6. protect (something, esp. an environmentally or culturally important place or thing) from harm or destruction
10. each of several hierarchical levels in an ecosystem, comprising organisms that share the same function in the food chain and the same nutritional relationship to the primary sources of energy
11. an organism, esp. a soil bacterium, fungus, or invertebrate, that decomposes organic material
12. The first trophic level in a food chain in which it serves as a food source for consumers or for higher trophic levels
13. the animal and plant life of a particular region, habitat, or geological period
14. a luxuriant, dense forest rich in biodiversity, found typically in tropical areas with consistently heavy rainfall
16. a hierarchical arrangement of organisms each dependent on the next as a source of food

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Rainforest Terms Crossword Puzzle Answers

Across

4. ForestFloor
7. KeystoneSpecies
8. CarryingCapacity
9. Unsustainability
12. Precipitation
13. Biodiversity
15. Fauna
17. UnderstoryLayer
18. EmergentLayer
19. Consumer
20. Commons
21. Flora
22. CanopyLayer

Down

1. Temperature
2. FoodWeb
3. Climate
5. Sustainability
6. Conservation
10. TrophicLevel
11. Decomposer
12. Producer
13. Biota
14. Rainforest
16. FoodChain

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Post Visit Activity for Rainforest Exploration: Decomposition Bottle Study

Objectives:

- Students will observe the process of decomposition, which is vital to the rainforest (and every other biome's) ecosystem
- Students will compare how the rate of decomposition and nutrient flow is affected by different climates/biomes

NGSSS: SC.912.L.14.53; SC.912.L.17.4; SC.912.L.17.6; SC.912.L.17.7;

CCSS: CCSS.ELA-Literacy.RST.9-10.3; CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.5; CCSS.ELA-Literacy.RST.9-10.6; CCSS.ELA-Literacy.RST.9-10.7

Materials:

- Either internet access or printed instructions
- 3 two-liter (empty) bottles PER GROUP
- 1 two-liter bottle cap PER GROUP
- Scissors
- Tape
- "Hole Poker" (push pins will work)
- Incandescent bulb lamps
- Aluminum Foil
- Water
- Decomposition Materials (http://www.bottlebiology.org/investigations/decomp_fill.html)
- pH paper or probes
- Thermometers
- Ruler
- Balance (scale)
- Nitrate test kit (optional)
- ActivBoard and software to collect and graph data (Excel)

Vocabulary: *Decomposition, Decomposer, Climate, Biome, Nutrient, Leachate, pH, Compost, Humus, Soil, Erosion*

Procedure: ***TEACHER FYI: This is a Long-Term Experiment (2-3 months to see the best results)***

1. Student groups (4 max) will construct decomposition bottles according to the instructions found here: http://www.bottlebiology.org/investigations/decomp_build.html
2. Students should fill their decomposition bottles with the same material, examples of which may be found here, and weigh it prior to the study: http://www.bottlebiology.org/investigations/decomp_fill.html
3. Assign a different biome to each group. Tell them the conditions their bottle should be under. They will develop the procedures using the materials above to make sure conditions are met:
    a. Tropical rainforest – hot, wet, low light
    b. Desert – hot , dry, high light
    c. Arctic Tundra – cold, dry, various light
    d. Etc. (teacher's discretion)

4. Students will then test the mass and other properties of the different bottles at least once a week over the next 2 months to see how decomposition differs in various biomes. These include:
    a. Mass/Height of column (rate of decomposition)
    b. pH of leachate
    c. Nitrates in leachate (optional)
5. Collect class data and throughout study discuss the trends you are seeing in the data

Extension:

6. Students write essays on their conclusions about how and why decomposition happens in different biomes around the world.

Sources:

- Bottle Biology Instructions: http://www.bottlebiology.org/investigations/decomp_main.html
- Experimental Instructions: Andy Harshman using resources from Bottle Biology website

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Post Visit Activity for Biodiversity: The Biodiversity of Medicine Project

Objective

- Students will explore the value of biodiversity by looking at the source plant of medicines used for different ailments (most will undoubtedly be tied to the rainforest)
- Students will explore the idea that extinction of species in the rainforest and world may impact future medicines and cures

NGSSS: SC.912.L.17.4; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.12; SC.912.L.17.13; SC.912.L.17.15; SC.912.L.17.16; SC.912.L.17.17; SC.912.L.17.18; SC.912.L.17.20; SC.912.L.17.19

CCSS: CCSS.ELA-Literacy.RST.9-10.1; CCSS.ELA-Literacy.RST.9-10.2; CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.7; CCSS.ELA-Literacy.RST.11-12.1; CCSS.ELA-Literacy.RST.11-12.2; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.7

Materials:

- Internet Access
- Instruction/Data Sheet
- Large World Map (or Map image from internet on ActivBoard)
- Different Colored Push Pins (if using physical map)

Vocabulary: *Medicine, Biodiversity, Distribution, Extinction*

Procedure:

1. Distribute instruction/data sheets to students
2. Students will research 3 different (non-recreational) drugs used to treat any number of ailments. The only caveat is that the medicine must have a plant source. Examples include:
    a. Lapachol – Antitumor, Anticarcinogenic – Derived from Taebubia - Found in Tropics of America and Mexico
    b. Theobromine – Diuretic – Derived from Cocoa – Rainforest
3. Students will record drug name, what it's used to treat, what plant it's derived from, where the plant is found, and the source of their information on a data sheet
4. Students will get up in front of class, read off their information, and pin their locations on the large map. Teachers should make a running list so no drugs are overlapped.

Extension:

5. Questions follow the activity that have students analyze how important biodiversity is to not only medicine, but so much of what goes into human life…and will hypothesize medicine and products that may not be discovered yet!
6. Once all groups have placed their pins, have students determine the biomes with the highest proportion of medicinal plants.

Sources:

- Activity created by Andy Harshman
- List of plant-based drugs here: http://chemistry.about.com/library/weekly/aa061403a.htm (Students may find this on their own, but I wouldn't show it to them first)

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Post-Visit Activity for Human Impacts: How to Restore the Rainforest

Objective:

- Students will see an example of rainforest restoration and then discuss its viability
- Students will work to determine methods to restore rainforest

NGSSS: SC.912.L.17.4; SC.912.L.17.6; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.12; SC.912.L.17.13; SC.912.L.17.15; SC.912.L.17.16; SC.912.L.17.17; SC.912.L.17.18; SC.912.L.17.19; SC.912.L.17.20

CCSS: CCSS.ELA-Literacy.RST.9-10.2; CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.8; CCSS.ELA-Literacy.RST.9-10.9 ; CCSS.ELA-Literacy.RST.11-12.2; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.8; CCSS.ELA-Literacy.RST.11-12.9

Materials:

- Internet Access/Projector

Vocabulary: *Deforestation, Grazing, Reforestation, Restoration*

Procedure:

1. Students will be shown the following TED talk about innovative ways people around the world are participating in the restoration in the rainforest.
    a. http://www.ted.com/talks/willie_smits_restores_a_rainforest.html
2. During the talk they must take notes on how the restoration has taken place and successes.
3. Following, lead a class discussion on if the long-term effectiveness of the method and the class will try to think of methods that may be even more successful.

Extension:

1. Have students research other methods that have been used to restore rainforests and compare and contrast the methods in terms of success.

Post-Visit Activity for Entire Unit: Rainforest Quiz

Objective:

- Students will be formally assessed on information they learned during the rainforest unit.

NGSSS:
SC.912.L.14.53; SC.912.L.17.4; SC.912.L.17.5; SC.912.L.17.6; SC.912.L.17.7; SC.912.L.17.8; SC.912.L.17.9; SC.912.L.17.12; SC.912.L.17.13; SC.912.L.17.15; SC.912.L.17.16; SC.912.L.17.17; SC.912.L.17.18; SC.912.L.17.19; SC.912.L.17.20

CCSS: CCSS.ELA-Literacy.RST.9-10.4; CCSS.ELA-Literacy.RST.9-10.5; CCSS.ELA-Literacy.RST.11-12.4; CCSS.ELA-Literacy.RST.11-12.5

Materials:

- Copies of quiz

Vocabulary: *Rainforest, Climate, Biota (Flora, Fauna, Animals), Precipitation, Temperature, Layers (Emergent, Canopy, Understory, Forest Floor), Biodiversity, Food Web, Food Chain, Keystone Species, Trophic Level, Producer, Consumer, Decomposer, Commons, Tragedy of the Commons, Sustainability, Unsustainability, Overuse, Conservation, Carrying Capacity, Deforestation, Grazing, Reforestation, Restoration, Medicine, Distribution, Extinction, Decomposition, Decomposer, Climate, Biome, Nutrient, Leachate, pH, Compost, Humus, Soil, Erosion*

Procedure:

1. Distribute quiz and grade!
    a. Quiz will be 20 questions long and will cover terms and concepts learned in the rainforest unit
    b. Review answers with class/have students perform corrections to ensure that they learn the material.