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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

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- 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?

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 found 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 (Emergent, Canopy, Understory, Forest Floor)*

Procedure:

1. This activity can be completed as a group or individual task, depending on the 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 the rainforest structure, biota, distribution, and climate with other biomes around the world (tundra, deciduous forest, hot desert, etc.)

Sources:

- WebQuest Worksheet Questions: Andy Harshman

- WebQuest Websites:
  - 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)
  - Others students may find themselves

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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

Extension:

1. Teacher breaks students into groups and groups combine food webs to create much larger
2. 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
- Students will learn that by working together, all can benefit from a commons, such as an open rainforest and keep it running long-term (sustainability)
- Students will 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 (Walmart, around $8.00)
- Enough straws for 1 per student
- 1 Bowl Per 4 Students
- Instruction/Data Sheets
- Some sort of reward for group who makes 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 student 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…student 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 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.

Extension:

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:

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.

Extension:

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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Post Visit Activity for Rainforest Exploration: Decomposition Bottle Study

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

Objectives:

- Students will observe the process of decomposition, which is vital to a rainforest's (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;

CC: 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 2-L (empty) soda bottles PER GROUP
- 1 2-L 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*

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Procedure:

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, and tell them the conditions their bottle should be under. They will then develop the procedures using the materials above to make sure the 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. (discretion of teacher)
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:

1. Students write essay 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 (the 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 that are used to treat any number of ailments. The only caveat to what they are researching is that the medicine must have a plant source. Examples include:
    a. Lapachol – Antitumor, Anticarcenogenic – 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. Teacher should make a running list so no drugs are overlapped.

Extension:

1. 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!
2. Once all groups have placed their pins, have students determine the biomes with highest proportion of medicinal plant.

Sources:

- Activity created by Andy Harshman
- Map can be obtained from Staples for Under $20: http://www.staples.com/Rand-McNally-Laminated-World-Wall-Map/product_458366
- There is a large 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 rainforest and compare and contrast the methods in terms of success.

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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

Extension:

1. Review answers with class/have student perform corrections to ensure that they learn the material.