



Save the Trees, Please

Lesson Plan

Overview

There has been much debate in recent years regarding the rapid pace at which forests of the Earth are disappearing. Widespread deforestation in places like the Amazon rain forest, southeast Asia, Africa, and even the Pacific Northwest of the United States continues to have a large impact on the Earth's systems. Yet human beings across the world use forests for many reasons as they often harvest wood as a means for survival, or for economic development and stability. How do scientists help us understand this delicate balance between sustaining resources of the Earth over the long term, and providing for human needs over the short term? In this 4-part lesson, students will explore the impact of deforestation on the Earth. Satellite imagery is used to show the vast devastation that humans have inflicted upon the Earth - the loss of forests and its impact on animal habitat, erosion, and sediment flow in oceans and rivers, etc. Students are encouraged to examine the role that humans play in deforestation (and reforestation), as well as the way that forests provide important resources for humans.

Suggested Lesson Sequence	Please see the Greenlinks , Landscape Changes , and Earth Systems and Humans module descriptions.
Lesson Level	Extended
Science Connections	Students will investigate several impacts of deforestation on the Earth and its ecosystems, including erosion , global climate change , and loss of animal habitat .
Math Connections	Students will estimate the deforested area on a grid overlay of satellite images. Geometry topics include surface area , perimeter , and pattern recognition .
Human Connections	Students will investigate the human dimensions of deforestation .
Technology Connections	Students will use satellite imagery to understand the broad extent of deforestation.
Assessment	Assessment and Standards Table (Word) Assessment Activity Description Authentic Assessment

Materials

There are four individual lessons within "Save the Trees," each requiring its own activity sheet:

- Lesson One: The Amazon Rain Forest ([Word](#)), activity sheet with questions
- Lesson Two: Deforestation in Bolivia ([Word](#)), activity sheet with questions
- Lesson Two: Area Investigation ([Word](#)), activity sheet
- Lesson Three: The Red Island ([Word](#)), activity sheet with questions
- Lesson Four: De/Reforestation in the Pacific Northwest activity sheet ([Word](#))
- Lesson Four: De/Reforestation in the Pacific Northwest questions ([Word](#))

Vocabulary Note

During this lesson, students will read passages of text on the activity sheets. Students may be unfamiliar with some of the vocabulary presented in this lesson. This is done intentionally, to build reading skills and to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about (or look up the meanings of) words they may be unfamiliar with that occur in the readings.

Procedure

Background Information for Teachers

There has been much debate in recent years regarding the rapid pace at which forests of the Earth are disappearing. Widespread deforestation in places like the Amazon rain forest, southeast Asia, and even the Pacific Northwest of the United States significantly impacts the Earth's systems. Deforestation greatly affects surrounding ecosystems. It alters the habitat of many animals that depend on trees for survival, it can lead to erosion of soil that then clogs up rivers with sediment, and it can destroy plant species that cannot survive outside the protection of the forest.

Equally importantly, trees are essential for life as they absorb carbon dioxide (a "greenhouse" gas that can affect climate), emit oxygen, and are a primary agent in sustaining the water cycle. In fact, the burning that accompanies tropical deforestation is estimated to annually release 15-50% of the amount of carbon dioxide released in the burning of fossil fuels. Sustainable management of the forests of the Earth, therefore, is not only critical for the health of plants and animals, but for *humans* as well.

Yet, on the other hand, human beings throughout the world use forests for many reasons such as harvesting wood as a means for survival, or for economic development and stability. Science is being looked upon as a way to help us understand this delicate balance between sustaining resources of the Earth over the long term, and providing for day-to-day human needs.

Save the Trees, Please and other ESC lessons (e.g. [Plants and the Water Cycle](#) and [Urban Changes](#)) address several of these important issues, focusing in particular on the ways that trees, and *leaves* in particular, are essential for life.

The primary intent of this lesson is to increase students' awareness of the widespread deforestation that is occurring in various parts of the world, and the impact it can have on the systems of the Earth. Four series of images (from Brazil, Bolivia, Madagascar, and the Pacific Northwest) help illustrate various instances of deforestation, and the ecological effects of such deforestation. Each of these themes is designed to last at least one full class period. Discussion questions and images are found on the activity sheets that accompany each lesson. Information about each series as described in the notes below will help you lead discussions about these images and what they reveal about the Earth.

Many large, color images are used in this lesson. Teachers may wish to project these images with the use of a computer (or have students observe the images on a computer themselves) in order to reduce the amount of printing necessary for these lessons, as well as to be able to illustrate these powerful images in full color. For each lesson, an activity sheet (without images) is provided for students to record answers.

Note: This lesson contains content that can become controversial. This lesson tends to highlight the need for forest conservation with respect to the ecological impact of deforestation rather than the many reasons that forests are harvested for economic development. Scientists are continuing to learn that the ecological services (e.g. clean air, clean water, pollinator diversity) of healthy ecosystems are very important to the long term (decades or even centuries) well-being of people, and it is in this vein that this information has been presented. You may have families in your school community that depend on harvesting trees for their own economic sustenance. It is our intent in this lesson to provide *ecological* information about deforestation in a way that does not cast judgment on people who have, for various reasons, harvested trees.

I. Assessing Prior Knowledge

Begin this lesson by asking students to brainstorm a list of all the ways that *humans* have used trees and forest products throughout history. They will generate a long list if given time. They may not be aware of the unique ways that humans have used trees - for protection, for medicine, and even to refrigerate food as African peoples have done for centuries. (The Baobab tree has a huge trunk. Caves and compartments are carved into the trunks of these trees, and food can be safely stored as though in a cooler!)

II. Contextual Preparation

After completing the previous activity about ways in which humans benefit from trees, prepare

the students for this series of lessons by asking a similar question: Why are trees important for the natural (non-human) world? How do trees interact with the various biotic (living, e.g., plants and animals) and abiotic (non living, e.g., water, wind, rock) elements we find on Earth? Students may struggle at first when generating this list. Here is a short list of ideas to generate some discussion:

- Protection, shade, and shelter for animals
- Protection for other plants
- Food for animals
- Roots hold on to soil to prevent erosion
- Recycling water
- Uptake and release of gases in the air (take up CO₂, release water vapor and O₂)

It is this focus on the role of trees as a vital element of ecosystems throughout the world that will be prevalent in this series of lesson activities.

III. Student Activities

Lesson One: The Amazon Rain Forest

This lesson introduces the notion of deforestation by looking at satellite images of the Brazilian rain forest. Distribute the [Amazon Rainforest Activity Sheet](#). This activity sheet is self-guiding, and answers to the questions are provided below. Teachers may wish to project the images on this activity sheet, or allow students to see pictures on a computer screen and record their answers on the activity sheet. It is important that teachers read the following information before beginning this lesson with students. Teachers may wish to use the information below as an introduction to this activity, and to the Amazon region of Brazil in general.

Teacher Background Information and Discussion Topics: In these images, one can observe the vast impact of deforestation in an area of a Brazilian portion of the Amazon Rain Forest. It is important to help the students understand what they are seeing in the images. First, in the satellite image, red in the image corresponds to green on the ground. Hence, the darker the red observed in the image, the darker the green would be if we were observing this land with the naked eye. (This has to do with how some satellites use infrared wavelengths to capture imagery. The colors are then projected on the screen differently from how our eyes can detect colors.) Likewise, the lighter colors (blue/gray) indicate a *lack* of green - i.e., deforested regions. In the first image, one can see roads, a river, and a small village as depicted by the gray/white colors. In the corresponding image 17 years later, the spread of the gray/white colors is quite evident. This grid of lines illustrates the deforestation taking place in the forest. This particular pattern illustrates what is called a "Herring Bone" logging practice, where one road (which can be seen in the 1975 image) is used as a main thoroughfare from which many additional perpendicular roads originate. Students can observe the vast

deforestation that has taken place in this region over 17 years by comparing the increase in the gray/white areas.

It is important to recognize that humans have harvested trees in the rain forest for a number of reasons, many of which are linked to their very survival. Logging timber is a form of income for many individuals, whether that means selling the logs for lumber, or clearing land to raise cash crops or herd cattle. Because the reasons for deforestation are varied, it is also important to realize that not all tropical deforestation is carried out in the same way. For example, lumber companies often carry out "selective harvests" where the most desirable species of trees are sought and individually cut for their highly valuable wood, prized for building fine furniture or strong structures. Other non-selective logging also occurs where many more species are cut for general lumber production. Agriculture here has traditionally been small homesteads in the forest, where people established vegetable/fruit gardens and small woodlots for their own sustenance. But increasingly, individuals, small communities, and large corporations have begun to practice "slash and burn" clearing where all trees in the forest are cut, left to dry in the hot tropical sun, and then burned in order to clear the land for crops and grazing.

Clearcutting of forests in tropical ecosystems, in many locations, leads to an unstable landscape and high-risk agriculture. In general, tropical soils are quite poor in nutrients due to high amounts of rainfall that washes nutrients out of the soil through a process called *leaching*. Scientists have learned that the nutrients contained within leaves of tropical trees are almost immediately taken up by the roots when the leaves fall. When trees are clearcut and burned for agricultural purposes, often the resultant field can sustain crop agriculture for fewer than 5 years, after which time the land is converted to less productive pasture. After pasture land is finally abandoned, the re-growing vegetation is vastly different from the original forest type that occurred because the soils are so depleted in nutrients. (It should be noted, however, that due to climate and soil type differences, in most temperate forest ecosystems soil productivity does not decline in the same way as in tropical soils following clear-cuts.)

Sample Responses for Amazon Rainforest Questions

1. What kinds of plants and animals do you think you would find in a forest like this?

Answers will vary. As the photograph illustrates, vegetation in this ecosystem is quite thick. Thousands of plant, animal, and insect species live in forest regions such as the one captured in this photograph.

2. What are the main differences you can see between this image and the first satellite image? What could those white lines be?

Answers will vary. Students should notice an increase in the blue color (i.e., deforestation)

both in terms of lines (roads) and various shapes (clear-cuts or villages), the pattern of deforestation (parallel lines), or other general observations.

3. The road ends at a large river. What do you think might happen to the logs after the truck drops them off at the end of the road?

The logs are floated to lumber mills where they are processed for various purposes.

4. What colors do you see in the stump? How do you think it became colored in this way?

This tree stump is discolored and blackened because it was burned. This is an example of the effects of "slash-and-burn" practices.

5. Those stumps we saw earlier were burned! What are some reasons that a person might want to cut down a forest and clear the land by burning it?

To create open space for planting crops or raising livestock.

6. What are the pros and cons of using this wood for furniture?

Answers will vary. The wood provides for beautiful and sturdy furniture, yet it also depletes the forests of the trees that are vital to the ecosystem.

7. a) What do you now see in this field that wasn't there before?

Grazing animals

- b) What do you think this field is being used for now that the forest has been cleared?

Cows are grazing on the field.

- c) Do you think that there are more or fewer kinds of plants located on the land now compared to when the land was a forest?

Far fewer plants.

- d) Do you think there are more or fewer animals that use this land now, compared to when the land was a forest? Why?

Far fewer animals use this landscape. There is far less plant growth for food, shelter, shade, etc., that animals need.

Lesson Two: Deforestation in Bolivia

Distribute the [Deforest Bolivia Activity Sheet](#), and the [Area Investigation Activity Sheet](#). The activity sheet is self-guided. Teachers may wish to project the images on this activity sheet, or allow students to see pictures on a computer screen and record their answers on the activity sheet. Answers to the questions on the activity sheets are provided below.

Teacher Background Information and discussion topics:

As noted in the activity sheet, these images illustrate a relatively new, governmentally sponsored relocation project in Bolivia. These small communities have been carved into the Bolivian forests and designed to provide both a place and a means for Bolivian citizens to live in relative stability.

Sample Responses for Deforestation in Bolivia Questions

1. What objects or features on the land can you identify in this picture?

Students may identify trees, roads, fields, buildings, etc.

2. Make an estimate - How big is the area captured in this image? That is, how many kilometers wide do you think this image is from side to side?

Answers will vary. Encourage students to elaborate on how they made their estimates. They should use informal reasoning and clues from the image to help them think about the size of the region of land. It is not necessary for students to have an exact answer, or even an answer that is close to accurate. Rather, the intent of this question is to encourage students to use their intuitions as they become more familiar with the breadth and depth of these images.

3. Why do you think they chose to cut into the forest in a circular pattern?

If given a fixed perimeter, a circular region will allow for the greatest area. Hence, expanding in a circular fashion affords them the most land while at the same time minimizing the distance between the outside edge of the border to the center of the circle (i.e., the village).

4. What can you identify in this picture of a Bolivian community?

Similar to #1: roads, trees, plants, fields, soil, roads, buildings, etc.

5. There are a number of straight lines that seem to start at the center of the image and extend out like a *radius* of a circle. What might these lines be?

Answers will vary: roads, paths, field dividers, irrigation canals.

6. The image reveals smaller, rectangular plots of land within the circles. What do you think the people are doing with these small plots of land?

Answers will vary: Growing crops, grazing cattle or sheep or goats, etc.

7. Do you think windbreaks are necessary to keep the topsoil in the *forested* regions adjacent to the rectangular fields from blowing away? Why or why not?

No, the soil is protected from wind by the many trees and plants in the undergrowth. The soil also clings to the roots of small plants and trees.

8. What might trees have to do with preventing erosion?

Their roots help protect soil from the forces of erosion.

Area investigation: This activity provides a rich context for students to explore notions of area and perimeter. As students look at these images, it might be a good opportunity to ask questions related to the mathematical tools that might be employed by scientists to determine exactly what percentage of the world's forests are being cut. Specifically, using area concepts, students might be able to draw comparisons between the amount of clear-cut land, and naturally forested (or reforested) regions in this image.

On the [Area Investigation Activity Sheet](#), a grid has been placed over the enlarged image. You may also wish to give the students various manipulatives including string, cubes, tracing paper, overhead transparencies and pens, etc., for those students who would be challenged to find the areas using other strategies. The most direct way to calculate the area is to count squares and record those that are completely forested, deforested, and partially deforested. Students will need to do some estimating and combining of the partial squares in order to come to a final estimation. This approximation activity is an excellent opportunity to develop both spatial sense and estimation skills. Allow students to share both their solutions and their solution strategies.

Lesson Three: The Red Island

Distribute the [Red Island Activity Sheet](#). This activity sheet is self-guided. Teachers may wish to project the images on this activity sheet, or allow students to see pictures on a computer screen and record their answers on the activity sheet. Answers to the questions follow below.

Teacher Information and Discussion Topics: Students should notice the portions of the island

that have been deforested (as evidenced by the visible red soil), as well as the red sediment in the ocean that surrounds portions of the island after having been washed away via river flow. As explored in the lesson entitled [Hold on Tight](#), the root systems of plants and trees are vital to preventing the erosion of soil. On the Island of Madagascar, heavy deforestation has resulted in the loss of millions of cubic meters of soil into the drainage systems of the island and, ultimately, the ocean.

Sample responses for The Red Ring questions

1. Describe the close-up image of Madagascar (above) in as much detail as possible. What do you see?

Answers will vary. Students should identify the forested and deforested regions of the island, as well as differences in the coasts on respective sides of the island.

2. There are some notable differences between the two sides of the island in the circled area. Describe those differences.

Answers will vary, and may overlap with answers from question 1.

3. In the circled portion of the image, there appears to be a green section of land on the island. Describe the color of the ocean water near this green section of the island.

The water is dark blue.

4. How is the water along the coasts on the red side of the island different than on the green side?

The water is dark blue on the green side of the island, and has red/yellow tones on the other side.

5. What might cause this difference in the color of the water?

Answers may vary. Hopefully students recognize that the forested side of the island does not have visible sediment in the ocean. Help students make the connection between deforestation, erosion, and sediment in the water.

6. It is clear to see that a lot of red sand or dirt is being washed into the ocean water. Another name that scientists use to describe this soil or dirt is *sediment*. Where do you think this red sediment in the water came from, and how did it get to the ocean?

Topsoil from the interior of the island. It was carried by rivers and streams to the ocean.

7. What might *trees* have to do with the red ocean water?

Answers may vary. Soil tends to cling to root systems of plants.

8. To be able to see such clear evidence of sediment in the ocean water from a satellite (600 kilometers above the Earth!) indicates that thousands and thousands of tons of topsoil have washed off the island. One of the sad things about the deforestation in Madagascar is that the topsoil that is now in the ocean can no longer support life on land. How are plants and animals affected if there is no topsoil?

Plants cannot grow well without topsoil. Animals depend on plants for shelter, food, and shade. Also, streams and rivers clogged with sediment can lessen water supply for animals.

Lesson Four: The Pacific Northwest

Distribute the [Deforest-Reforest Activity Sheet](#). This activity sheet is self-guided. Teachers may wish to project the images on this activity sheet, or allow students to see pictures on a computer screen and record their answers on the activity sheet. After students work through the photos and questions on this activity sheet, distribute the [Deforest Reforest Questions](#) worksheet. The questions on this sheet refer to the pictures and images in the activity sheet. Answers to these questions follow below.

Teacher Information and Discussion Topics: This series again raises questions of deforestation, and includes photographs from hand-held cameras as well. An important contribution of this sequence is the notion of *reforestation*. As suggested in the activity sheet, forests can grow back both by natural means, as well as with the assistance of humans.

This sequence of images and questions encourages students to think again about *loss of habitat* that accompanies deforestation, and the ways that it may impact animals with respect to loss of food sources, loss of shade and protection, loss of nests and dens, etc. With these ideas in mind, then, it is important to illustrate the positive benefits of reforestation. Even if the trees that are planted do not replace the old growth forests in terms of their size and stature, they do provide habitat for animals.

Initiating Discussion with Students

There are several general discussion questions interspersed among the opening images of this sequence. These points for discussion have been underlined on the activity sheet. Engage students in these questions as preparation for the more formal questions that will follow. Encourage students to discuss their opinions and hypotheses with each other as they continue to build their understandings of deforestation. For the first discussion topic, they should notice that the forests within the Olympic National Park have been protected unlike those in

surrounding areas. Teachers should also discuss the idea of forest *fragmentation* to the children. When forests are fragmented (clear cut in some areas and not others), the habitats of animals and other plants in the ecosystem is greatly altered.

Sample responses for the Deforestation/Reforestation Questions

1. Answers will vary.
- 2a. Birds, deer, elk, bear, ground squirrels, etc.
- 2b. Loss of habitat, food sources, protection, nests, etc.
- 2c. More sunlight available, exposed to animals, erosion of soil that supports root systems, drying of soil, etc.
3. Answers will vary. Examples might include: loss of habitat, loss of nests, impact on food sources, protection from predators, etc.
4. Answers will vary. Students will likely compare prominent features of the map. For example, the parallel ridges in the lower left hand corner of the image, etc.
5. Much less pink in the second image means much less barren land.
6. The dark green probably indicates larger tree growth. The light green is re-growth that likely includes small trees and lots of green ground cover.

Summary question: Answers will vary.

IV. Assessment

At the end of this series of lessons, students should be able to describe what deforestation is, as well as its impact on plants and animals in the ecosystem. Students should also recognize the role humans in both deforestation and reforestation. The summary questions on each of the lesson activities provide good assessment measures. As a final assessment for this lesson, have students respond to the following questions:

- 1) What are some reasons that people cut trees down?
- 2) How can satellite imagery help us study deforestation?
- 3) Why should we be concerned about cutting down too many trees?
- 4) How can humans use forests and trees responsibly?

Lesson Extension for Authentic Assessment

Made in the Shade

Conversion of tropical forest land to agricultural use by people can be done in many ways. Each of these different ways has different environmental effects--some of which have broad impact. For example, one of the richest cash crops throughout the tropics is the production of coffee beans. Coffee plantations come in many shapes and sizes, from small single-farmer operations to large, corporate farms. Traditionally, coffee has been grown in semi-cleared areas, under the shade of large rainforest canopy trees, by individual farmers. Today, however, to meet heightened demand and to maximize profits, coffee is increasingly grown on plantations that have been wholly cleared of the native canopy. These two styles of coffee production have great impacts upon the local wildlife community. In particular, the concentrations and diversity of bird species (many of which migrate to North America in the spring) decline markedly as the structure of the forest is altered from a multiple-layer structure (including existing canopy trees as well as low-growing coffee plants) to a single-layer structure (coffee plants only).

As an extension activity for this series of activities, encourage students to explore the connections among coffee production methods, biodiversity, and even economics. Specifically, have students research "shade-grown" coffee that was produced without the harmful effects of clear-cutting deforestation. Students could interview employees at coffee shops to see where their coffee beans come from, and they could examine the labels of the coffee that is on sale at their local supermarket. What are the prices of these different kinds of coffee? Where do the proceeds go from the coffee sales? Some coffee cooperatives have been established such that a maximum amount of return comes to small, individual producers, allowing them to compete with large-scale coffee plantations that arise when large tracts of rainforest have been clear cut. Have students research shade-grown coffee on the Internet to accompany their first-hand research at the marketplace, to give them a more complete appreciation of what is "behind the label" of various products sold at the market.