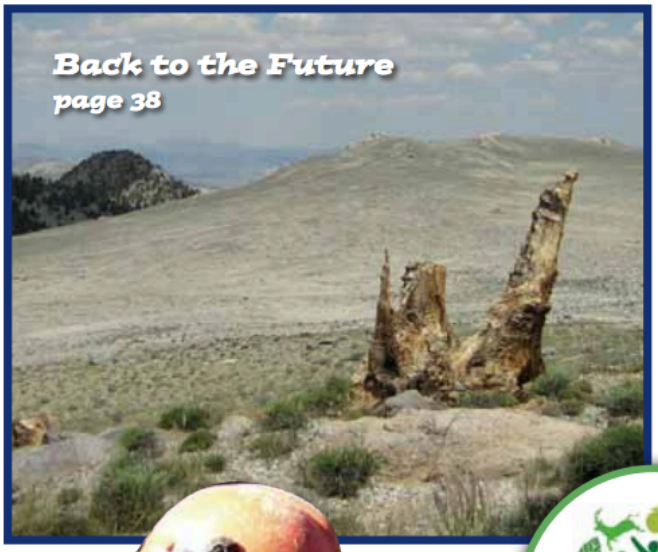
My NASA Data - Lesson Plans

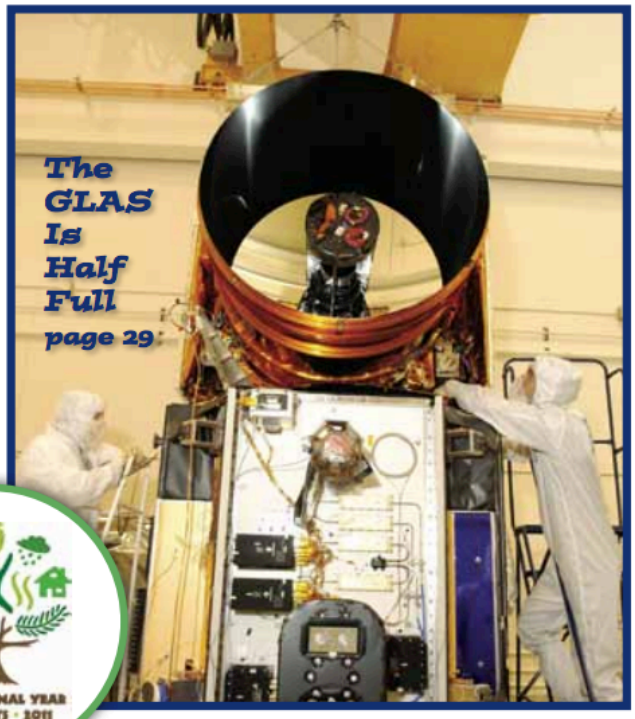
How can a series of Landsat images help scientists estimate a forest’s age over time?

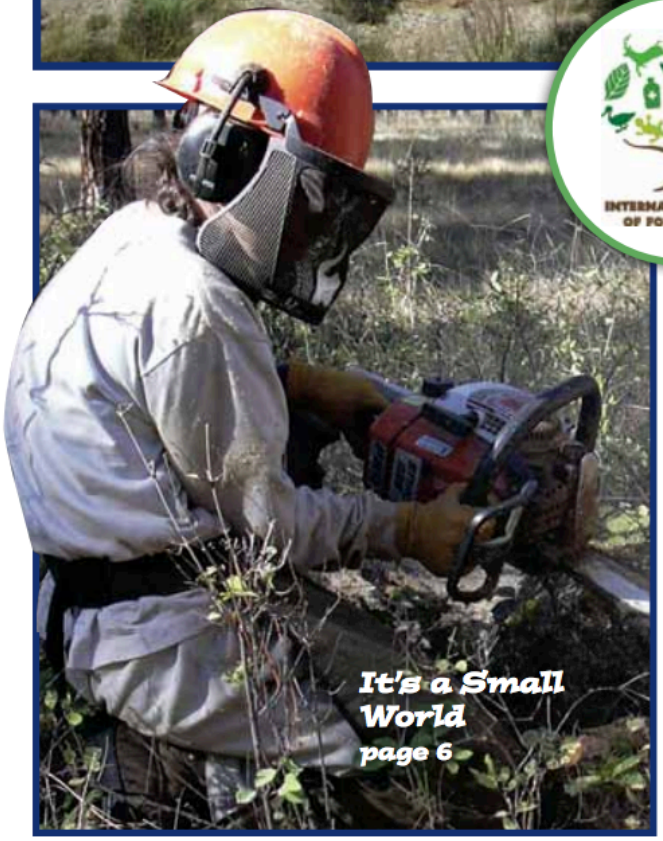
Natural INQUIRER

Climate Change Edition

Number 14







Overview

This activity is modified from the USDA/US Forest Services' lesson found in the Natural Inquirer newsletter. The purpose of this hands-on activity is to engage students in a similar process for monitoring forests as NASA scientists use to study the Biosphere, whereby they apply what they know of human aging (i.e., the appearance of gray hair's on heads) to the change of forests over time.

Learning Objectives

The student will:

- chart the relative appearance of gray hairs by the decade of human growth and development
- analyze Landsat images
- explore how satellites collect data and help scientists infer change over time

Why Does NASA Study This Phenomenon?

NASA supports and conducts research on tropical forests from space-based and ground-based perspectives, helping provide the information that national and international leaders need to develop strategies for sustaining human populations and preserving tropical forest biodiversity.

Measurements of global vegetation are valuable to scientists because they provide insight into the carbon cycle. Scientists use vegetation measurements to determine the planet’s net primary productivity: how much carbon is being used by the plants to grow. Carbon cycles through the oceans, soil and rocks, plants on land and in the ocean, and the atmosphere. The buildup of carbon dioxide released into the atmosphere by burning fossil fuel is the primary cause of global warming. The global biosphere has been helping to offset some of the excess carbon dioxide people have been pumping into the atmosphere.

Examples of Deforestation & Forest Disturbance

Video: International Deforestation Patterns in Tropical Rainforests

Video

International Deforestation Patterns in Tropical Rainforests |

https://www.youtube.com/watch?v=6AVkjJKK3iE | Source: NASA Video

Video: NASA | When Trees Fall, Landsat Maps Them

Video

NASA | When Trees Fall, Landsat Maps Them | https://www.youtube.com/watch?v=5XFS_oCETaw | Source: NASA Goddard

Essential Questions

- How can a series of Landsat images help scientists estimate a forest's age over time?

Cross-Curricular Connections

National Geographic Education Standards

- **Standard 14**: "Environmental modifications have economic, social, and political implications

for most of the world’s people. Therefore, the geographically informed person must understand the reasons for and consequences of human modifications of the environment in different parts of the world.”

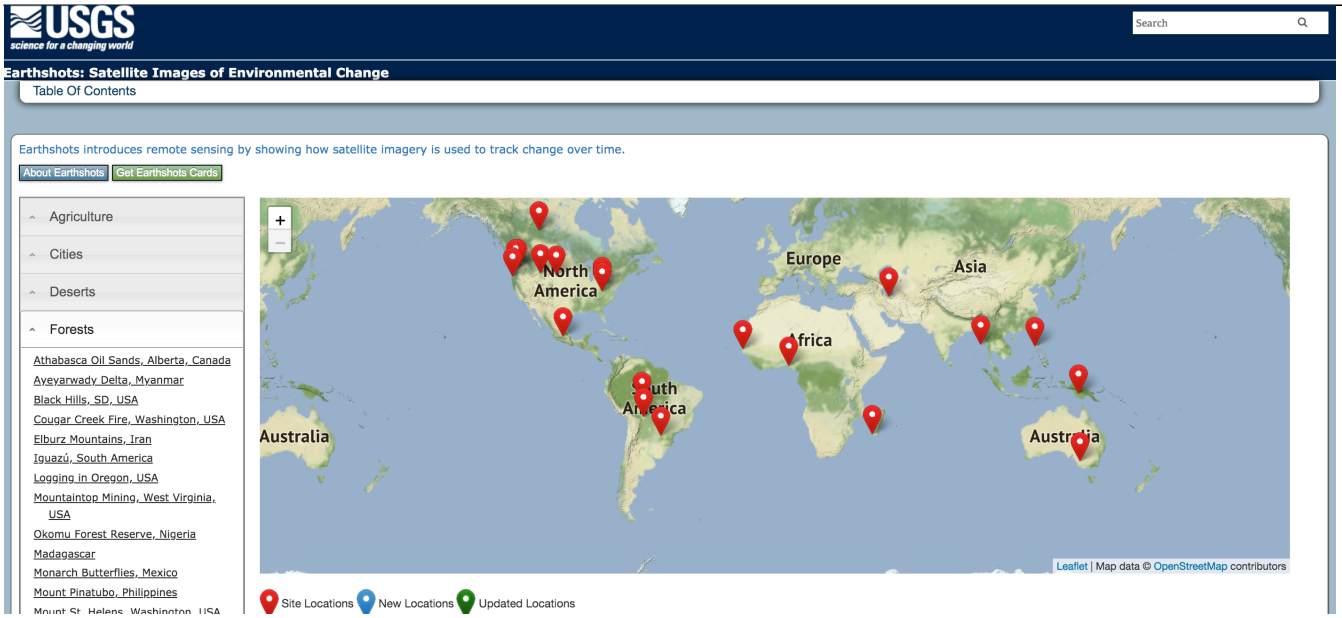
Materials Required

- One sheet of blank paper
- 8.5- X 11-inch
- Crayons or colored markers (brown, black, red, orange, yellow, and gray)
- Stapler
- Scissors
- Student Copies (one per group of 2) of The GLAS is Half Full: Satellites and Changing Tropical Forests
- 1 (duplexed) Earthshot cards (See Teachers Resources) printed in color and/or the dated images found from 1975-2017 pulled from the Rondonia Link on the Earthshots website (directions are provided below).

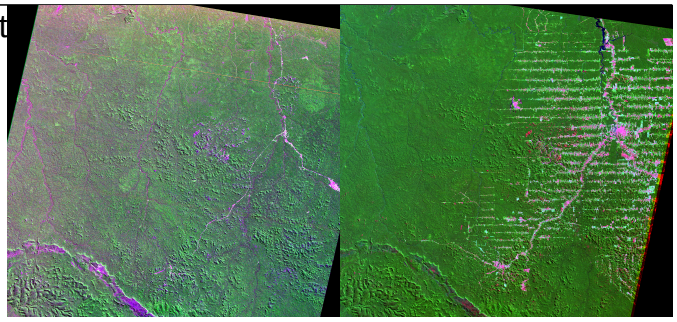
Credit: USGS

Alternatively, if computers or tablets are available, consider having students use the online Earthshot resource with their graphic organizer.

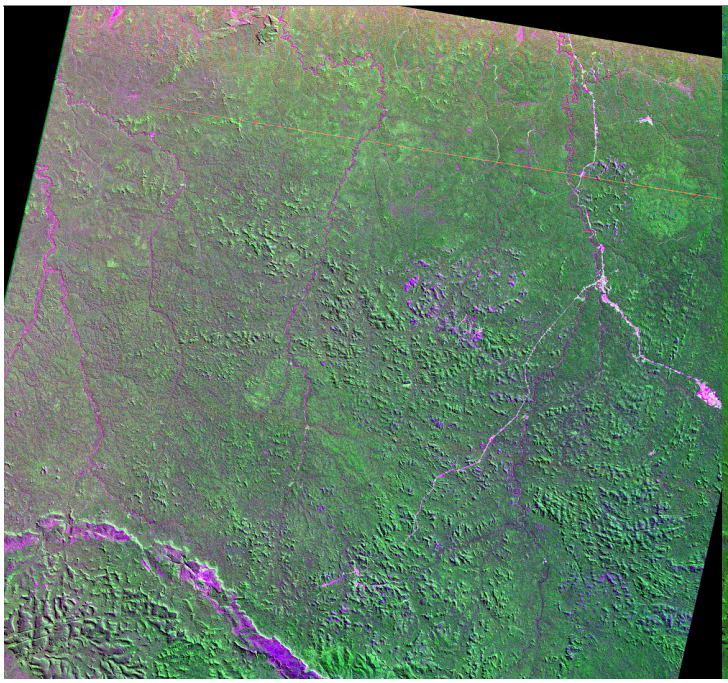
- Students should review the "Forests" Section. See below for details.



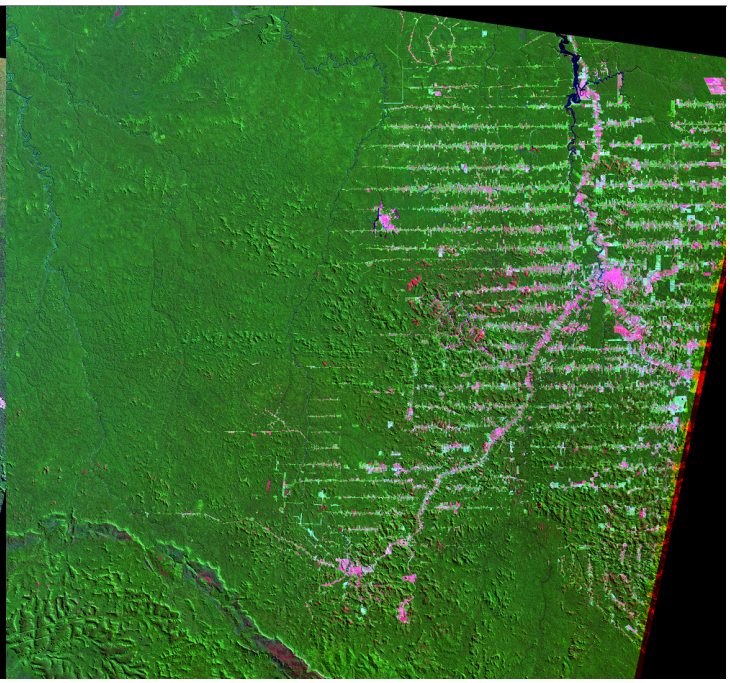
Earthshot Images of RondoniaCredit: USGS Earthshot



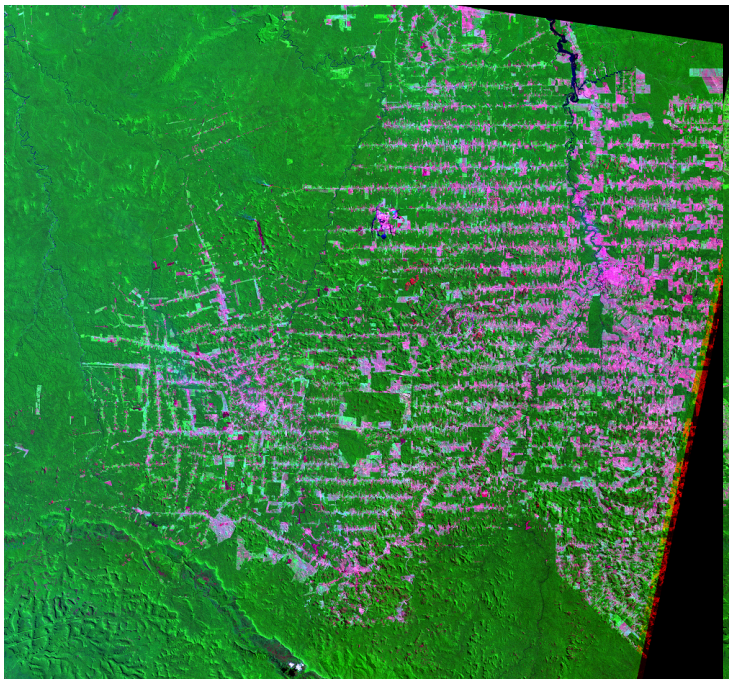
1975 1992



1975



1992



2001

Technology Requirements

- Standalone Lesson (no technology required)

Teacher Background Information

What is Deforestation?

Forests are an important and common feature of the Earth’s land cover, covering 31 percent of the

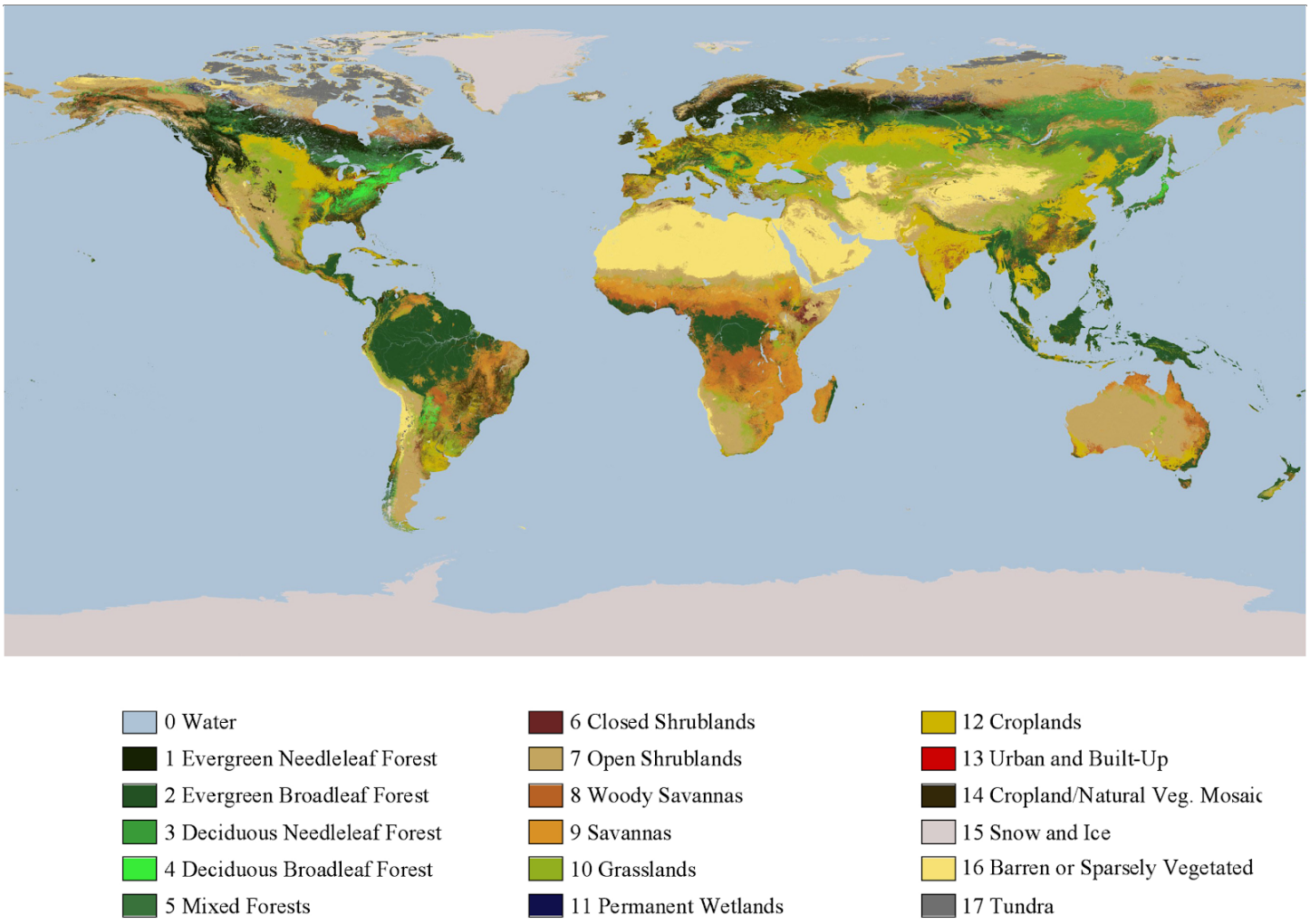
total land surface. There are two regions in particular where forests are common. A large area of forests (the taiga, or boreal forest) is found across northern North America, Europe, and Asia. Stretching out from the equator on all Earth’s land surfaces is another wide belt of forests of amazing diversity and productivity. These tropical forests include dense rain forests, where rainfall is abundant year-round. They also include seasonally moist forests, where rainfall is abundant but seasonal, and drier, more open woodlands.

Human activity and other factors result in deforestation. Humans clear the natural landscape to make room for farms and pastures, to harvest timber, and to build roads and houses. Tropical forests of all varieties, in particular, are disappearing rapidly by human activity. Other causes of deforestation may include drought, forest fires, and climate change.

Although deforestation meets some human needs, it also causes major problems, including social conflict, the extinction of plants and animals, and climate change. These challenges aren’t just local. Deforestation also has global impacts.

Where are the World's Forests Located?

Tropical forests span both sides of the Equator, thriving in the warm, usually wet, climate, under the Sun’s most direct rays. Boreal forests are found across the high latitudes of all land areas in the Northern Hemisphere.



This image shows land cover through a color-coded classification. There are 17 types of land cover, ranging from evergreen needleleaf forest to tundra. Water is depicted in light blue. Credit: NASA GSFC

How Do Deforestation Events Occur?

Intentional Deforestation of Tropical Forests

The biggest direct cause of tropical deforestation is turning the land into cropland and pasture. Countries build roads to improve transportation of goods. The road development itself causes some deforestation. The new roads also provide entry to land that could not be accessed before. Logging often comes after the new roads. In some cases, it is the reason the roads were built. When loggers have harvested all the wood in an area, they move on. The roads and the logged areas attract settlers. The settlers destroy the remaining forest for cropland or cattle pasture.

Government policies to encourage economic growth, like road projects, have caused significant, unintentional deforestation. Global economic factors can also encourage deforestation. These include things like foreign debt or expanding global markets for rainforest timber and pulpwood.

Droughts

As global temperatures continue to rise, droughts are expected to become more frequent and severe in many regions during this century. A new study with NASA participation finds that land ecosystems

took longer to recover from droughts in the 20th century. Incomplete drought recovery may become the new normal in some areas, possibly leading to tree death, loss of forest cover, and increased emissions of greenhouse gases.

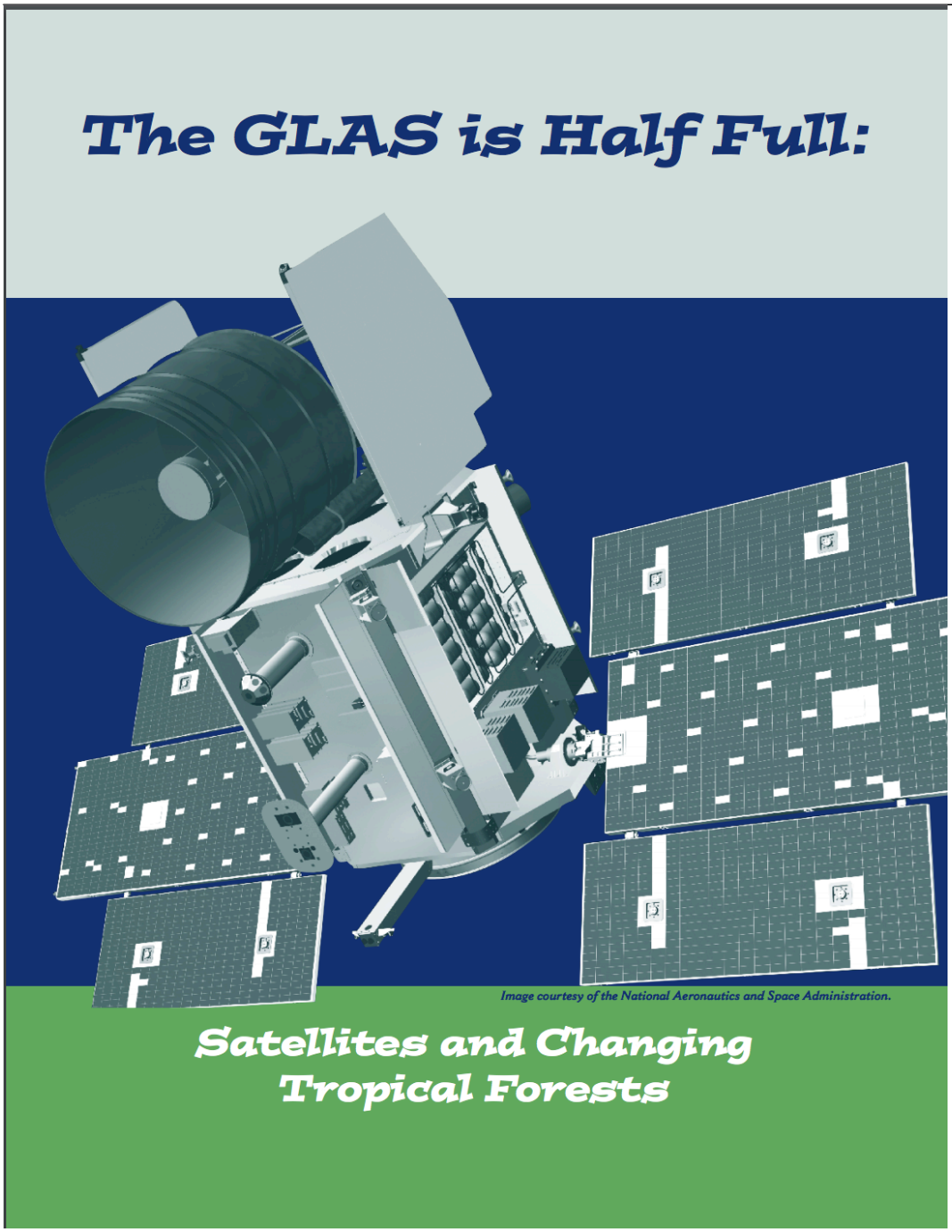
Forest Fires

Intentional fires get out of control and burn through the understory of nearby forests, killing, but not completely burning small trees, vines, and shrubs. The dead and dying trees collapse, spilling firewood and kindling to the ground and ripping a great tear in the tent of the forest overhead. In the past, thousands of deliberately set forest fires have raged out of control in Indonesia, Brazil, and Mexico, burning millions of hectares of rainforest.

Climate Change

Changes in temperature and rainfall/snowfall affect the health of forests. Many trees in the Western U.S. are already suffering from climate change. With warmer, drier conditions in the region, pine trees are more likely to become infected with insects. These bugs bore into the trees and lay their eggs. Eventually, they kill the tree. Some forests in the West have lost over half their trees already to pine beetles. When the forest is gone, birds and small mammals that lived there have to find new homes--if they can.

Also see the Satellites and Changing Tropical Forests for background information.



Credit: The Natural Inquirer

Procedure

1. Distribute the reading passages to students.

2. Assign the Reflection Questions.

    - What questions were the scientists trying to answer?
    - How do you think using information gathered by satellites could be more efficient than collecting information in person?
    - Why did the scientists study an area that had already been studied by other scientists working within the forest?

- Do you think the information collected by the satellites is exact or an estimate? Why or why not?
- Think about your own achievement of accuracy on a test. Is an 88-percent accuracy rate acceptable? Consider that the satellites collect a lot more data from all across the planet than scientists could collect by visiting forests in person. Do you think an accuracy rate of 88 percent is acceptable? Why or why not?
- Based on the results of this research, would you say that data collected by satellites may one day be used to help estimate the amount of carbon being held by the world's forests? Why or why not?
- The scientists did not claim that their methods could be used to study all forests. Why do you think they did not make this claim?
- From a climate change perspective, why is it important to understand how fast the amount of biomass increases in young tropical rain forests?

3. Read aloud or divide sections of reading passages to students (or assign as homework prior to doing the activity.)

4. Address the Reflection Section questions and answer with the students.

5. Cut the sheet of paper into 8 equal pieces. Staple one side to make a small book. Number each sheet of paper in the lower right-hand corner. The first page will be 1, the next page will be number 10. Then number each page in increments of 10 (20, 30, 40, and so on, until you have numbered all of the pages).

6. Draw a large empty circle on each page. Each of these numbers represents a person's age, from age 1 to 70. The circle represents the top of a person's head as if you were looking down at them from above.

7. Think for a moment of a person's hair color. Hair gradually loses its pigment and becomes white (or gray) as a person ages. Now color the circle (the top of a person's head) for each age. You decide when your person starts to get some gray hairs. Over time, your person becomes completely gray. Make this as realistic as possible, based on when you think most people's hair starts to become gray, and when it becomes completely gray.

8. As a class, complete the chart below. (You may put this chart on the whiteboard or blackboard.)

Age of person	1	10	20	30	40	50	60	70
Number of heads showing their first gray hairs								
Number of half-gray heads								
Number of completely gray heads								

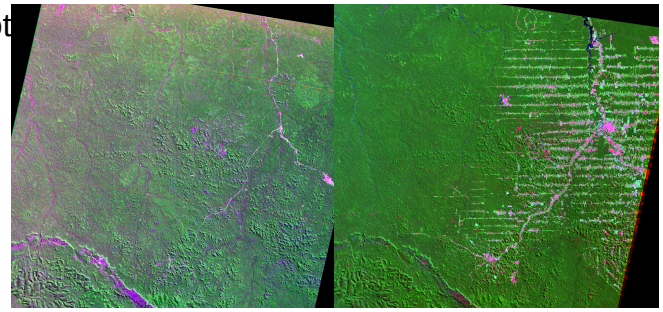
Credit: Natural Inquirer

- According to your class, at which age are people most likely to see their first gray hairs? At which age are they most likely to become about half gray? At which age are people most likely to become completely gray?
    - If you had a stack of photographs of the tops of people's heads, how could you use this activity's results to help you assign an age to each head?

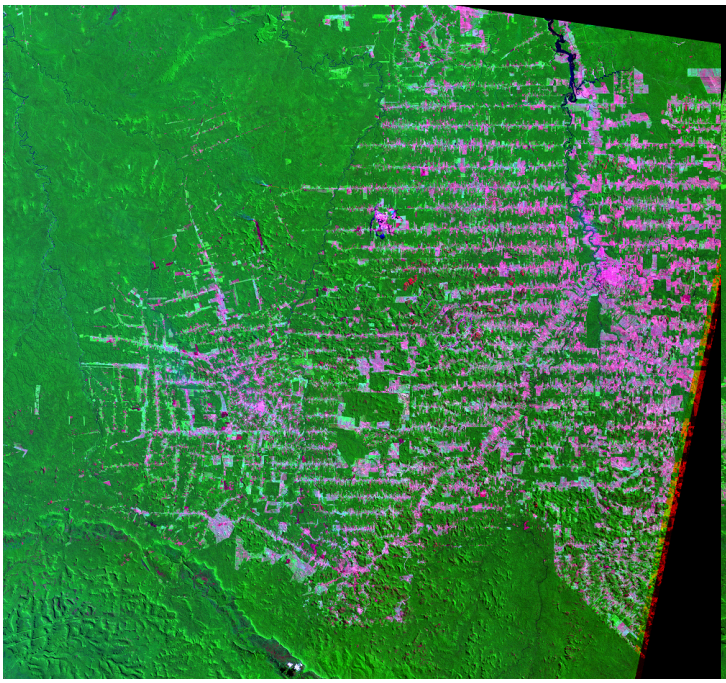
9. Compare this activity with the use of Landsat images provided in this lesson through Earthshot website or using the Landsat images from 1975 - 2017 provided.

- Find the oldest image and review.

Earthshot Images of Rondonia, Credit: USGS Earthshot



1975 1992



2001

- Model the I^2 Technique:
    - Step 1: Identify
        - Model for students what you "see". Here you are establishing a baseline by describing the different features, their properties, and characteristics. Be concise with your observations; focus only on what you observe. Do not infer (or attempt to explain) at this time.
    - Step 2: Interpret
        - Model for students how to interpret or infer the meaning of the first image by making a "What it means" statement (e.g., "This must mean that this area is a forest close to the river.").
    - Step 3: Caption

        - Now model for students how to make a caption for this image by joining the "What I see" with the "What It Means" comments to create a sentence using the text features from the Landsat image information.
    - Then review the next sequenced satellite image and repeat the process and so on.

10. Answer the Essential Question, How can a series of Landsat images help scientists estimate a forest's age over time? with the class.

- Explain that students have completed a process similar to the actions of scientists working within forests on the ground? What makes them similar?

11. Discuss the following questions:

- What threat does increasing human populations present on our forests?
- What can humans can do to reduce the impacts of deforestation? Have students generate ideas of things that they can do in their community and school.