



FOCUS QUESTIONS

- How has the Atlantic Forest of Brazil changed over the last few centuries and what effects have these changes had on the natural functions of the forest ecosystem?
- What is habitat fragmentation and what effects does it have on wildlife?
- What are the steps involved in restoring a forest ecosystem?
- How can drone technology be used to help reverse the effects of habitat loss and fragmentation?

OVERVIEW

“Tem o momento da virada na minha vida em que esse amor pela natureza se transformou em ativismo ambiental... Cada árvore plantada é uma semente no coração. Então essa é a nossa ação, essa é a maneira como a gente atua.”

“There was a turning point in my life when this love for nature turned into environmental activism... Each tree planted is a seed planted in the heart. So this is our action, this is how we act.” Mauricio Ruiz, founder, the Instituto Terra de Preservação Ambiental (ITPA; Earth Institute for Environmental Preservation)

In ***Rebuilding a Forest*** we meet three leaders in the efforts to rebuild and reconnect the habitat islands that much of Brazil’s Atlantic Forest has become. Since 1998 Mauricia Ruiz and his organization, ITPA, has been growing and replanting trees to restore habitat connectivity throughout the forest while also putting out illegally set fires. Ruiz’s colleague, Rejane Duarte da Costa, runs the nursery for ITPA which provides 58 different native tree species for the restoration effort. The ITPA team has recently recruited Gregory Maitre and his drone technology to significantly increase the number of tree seeds that can be planted in a day while also creating a more efficient system for monitoring landscape conditions and planting success.

KEY CONCEPTS

- **Habitat loss and fragmentation:** Over the last three centuries a combination of logging, clearing for agriculture, and urbanization has reduced the Brazilian Atlantic Forest to 26% of its original area and 35% of the remaining forest area is composed of small, isolated fragments of forest habitat.
- **Ecosystem ecology:** Understanding how living organisms interact with each other and their physical environment within a specific natural system is essential for reversing and restoring the Earth’s degraded habitats.
- **Corridor ecology:** Wildlife have many reasons for needing to travel across large swaths of land but human activity has removed that ability by fragmenting large contiguous ecosystems into small isolated island habitats. Corridor ecology studies how and why animals move throughout the Earth’s landscapes and how we can restore this essential ecosystem process.
- **Environmental activism:** The goals of environmental activism are to address environmental issues, promote sustainable practices, and ensure a healthy planet for future generations. Mauricio Ruiz’s organization, ITPA, not only grows and plants trees to rebuild and restore the Atlantic Forest, but it also works to educate local communities about the importance of the ecosystem processes upon which they depend and how to protect and maintain those processes.
- **Restoration ecology:** Centuries of unsustainable human activities have degraded the Earth’s terrestrial, freshwater, and marine ecosystems. Some terrestrial areas that used to contain expansive, continuous habitat have been reduced to a few islands of vegetation that cannot support many species or protect vulnerable ones. Restoration ecology is focused on reversing this degradation by restoring natural habitats and processes, including providing connectivity between habitats so individuals can move from one breeding population to another thereby increasing genetic diversity. Effective conservation often requires coordinated approaches involving several different groups of players.



- Ecosystem services: Nature provides humans with benefits that are essential for human health and well-being. These free ecosystem services range from bees and other insects that pollinate crops to wetlands and forests that clean water and air. Clean water for local communities is one of the many critical ecosystem services we learn about in ***Rebuilding a Forest***.
- Environmental education: Mauricio Ruiz's ITPA organization we learn about in ***Rebuilding a Forest*** helps local communities understand and care for their environment, fostering skills to address environmental challenges. The education arm of ITPA aims to create awareness, knowledge, and concern for the environment, promoting sustainable practices, stewardship skills, and responsible behavior.
- Biodiversity: Habitat fragmentation has created barriers to the movement of wildlife across landscapes which reduces the genetic diversity and health of isolated populations. Many species that find themselves in small isolated patches are unable to maintain large enough populations and species with more fragmentation are at greater risk of extinction. For example, nearly 30% of mammal species are globally at risk of extinction and habitat fragmentation is a primary driver of this risk. The 58 native forest plant species that the ITPA team raises and plants are also critical to support the animal biodiversity.
- Conservation biology: The practice of conservation biology recognizes the intrinsic value of the Earth's natural diversity of organisms. Conservation biology works to understand how the natural world operates, how humans affect nature, and how we can use collective scientific and cultural knowledge to conserve Earth's biological diversity.

BACKGROUND

The Atlantic Forest, known in Portuguese as the Mata Atlântica, is one of the most biodiverse ecosystems on Earth, rivaling even the Amazon in species richness. Stretching along Brazil's Atlantic coast and reaching inland toward Paraguay and Argentina, the Atlantic Forest originally covered around 1.5 million square kilometers (580,000 square miles), which was nearly 12% of Brazil's territory. Human interaction with the Atlantic Forest dates back thousands of years, with Indigenous peoples sustainably managing the land. However, large-scale deforestation began with the arrival of Portuguese colonizers in the 16th century. Driven by the demand for sugarcane, coffee, and later urban development, huge swaths of forest were cleared. The exploitation intensified through the colonial period and into the 19th and 20th centuries as cities like São Paulo and Rio de Janeiro expanded rapidly.

While the urbanization, industrialization, and agricultural expansion did lead to economic growth for Brazil, it also led to the significant loss of forest habitat and considerable fragmentation of the remaining forest. A substantial portion (35%) of this important biome is now a patchwork of over 245,000 small islands of forest vegetation embedded in a matrix of degraded areas, pasture, agriculture, forestry plantations, and urban areas with 83% of these fragments smaller than 50 hectares (about 123 acres).

This decimation of forest habitat has resulted in the Atlantic Forest being designated as one of the Earth's 'hottest' biodiversity hotspots; the remaining blocks and islets of native forest and non-forest ecosystems are still home to 2,420 vertebrates and roughly 20,000 plant species, with many of these species found nowhere else on Earth. However, nearly 2,000 of the plant and animal species that depend on the Atlantic Forest are listed as endangered with extinction, including the golden lion tamarin and the maned three-toed sloth. Despite its history of degradation and current status, the Atlantic Forest is still a critical reservoir of biodiversity, home to around 8% of the world's plant species and 5% of its vertebrates. Conservation efforts have grown in recent decades with goals to restore 15 million hectares by 2050, though challenges like illegal logging, urban sprawl, and agricultural pressure remain significant threats.



In ***Rebuilding a Forest*** we meet Mauricio Ruiz and learn about one of the major conservation efforts to rebuild and restore as much of the Atlantic forest as possible. Mauricio Ruiz founded the Instituto Terra de Preservação Ambiental (ITPA; Earth Institute for Environmental Preservation) in 1998 with some school friends when he was only 14-years-old. Since its inception, Ruiz and the ITPA staff and community volunteers have worked tirelessly to help restore the Atlantic Forest by both planting trees and fighting fires that are illegally set to clear land for crops and livestock. The organization also runs an environmental education center complete with a school that teaches students about the biology of growing trees and also the value of preserving the forest ecosystem upon which they and their communities depend, especially its function as a source of freshwater.

Recently ITPA has teamed up with Gregory Maitre, the CEO of MORFO Brazil. MORFO is a company that uses drones to diagnose soil conditions, plan tree planting strategies, drop seeds across the landscape, and monitor the progress of the reforestation efforts. The MORFO drone technology can plant three tree seeds per second, or 50,000 seeds per day and has helped Mauricio Ruiz plant several million trees since he started working with the high tech forest restoration group. As ITPA continues its intensive tree nursery and youth education efforts and matches drone technology to its reforestation goals, Ruiz will almost certainly succeed in rebuilding connectivity among the habitat islands the Atlantic Forest has become. The forested corridors the team has been building are reconnecting fragmented animal populations and restoring their ability to migrate across a safer landscape, find new food sources, and interbreed. In this hopeful film, Mauricio Ruiz shows us what 25 years of civilian-led action looks like.

BIODIVERSITY THREATS

The major threats to the Earth's biodiversity can be grouped into seven categories that spell the easily recalled acronym H.I.P.P.O.: **H**abitat destruction and fragmentation, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**verharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In ***Rebuilding a Forest*** we learn how the creative combination of human labor and nurturing with new technology is being used in Brazil to reverse centuries of habitat loss and fragmentation of the Atlantic Forest by reconnecting the thousands of habitat islands much of the forest has become.

DISCUSSION QUESTIONS

- [Before showing the film] Have students research and list the current and historical threats to their local and regional biodiversity, then have them brainstorm some strategies for reversing those threats and restoring some of the lost ecosystem functions and services.
- [Before showing the film] Have students brainstorm how they might use drone technology to rebuild and restore a forest ecosystem.
- After showing the film, have students review what they learned by creating a concept map or flowchart that illustrates the steps and processes involved in restoring a forest ecosystem.
- In the film we learn that a major focus of ITPA is building habitat corridors to reconnect the fragments that remain of the Atlantic Forest. Have students research what types of wildlife will most benefit from these corridors and why.
- Have students research local and regional groups involved in environmental activism, outline the reasons the groups were formed, and the goals they hope to accomplish.



Curriculum Connections

NGSS

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- LS4.D: Biodiversity and Humans

HS-LS3 Heredity: Inheritance and Variation of Traits

- LS3.B: Variation of Traits

HS-LS4 Biological Evolution: Unity and Diversity

- LS4.C: Adaptation

ETS1.B: Developing Possible Solutions

AP Biology (2021)

Enduring Understandings

- Energetics (ENE)
 - ENE-4: Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- Systems Interactions (SYI)
 - SYI-1: Living systems are organized in a hierarchy of structural levels that interact.
 - SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

IB Biology (First Exam May 2025)

A. Unity and Diversity: Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.

- A1.1 Water
- A3.1 Diversity of organisms
- A4.2 Conservation of biodiversity

B. Form and Function: Adaptations are forms that correspond to function. These adaptations persist from generation to generation because they increase the chances of survival.

- B4.1 Adaptation to environment
- B4.2 Ecological niches

C. Interaction and Interdependence: Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.

- C1.3 Photosynthesis
- C4.1 Populations and communities

D. Continuity and Change: Living things have mechanisms for maintaining equilibrium and for bringing about transformation. Environmental change is a driver of evolution by natural selection.

- D3.3 Homeostasis
- D4.2 Stability and change
- D4.3 Climate change

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CREDIT

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