



The Future of Forests

Landscape Recovery Case Study - Teacher Guide

Setting the Stage

As part of a 2017 study scientists sought to determine how a changing climate (drier) over the last several decades impacted post-fire tree regeneration. To answer this question, scientists measured the recruitment threshold and presence of seedlings (see vocabulary) at 1485 sites across 52 fire affected regions across the US Rocky Mountains. The results of this study suggest that seedlings (small trees) have a hard time regenerating (regrowing) in dry conditions.



Photo Description: University of Colorado Boulder researcher Monika Rother squats next to a seedling (young tree less than 3 feet tall) at the site of the 2000 Walker Ranch fire in Boulder, CO. Photo from the [University of Colorado Boulder](https://www.colorado.edu/boulder).

Lesson Overview

In this lesson, students analyze and interpret post-fire tree regeneration data from 1485 sites across 52 fire affected regions of the US Rocky Mountains.

- *Part 1 – (15 minutes) Future of Forests*
Students watch a video focused on scientists studying the landscape recovery process after the 1988 Yellowstone National Park fires.
- *Part 2 – (15 minutes) Case Study Background*
Students are introduced to a study in which scientists sought to understand how a changing climate has impacted the ability of trees to regenerate (grow) after a fire.
- *Part 3 – (20 minutes) Case Study Data Analysis*
Students create bar graphs to represent tree regeneration data.
- *Part 4 – (10 minutes) Update Summary Table*
Students reflect on what they learned from the lesson and how it relates to the unit driving question.

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Instructional Overview	
Grade Level	Middle/High School
Instructional Time	60 minutes (<i>total time needed</i>)
Unit Driving Question	How do landscapes recover after a wildfire?
Lesson Driving Question	How has a changing climate impacted post-fire tree regeneration?
Building Toward	Middle School: MS-LS2-4 , MS-ESS3-3 High School: HS-LS2-7
Three Dimensions	<p>Science and Engineering Practices:</p> <ul style="list-style-type: none"> Analyzing and Interpreting Data <p>Disciplinary Core Ideas:</p> <p><i>Middle School:</i></p> <ul style="list-style-type: none"> LS2.C: Ecosystem Dynamics, Functioning, and Resilience ESS3.C: Human Impacts on Earth Systems <p><i>High School:</i></p> <ul style="list-style-type: none"> LS2.C Ecosystems Dynamics, Functioning, and Resilience <p>Crosscutting Concepts:</p> <ul style="list-style-type: none"> Stability and Change Patterns
What Students Will Do	<ul style="list-style-type: none"> Analyze and interpret post-fire landscape recovery datasets to identify tree regeneration patterns.
Materials	<ul style="list-style-type: none"> <input type="checkbox"/> Landscape Recovery Case Study PPT <input type="checkbox"/> Landscape Recovery Case Study Student Worksheet (1 per student) <input type="checkbox"/> Answer Key <input type="checkbox"/> Video: Future of Forests <input type="checkbox"/> Initial Ideas Public Record <input type="checkbox"/> Summary Table <p>Optional</p> <ul style="list-style-type: none"> <input type="checkbox"/> Link to Scientific Paper (source of case study summarized in this lesson.)
Material Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue and test web links <input type="checkbox"/> Print student worksheets <input type="checkbox"/> Review speaker notes in the Landscape Recovery Case Study PPT <input type="checkbox"/> Review Answer Key <input type="checkbox"/> Display summary table and initial ideas public record



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Vocabulary	<p><u>Tree regeneration</u> - cones that only open and release seeds only when a fire sweeps through and melts the resin (adhesive) keeping the cone closed.</p> <p><u>Seedling</u> - Series of steps by which life comes back after a disturbance (e.g., fire, tornado, volcanic eruption, flood, etc.)</p> <p><u>Recruitment threshold</u> - % of field sites that meet or exceed pre-fire tree densities (the same number or more seedlings/trees grow back after fire)</p> <p><u>Seedling Presence</u> - % of field sites that experience no post-fire regeneration (no seedlings/trees grow back after fire)</p>
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Part 1 - Future of Forests (15 minutes)

Refer to Part 1 slides including in the [Landscape Recovery Case Study PPT](#). See PPT presenter notes for additional information.

1. Watch the [“Future of Forests” video](#) (7:28).
 - a. Students summarize the video in EXACTLY 30 words.

Part 2 - Case Study Background (15 minutes)

Refer to Part 2 slides including in the [Landscape Recovery Case Study PPT](#). See PPT presenter notes for additional information.

1. Use the [Landscape Recovery Case Study PPT](#) to introduce students to a 2017 study in which scientists visited 1485 field sites that had been impacted by wildfires to study post-fire tree regeneration patterns.
 - a. Students follow along with PPT by engaging in discussions, identifying the scientific question, defining and drawing pictures to represent vocabulary words (seedling, recruitment threshold, seedling presence), and answering two “Quick Check” formative assessment questions.

Part 3 - Case Study Data Analysis (20 minutes)

Refer to Part 3 slides including in the [Landscape Recovery Case Study PPT](#). See PPT presenter notes for additional information.

1. Students construct two bar graphs to compare and contrast post-fire recruitment threshold and seedling presence datasets from fire-affected sites during two distinct time periods, 1985-1999 and 2000-2015.
2. Students refer to bar graphs as evidence to answer the analysis questions. See [Answer Key](#) as needed.



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- a. Review analysis questions as a whole class.

Part 4 - Update Summary Table (10 minutes)

Refer to Part 4 slides including in the [Landscape Recovery Case Study PPT](#). See PPT presenter notes for additional information.

1. Students work in groups to reflect on their learning and how it relates back to the unit driving question, “How do landscapes recover after a wildfire?”
2. Facilitate a discussion in which students come to a consensus about what they learned and how it helps them understand the unit driving question. Ideas/concepts agreed upon by the class should be included in the whole class summary table (see [Answer Key](#)).
 - a. Students record new summary table entries onto their own summary tables.