



The Future of Forests

Succession Survey - Teacher Guide

Setting the Stage

Satellite observations of landscape disturbances (e.g., wildfire) allow scientists to monitor both the extent and recovery of affected landscapes. These satellite observations are important in helping land managers make decisions, including decisions about restoration efforts. As such, the U.S. Forest Service has developed the Landscape Change Monitoring System (LCMS) data explorer tool to map, monitor, and easily visualize landscape change across the United States.

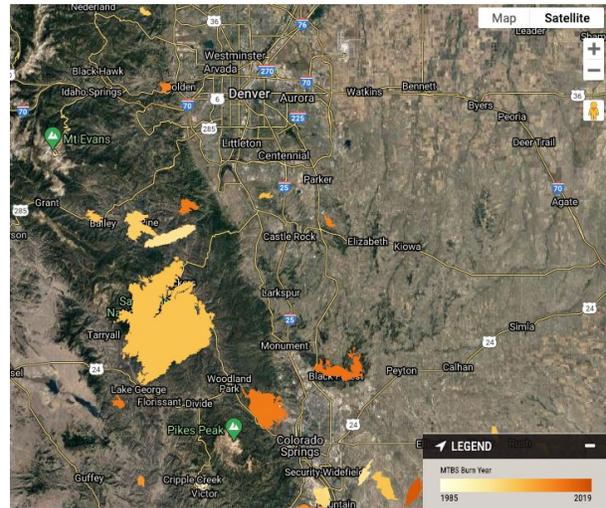


Photo Credit: [USDA Forest Service](https://www.usda.gov/forestservice)

Lesson Overview

In this lesson, students will engage with the Landscape Change Monitoring System (LCMS) data explorer tool developed by the USDA Forest Service to evaluate the recovery of fire-affected landscapes.

- **Part 1 – (20 minutes) NASA Satellites Monitor Forest Recovery (1988 Yellowstone Fires)**
Students explore the process of secondary succession by engaging with a NASA satellite visualization that documents the recovery of Yellowstone National Park after the 1988 wildfires.
- **Part 2 – (30 minutes) Landscape Change Monitoring System Tool**
Students engage with the Landscape Change Monitoring System (LCMS) data explorer tool developed by the USDA Forest Service to locate burn areas and assess their recovery.
- **Part 3 – (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	Do all landscapes recover the same way after a fire?
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"> Obtaining, Evaluating, and Communicating Information <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
What Students Will Do	<ul style="list-style-type: none"> Evaluate the recovery of fire-affected landscapes using the Landscape Change Monitoring System data explorer developed by the National Forest Service.
Materials	<ul style="list-style-type: none"> <input type="checkbox"/> Succession Survey PPT <input type="checkbox"/> Succession Survey Student Worksheet (1 per student) <input type="checkbox"/> Answer Key <input type="checkbox"/> NASA Earth Science video <input type="checkbox"/> The Yellowstone Fires of 1988 video <input type="checkbox"/> NASA satellite visualization - Yellowstone Recovery <input type="checkbox"/> Video of the NASA satellite visualization - Yellowstone Recovery <input type="checkbox"/> Landscape Change Monitoring System data explorer <input type="checkbox"/> Landscape Change Monitoring System data explorer overview video <input type="checkbox"/> Computer/Ipad (1 per student or 1 per student pair) <input type="checkbox"/> Butcher paper to create “Forest Recovery Factors” public record (see Part 2) <input type="checkbox"/> Initial Ideas Public Record <input type="checkbox"/> Summary Table
Material Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue and test web links <input type="checkbox"/> Print student worksheets



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	<ul style="list-style-type: none"><input type="checkbox"/> Review speaker notes in the Succession Survey PPT<input type="checkbox"/> Review Answer Key<input type="checkbox"/> Display summary table and initial ideas public record
Vocabulary	<p><u>Satellite</u> - Machine that is launched into space and moves around Earth or another body in space.</p> <p><u>Landsat</u> - Longest-running program (began in 1972) capturing satellite imagery of Earth.</p>

Part 1 - NASA Satellites Monitor Forest Recovery (20 minutes)

Refer to Part 1 slides including in the [Succession Survey PPT](#). See PPT presenter notes for additional information.

1. Students complete warm up prompt, “How do scientists measure the recovery of landscapes after a wildfire or other disturbance (e.g., flood, tornado, logging)?”.
2. Introduce NASA satellites and the Landsat program by watching [this NASA Earth Science video](#).
3. Refer to the PPT and student worksheet to introduce the 1988 Yellowstone wildfires that burned more than 800,000 acres (~36% of the park).
 - a. Watch “[The Yellowstone Fires of 1988](#)” video.
4. Students engage with a [NASA satellite visualization](#) to observe the landscape recovery process following the 1988 Yellowstone wildfires.
 - a. Students should answer Part 1 questions on their student worksheet as they interact with the visualization.
 - b. Review Part 1 questions as a whole class.
 - c. Consider showing [this video](#) in which a narrator describes what is going on in the satellite visualization.

Part 2 - Landscape Change Monitoring System Data Explorer (30 minutes)

Refer to Part 2 slides including in the [Succession Survey PPT](#). See PPT presenter notes for additional information.

1. Refer to the [PPT](#) to introduce the Landscape Change Monitoring System (LCMS) data explorer tool developed by the National Forest Service, NASA, and others.
 - a. Highlight the goal and purpose of the data explorer



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2. Open the [LCMS data explorer](#) and model for students how they will use the tool to 1) locate and date burn areas, 2) assess the recovery of burn areas, 3) determine the size of the burn area.
 - a. Use PPT slides (#9-15) and/or the [LCMS data explorer overview video](#) for detailed instructions on how to use the tool.
3. Teacher Demonstration - Using the LCMS data explorer, zoom in on Colorado Springs, CO. Highlight the burn areas just west of Colorado Springs. By selecting and deselecting the “MTBS burn year”, students will observe that these fire-affected landscapes have not recovered from recent wildfires. *See PPT or LCMS data explorer overview video as needed.*
4. Students will use the LCMS data explorer to locate burn areas and assess their recovery just as they observed in the teacher demonstration. Encourage students to analyze burn areas from their own state.
 - a. Students will complete the LCMS data explorer table and analysis questions on their student worksheets as they engage with the data explorer tool.
5. Facilitate a whole class discussion in which students reflect on their experience with the LCMS data explorer and their responses to the analysis questions.
6. Create a “Forest Recovery Factors” public record based on based on student ideas from analysis question #6, “What factors might prevent a landscape from recovering after a fire? (*Hint: consider factors plants need in order to survive.*)”

Teacher Tip: In the next lesson, students will analyze various datasets to explore drought conditions of the past and present across the western United States. As such, it is important that water or drought is included in the “Forest Recovery Factors” public record (see [Answer Key](#)). Students will discover in future lessons drought-like conditions are preventing some landscapes from recovering to their pre-fire state.

Part 3 - Update Summary Table (10 minutes)

Refer to Part 3 slides including in the [Succession Survey 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?”



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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.