



FIGHTING FIRE WITH FIRE: Can Fire Positively Impact an Ecosystem?

Subject Area: Science – Biology, Environmental Science, Fire Ecology

Grade Levels: 6th-8th

Time: This lesson can be completed in two 45-minute sessions.

Essential Questions:

- What role does fire play in maintaining healthy ecosystems?
- How does fire impact the surrounding community?
- Is there a need to prescribe fire?
- How have plants and animals adapted to fire?
- What factors must fire managers consider prior to planning and conducting controlled burns?

Overview:

In this lesson, students distinguish between a wildfire and a controlled burn, also known as a prescribed fire. They explore multiple controlled burn scenarios. They explain the positive impacts of fire on ecosystems (e.g., reduce hazardous fuels, dispose of logging debris, prepare sites for seeding/planting, improve wildlife habitat, manage competing vegetation, control insects and disease, improve forage for grazing, enhance appearance, improve access, perpetuate fire-dependent species) and compare and contrast how organisms in different ecosystems have adapted to fire.

Nature Works Everywhere Themes:



Controlled burns can improve the capacity of natural areas to absorb and filter water in places where fire has played a role in shaping that ecosystem.



Controlled burns help keep people and property safe while supporting the plants and animals that have adapted to this natural part of their ecosystems.

Introduction:

Wildfires often occur naturally when lightning strikes a forest and starts a fire in a forest or grassland. Humans also often accidentally set them. In contrast, controlled burns, also known as prescribed fires, are set by land managers and conservationists to mimic some of the effects of these natural fires.

Today, controlled burns are often conducted to counteract years of fire prevention policy, which called for all fires to be suppressed as quickly as possible. The policy of blanket fire suppression resulted in a tremendous buildup of forest underbrush and natural litter, such as pine needles. As a result, when these forests do catch on fire, the fire can be very destructive and intense. Controlled burns reduce the buildup of forest underbrush and litter, effectively lowering the intensity of future wildfires. Since 1972 National Park officials have adopted a policy of letting selected lightning-caused fires burn themselves out, within reason. Fires that threaten human lives, buildings, private property, or wildlife are extinguished.

In certain ecosystems, fires are necessary for the health of plant and animal species. The quick recovery of vegetation is evidence of how fire enhances habitat for most plants and animals in Florida. Herbivores, such as the white-tailed deer, are attracted to the highly nutritious plants after a fire. Fruit production is stimulated by fire, resulting in increased availability of seeds and berries that provide food for many species of wildlife. Predator populations increase in these areas, as they are attracted to increase in prey. Both plants and animals have developed adaptations to survive in this unique ecosystem, even relying on each other for protection. Controlled burns help preserve habitat that supports diverse plant and animal species adapted to both lightning- and human-caused fire.

Objectives:

The student will...

- Identify the benefits and dangers of fire in their own lives.
- Understand and explain the role of forest fires in maintaining healthy ecosystems.
- Explore and evaluate the different fire management policies, including fire suppression and controlled, or prescribed, burning.
- Understand behavioral and structural adaptations and examine how animals and plants adapt to frequent forest fires.
- Identify and evaluate the circumstances under which a controlled burn is useful and understand the phases of a controlled burn.

Standards:

[Next Generation Science Standards - Middle School](#)

Disciplinary Core Ideas:

- LS2.A Interdependent Relationships in Ecosystems
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS4.C Adaptation
- LS4.D Biodiversity and Humans
- ETS1.B Developing Possible Solutions

- ETS1.A: Defining and Delimiting Engineering Problems
- ESS3.A Natural Resources
- ESS3.B Natural Hazards
- ESS3.C Human impacts on Earth Systems

Crosscutting Concepts:

- Causation
- Patterns
- Energy and Matter
- Stability and Change
- Systems

Science and Engineering Practices:

- Asking Questions/Defining Problems
- Constructing Explanations
- Arguing from Evidence
- Communicating information

Performance Expectations

- MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-4 Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Common Core English and Language Arts Standards Grades 6-8

- CCSS.ELA-LITERACY.SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- CCSS.ELA-LITERACY.SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
- CCSS.ELA-LITERACY.SL.6.4 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

Vocabulary:

Adaptation: A characteristic that increases an organism's ability to survive and reproduce in its environment.

Behavioral Adaptation: Something an animal does, usually in response to some type of external stimulus, that helps it survive in its environment.

Controlled Burn: A fire purposely lit in order to safely apply a natural process to ensure ecosystem health.

Keystone species: A species that has a critical role in maintaining the structure of an ecological community.

Structural Adaptation: A physical feature or a part of an organism's body that helps it survive in its environment.

Materials:

For the teacher:

- Access to computer, projector, Internet
- Fire and Controlled Burn Images PowerPoint
<https://www.natureworkseverywhere.org/resources/can-fire-positively-impact-ecosystem/>

Nature Works Everywhere videos that support this lesson plan:

- **Fighting Fire with Fire: Can Fire Positively Impact an Ecosystem?** <https://vimeo.com/77792710>
- **Meet the Scientist: Zachary Prusak** video <http://vimeo.com/77788833>
- Scientist Interview Questions
 - **Fire #1: Florida** <https://vimeo.com/78369016>
 - **Fire #2: Benefits.** <https://vimeo.com/78369157>
 - **Fire #3: Keystone Species** <https://vimeo.com/78368877>
 - **Fire #4: Gopher Tortoise Burrow** <https://vimeo.com/78368879>
 - **Fire #5: Adaptations** <https://vimeo.com/78368875>
 - **Fire #6: Prescribed Burn** <https://vimeo.com/78368876>

Other videos that support this lesson plan:

- Optional - **Gopher Tortoises: Burrowing to Escape Forest Fires**
https://www.pbslearningmedia.org/resource/nat15.sci.lisci.gopher/gopher-tortoises-burrowing-to-escape-forest-fires/#.WWO_cneZM_U

For each group of students/individual student:

- Notebook paper/journal
- Copy of the Fire Impacts and Benefits list found here
<https://www.natureworkseverywhere.org/resources/can-fire-positively-impact-ecosystem/>
- Sticky notes

Classroom Activities:

Part 1: Engage

1. Ask students to fold a piece of paper into two columns and label one as **Harmful** and the other as **Helpful**. Guide students to brainstorm ways that fire can be harmful and ways it is helpful.
 - a. Examples of *harmful* may include damaging buildings and/or ecosystems and harming people.
 - b. Examples of *helpful* may include cooking, heating, powering machines, and its symbolic use in religious practices and during ceremonies such as the Olympics.
2. Facilitate a discussion asking students to share from their lists.
3. Pose the following questions as you show students the fire photographs in the Fire and Controlled Burn Images PowerPoint (<https://www.natureworkseverywhere.org/resources/can-fire-positively-impact-ecosystem/>) that accompanies this lesson.
 - a. What do you think is happening in the photograph? How long did it take you to decide? What information in the photograph helped you decide?
 - b. Were you curious about why this fire occurred?
 - c. Did you wonder about where this was taking place?
 - d. Do you think this fire is harmful or helpful? Why?

Explain that many fires are caused either naturally by lightning or accidentally by humans and that fire may be necessary to the health of some ecosystems. Fire managers sometimes set fires as *controlled burns* (also known as *prescribed burns*).



4. Share with the students the introductory video **Fighting Fire with Fire: Can Fire Positively Impact an Ecosystem?** <https://vimeo.com/77792710>. Ask them to take notes of what they think are the key ideas from the video.
5. Explain to students that they will work to answer the following guiding questions during the lesson:
 - a. What role does fire play in maintaining healthy ecosystems?
 - b. How does fire impact the surrounding community?
 - c. Why do fire managers prescribe fire?
 - d. How have plants and animals adapted to fire?
 - e. What factors must fire managers consider prior to planning and conducting controlled burns?
6. For more information about Zachary Prusak, the Nature Conservancy Fire Manager featured in the videos, show students the **Meet the Scientist: Zachary Prusak** video <http://vimeo.com/77788833>.

Part 2: Explore

1. Explain that Florida is an example of an area that has many naturally occurring wildfires because its geographical location lends itself to frequent lightning.
2. Have students view the interview question video **Fire #1: Florida** that answers the question “How has a place like Florida been shaped by fire?” <https://vimeo.com/78369016>.
3. After students view the video, have them identify the following statements as true or false:
 - Lightning first became a major source of wildfires in Florida in the 1970s. [false]
 - Many Florida organisms expect fire in their environment. [true]
 - Fire is not a natural part of an ecosystem. [false]
4. Provide students with the definition of **Controlled Burn** – A fire purposefully lit in order to safely apply a natural process to ensure ecosystem health. Re-emphasize the concept of wildfires as a valuable and necessary part of forest or grassland ecosystems.
5. Show students the images of a controlled burn in the Fighting Fire Images PowerPoint (<https://www.natureworkseverywhere.org/resources/can-fire-positively-impact-ecosystem/>)
6. Share the interview question video **Fire #2: Benefits** (<https://vimeo.com/78369157>). Then ask students to identify the key idea of the video [*that fire can benefit animals, plants, people, or all three*].

7. Next, hand out the list of fire impacts and benefits, found in the student handouts section (<https://www.natureworkseverywhere.org/resources/can-fire-positively-impact-ecosystem/>), to each group and create 4 columns on the board labeled **Humans**, **Other Animals**, **Plants**, and **All Three**. Ask students to look at the list and identify whether each of the impacts of fire benefits humans, other animals, plants, or all of these. Note their responses on the board.

1. Reduce hazardous fuels
2. Dispose of logging debris
3. Prepare sites for seeding/planting
4. Improve wildlife habitat
5. Manage competing vegetation
6. Control insects and disease
7. Improve forage for grazing
8. Enhance appearance
9. Improve access
10. Perpetuate fire-dependent species

**Note that each of these impacts benefits all three, humans, other animals, and plants.*

8. Now that students have explored how fires can benefit ecosystems, they are going to investigate how certain plants and animals have adapted to wildfires. Ask students to define **Adaptation** [a characteristic that increases an organism's ability to survive and reproduce in its environment].
9. Ask students what they think a **behavioral adaptation** is [something an animal does to survive in its environment]. Over generations, animals have adapted to know what to do when there is a change in their environment. Next ask them what they think a **structural adaptation** is [a physical feature or part of an organism's body that has helped it survive in its environment]. Ask them to keep these in mind as they view the following videos.
10. Share the interview question videos **Fire #3: Keystone Species** <https://vimeo.com/78368877> and **Fire #4: Gopher Tortoise Burrow** <https://vimeo.com/78368879>. These videos explain how the gopher tortoise and other species have adapted to this unique ecosystem and how they behave during a wildfire.

Optional: For more information about Gopher Tortoise burrows, show the video Gopher Tortoises: Burrowing to Escape Forest Fires (https://www.pbslearningmedia.org/resource/nat15.sci.lisci.gopher/gopher-tortoises-burrowing-to-escape-forest-fires/#.WWO_cneZM_U).

11. Ask students what kind of adaptation the animals in the video were showing [behavioral].
12. Next, have students view the video **Fire #5: Adaptations** that answers the question "How do plants and grasses adapt to fire?" <https://vimeo.com/78368875>.
13. Ask students whether the plants discussed in the video are showing behavioral or structural adaptations [structural]? Explain that structural adaptations are physical features that

help protect the plants against fires. For example, the oils in the saw palmetto ensure that primarily the palm burns, protecting the growing bud.

Part 3: Explain

1. Explain to students that the person responsible for organizing and conducting a controlled burn is called the “Burn Boss.” (This is not considered to be informal; that is the correct title. A “Fire Manager” is a term that denotes the person in charge of a fire program; it is more of a Federal fire term.) Ask students to work in small groups and answer the question, “As a Burn Boss, what are some things you would need to consider before setting a controlled burn?”
2. Guide students to brainstorm factors and to write each response on a separate sticky note. Provide students with categories to consider such as impacts on the ecosystem, effects on humans, and considerations of weather and climate. As students brainstorm, ask them to add their response on a chalkboard or a larger wall or floor space under the category it supports. Ask students in small groups to rank the items under each category from most to least important. Guide them into sharing their ranking and defending their top choice.
3. View the interview question video **Fire #6: Prescribed Burn** that answers the question “what does it mean to do a prescribed fire or controlled burn?” <https://vimeo.com/78368876>
4. Explain that there are several phases for a controlled burn. Review these with students.
 - a. First, biologists and natural resource managers inventory (identify and count) plant and tree species in the area of the burn. They measure the slope of the land (fire moves faster on steeper slopes). They also look at these criteria:
 - the local weather patterns (what are the monthly averages, how windy is it?);
 - how dry the area is on average and has been recently; whether the plants and wildlife are adapted to surviving wildfires;
 - what structures and landscape features (e.g., rivers, lakes, hills, valleys);
 - how extensive the growth is on the site and whether preliminary work needs to be done (e.g., pruning);
 - what specifically is going to fuel the fire.

This information is used to develop a burn plan. The burn is only done when it is safe and the fire can be controlled.
 - b. Trained professionals start, manage, and extinguish the controlled burn. They wear protective clothing and have water and equipment ready to extinguish the fire.
 - c. The landscape immediately after the burn seems inhospitable, but the burnt grass and plants provide nutrients to the soil.
 - d. Several months later, the warm, bare soil is filled with nutrients new plants need to grow. The final photo is of the same field in June 2005, two months after the controlled burn. The green grass is abundant.

5. Explain that burn bosses directly affect how and where fires are allowed to burn by managing wildfires and setting controlled burns. In places with fire-adapted plants and animals, burn bosses are increasingly using fire as a tool to increase ecosystems' resilience to the impacts of climate change and other threats, ensuring that natural areas continue to provide healthy habitats and clean water for people.
6. Conclude the lesson by randomly selecting individuals to summarize the adaptations of plants and animals in Florida.
7. Reinforce the concept that forest fires and prairie fires are a part of nature; they're both powerful change agents that shape ecosystems. The specific pattern of fire—including how frequently it burns, how hot it burns, and during which season it burns — helps dictate the types of plants and animals found in a given area and the adaptations they need to survive. Reinforce that fires can have implications for human safety as well and influence the infrastructure and economy in a given area. In turn, the landscape and structures in an area can often help to contain fires and limit their potentially negative impacts

Part 4: Evaluate

Have students self-evaluate for:

- Their understanding of the role fire plays in maintaining healthy ecosystems.
- Examples and descriptions of how plants and animals have developed adaptations to protect them from fire.
- Examples and descriptions of the factors fire managers consider prior to planning and conducting controlled burns.

Specific questions:

1. Compare and contrast Behavioral and Structural Adaptations.
2. State three benefits of fires to an ecosystem.
3. Imagine you are a Burn Boss. A community wants to hire you to hold a prescribed burn.

Review the following scenarios:

○ **Scenario 1:**

The community wants to control the establishment and spread of invasive species and the overabundance of woody plant species in their area. They are interested in prescribing a controlled burn in order to get rid of these invasive species and to clear out overgrowth of woody plant species.

Coyote and bur oaks make their home in this area. Bur oaks have very thick bark, which offers high resistance to fire. Coyotes are very accomplished runners and will quickly flee to safety in the presence of fire.

The weather report for the area is

“Today is March 18th. Temperatures will reach a high of 59 degrees Fahrenheit with lows in the mid 30’s tonight. Some light rain is predicted for later in the week but today will be clear and sunny with some clouds rolling in later this evening.”

○ **Scenario 2:**

The community also wants to promote the growth and abundance of native prairie grasses in a Tallgrass Prairie Preserve. They are interested in prescribing a controlled burn to stimulate growth of their prairie grasses to attract animals to graze. In addition to prairie grasses, badgers make their home in this area.

Badgers are well adapted to prairie habitat because they can dig through soil full of the tough roots of prairie plants. Most prairie grasses are adapted to drought, fire, and grazing. They are perennials that grow back every year and have their growing points underground. During a prairie fire, the above-ground portion of the plant is destroyed, but the below-ground growing structures are unharmed because the soil protects the underground structures.

The weather report for the area is

“Today is July 19th and you can expect another hot one today! Temperatures will reach a high of 101 degrees Fahrenheit with lows in the high 90’s tonight. There is a slight wind coming from the East. We are in day 40 of a drought and there is no precipitation predicted for the next 10 days.”

Use the criteria reviewed earlier and the information above to make a recommendation for each area about whether to hold a controlled burn. (Note that you will not have information about all the criteria.)

Scoring key for evaluation

1. Behavioral adaptations are things organisms do/ways organisms behave that help them survive in their environment. Structural adaptations are physical features or parts of an organism’s body that helps it survive in its environment.
2. Any three of the following:
 - Reduce hazardous fuels
 - Dispose of logging debris
 - Prepare sites for seeding/planting
 - Improve wildlife habitat
 - Manage competing vegetation
 - Control insects and disease
 - Improve forage for grazing
 - Enhance appearance
 - Improve access
 - Perpetuate fire-dependent species
3. Scenario #1: This area is a good candidate for a prescribed burn. Coyote and bur oak are well adapted to fire and the predicted weather in this area shows mild temperatures and rain a few days away.

Scenario #2: This area is not a good candidate for a prescribed burn at this time. While badgers and prairie grasses are well adapted to prairie habitat, the predicted weather in this area shows very high temperatures and there is an ongoing drought. Under these conditions, even the slight wind predicted could cause a fire to burn out of control.

Additional Resources and Further Reading:

- *Introduction to Prescribed Fire in Southern Ecosystems*
http://www.srs.fs.usda.gov/pubs/su/su_srs054.pdf
- *Fire Effects Information System (FEIS)* <http://www.feis-crs.org/beta/>
- *Firewise Communities* <http://www.firewise.org/>
- *Fire Management-Yellowstone National Park (National Park Service)*
<https://www.nps.gov/yell/learn/management/firemanagement.htm>
- *Fighting Fire with Data, Spacecraft, Drones (CNN)*
<http://www.cnn.com/2012/07/26/tech/innovation/technology-fighting-fire/>
- *Florida Fights Fire with Fire (CNN)*
<http://www.cnn.com/videos/us/2012/07/02/marciano-fight-fire-with-fire.cnn>
- *National Interagency Fire Center* <https://www.nifc.gov/>
- *Wildland Fire Assessment System* <https://www.wfas.net>
- *National Weather Service* <http://www.weather.gov/>
- *Forest Fire Research Questions the Wisdom of Prescribed Burns (The)New York Times*
http://www.nytimes.com/2012/09/18/science/earth/forest-survey-questions-effect-of-prescribed-burns.html?pagewanted=all&_r=0