



Lesson 8: Fires and Forests – Evaluating Solutions

SEEd Alignment: 6.4.5 – *suggestions for acclimating to phenomenon education in italics*

Evaluate competing design solutions for preserving ecosystem resources and biodiversity based on how well the solutions maintain stability within the ecosystem. Emphasize obtaining, evaluating, and communicating information from differing design solutions.

Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
<ul style="list-style-type: none"> LS2.C: Ecosystem dynamics, functioning, and resilience 	<ul style="list-style-type: none"> Stability and Change 	<ul style="list-style-type: none"> Obtaining, Evaluating, and Communicating Information Engage in Argument from Evidence

Time Commitment: These lessons are designed to provide flexibility in both length and depth. Plain text in black contains the middle-of-the-road option, **while text in red contains time-saving options** and **text in purple contains options to dive deeper into the subject matter.**

50 – 100 minutes (2 classes) , **45-55 minutes**, and **100+ minutes (2-3 classes)**.

Lesson Summary

This lesson provides a final capstone where your students can apply all they’ve learned about how ecosystems function on solving a real-world problem. Students now understand that a stable ecosystem is a sign of a healthy, balanced ecosystem and that biodiversity and resource availability are integral to a stable ecosystem. One of the greatest, and longest-running experiments in forest ecosystem health and stability has occurred over the last 100+ years as humans have tried to understand how to live with fire in our forests. Students will investigate how forests lived with fire before the large-scale interventions of the last century, how those interventions changed the forest, and evaluate solutions for creating healthy, stable forests in the future. **A large part of the story of fires in our forests has been the tale of Smokey Bear. Smokey was instrumental in spreading the message that fires are a force of deadly destruction and a foe to be battled and overcome at nearly any cost. Even as our understanding of fires natural place in the forest has changed, the public perception of Smokey and the fear of fires has largely remained. In this capacity, Smokey presents a great opportunity to discuss the power of propaganda in policy making, sometimes even eclipsing science in understanding and creating healthy forests.**



Previous Knowledge

Through their exploration thus far, students have seen the effects of resource availability on organisms and populations, discovered patterns of interactions between organisms, modeled the movement of matter and energy between abiotic and biotic components, and found evidence that stability can be affected by changes to the ecosystem. This knowledge will help them to evaluate possible solutions for preserving ecosystem stability. They will also need to use the scientific skills they have honed: asking questions, looking for patterns, creating models, analyzing data, obtaining and evaluating information, etc. Like any skill, the more they practice the better they will be at using these skills, but the foundations have been laid.

Background Information

It is easy to see fire as something to be feared and fought. When witnessing raging flames or the resulting charred forest it can be difficult to understand how the forest could be benefiting from such destruction. But with the perspective of time, and an understanding of the adaptations that the forest possesses, the benefit and necessity of fire can be found. Fire is a natural part of nearly every ecosystem, and those ecosystems have adapted to take maximum benefit from those fires. Relatively regular low-scale fires, like those that are typical for healthy, stable forests, have a variety of positive results. Native Americans would work with these natural cycles in many places, creating small scale fires to help regenerate forests and not working to stop fires when they did occur. In the late 1800's settlers decided that fires need to be prevented and fought. They saw fire as a threat to their communities and crops and worked aggressively to stop fires. Over the following century the disruption of the natural fire cycle created forests that are unstable, and more likely to have fires far greater in scale than those found in natural fire cycles.

In a healthy, stable forest a typical fire largely remains on the forest floor, removing build-ups of dead plant matter and thinning the living vegetation. The fire acts to clean and open-up the forest floor. Burned organic matter adds nutrients to the soil and removal of debris allows sunlight to penetrate further to the ground. These regular low-scale fires typically do not kill all of the understory plants, but remove the weakest in the population. The remaining plants, both understory and canopy, benefit from not only an increased nutrient load in the soil but also a decrease in competition. The plants that are left are healthier and stronger.

Trees are also thinned during the low-scale fires as older trees, seedlings, and weaker trees are more likely to be killed by the fire. Before humans began altering the forests, largely by trying to remove fire, forests had far fewer trees. Forests were more open as fire culled many trees, leaving the healthiest behind. When fire was suppressed by humans, forests became much denser as many more trees survived. More trees living to maturity also meant that there were eventually more dead trees falling to the forest floor. The understory became littered with dead, dry litter.



When fire did eventually come through the forests, and humans were unable to stop it, the fires were no longer low-scale. The buildup of both the understory and the denser tree canopy allowed fires to spread more easily and burn much more intensely. These new fires have so much fuel that their temperatures are able to kill trees that would typically survive, and sometimes become so hot that instead of nourishing the soil it can sterilize it. Instead of creating a healthier, more stable forest, the forests that have resulted from over a century of fire suppression have begun to truly be forces of destruction. Disturbed natural fire cycles have disrupted the stability of the forest as resources were lost or spread among far more organisms.

Low-scale fires benefit the fauna of the forest as well. When fires clean the forest floor they prevent the formation of thick stands of shrubs and allow for a more open areas where fauna can pass more easily and where the grasses and forbs they browse on can grow. Aquatic fauna benefits as well when water hungry shrubs are thinned and water is allowed to pass to streams and lakes that would otherwise be trapped. Fire exclusion can lead to forests where the ground is choked with shrubs, reducing the diversity of grasses and forbs, and handicapping the fauna that try to pass though.

Disease is also controlled by low-scale fires. Bark beetles in particular are less likely to reach outbreak population levels when fire cycles are allowed to happen naturally. With fewer trees spaced further apart, there are fewer breeding grounds for the beetles. While high-intensity fires will definitely remove the beetles, they also remove even healthy trees. Low-scale fires can drastically reduce bark beetle populations while allowing healthier trees to survive.

Flora, especially trees, have adapted to low-scale fires and are often dependent on those fires. Many trees have fire resistant bark that allows them to survive, and some have cones that require fire to open and spread their seeds. Even some smaller plants have seeds that need fire temperatures to germinate. Without fire to help these plants create new generations, biodiversity is reduced as new generations are unable to develop or develop in much smaller numbers. High-intensity fires can become so intense that even those seeds and cones that require fire can be destroyed.

In the 1930's and before some land managers and policy makers began promoting prescribed fires and an attempt to return to a more natural fire cycle. Those ideas did not find more wide-scale acceptance until the 1970's and are not fully embraced ,even today. The public education campaigns and propaganda, based on complete fire suppression was incredibly effective and has been difficult to overcome. Public perception, even when not based in science or an understanding of what makes a healthy forest and prevents large-scale fires, heavily effects public policy.

Lesson Plan:



Fires and Forests – Evaluating Solutions

Materials	Location
Blackline: L8 Fires and Forests – Evaluating Solutions	Addendum Folder – Tab L8 or USB – L8 Folder
Blackline: L8 Fires and Forests – Potential Solutions	Addendum Folder – Tab L8 or USB – L8 Folder
Optional:	Bark Beetle Specimen Bag
Smokey Bear Comic	Addendum Folder – Tab L8 or USB – L8 Folder
Wildland Fire in the United States brochure	Addendum Folder – Tab L8
Why are you letting it burn? brochure	Addendum Folder – USB – L8 Folder

Preparation

- This lesson can be done in class or as a take home assignment. The students will need internet access to study potential approaches to fire management.
- Students can either read the background information in the National Inquirer article on a computer as a pdf , through a weblink, or you can print out copies from the copy on the USB or from the weblink.
- **To save time this activity could be done as a class, raising and discussing each solution together.**

Set-up

- Explain that students will be learning about a significant issue in Utah’s forests and using their scientific thinking skills to determine what solution they think would be the most effective.
- Ask the students about their personal experiences with fire.
 - Have they ever seen a forest fire, even from afar?
 - Have they ever visited a forest after a fire?
 - Have they ever watched news coverage of a fire?
- Ask the students how they think fire affects a forest?



- Are fires a positive or negative force in the forest?
- If they could dictate fire in forests, how would they change things?
- Distribute the Wildland Fire Vol.2 Issue of the National Inquirer to the students, either digitally or in hard copy, and ask the students to read pages 4–13.
 - For a more in-depth look at the situation, you can also ask the students to read the articles on page 25 and 41, or the entire issue.
- Ask the students if they have any different opinions about forest fires after reading the article.
 - Do they still see fire as a positive or negative force in the forest?
 - Would they change their approach in dictating fire in the forest?
- On your whiteboard, work with the students to outline the problem.
 - What does a healthy, stable forest look like in regards to fire?
 - What is the current state of fires in the forest and how does that affect their stability?
 - What do land managers need to consider when looking at solutions to the problem?
 - Items to consider could include; human resources, funding, scale of forests, threats to human structures, public perception, effectiveness

Activity

- Tell the students they will now evaluate different approaches to the problem of forest fires and determine which offers the best outcome as far as creating a healthy and stable forest.
- Distribute copies of the blackline, “Fires and Forests – Evaluating Solutions” and walk the students through the sections discussing what the students need to include in their report.
- Depending on your class, you can either instruct the students to research potential solutions on their own or assign them potential solutions from the list on blackline, “Fires and Forests – Potential Solutions.”
 - If your students need more direction, you can give them the blackline, “Fires and Forests – Potential Solutions” and direct them to use the links provided to research the solution.
 - The research portion of this report offers a good opportunity to discuss critical thinking in choosing sources and how to cite their sources.
- Give the students a set amount of time to complete and submit the report.
 - This activity can be completed in class or extended to a take-home assignment.



Discussion

- When the students have finished their reports, you can have an open discussion where students engage in arguments based on the evidence they collected, either in teams or as individuals.
 - The goal is to have students consider the positive and negative aspects of each solution and how it could affect different organisms.

Smokey Bear – Propaganda and Public Policy

While the use of Smokey Bear as a communication tool started with the best of intentions, and based on the knowledge at the time, his message of fires as a foe to be fought have created long lasting problems with the implementation of policies that could help to restore forest stability. As our understanding of the importance of fire has evolved, so has Smokey’s message: from a beginning in promoting complete fire suppression, to a more measured message of personal responsibility in the prevention of starting fires. When land managers and policy makers create plans for managing fires in our forests, they have to consider public opinion and often end up having to modify plans to mollify their constituents. The history of Smokey Bear offers your students a chance to understand that policy decisions are not only grounded in what studies have shown is best for the forest.

- Distribute the hard copies of the “Wildland Fire in the United States” brochure, or the digital pdf of “Why are you letting it burn?” brochure, and ask the students to read the brochure.
 - Ask the students how they feel about forest fires after reading the brochure.
 - Do they feel emotionally connected to the problem?
 - Ask them to rate how important they feel the problem is, and how much they care about addressing it.
- Distribute copies of the Smokey Bear comic, either as digital copies from the USB or the hard copies found in the addendum folder, and ask the students to read the comic.
 - Ask the students how they felt about forest fires after reading that comic.
 - Did they feel more emotionally connected to the problem of forest fires?
 - After reading the comic, do they feel it is more important to stop forest fires?
 - Ask them to rate how important they feel the problem is, and how much they care about addressing it.



- Discuss the difference between the student's reactions to the two different presentations of information on forest fires.
 - Which format did they feel was most effective in presenting its message?
 - Why do they think it was more effective?
- Explain to the students that the Smokey Bear comic was from the earlier in the 1900's and had an important part in forming public perception of fire and how it should be handled.
 - Discuss how the remaining emotional effects of Smokey Bears story might affect public policy on fires.
- Ask your students to look elsewhere in public policy to see if they can find other examples of emotional stories or propaganda affecting public policy.

Assessment

Students should demonstrate an understanding of critical thinking and an understanding of the importance of ecosystem stability and how it relates to resource availability and biodiversity. Informal observations and assessments of participation are most applicable for the group discussion portion of this lesson. Assessments of written reports should focus on the student's arguments, look for ties to evidence, understanding of ecosystems and critical thinking skills.

Extensions

The U.S. Forest Service has produced lesson plans based on fire ecology for all grade levels. The lesson targeted to 7th grade in this packet could be a wonderful extension on the topic of this lesson:

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5107845.pdf

Name(s): _____ Date: _____

Describe the Problem

Using the space below, and additional paper if necessary, describe how fires are affecting forests currently and how that differs from fires of the past.

Define the Effects

Using the space below, and additional paper if necessary, describe how the problem is affecting the stability of the forest focusing on changes in biodiversity and resource availability.

Name(s): _____ Date: _____

Obtain Solutions

Using the space below, and additional paper if necessary, explain the potential solutions to the problem, focusing on how they would help to restore forest stability.

Evaluate Solutions

Using the space below, and additional paper if necessary, list the potential benefits and problems with the solutions you described above.

Name(s): _____ Date: _____

Communicate Solutions

Using the space below, and additional paper if necessary, explain which solution you have found to be the best choice for managing fires to restore forest stability.

Create Solutions

Using the space below, and additional paper if necessary, create your own solution to the problem. Your solution could be a combination of, or different than, those listed above.

Name(s): _____ Date: _____

Potential Solutions

At your teacher direction, chose 2 or more of the following potential solutions to evaluate. Focus on how efficient and effective each solution could be to restore forest stability by addressing forest fires.

Using logging to prevent high-intensity forest fires:

CNBC article:

<https://www.cnbc.com/2018/08/03/california-timber-firms-maybe-piece-of-the-puzzle-to-cut-fire-risk.html>

Pacific Standard article:

<https://psmag.com/environment/logging-does-not-help-prevent-forest-fires>

Prescribed Fires:

Forest Service article:

<https://www.fs.usda.gov/detail/dbnf/home/?cid=stelprdb5281464>

Outside article:

<https://www.outsideonline.com/1988971/playing-fire-feud-grows>

Fire Prevention

State Foresters article:

<https://www.stateforesters.org/news-events/blog/forest-management-plays-critical-role-wildfire-prevention#sthash.MCzNqw0b.dpbs>

Letting Fires Burn

BBC article:

<http://www.bbc.com/earth/story/20160722-why-we-should-let-raging-wildfires-burn>