H11: Smoke from Wildland Fire: Just Hanging Around?

This activity is based on the US Forest Service's "FireWorks Northern Rocky Mountains & Northern Cascades" Curriculum

Overview

This lesson explores the complex relationship between fire, the prairie and people. Students explore the benefits and trade-offs of this practice and understand the complexities from multiple points of view.

Lesson Goals:

Students will understand the complex relationship between fire, prairie health and human health.

Objectives:

1. Students will be able to use available data to create a smoke map of the area near their school and make observations about smoke drift and potential impacts.
2. Students will use an online simulator to model the smoke drift of a prescribed burn in the area of o their school and identify the factors and conditions that should be considered when conducting a prescribed burn.
3. Students will develop persuasive mock testimony from a given point of view and will analyze these testimonies as a decision-making tool.

Anchoring Phenomena:

The relationship between fire, prairie and people

https://prairieecologist.com/tag/prescribed-burn/ (some time lapse of prairie burns)

https://www.youtube.com/watch?v=Xdp4CjvCkyU (KSRE Prairie Management)

https://www.youtube.com/watch?v=jy21uSG3ma8 (Last Stand of the Tallgrass Prairie Intro)

Subjects: Science, Social Studies, Health

Duration: 3 Class Periods

Group Size: Small Groups

Setting: Indoor

Vocabulary: Prescribed Burns, Smoke Drifts, Particulate Matter

Academic Standards:

Standards		High School (9-12)
NGSS – Disciplinary Core Ideas	**Cross Cutting Concepts**	Systems and System Models
	Disciplinary Core Ideas	LS2.C: Ecosystem Dynamics, Functioning, and Resilience ETS1.B: Developing Possible Solutions ESS3.C: Human Impacts on Earth Systems
	Science and Engineering Practices	Engaging in Argument from Evidence Analyzing and Interpreting Data
NGSS – Performance Expectations	**Speaking and Listening**	SL.9-10.1, SL.11-12.1 SL.9-10.3, SL.11-12.3 SL.9-10.4, SL.11-12.4
	Literature	
	Writing	W.9-10.1, W.11-12.1 W.9-10.4, W.11-12.4 W.9-10.7, W.11-12.7

Teacher Background:

There is a long history of the Tallgrass prairie being burned. Most likely it started with lightning strikes, but over time, these fires are set intentionally. The Plains Indians would start prairie fires to attract bison herds to the fresh grass and this practice was mimicked as cattle ranching began to take hold in the area. In fact, many scientists attribute the long-term health of the remaining

stand of tallgrass parried to the grazing and burning of these pastures overtime, without which, the native grasses and forbs might be crowded out by invasive species.

In the Spring of each year, many ranchers in Kansas and Oklahoma conduct prescribed burns of an estimated 2.3 million acres of pasture land. According to the Kansas Department of Health and Environment, the state agency that sets standards for these prescribed burns, "These burns help preserve the tallgrass prairie, control invasive species such as Eastern Red Cedar and Sumac and provide better forage for cattle. Prescribed burning minimizes risk of wildfires and is effective in managing rangeland resources. Smoke from the burns can influence the air quality of downwind areas. The use of smoke management techniques is vital to reduce impacts" (KDHE, 2018, http://www.ksfire.org/docs/2018_Health_Advisory.pdf). Additional benefits include the quick release of nutrients, improved wildlife habitats and improved biodiversity for plant and wildlife species.

For ranchers to safely burn these large sections of pasture, the weather conditions must be ideal. This creates a concentration of burning on days when the winds, humidity and temperatures align and in turn, creates air quality impacts. The smoke from a burning pasture can travel long distances—as far as Washington DC, as witnessed by smoke maps in 2010 (Wichita Eagle, May 1, 2010 https://www.kansas.com/news/local/article1033882.html). The smoke drift from these prescribed burns most often has air quality impacts in larger communities where air quality is already a challenge and include Wichita, Kansas City and larger towns in Nebraska including Omaha and Lincoln.

Prescribed burns release large amounts of particulate matter (PM) and substances that can form ozone. Particulate matter and ozone can cause health problems, even in healthy individuals. Common health problems include burning eyes, runny nose, coughing and illnesses such as bronchitis. Individuals with respiratory issues, pre-existing heart or lung diseases, children and elderly may experience worse symptoms (KDHE, 2018). In order to minimize the negative health impacts, it is suggested that healthy people avoid strenuous outdoor work or exercise and those with respiratory or heart related illness should stay indoors, with windows and doors closed and using air conditioning with air filters.

Because prescribed burns have both ecological and economic benefits to ranchers, while also creating potential health risks because of smoke drift, this practice of burning in the springtime is being closely examined, monitored and regulated.

Materials and Preparation:

Each group will need access to a computer to both develop a smoke map and do smoke modeling.

Procedure:

1. **Engage:**
   Tapping into prior knowledge: To begin the lesson with students, ask students to think about experiences they might have had around a campfire or grill and the smoke from that fire. What benefits are there to having a grill or campfire? Have you ever experienced any effects from the fire?   Maybe your eyes have watered or you've coughed from the smoke?

What do you think causes your eyes to water or for you to cough? What do you think is different about smoke filled air compared to air that does not have smoke in it? What do you think might be some of the impacts to people if the air was filled with smoke from a large fire?

Anchoring phenomenon: What do you think might be some causes for a large amount of smoke to fill the air? In Kansas in the springtime, there might be days when you've noticed lots of smoke in the air. Ranchers across the state will often burn their pastures in the Spring. Show this video and asks students to record their observations: https://youtu.be/SP987AyhBgM (6:41 minutes) What did you observe? Why do you think that ranchers might burn their prairie pastures?   What do you think might be some of the effects? What questions do you have about these pasture burnings? Let's explore this phenomenon further.

2. **Explore:**

To provide context for understanding the complexity of the issues around burning the prairie, begin with a jigsaw method for students to gather information.   Divide students in group of three of four and assign each group a topic to become the expert team—topics might include: historic burning of the Flinthills, benefits of burning for ranching, other benefits of burning to the prairie ecosystem, current best practices for burning, negative impacts of burning, health impacts of smoke from burning, how burning is regulated and controlled, current research on burning, etc. Create a Google Document that has the topic headings of the research areas assigned and provide the link to all the groups. Assign the following roles: Lead Researcher, Lead Recorder, Lead Team Manager and Lead Reporter. The responsibilities of the Lead Researcher are to work with your team to determine sub topics and assignments for research. The Lead Recorder is responsible for helping the group to synthesize and organize the research. The Lead Team Manager's role is to make sure the group stays on track and manage the time to complete the team task. The Lead Reporter will be responsible for presenting your team's findings. Give students 30 minutes do the research and prepare their presentations using a visual aid to share findings, which might include a poster, a Google Presentation or poster display. Have groups present using a time limit of 3-4 minutes.

Smoke Map Modeling: TEACHER NOTE: Remind students that most prairie burns occur in early to mid-March through April, though some are burning in the fall after the first killing frost in November and into December. You may have to pick a neighboring county/near county for students to explore the smoke effects as not all counties in Kansas currently have smoke modeling data at http://ksfire.sonomatechdata.com. Explore the site to determine which county might work best for looking at impact to your school site.

Give groups the following scenario: You have a ranch pasture of 6000 acres in XX County (See Teacher Note) that you would like to burn in the spring (March or April) and you want to know the smoke impacts on your school. Use the resources provided on the website to develop the smoke map for your school. Explore the smoke impacts for your school site. NOTE TO TEACHER: You might want to assign a different week during March and April to

each group so they can look at data over time.   Next, use this website to map your likely smoke impact: http://ksfire.sonomatechdata.com. Look at the weather conditions and determine which day this week might be the most ideal for burning and what smoke impact might be that day. Do you think the school might be impacted? Why or why not?? What will be the benefits of your decision? What will be the tradeoffs?   Provide a rationale for your choices.

Have groups present their finding using Google slides.

3. **Explain:**

Discussion: What did you observe about the different burn plans? What was the most compelling rationale provided for the choices made? What do you think might happen if several people were burning their pastures on the same day? Why might that be likely to happen? What are the opportunities for maximizing benefits and minimizing impacts? What do you think might be the benefits and tradeoffs of burning less regularly?

4. **Elaborate:**

Simulate a public meeting on prescribed burning in the Fiinthills and give students the following scenario:

There is to be a public meeting to seek input through the Kansas Flinthills Smoke Management Advisory Committee. Several groups will be represented at the meeting including the The Kansas Department of Health and Environment/Bureau of Air, Kansas Ranchers Association, Citizens for Clean Air, The Kansas Asthma Association, The Preservation of the Flinthills Committee, and the Kansas Rural Economic Development Committee.

Assign students in groups of 4 to each of the interest groups and give groups time to develop a profile of the group they're representing and develop their 1-page testimony to provide input to the Kansas Flint Hills Smoke Management Advisory Committee. Each group should prepare by exploring the following questions:

1. What are the key concerns related to burning in the Flinthills of your Group? Why are they concerned about these issues?
2. What would your group encourage the advisory committee to do in regards to prescribed burning in the Flinthills?
3. What evidence, research or data does your group have to back up your testimony?
4. What's the most compelling way to write and present your testimony?

Allow each group to present their testimony to the class and discuss. Which groups seemed to have the most compelling testimony? What are some of the benefits and trade-offs of the proposed recommendations from each group?   If you were on the advisory committee, what would you recommend happen next?

Evaluation, depending on focus could include evaluation of:

a. Group research on impacts of burning and construction of smoke mapping through google sites
b. Group development of a burn plan
c. Group presentations of testimony for the mock state hearing on Prescribed Burning

Evaluation Rubric:

Rubric for Group research on impacts of burning and construction of smoke mapping through google sites (30 points)

0-5 Points	6-10 Points	11-15 Points	Points Awarded
Group presents an overview of their assigned topic which is limited and includes only one source, not all team members contributed to the completion of their report development and sharing.	Group presents an overview of their assigned topic which includes at least 2 subthemes that were investigated and most team members contributed to the completion of their report development and sharing.	Group presents an overview of their assigned topic which includes at least 4 subthemes that were investigated and each team member contributed to the completion of their report development and sharing.	
Group partially develops a smoke map for the area near their school and minimally explores potential impact to the school grounds and identifies at least 1 benefit or tradeoff of prescribed burning.	Group develops a smoke map for the area near their school and explores dates/times of potential impact to the school grounds and identifies at least 2 benefits and tradeoffs of prescribed burning.	Group develops a smoke map for the area near their school and explores dates/times of potential impact to the school grounds and identifies at least 4 benefits and tradeoffs of prescribed burning.	
		TOTAL OUT OF 30 POINTS	

Rubric for Group Development of a Burn Plan:

0-5 Points	6-10 Points	11-15 Points	Points Awarded
Group presents an overview of their burn plan and identify appropriate dates/times for a prescribed burn in their area to with no discussion of potential impact. Students can demonstrate their modeling. One or two team members have a role in presenting.	Group presents an overview of their burn plan and identify appropriate dates/times for a prescribed burn in their area to with minimum discussion of potential impact. Students can demonstrate their modeling. Most team members all have a role in presenting.	Group presents an overview of their burn plan and identify appropriate dates/times for a prescribed burn in their area to minimize impact. Students can demonstrate their modeling and explain the potential impacts. Team members all have a role in presenting.	
Group provides minimal discussion of the factors that impacted their decision making including forecasted weather, the fires currently burning and the prevailing winds and wind forecasts.	Group discusses the factors that impacted their decision making but don't address all the factors that might influence their including forecasted weather, the fires currently burning and the prevailing winds and wind forecasts.	Group discusses the factors that impacted their decision making including forecasted weather, the fires currently burning and the prevailing winds and wind forecasts.	
		TOTAL OUT OF 30 POINTS	

Rubric for Group presentations of testimony for the mock state hearing on Prescribed Burning:

0-5 Points	6-10 Points	11-15 Points	Points Awarded
Group identifies the likely point of view of the group they're assigned presents testimony that includes two or fewer appropriate and verifiable references to support arguments appropriate to the group they have been assigned to.	Group identifies the likely point of view of the group they're assigned presents testimony that includes at least three appropriate and verifiable references to support arguments appropriate to the group they have been assigned to.	Group identifies the likely point of view of the group they're assigned presents testimony that includes at least five appropriate and verifiable references to support arguments appropriate to the group they have been assigned to.	
Only one or two group members have contributed to the development of the testimony and presentation. .	Most group members have contributed to the development of the testimony and presentation. .	Each group member has contributed to the development of the testimony and presentation.	
		TOTAL OUT OF 30 POINTS	

References/Resources:

https://www.nps.gov/tapr/learn/nature/fire-and-grazing-in-the-prairie.htm
https://www.nps.gov/tapr/learn/nature/fire-regime.htm

http://keep.konza.k-state.edu/prairieecology/fire.html

https://www.npr.org/sections/thesalt/2014/04/28/306227655/fire-setting-ranchers-have-burning-desire-to-save-tallgrass-prairie

http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC09/reference/econatres.napc09.lhulbert.pdf

https://link.springer.com/article/10.1007/BF02390180

https://people.clas.ufl.edu/rdholt/files/187.pdf

Traditional Ecological Knowledge on wildfire management:
https://www.indianaffairs.gov/bia/ots/dfwfm/bwfm/fuels-management/traditional-ecological-knowledge