

Forestry and Climate Change

The Impact of Fires on the Ecosystem

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Author's Note:

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Introduction

Every spring since the early eighties, community members from Navajo Nation would get together to take a test that would determine if they made the wildland fire crew. The test included questions to assess their knowledge of fire behavior and a physical exam. The test included questions about fire behavior such as where and how to set up back burns and about the rate of spread of fire in natural terrain. The physical exam was the completion of a three-mile course in full gear weighing 50 pounds in a limited amount of time.

I remember my father and brothers sitting at home, waiting for a call, with their green packs with their yellow jackets and helmets ready to go by the door or in the truck. As soon as the call came in to the Trading Post, a message would be sent throughout the community to the “Hot Shot” crew members. Often, it was first come, first serve on who went out on the fire call, so every second counted as my brothers and father drove off to sign up.

When they did go out on a fire, they would be gone for at least a week and often for the maximum of 14 days. When my brothers, and most especially when my father came home, my family was ecstatic. We could smell the smoke lingering on their clothing and coming from their bags. As a child, I didn’t realize what it took to manage fires.

In the last few years, fires have been occurring with higher intensity often caused by lightning strikes or careless people. There are many factors that contribute to the devastation of the forests including laws and policies that have promoted fire suppression and have contributed to preventing historical and natural fire regimes. Additionally, climate change has contributed to the increase in the intensity of forest fires. I have created this curriculum unit to teach fourth grade students about the role of fire in our forests. This unit can also be adapted for students in third grade.

Context

Kayenta is on the Navajo Reservation in Northeastern Arizona located about thirty miles from the Utah Border. Kayenta is known as the gateway to Monument Valley Tribal Park. The land around Kayenta is synonymous with the American Southwest with its mesmerizing and dramatic landscapes, the red sandstone, and blue skies (*Kayenta*, n.d.). The town is located in a natural alcove, with Black Mesa to the South, Skeleton Mesa to the West, a sandstone ridge to the north, and an opening to the East toward volcanic necks (also called volcanic plugs).

According to the 2010 U.S. census, the population of Kayenta is 5,189 people and 92.27% of the population is Native American, 4.56% white, 0.25% black or African American, and the remaining 2.92% of the population is made up of Asian, Pacific Islander, and Latino or Hispanic (*Kayenta, AZ Population - Census 2010 and 2000 Interactive Map, Demographics, Statistics, Quick Facts - CensusViewer*, n.d.). Kayenta is the only town on the reservation that runs on two different governments: the Kayenta Township and Kayenta Chapter House. The Kayenta Chapter House is a division of the Navajo Nation government and is run by elected officials. The Kayenta Township is a municipal-style government that is managed by five elected board members.

The town of Kayenta was established in the early 1900s when John and Louisa Witherille and Clyde Colville moved to Todineeshzhee’ from their previous trading post in Oljato, Utah. When

the Witherilles moved to Kayenta, they built a home, a trading post, and a lodge from logs, stone, and adobe. John Witherille was given the position of custodian of the Navajo National Monument and moving to Kayenta was convenient for the family. He guided tourists and archeological expeditions while Clyde Colville took care of the trading post.

With the development of the Navajo National Monument, what we now call Kayenta grew in population and a post office needed to be established. The new post office needed to have a name, but it could not be called 'Todineeshzee' because this name was already used by another office. The founders of the post office decided to use the word, "Teeh-in-Deeh," the name for a sinkhole that was three miles away. Eventually, Teeh-in-Deeh was translated into Kay-en-ta. Kayenta has two schools: Kayenta Boarding School which is a BIE school, and Kayenta Unified School District #27 (K.U.S.D.) which is a public school. K.U.S.D. teaches pre-k through 12th grade and has 1,522 students according to the June 9, 2021 Regular Governing Board Meeting. K.U.S.D. serves students from Kayenta and communities within a 50-mile radius. The racial make-up of the school according to the 2019-2020 AZ School Report from the Arizona Department of Education website is 94.64% Native American, 1.81% Hispanic, and 3.09% multiple races. Kayenta has four schools: Kayenta Early Childhood Education (pre-k to kindergarten with 118 students), Kayenta Elementary School (first through fourth grade with 386 students), Kayenta Middle School (fifth through eighth grade with 456 students), and Monument Valley High School (ninth through twelfth grade with 562 students). MVHS is the only High School in a 70 miles radius and serves as a feeder school for K-8th grade schools from Rough Rock, Shonto, Chilchinbeto, Dennehotso, and other smaller schools.

Kayenta Elementary School has four to six classes for each grade level. According to the 2019-2020 AZ School Report from the Arizona Department of Education website, 97.72% of the students are Native American. This past year, there were six fourth grade classes, one of the largest class sizes in the building and 95.41% were Native American. Each class served general education students and two or three students in each class identified as English Learners (EL) and two or three students were identified as Exceptional Student Services (ESS). There were 22-24 fourth graders in each classroom. Every student has their own learning styles, some students prefer to learn on their own, others need explicit instructions, and all students do well when they practice with hands-on activities. The next school year, we are expecting five fourth grade classes with close to 15 students in each classroom. The teaching style for the next group of fourth graders will be determined as the school year begins.

During the pandemic, we started the school year with online synchronous learning from 8 am to 3 pm. After the first quarter, synchronous learning was cut in half and we taught from 8am -12 pm. From 1-3pm we focused on asynchronous learning. When synchronous learning was cut in half, it affected science and social studies. Instead of teaching these subjects for 50 minutes, we had less than 30 minutes. Science is more of a hands-on subject and because of limited supplies and class time, teaching science to the students became a challenge.

This unit is intended for fourth-grade students at Kayenta Elementary School, who have a very limited knowledge of science. For the past several years, science and social studies were often taken out of the Kayenta Elementary School curriculum so that more time could be allocated to Language Arts and Math. Language Arts and Math have been the focus of our school in the hope

that we will get a passing grade from the state. As teachers, we tried to advocate for students to have more time for social studies and science, or integrate these subjects into Language Arts, but were often overruled. Science and social studies have the advantage of integrating informational text and higher-level vocabulary. Informational text requires students to build vocabulary. My unit integrates Life and Earth Science and social studies to build comprehension and vocabulary. Furthermore, I hope that this unit will help my students build a sense of identity and pride.

Rationale

Kayenta Elementary School has been struggling to get a passing grade from the State, including for Arizona AIMS science, for the last ten years. In the past, the Kayenta 4th grade AIMS program was one of the best in the state of Arizona. Fortunately, this year the State Science assessment has been moved from fourth grade to fifth grade giving students more time to learn the material.

The students in my fourth-grade class have struggled with comprehension because of their lack of knowledge and lack of vocabulary skills. Often, the focus of reading was learning how to read, meaning that the focus was on foundational reading phonics. The type of learning did not help students pass summative assessments like the state assessment AzM2 or Northwest Evaluation Association. The results of the assessment often show that students score poorly on reading, and especially on the reading comprehension. My belief is that in order to build comprehension skills, students need to be exposed to informational texts which will help them gain more knowledge about the world around them.

In this unit, I want to use forest fires to teach my students comprehension skills. I want to focus on informational texts and to work on building vocabulary skills. In this unit, students will learn about the impact of forest fires, as well as the impact and contribution of forest fires to the forest ecosystem. Also, students will explore how climate change affects forests. The students will also explore the practices of historical and cultural burning. We will discuss how Native Americans used to use fire to manage their forests. I will ask students, “How is this different from fire suppression? How did fire suppression contribute to our current state of our forests and how does it contribute to fire damages?”

I will also teach students the Navajo philosophy about the four main elements: light, rain, pollen, and earth. These elements have the ability to give life or to take it away. For example, fire has positive forces and can do good things for human beings. We can use it for light, for heat to cook food, and for staying warm. However, if respect is not given to fire, it can also cause damage. The students will explore how Native Americans understood this philosophy and used it to manage the forest. Now, with our current policy of fire suppression, when fires occur, they cause more damage to the environment and emit dangerous smoke.

Content

The goal of the Forest Service under the umbrella of the United States Department of Agriculture (USDA) is to sustain the nation’s forests and grasslands, to deliver benefits to the public, apply knowledge globally, and excel as a high performing agency. One of the main objectives of the

Forest Service is to manage the forest in an ecologically sustainable manner. Originally, the objectives included “improving and protecting the forest, to secure favorable watershed conditions, and to furnish a continuous supply of timber for the use of the citizens of the United States” (*About Us*, n.d.). The objective of the U.S. Forest Service has since included ecological restoration and protection, research and production development, to reduce fire hazards, and to work to maintain healthy forests.

The Forest Service

The Forest Service was established in 1905 to provide “leadership in the management, protection, use, research, and stewardship of natural and cultural resources on our country’s vast forests and grasslands” (*Home*, 2021). The goal of the forest service is to sustain our national forests and promote conservation. The organization manages 154 national forests and 20 national grasslands. Designated wilderness areas, wild and scenic rivers, national monuments, research and experimental areas, and other natural and cultural treasures are included under the National Forest system. The Forest Services also operates research units, labs, and experimental forests and rangelands. They also help state, local, and tribal governments, and private owners improve the conditions of the forests in urban and rural areas.

Wildfires in America

“It is a peculiar quality of fire that is both natural and cultural.” (Pyne, 1982, p. 6)

Fire, a force of nature, has been adopted and is used by humans due to our ability to establish limits based on our observations of fire behavior and effects. The origin of natural fire is lightning, meaning that fire is an essential part of any environment. Wildfire is among the oldest natural phenomena. As Pyne explains, “fossil evidence of fires is buried within the coal beds of the carboniferous period, although there is no reason to suppose that these mark the origin of natural fire” (Pyne, 1982, p.3).

Before European settlement, fire was common in North American forests. Fires were started by lightning and by Native Americans who used fire as a tool to shape nature. Native Americans “actively used fire as a way of manipulating the landscape for hunting, transportation, farming, and other purposes” (Nelson, 2000, p.15). Native Americans often carried flints to start controlled fires in order to clear space for cornfields and other crops. They also used fire to create havens to attract game such as elk, deer, and bear. These havens were created by burning the undergrowth in forests. The cleared spaces would draw animals in the spring as the new, green growth sprouted making it easier for hunters. Native Americans who lived in the Great Plains also used fire to extend the grazing area for buffalo that they would then hunt (Dunbar-Ortiz, 2019, p. 28).

Historically, forest fires occurred in the Western U.S. as often as every 10-15 years (Nelson, 2000, p.15). Research on the frequency of fires in the Sierra Nevadas prior to the twentieth century demonstrates how studying certain trees reveals historical wildfire regimes. For example, Nelson explains how the “red fir-fire could be expected to burn over stands every twenty-six years; mixed conifer-pine every fifteen years; mixed conifer-fir every twelve years; ponderosa pine every eleven years; and blue oak every eight years” (Nelson, 2000, p.15). Scientists have

been able to determine the frequency of fires through the use of fire scars and dendrochronology, the study of tree rings to determine things like climate events.

Furthermore, large ponderosa pines, redwoods, and other species of trees have adapted to fire by growing thick, fire-resistant bark. When a fire burned through a forest, it would clear the forest floor of shrubs, debris, and other small trees while basically leaving the larger trees unharmed. Like the ponderosa pines, Giant sequoias in the Sierra Nevada Mountains have also benefited from frequent low-intensity fires. When these fires occurred, many of the smaller trees including white fir, sugar pine, incense cedar, and other mixed conifers were killed, leaving only the big sequoia trees. As Nelson explains, “shade-intolerant species such as sequoia also depended on localized intense forest fires to open clear areas where regeneration of new trees could occur” (Nelson, 2000, 2000, p.17). Lodgepole pine is another species that depends on forest fires to thrive. They need intense fires to kill all the old trees and clear a new area for a new lodgepole pine forest to grow.

The frequency of fires in North America was greatly reduced with the arrival of European settlers. The Native Americans were displaced from their native lands, ending their burning practices. Additionally, the introduction of livestock greatly reduced many natural grasses which were often used as “combustible fuel to sustain natural and Indian fires and to carry fires easily from one place to another” (Nelson, 2000, pp. 15-16). Where Native Americans used fire to their benefit, Europeans did not. This was the beginning of how we changed the historical fire regimes.

At the beginning of the 20th Century, the United States federal government introduced a policy of active fire suppression. The government rejected the idea that fire should be used for forest management because it was “primitive” and “unscientific.” As Pyne states, “In the early years of systemic fire suppression prevention programs were directed almost entirely against traditional fire practices” (Pyne, 1982, p. 161). Early conservationists, Franklin Hough and Bernard Fernow, believed that forest fires threatened future commercial timber supplies. Concern for the supply of timber helped convince the U.S. government to set aside land for National Forests and in 1905, the U.S. Forest Service was established. At that time the primary goal for fire management was to require fire protection as a means for eliminating forest fires (Nelson, 2000, p. 16).

Then came the 1910 fires. The wildfires in 1910 were the worst in United States History, setting the course for a change in fire policy. In the late summer of that year a series of forest fires swept over Idaho, Montana, and Washington, burning three million acres in just two days. In one example, on August 10th a report came into the Missoula, Montana’s district office that a fire had broken out and was quickly spreading. The undermanned, underfunded, and under-prepared agency was quickly overwhelmed. President Howard Taft deployed 4,000 soldiers to supplement the firefighting force. On August 19th, supervisors started to release fire fighters believing that they had the fire under control; however, “on August 20th hurricane-force winds swept through the region and fanned the embers and low flames back to life all across the Northern Rockies” (*The 1910 Fires*, 2017). The fire burned out of control, forcing evacuations of towns.

In total, 1,736 fires burned five million acres of both private and federal land in 1910. The fires burned seven and a half billion feet of timber, destroyed several towns, and killed 86 people. The

smoke and soot from the fires reached Greenland. U.S. fire policy changed as a result and “Chief Henry Graves reiterated a call for an aggressive fire prevention policy as the best way to protect America’s private and public forests and the nation’s economic well-being” (*The 1910 Fires*, 2017). Ferdinand Silcox (who would later become the 5th Chief of the U.S. Forest Service) further argued that applying science, technology, and manpower could prevent disasters in the future. He believed that fire could be eliminated from the land leading to the institution of a total fire suppression policy (*The 1910 Fires*, 2017).

The two goals within the total fire suppression policy were the prevention of fires and the suppression of fires as quickly as possible. Many ranchers, farmers, and timbermen opposed the policy because the practice of “light” burning improved land conditions. Still, “forest service leaders simply argued that any and all fire in the woods was bad because it destroyed standing timber” (*The 1910 Fires*, 2017). An important aspect of fire prevention was public education and Smokey the Bear was introduced in 1944 to help deliver fire prevention messages.

Our fire suppression policy has completely altered our forests in many ways. For example, in the Sierra Nevada ecosystem it is estimated that the frequency of fire since 1910 was greatly reduced from every 10-15 years to 78-1,644 years (Nelson, 2000, p.16). At the current rate, fire is expected to burn in red fir forests every 1,644 years, mixed conifer-fir will burn every 644 years, mixed conifer-pine will burn every 185 years, ponderosa pine will burn every 192 years, and blue oak will burn every 78 years. In other parts of western forests, fire suppression has altered the forest by replacing one species of tree with another. For example, over 67% of the ponderosa pine acreage was replaced by Douglas fir and mixed conifer in Deschutes National Forest in Oregon.

Giant sequoias have been impacted by fire suppression in two ways. First, fire suppression allowed the understory of white fir, sugar pine, incense cedar, and another mixed conifer to grow. Nelson explains that, “The overgrowth of the understory allowed for more intense fires that threatened crown fires and decreased new growth of the shade-intolerant Sequoia, therefore reducing the population of the giant Sequoia” (Nelson, 2000, p.17). New sequoia trees struggle to grow because natural wildfire was removed from the ecosystem. In order to see new giant sequoias, fire needs to clear away the overgrowth, allowing the sun to shine through the canopy. Another destructive impact of the policy of fire suppression includes the increased density of red fir at higher elevations. The Forest Service has been under less pressure to act quickly to put out these fires because red fir is less valuable than other species, there are fewer man-made structures at the higher elevations, and fire suppression is very costly in the rocky terrain found at these high elevations. In addition, smaller trees and shrubs that were once controlled by frequent fires have grown abundantly meaning that when fire does come to these areas, the severity and intensity are greater. “In one study of the Coconino National Forest in Arizona, two researchers estimated that the number of trees had increased from 23 per acre in pre-settlement time to a present level of 851 trees per acre” (Nelson, 2000, p. 18). In the nearby Kaibab National Forest, the number of trees has increased from 56 to 256 trees per acre. Douglas firs in Montana have invaded grasslands because of fire suppression. The firs would normally have burned before having time to mature. The density of Douglas firs in Idaho is now three times as high due to suppression efforts, creating a major fire hazard. The competition for survival among these trees has further weakened them adding to the fire hazard (Nelson, 2000, pp.18-19).

Fortunately, these problems do not apply to state and private forests because they are managed more intensely.

There are a total of 192 million acres of land in the National Forest system including wilderness areas. “The Forests Service estimates that 57 millions of these acres involve ecological systems where periodic fire should be a normal part of the ecosystem workings” (Nelson, 2000, p. 19). The current condition of these forests is unsustainable because fire suppression has caused the land to contain an excess of fuel. Furthermore, the forests have become less productive economically, more susceptible to disease and insect infestation, and “ironically now also prone to new and much greater fire hazard” (Nelson, 2000, p. 19).

Our century old federal fire policy resulted in severe fire seasons in 1988, 1994, and 1996. More than 500,000 acres of the National Forest burned in the 1994 fire season. More intense, harder to control, and more ecologically harmful forest fires are expected in the future. Existing forests with dense stands of thinner trees and numerous weakened, dying, or dead trees, have become more flammable. The danger of thinner trees is that they burn rapidly and with greater heat intensity. Additionally, “advancing fires can now often reach up into the lower branches, and from them spread to the ‘crown’ of the ponderosa pines and other large older trees” (Nelson, 2000, p. 21). These destructive fires can burn entire forests and can destroy the soil by fusing the soil, resulting in a sterilized forest environment, which may delay regeneration indefinitely. Furthermore, the scarred forest floors are susceptible to erosion.

Under current policies, 98% of forest fires are rapidly and effectively controlled. “However, if a fire is not quickly controlled today in the fire-prone forests of the West, there may be no stopping it – especially in periods of drought and wind, when the fire hazard in a dry forest escalates” (Nelson, 2000, p. 22). The 2% of forest fires remaining are responsible for 98% of the burned acres across the country. This 2% also accounts for 60% of the expenditure set aside for fire-fighting. These large fires cause more damage to structures and endangers the lives of firefighters.

It wasn't until the 1960s and 1970s that serious questions were raised by ecologists and fire experts concerning federal fire policies. This questioning resulted in the enactment of the Wilderness Act of 1964 and the creation of the national wilderness system.

Sustainability

Sustainability in relation to wildfire implies that forests will recover after a fire if they have adapted to frequent low intensity fires, like the ponderosa pine forests of the Southwest. Devastating, high intensity wildfires can be prevented with modern forest management. “It is possible to reduce the level and extent of the destruction” (Walstad, 1990, p.3). Good forest management can also reduce the damage to forest floors and the underlying soil, which would shorten the recovery time after a fire.

A variety of silvicultural techniques need to be employed to reduce the intensity of forest fires and benefit the forests. Silviculture is a technique of controlling growth and quality of forests to meet the values and needs of forest productions. Furthermore, silviculture describes the practice

of treating forest stands to preserve and improve productivity. One technique of silviculture is to use prescribed burning. There are two types of prescribed burning: under-burning which is when fire burns below the mature forest canopy, and slash burning which is the burning of residue and debris left from behind from logging.

Many factors have to be considered before doing a prescribed burn. The first thing to consider is that the objective for each unit of land is different. A second factor is the means of igniting a fire falls into two categories: a planned ignition which is planned out in accordance with an objective, and unplanned ignition which is a natural ignition like lightning.

The forest service and state governments have established a distinct decision process for controlled burning, beginning with philosophy and goals of each fire. We also have land management plans which define specific objectives for small units of land. The burn objective “may include restoration of natural conditions, maintaining attractive landscapes, ensuring output of timber, wildlife, livestock, and water and providing recreation” (Walstad, 1990, p. 55). If it is determined that treatment is needed, the next step is to choose a method (manual, mechanical, fire, chemical, or biological) to meet the objective.

Management goals for a given piece of land determine the burn objective. Objectives have to be specific in order for a manager to measure the success of a burn. Examples of burn objectives may include: to kill two-thirds of sprouting shrubs or to reduce the understory by 60%. One restraint to consider when planning a prescribed burn is to wait for suitable weather. Another constraint is to consider the cost of burning.

Prescribed burning can be used to encourage reforestation. Logging slash, debris, and vegetation can become obstacles for reforestation. By removing these obstacles through prescribed burning, we can improve greater access for planting trees, seeding, and trapping pests. Prescribed burning also creates suitable environmental conditions for regenerations of some species of trees that are acclimatized to growing in open areas because after the burn they will have access to direct sunlight, heat, and there will be a reduction of competition for natural resources like moisture.

Navajo Nation Forests

The Navajo Reservation is about 18 million acres. Of this land, six million acres are pinyon/juniper and half a million acres are ponderosa pine/mixed conifer. Most of the forested land is located on the Chuska Mountains (Martin, May 2021). Forests on the Navajo Nation provide necessities such as “food, wood products for homes, other dwellings, corrals, fence posts, ceremonial needs, firewood, and habitat for deer and other wildlife...and grazing for domestic livestock along with wildlife” (Yazzie, 1987). Our forests are also used for recreation all year long.

The Indian Self Determination and Education Assistance Act of 1975 (amended in 1994) allowed the Department of Interior to “award contracts and grants to Indian tribes without the unnecessary burden or confusion associated with having two sets of rules for single program legislation” (Indian Self Determination and Education Assistance Act, 1975). In other words, tribes were given the capabilities to manage their own natural resources including forests. Tribes,

including Navajo Nation and the Navajo Department of Forestry, were given the ability to contract with the BIA to take over management of existing programs which included funding, facilities, and equipment. However, the BIA continued to control Fire Management and to “retain the trust responsibility and signatory approval of management plans, timber sales, and use permits” (Martin, June 2021).

Furthermore, the National Indian Forest Resources Management Act (1990) required all management activities on Indian Trust Forest lands to be consistent with an approved Forest Management Plan. The plan requires the applicant to apply sustained yield principles, standards, and objectives. In other words, the tribes have to explain how they will continue to maintain timber production indefinitely on the reservation that does not exceed the growth of the forests especially after consumption and total felling. This also allows Native Americans to promote self-sustaining communities. Furthermore, tribes are given the ability to retain their forests in their natural state and “the management and protection of forest resources to retain the beneficial effects to Indian forest lands of regulating water run-off and minimizing soil erosion” (Martin, June 2021). Lastly, tribes are given the ability to maintain and improve timber production, fisheries, wildlife, and recreation like camping, fishing, and hunting.

As a result of PL 93-638, Navajo Nation came up with a 10-Year Forest Management Plan. The plan was a 638 contract between the Navajo Department of Forestry and the BIA Forestry. Although the Navajo Nation took over the Navajo Forestry program, the BIA Forestry still retained the authority for approval and oversight. Our 10-Year Plan had to solicit input from the public through a series of chapter meetings (Martin, May 2021). In this plan, the Navajo Nation describes its goal that “Tribal Forests are managed to maintain diversity of species, respect culturally important landscapes, mitigate the negative effects of wildfire, and protect water resources” (Dockry & Hoagland, 2017, p. 1).

The Navajo Nation has recognized that climate change will impact the Navajo people, places, and ecosystems. The “Climate Adaptation Plan for the Navajo Nation” was created by the Navajo Nation Department of Fish and Wildlife in 2018 “to prepare the Navajo Nation to adapt to our changing climate, and implement strategies that will preserve and enhance natural resources and provide a resilient future for the Navajo communities” (Tom et al., 2018, p. 3). The purpose of the plan is to spread awareness to the Navajo people about how climate change will impact them. The main concerns among community leaders includes a shortage of water, the number of feral horses, the difficulty of communication across Navajo Nation, creating enforcements and compliance, the increase of pollution and the worsening air quality, illegal dumping, and grazing management. The main concerns of the Navajo Nation Department of Natural Resources are a similar list and is ordered in terms of priority. First overgrazing by feral horses and livestock. Second, water security, both quality and quantity. Third land use management and planning. Fourth, interdepartmental collaboration and communication. Fifth, education, information, and outreach. And sixth, enforcement (Tom et al., p. 15).

The history of forest fires on Navajo Reservation has a similar history to that of the United States. According to a fire regime study near Buffalo Pass on the Lukachukai mountains, “Fire occurrence within the full Lukachukai landscape (all 50 plots) was frequent until the late 19th century, after which there was a decline in fire events” (Whitehair, 2018). Fires were frequent in

the 19th Century. Between 1644 and 1920, the frequency of forest fires was about 3.17 years. Forest fires were more likely to occur during La Nina seasons. Since the 1930s, the frequency of fire has declined. In fact, the last recorded fire in the Buffalo Pass area was in the 1920s (Whitehair, 2018).

Recently, there have been major fires on the Navajo Reservation including the Asaayii Lake Fire and the Wood Springs Two Fire. The Asaayii Lake Fire burned 14,712 acres. The Wood Springs Two Fire was caused by lightning on June 27, 2020 and burned more than 12,861 acres.

Teaching Strategies

Pictorial Input Chart

Pictorial Input Charts are a highly effective strategy, especially for young students and English Learners because they build vocabulary, sentence structure, and content knowledge. Pictorial Input Charts are a way for the teacher to present information and concepts by drawing a visual presentation (Brechtel, 2001). The teacher will create the visual presentation ahead of time with light pencil sketches so the teacher can keep pace when presenting the information with the students. Pictorial Input Charts help with imprinting information in students' minds. This process should take no longer than ten minutes. Student processing is often assisted by group discussion or partner sharing so, "to deliver this strategy effectively, the teacher must be aware of content and linguistic needs of the students within this particular content" (Brechtel, 2001, p. 30).

Scaffolding

Scaffolding is a crucial part of guided oral practice as a way of internalizing new vocabulary and content. It allows students to absorb the information by practicing with someone they understand, in this case they will practice with another student. "Students must have time for negotiating for meaning, comprehensible output, or discussions, using new vocabulary and concepts with someone they understand" (Brechtel, 2001, p. 31). Scaffolding uses activities to promote interdependence by working together to process information and problem solve. Collaborating with other students provides the low affective filter which is helpful in developing vocabulary and language development. It also encourages students to share their own way of experiencing the meaning of new concepts.

Picture File Cards

Picture File Cards can be one of the most valuable tools a teacher can use if used correctly. Teachers should choose picture "cards that are thought or emotional provoking for you" (Brechtel, 2001, p. 144). The picture cards chosen must be interesting to both you and the students so they will want to discuss them. Picture cards can be used in "numerous activities ranging from direct teaching to follow-up and independent use" (Brechtel, 2001, p. 145).

Classroom Activities

Comparative Input Charts

Students will compare sketches and discuss how fire suppression has altered our Navajo Nation forests. This activity will take a couple of days. Comparisons and contrasts include the characteristics of a forest before fire suppression versus after fire suppression. This comparison includes the number of trees that grow in a given area, the competition for resources, the overgrowth of new trees, and how invasive trees are encroaching on meadows. The first Pictorial Input Chart would start with a healthy forest that includes a meadow, few and larger trees, and higher crown heights. The second Pictorial Input Chart, will depict the same forest, but this time show it as unhealthy by including trees, but smaller and less spread out. The second Pictorial Input should not have a meadow and should show more undergrowth. The teacher should explain that the second Pictorial Input is unhealthy because the meadow is gone due and the addition of more trees has led these trees to compete for resources. The teacher will also explain that overgrown forests are susceptible to extreme fires and the reasons why the first Pictorial is healthier than the second. This comparative type of learning is useful because “when two figures are compared and contrasted, comprehension is increased and the oral pattern for that style of writing is modeled” (Brechtel, 2001, p. 137).

Dioramas

An extended activity is for students to make a diorama of a healthy forest. Thinking about students’ individual learning styles is important when trying to reach each student. This extended activity, “based on brain research, is intended to ensure that we include in our units opportunities for students to participate successfully in a variety of ways: right brain, modalities, learning styles, and multiple intelligence” (Brechtel, 2001, p. 34). Dioramas are especially useful for students who are divergent thinkers. Using a diorama is also a great tool to reinforce comprehension.

Farmer and the Dell

Students will develop a poem using an activity called “Farmer and the Dell.” Often, Farmer and the Dell is used after students have developed an understanding of the content the teacher has presented. For this unit, students will use Farmer in the Dell to write a poem about the elements of both good fire and bad fire. The activity is presented on a piece of large butcher paper that is divided into four columns, one for each part of speech (adjective, noun, verb, and prepositional phrase). With guidance from the teacher, the students will brainstorm as many adjectives, prepositional phrases, and verbs as possible about fire. (Fire will be written in the noun column.) It is recommended to use a plural form of each noun to prevent fewer problems with subject verb agreement and the unnecessary use of articles. In the end, the chart creates a sentence frame that students are able to use to create sentences. For the Farmer in the Dell, it will require an adjective and an adjective and a noun in the first line, then will repeat the same adjective, adjective, noun from the first line for the second line. Then the same adjective, adjective, noun, for the fourth line, and finally verb, prepositional phrase for the fourth line. For example, Enormous hot fires, enormous hot fires, enormous hot fires run through the forest. Other poems can be created by using other poetry frames to reinforce vocabulary and concepts. Students or teachers can create poems using poetry frames, poetry rap, or poetry Bugaloo.

Alignment with Standards

Fourth Grade Earth Science: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate. This standard will be used to explain climate change to the students.

Fourth Grade Life Science: Organisms are organized on a cellular basis and have a finite life span. This life science standard will be used to explain the impact of forest fires in terms of the effects of healthy forests versus unhealthy forests.

Diné Standards 4-6, Concept 2 PO2. I will retell my cultural teachings of earth and sky. This standard will be used to explain climate change in terms of culture as well as Navajo adaptation to climate change.

Diné Standards 4-6, Concepts 4, PO4. I will acknowledge the duality in nature. This standard will be used to explain the concept of the duality of fire. Fire can be good or it can be bad.

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