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The Children's Forest Association fire ecology hike

Michael Stephen Dufilho

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THE CHILDREN'S FOREST ASSOCIATION
FIRE ECOLOGY HIKE

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Environmental Education

by
Michael Stephen Dufilho
June 2005
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June 2, 2005
ABSTRACT

This project provides a fire ecology lesson to accompany a hike for student groups from fourth through eighth grade. The lesson plan will acquaint students with the beneficial aspects of forest fire. These lessons allow students to connect with nature and the principles of fire ecology on an experiential basis. It was prepared for the use of the Children’s Forest Association in the San Bernardino National Forest, an educational partner of the United States Forest Service.
ACKNOWLEDGMENTS

I would like to thank Dr. Darleen Stoner, Cheryl Nagy, Margaret Hardy, and coolest kids I know Steve and Adele Dufilho.
DEDICATION

To my parents... and Kosmos Spoetzl, it's been way too long.
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In October of 2003 a fire stormed through the San Bernardino Mountain range ravishing the ignitable chaparral. Within hours the “Old Fire,” a misnomer of grave proportions, had crackled and burned thousands of acres, possessed with the fiery remorselessness of Hades. Residents were unprepared and panicked. The Old Fire scorched within our memories lost homes, engulfed in a blazing inferno that no amount of tormented tears could extinguish.

Finally, once the insatiable burning beast was dispelled, a general misunderstanding of fire, fueled by trepidation, swept through the tiny mountain communities almost as quickly as the Old Fire itself. However, residents soon began to take notice of something wonderful. From the ashen remains of the charred earth arose wildflowers of every color, as if the hope of the mountain folk itself ascended from the depths of despair. Due to the Old Fire, questions and concerns regarding the role of fire have never been more relevant. It is now important for forest fire education to make its way into Southern California’s education curriculum.
A fire ecology lesson plan will explain the importance of fire and its vital role in the various ecosystems that make up the San Bernardino National Forest. In learning about the beneficial aspects of fire, the students will come to understand that they live in, or near, a fire regime, and that certain types of wildfire help improve forest conditions, better preparing vegetation for the next wildfire.

The educational goal of this lesson plan is for students visiting the San Bernardino National Forest to gain a more comprehensive understanding of the intricacies of fire and its effects on the ecosystem. Forest Service Fuels Battalion Chief David Kelly (personal communication, December 13, 2004) has stated that a proper fire ecology curriculum must cover the components of fire and develop an appreciation of the beneficial and detrimental effects of fire. According to Mountain Public Relations Officer Tricia Abbas (personal communication, January 25, 2005) one of the impediments that a fire ecology lesson plan must overcome is public fear of fire and misconceptions regarding its role in nature. Furthermore, there is inherent difficulty in constructing a lesson plan that placates the fears of forest residents, while emphasizing
the need for a natural forest fire to burn and enrich the local environment.

The core of the lesson plan is a three to four hour hike that will take place for fourth through eighth grade students at Mill Peak in Running Springs. Hiking within the San Bernardino National Forest will allow students to have a closer look at the effects of wildfire in the local area. A natural fire will normally burn through the southern California Mountains once every 20 to 30 years. Due to its frequent visits to the area, it is imperative for students to learn the complexities of fire.

The lesson plan will familiarize students with the components (heat, fuel, and oxygen) and different types of fire (this background of fire ecology can be found in Appendix A). They will recognize the valuable attributes of wildfire, such as seed germination, sweeping out diseased vegetation, leaving snags (standing dead trees) for habitat, and creating fertile forest floors. Activities within the lesson plan will also address the detrimental aspects of fire: home and property loss, personal safety, and environmental destruction from catastrophic wildfire.

An informed public will help foster a better understanding of forest fire, as well as prepare residents
for the next time a forest fire may occur. With proper knowledge that relentless rogue of radiating recklessness, which we call wildfire, will no longer lurk in the shadows of machination. The activities, found in Appendix B, will help students learn that, under natural conditions, the forest was indeed born to burn.
CHAPTER TWO

REVIEW OF THE LITERATURE

This chapter encompasses the research used to guide the preparation of the fire ecology lesson plan. In order to build the framework for the fire ecology lesson plan and subsequent hike, a suitable definition of environmental education must be determined.

Environmental Education Defined

William Stapp of the University of Michigan has defined environmental education as

aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution. (Stapp et al., 1969, p. 30)

Eight years later in 1977, the intergovernmental environmental education conference took place in Tbilisi, Georgia, formally of the USSR, where the conference attendees looked to expand upon a definition of environmental education (EE) and frame it within the context of EE goals, EE objectives, and EE principles. The Tbilisi Declaration recommended that EE must aim to show
the interdependence of ecology and economics, facilitate an understanding of the complexities of nature, and provide EE opportunities to all ages and ethnicities ("The Tbilisi Declaration," 2001).

Previous Lesson Plans

Fear of natural and human induced fires in the Western world has led to a failure to recognize the role of fire in habitat management. (Woods, 1995, p. 30)

Many current articles pertaining to fire ecology have stressed a reversal in the traditional attitude of fire’s role in nature, and identified the misleading information that has caused wildfire to be feared. Rather then decry fire as a destructive force in the environment agencies, such as the California Department of Forestry and Fire Prevention (CDF), stress new evidence suggesting natural burnings occurring before European settlers arrived. The source of these fires sprouted from lightening strikes and volcanic eruptions (California Department of Forestry and Fire Prevention, 2000).

There are relatively few fire ecology programs within the United States. One of these is Forest Fires, developed by the Discovery Channel for high school teachers, which
part of understanding the environment and necessary to create healthier forests.

The subject of wildland fire provides a rich context for education because it promotes the understanding and integration of numerous scientific concepts, including properties of matter, ecosystem fluctuations and cycles, habitat and survival, and human interactions with ecosystems. These concepts are considered benchmarks for science literacy. ("Education and Social Sciences," 2000, p. 133)

Historically, the view on wildfire has changed dramatically since the inception of the Forest Service in the early 20th century. Those early foresters, while heroic in their vision of wise use and conservation, misunderstood the function of forest fire. These conservationists failed to realize that fire had naturally occurred in forests for centuries, allowing the native flora to adapt to the conditions. Furthermore, many landscapes had also been altered by Native American Indian burnings in forested areas. The native tribes people often burned an area to flush game out of the woods, clear paths, create diverse environments, and create better growing soil (Williams, 2000a). Furthermore, many
indigenous peoples used fire as a tool of conservation, the wildfires virtually ensuring regrowth in the spring (Woods, 1995, p. 30). During set burning times or when fire naturally occurred, tribes migrated to new hunting grounds until the end of fire season (Pyne, 2001, p. 1005). During their departure, the wildland fires were able to burn themselves out, thereby cleansing the forest of diseased vegetation, adding nutrients to the soil, and allowing for seed germination of serotinous plants. In the early years of the 20th century foresters did not recognize these practices. What foresters did note, however, were the terrifying wildfires happening around the country (Williams, 2000b).

The year 1910 saw an onslaught of ravenous fires that led the newly commissioned United States Forest Service to quickly stamp out all wildfires and deride any positive aspects of forest fire. This guided the Forest Service to continue such practice throughout the majority of its existence, swooping in to extinguish all wildland fire at first spark ("The Blaze Next Time," 2001, p. 32).

Fire fighting techniques, fire management, and fire theory have all evolved since the early days of the Forest Service. As the benefits of forest fire have been discovered, fire ecology theory has changed. In fact, the
potency of fire-induced germination has led to new theories of seed germination, including new discoveries such as smoke germination (Milius, 2004).

The biggest obstacle that has contributed to misconceptions of fire is the portrayal of fire on television, film, and radio (Pyne, 1999), wherein mainstream media has likened fire to a villainous character actor.

The current state of fire ecology is mired in misinformation. It is the San Bernardino National Forest Association’s Fire Ecology program that intends to teach the subject outdoors, where a hands-on approach will improve students’ familiarization with fire ecology. Students will learn the fundamentals of fire and fire behavior, the beneficial and detrimental effects of fire, as well as animal and vegetative adaptations to survive forest fire. It is important to regain the connection between fire, nature, and human society, as expressed eloquently by:

The new colonists [of rural landscapes] are exurban migrants, stocked with urban values and perceptions and funded by an urban economy. They are living off the land not on it. (Pyne, 2001, p. 1005)
CHAPTER THREE

METHODOLOGY

This project was designed for use by the Children’s Forest Association Environmental Education Department, located in Running Springs, CA. The aim of the project was to design a hike from the Children’s Forest Visitor Center, located a quarter mile east of the town of Running Springs, to the top of Mill Peak. The hike includes various teaching points and activities along the trail to familiarize students with the nature of forest fire in the San Bernardino Mountains and Southern California. This fire ecology hike and lesson plan have been designed to correlate with the California Science Standards (see Appendix D), so that the students acquire scientific knowledge of the local terrain and fire ecology, while also enjoying the outdoors.

In preparation for the Children’s Forest Fire Ecology Hike and associated lesson plan, a meeting was held (January, 25th 2005) with U.S. Forest Service Mountain Top Public Relations Officer, Tricia Abbas. This meeting produced the central theme for the fire ecology hike: fire is a natural and beneficial part of the environment. In support of the main theme, subtopic activities concerning
the science of fire, as well as the detrimental effects of catastrophic fire, were added to strengthen the theme of fire as a natural component of the San Bernardino Mountains.

Once the key themes of the fire ecology lesson plan were determined, a meeting was held with U.S. Forest Service Fuels Battalion Chief David Kelly (February, 9th 2005). A few days were spent in the field together to better obtain an understanding of the science of fire ecology, the characteristics of fire behavior, and issues Kelly felt would best address fire ecology on the hike.

Finally, a meeting took place (February 14th 2005) with Jon Regelbrugge, a Forester with the U.S. Forest Service, who had spent several years working as a technician in the Riverside Fire Lab. Regelbrugge provided great insight regarding misinformation of forest fire. Regelbrugge stated that one of greatest misconceptions people have regarding forest fire is the notion that fire is purely a destructive force in the environment. The positive aspects are rarely reported in the media. Regelbrugge felt that stressing fire's positive attributes to the ecosystem made an excellent theme for the hike. Regelbrugge also agreed that management principles, as well as the difference between healthy and unhealthy
forest fires were also important issues to address within the lesson plan. Since public knowledge of general fire ecology is low, Regelbrugge suggested that basic fire ecology activities be included to help support the theme.

These data gathering meetings finished the qualitative portion of the project. The next step in the creation of a fire ecology hike was to research similar lesson plans and appropriate outdoor educational practices.

One of the largest impediments in designing the project was that many of the reviewed lesson plans focused solely on classroom teaching and very few on actual field activities. However, the lesson plans created by the National Park Service (Petrick-Underwood, 1990) maintained a notable balance between classroom and outdoor activities.

This project has been designed to serve educators and students in acquiring a greater knowledge of the role of forest fire. This project provides basic insight into the geographical composition of the San Bernardino Mountains, the behavior and role of fire within the area, and the adaptations of flora and wildlife in this area.
CHAPTER FOUR
IMPLICATIONS FOR EDUCATORS

Currently, fire ecology education as an academic subject is not recognized within our schools' classrooms. Yet, it is a subject pertinent to all residents in San Bernardino County, and many residents of southern California. As occupants of this land it is imperative that knowledge of fire and its role in the environment are taught. A fire ecology hike would provide a desired experiential learning experience for students. Environmental education is an excellent tool for developing and fostering knowledge and appreciation of forest fire.

One of the goals of this lesson plan is for students to leave with an educated position on forest fire. The students will learn the value of fire, as well as forest health, stewardship, environmental responsibility, and sensitivity. This information will facilitate youth leadership on issues associated with the role of fire within an ecosystem and forest/fire management.

The fire ecology hike and lesson plan provides teachers the opportunity to move their classroom outdoors, allowing their students to learn in a creative and
physical environment. While this style of learning environment may seem daunting at first for teachers, safety concerns regarding the hike are addressed in Appendix C.

Educators have emphasized the importance of experiential learning for years. The core of all applied learning occurs through active experiences (Rogers, 1996). Experiential learning is readily applicable to environmental education. Active experiences will enhance fire ecology awareness in students.

Outdoor teaching allows the student to understand the subject from a holistic approach, connecting the student to the environment and the fire regime that exists within it. Furthermore, an outdoor hike encompasses elements for developing movement, coordination and hiking skills, and environmental ethics. The students will gain a comprehensive understanding of the fire cycle when they are in its environment, rather than reading and memorizing it from text.

The activities within the lesson plan are intended to suit not only the San Bernardino Mountains, but are applicable to any area situated within a regular fire regime. This allows educators the ability to better incorporate these lessons into their own curriculum.
APPENDIX A

FIRE ECOLOGY BACKGROUND
FIRE ECOLOGY BACKGROUND
FOR ACTIVITIES

The haze of the smog often slowly settles down into the San Bernardino Valley, layers billowing downwards wholly enveloping the town of Highland, California. There are days when the surrounding mountains seem like a chimerical fabrication of fancy, a figment of a long ago age, lost to the days of timber production and gold sluicing. Even the perilous crags towering above the east in the San Gorgonio Wilderness assume a dreamy surrealistic form through the murky miasmic fog. As you head north, leaving the frantic lifestyle of the urbanized valley below, you find yourself winding through the grassy foothills along City Creek. During the years when the rains come, the foothills sparkle with wildflowers, and City Creek bubbles and gurgles as it flows downstream.

As the elevation climbs the gloom of the smog fades. Harrison Mountain lies before you, while more peaks to the northeast become visible. At this moment however, you find yourself in an area that feels much different then the alpine forest you notice above you. Locals commonly refer to this area as the “Elfin forest” (Head, 1989). There are unworldly characteristics to this shrunken forest, and to understand the complexity of fire, one must begin here, in the chaparral.

An Overview of Biomes and Ecosystems:
San Bernardino Mountains Concentration
Chaparral, Spanish for thicket (Cunningham, Cunningham, & Saigo, 2003) is composed of evergreen, woody shrubs (United States Department of Agriculture [USDA], 1999) and can be found in the San Bernardino Mountains from roughly 1000 to 5000 feet in elevation (Harvert & Gray, 1996). Fire has thinned the taut diminutive trees and shrubs of the area, marking its presence upon the landscape (Robinson, 1989). Chaparral, similar to the area of tantalizing towering conifer trees on the ridgeline above, is a type of biome. A biome is a “geographical area that is characterized by relatively similar plant and animal representatives” (Wallace, 1987, p. 484). There are different types of biomes found throughout the world, for example polar ice cap, tundra, boreal forest, temperate forests, Mediterranean scrub and woodland (chaparral), grassland, desert, tropical rainforest, and savanna.

Within biomes are smaller communities or ecological “components” identified as ecosystems. In an ecosystem there is a relationship where vegetation, organisms, and the physical environment interact with one another (Wallace, 1987). Ecosystems can be viewed on a large scale, such as the lower-desert montane community (USDA, 1999), or on a smaller level, such as the interactions that occur at a small local pond.

California is a melting pot of various biomes, and ecosystems. These ecosystems are often referred to as vegetation mosaics/landscapes (USDA, 1999), or sometimes by naturalists as “life-zones” (Havert & Gray, 1996). For the purpose of this project, the term life zone will be used. The San Bernardino Mountain range includes several of these zones, from the Mojave Desert floor to the peak of San Gorgonio. To greater understand the role of fire within chaparral and the conifer forest,
the life zones and landscapes of the southern slope of the San Bernardino Mountains should be explored. There are five life zone transitions that occur in this area (Havert & Gray, 1996).

1. Lower Sonoran: From 1000 to 2000 feet. White Sage (*Salvia apiana*), Mountain Whitethorn (*Ceanothus leucodermis*), Deerbrush (*Ceanothus integerrimus*), California Buckwheat (*Eriogonum fasciculatum*), and the picturesque Yucca, Our Lord’s Candle (*Yucca whipplei*) can be found here. This is a chaparral dominant area. (*Wildflowers of the San Bernardinos, 1999*).

2. Upper Sonoran: From 2000 to 4000 feet. Also known in the San Bernardino Mountains as the lower montane landscape. Islands of coniferous trees begin to creep into the chaparral-dominated region, such as the Knobcone pine (*Pinus attenuata*) and the Big Cone Spruce, locally known as Big Cone Douglas-Fir or False Hemlock (*Pseudotsuga macrocarpa*). Mule deer (*Odocoileus hemionus*), Merriam chipmunks (*Eutamias merriami*), kangaroo rats, (*Dipodomys agilis*), and coyotes (*Canis latrans*) are just some of the animals you may see in this area.

3. Transition Zone: From 4000 to 6000 feet. Around 5000 feet the influence of the chaparral landscape begins to wane, as incense-cedar (*Calocedrus decurrens*) and Coulter pine (*Pinus coulteri*) appear (Trees of the San Bernardinos, 1999). This marks the start of the Yellow Pine Forest. Not limited to this zone, but often found here, are
mountain lions (Felis concolor), bobcats (Lynx rufus), and black bears (Ursus americanus).

4. Montane Conifer Landscape: From 6000 to 9000 feet. The lower elevation areas of the montane conifer landscape belong to the yellow pines: Coulter pine (Pinus coulteri), Jeffrey (Pinus jeffreyi) and Ponderosa (pinus ponderosa). There are still healthy amounts of varying species of manzanita (Arctostaphylos spp). The painful prickly burrs of chinquapin (Chrysolepis sempervirens), as well as the California black oak (Quercus kelloggii), Sugar pine (Pinus lambertiana), and White fir (Abies concolor) are also found in this zone (Trees of the San Bernadinos, 1999).

5. Artic Alpine: 9000 to 10,000 feet. Some Lodgepole pine (Pinus contorta) may be found at the end of the tree line in the artic alpine, also Parry manzanita (Arctostaphylos paryana).

An Introduction to Fire

In the most basic sense, there are three components needed in order to start a fire (Petrick-Underwood, 1990):

1. Heat: Sources can include lightning, matches, engine sparks, campfires, discarded cigarettes.

2. Oxygen: A gas that exists naturally in the atmosphere and is produced by plants during photosynthesis that humans and other animals breathe.
3. Fuels: Wood, gasoline, natural gas, and duff. Duff is decomposing organic matter found on the forest floor (Whiteman, 2000). Duff is a key in forest fire ignition.

In order for a fire to burn all three aspects of the fire triangle must be present. If one element is taken out of the triangle, then the fire will quickly cease to burn. The next step in comprehending forest fire is to identify the behavioral patterns of fire.

![Fire Triangle Diagram]

**Fire Behavior**

Fire behavior involves three facets that can affect how hot a fire burns, how manageable it is, how quickly it spreads, and in what direction. The three aspects of fire behavior are fuel, weather, and topography (Alberta Environment Environmental
Training Centre [AEETC], 2002). The following information has been adapted from the Alberta Environmental Training Centre’s Introduction to Fire Behavior handout.

**Fuels**

Fuels can either be alive or dead organic material. Their distribution will partly determine the severity of the fire. Continuously distributed fuels will lead to more intense burning that is difficult to control for fire fighters. Patchy fuels scattered throughout an area burn less intensely, making the blaze easier to control for fire fighters. Another factor in fuel ignitibility is moisture content. This is essentially the wetness of an area, including grass, duff, and timber. There are two characteristics of fuel moisture that affect fire: the greenness of the vegetation (how healthy/"alive" the vegetation is) and the amount of moisture from the air absorbed by the fuels.

**Weather**

This is a significant element of fire behavior. Even a slight change in the weather can affect the intensity, direction, and size of a forest fire. On hot dry, windy days fire may be very difficult to contain. Conversely, forest fire is much more manageable on cool, moist days. There are four basic weather components that influence fire. They are:

1. **Humidity**: Humidity is the current amount of moisture in the air compared to the total amount that it could possibly hold. It affects the moisture level within fuels. Humidity is highest during the early morning and late at night, therefore adding more moisture to fuels. Humidity is at its lowest during the middle of the day/late afternoon,
when temperatures are high and winds are strong. Due to its effect on the moisture of fuels humidity can help dramatically lower or raise the intensity of a fire.

2. Temperature: Temperature directly affects and influences humidity. As the temperature goes up, the humidity will go down, and as the temperature drops humidity will rise.

3. Wind: Wind affects fire behavior in a number of Ways. It will govern the direction and the “spread rate” (how quickly a fire moves) of fire. Wind also can shift fire fronts moving the direction of the fire, putting fire fighters in danger. Finally, wind can carry sparks starting new blazes nearby. Wind is a dangerous portion of the fire behavior triangle, and is closely watched by fire personnel for safety reasons.

4. Precipitation: Rain is an important participant in fire behavior. Long, lasting rain will aid in slowing down the spread and intensity of a fire. Short rains, even though heavy in precipitation, can only make a small or short-term effect in extinguishing forest fire.

**Topography**

Topography entails the terrain of the land, and its elevation changes, which is the slope of the area. The effect of topography on a forest fire can be seen through slope reversal. Fire spreads much faster uphill then downhill. This is due to:

1. Wind currents normally flow uphill, fanning and pushing the flames in that direction.
2. Flames traveling uphill are closer to the fuel (above it) then on level ground. The flames will dry out and preheat higher fuels more intensely then fuels below it.

3. Once a fire reaches the crest of a hill, the wind patterns change, as well as the ability of the fire to preheat fuel, which causes a fire to lessen in intensity and spread rate. This is called slope reversal.

Another topographical influence on fire behavior is the directional face of a hill slope. In the northern hemisphere, the sun will shine longer upon hillsides facing due south then those that face north. This is because a south-facing slope is closer to a right angle towards the sun than a north-facing slope. The greater solar exposure can change the fuel moisture and lead to a greater chance of fire ignition on south facing slopes.

Elevation can also affect the behavior of a forest fire. Elevation affects temperature, and temperatures normally decrease as elevation raises.

Healthy and Detrimental Effects of Forest Fire

Media outlets have commonly portrayed fire as the great destroyer (Pyne, 1999). Fighting misconceptions about the importance of forest fire is one of the most difficult, yet necessary portions of a fire ecology hike. Due to the recent forest fires in Southern California, it is of great importance to stress the valuable attributes of forest fire, without diminishing the terrible consequences. A forest fire, or grass fire, is a fire that occurs in the natural environment rather than in an urban setting (Pringle, 1995).
Forest fires can be very beneficial to an ecosystem, such as the chaparral and, to some extent, the yellow pine forest.

1. Fire is a natural component of the ecosystem. Lightning strikes spark fires that are normally less severe than fires started by humans (Pringle, 1995).

2. Fire creates a fertile forest floor. The ashes of burned vegetation and robust healthy soil, prime for new vegetative growth.

3. Fire creates habitat and shelter for animals. Fires help create snags; snags are standing dead trees. Snags provide homes and food for many birds and insects. Fire will remove areas of heavy brush, and with the thicker stands gone there is more water for animals. Additionally, the open space created by forest fire will allow new young growth to emerge and provide foraging opportunities for wildlife.

4. Fire allows seed germination for trees with serotinous cones, such as the Knobcone, and the Coulter pine tree. These cones will not open to release seed unless heated. These seeds also need the open space and rich soil that a forest fire creates (California Department of Forestry and Fire Protection [CDF], 2000).

5. A fire will eliminate undergrowth so that the established trees can be become larger and stronger. Forest fire will help naturally thin out trees reducing competition in overcrowded forests. When an area has too many trees, competition for resources increases.
Fire, however, does not always solely produce profitable outcomes for the chaparral and forest. When a forest fire becomes catastrophic, it loses its beneficial attributes. Catastrophic wildfires are severe forest fires that burn wildly and have few of the positive after effects of a natural forest fire. This can prompt detrimental events to humans and wildlife:

1. Human life and property loss
2. Environmental destruction: Despite the benefits of forest fire to the environment, a catastrophic fire will badly damage an area.
   * Some newly formed snags are hazardous to hikers in the forest.
   * Catastrophic wildfire can destroy large stands of trees rather then only eliminating the weaker ones.
   * Topsoil removal (erosion)
   * Flooding
   * Threatens wildlife

Adaptation to Fire:

Vegetation Adaptations

Traveling along Forest Service Road 1N09 east from California State Route 330 to State Route 38 normally implies that one is visiting the shooting range located five miles in. However, there are days when the road is closed to traffic and the shooting ranges are silent. As you meander along the Forest Service road, the sounds of cars slowly lose their persistency, as vehicular white noise melds into the melodious
singing of a Cassin’s finch (*Carpodacus cassinii*) making its way southward from its beloved yellow pine forest. One is quick to note the small shrubby bushes, with thick tough evergreen leaves that populate the region. These plants have adapted to the fire regimes that naturally sweep through the Southern California chaparral every fifty to eighty years (USDA, 1999). So in tune to the fire regime of the chaparral, the leaves of Chamise (*Adenostoma fasciculatum*), are coated in a waxy oil produced to protect the leaf from moisture evaporation. This oil-like resin is also highly flammable, and actually encourages the spread of fire in the area.

The vegetation and animals of this region have adapted to the particulars of chaparral. Adaptation is the ability to modify. Adaptation can occur in a limited capacity, for example, in which a particular plant subjected to a harsh winter may grow tougher leaves to compensate for the weather, once it survives the initial frost. The change made is temporary and will not be passed down genetically to the next generation of organisms. However, adaptation can take place at the genetic level, wherein survival traits are eventually passed down from one generation to the next over time (Cunningham et al., 2003). It is this genetic enhancement and adaptability that allow indigenous plants to survive the extreme weather conditions of the chaparral. Years of exposure to drought, fire, and sharp winds have allowed life in the chaparral to evolve in accordance with seasonal changes, and cyclical events as well, giving these organisms an advantage over nonnative species (Steinhart, 1990). The most dominant of these cyclical forces is fire, and the chaparral is considered a
fire-climax community, an area that is “shaped and maintained by periodic fires that have long been part of their history” (Cunningham et al., 2003, p. 96).

Fire does not always begin and end in the chaparral, as the 2003 Old Fire taught many of the mountain residents. Rising above the chaparral is the yellow pine forest. Due to its proximity to a fire prone region, many trees within the San Bernardino Mountains have adapted to survive forest fires. This allows healthier, established trees to survive when fire sweeps through, killing the weaker trees and creating less competition. Some yellow pines have adaptations such as serotinous cones (cones that require heat to release seed), thicker fire-resistant bark, and a higher branch level. The higher branch level helps reduce the risk of crown fires.

Crown fires are fires that have moved from the ground to the canopy of trees, and that move from tree top to tree top (crown to crown), rather then fire that moves at the bottom of the forest floor (Pringle, 1995). Crown fires occur when forest fire moves up along a “ladder of fuel,” known as the fuel ladder. Ladder fuel is “forest vegetation situated at different heights and close enough together to allow a surface fire to become a potential crown fire” (State of South Dakota, 2001, p. 15).

Due to vegetation adaptation though, a natural, low-laying forest fire could burn through and the trees would survive. The fire-resistant bark would protect the trees’ cambium layer, from intense scorching. The cambium layer is “undifferentiated meristematic tissue in a plant” (Wallace, 1989, p. 276), essentially, the tissue that allows a plant to grow in diameter, through producing food and water carrying cells. A natural low-laying fire would not reach the higher branches of the yellow pine.
Animals During a Forest Fire

One of the biggest concerns the public may have about fire is the effect it has on wildlife. Many people erroneously believe that any forest fire will displace and/or harm the peaceful inhabitants of the woodlands. Animals rely on their instincts to survive a forest fire. The larger animals of the chaparral and yellow pine forest, such as bears, deer, and mountain lions, are agile enough to run, jump, and scamper their way off to safety during wildfire (CDF, 2000). Smaller animals like mice, snakes, and lizards tunnel their way into burrows underground, staying safe until the threat of fire has moved on. Older birds utilize their ability of flight and can easily move to safer ground during a forest fire.

Unfortunately, not all creatures can escape. However, in death they provide an important role. Most hatchlings and immature birds do not have the developed ability of flight. Their remains encourage scavengers, such as coyotes and vultures, to return to the burned area, helping repopulate the region (CDF, 2000). Many soil based creatures also perish in forest fires; however, their burnt bodies add to the organic matter on the ground to contribute to the nutrient-rich soil that occurs after a forest fire.
References


APPENDIX B

FIRE ECOLOGY ACTIVITIES
ACTIVITIES AND TEACHING POINTS

ACTIVITY 1:
The Fire Triangle

Area:
Cemented area outside Children’s Forest Visitor Information Center

Materials:
Two Candles
Match/lighter
Two jars with lids

Explain the fire triangle to the students. Ask the group about oxygen and where it comes from. Then ask the group to identify examples of fuel. The most likely answer you will get is wood. Explain to the group that there are other types of fuels. For example, your car burns on gasoline or your stove/oven may burn on natural gas. Explain the term duff, and how duff is fuel for a forest fire.

Light both of the candles and place one in each jar. Tell the group that if one element is removed from the fire triangle, a fire cannot burn. Explain that you are going to place the lid on top of one of the jars. Which element will be removed when the lid is on? (Oxygen) Ask the group to guess how long they think the candle will stay lit without the element of oxygen. Place the lid on and begin counting.

This lesson will assist the group in understanding the components of the fire triangle. It is a good, safe, introduction to fire, so that students may begin to understand the basic principles of fire, and the necessity for the presence of all three components.
ACTIVITY 2:
Adaptation: TEACHING POINT

Area:
Lower open space after Mill Peak Road Forest Service gate

Materials:
None

Ask the group if they notice any difference between the five trees grouped in the middle and the others that are around it. Some correct responses include: the yellow pines in this area are much taller (older) then the others, the bark looks different, the branches start out much higher then the fir and oak in the area, and that the area seems more “spread out” then some of the other areas of the forest. Explain that these older trees (although dead now) exhibited adaptive behavior to survive fire.

Here is also an excellent spot to discuss crown fire versus a natural forest fire. In this area, a forest fire would burn through killing the younger/weaker trees, but allowing the mature, established trees to survive. Discuss crown fires and ladder fuel. How has fire suppression contributed to the possibility of crown fire? Ask the group if any of the surrounding trees may act as ladder fuel.
ACTIVITY 3
Investigation of Vegetation and Adaptation

Area: Open clearing past Dry Creek/Winter Shelter Area, off of Mill Peak Road.

Materials Needed:
Clipboards
Checklist
Pencils/Pens
Compasses

Prep the group with information from the background section. The naturalist should explain the core elements of fire behavior as well as the section on vegetation adaptation from the background information, and include some of the positive and negative results from a forest fire.

Have the students split into groups to investigate the area. Each group will receive a clipboard with a checklist. The checklist [included on the following page] has the various components that affect fire behavior. The students will explore the area with the checklist, recognizing and reflecting on the area. Students should look for duff, topographical factors, and other features that may affect a fire illustrated in the information background. The groups will then decide if the vegetation of the area has adapted to a fire regime and if preventable measures have been taken to prevent catastrophic fire. The students will then gather as a group and discuss their results.

The investigation area is bordered by Dry Creek on two sides and has fencing on the opposite two sides.
INVESTIGATION CHECKLIST

___ Dead Vegetation
___ Firebreak
___ Fire adapted trees
___ Burnt logs
___ Fire damaged trees
___ Regrowth (Regeneration)
___ Serotinus Cones
___ Duff
___ Nesting Spots in Burned Trees
___ South Facing Slope
___ North Facing Slope
___ Moist Fuels
___ Dry Fuels
___ Nutrient Rich Soil
___ Strong Winds
___ Easy Access for Fire Vehicles
___ Snag from Fire
___ Wildflowers

Has a fire recently swept through this area? What evidence points to your answer?

Is this area properly maintained to best avoid catastrophic fire? What evidence leads you to this answer?

How would a fire affect this area? Why?
ACTIVITY 4
Fire Behavior

Area:
Open clearing past Dry Creek/Winter Shelter Area, off of Mill Peak Road.

Materials Needed:
Green pennies
Blue bandanas
Red penny

This activity depicts the relationship between the fire triangle and fire behavioral patterns. Fire grows when conditions are favorable. As displayed in Activity 1, fire will cease when one element is removed. Water can be used to extinguish or slow the spread of fire, by lowering the intensity of heat. Students will learn that fire can be erratic and chaotic, as well as the importance of fuel removal to stop a fire.

Assign one student as “the ember” of the fire. This student will wear the red penny. One fourth of the students will wear the green pennies. They will be the fire fighters. Hand each firefighter a blue bandana. The remaining students will be designated as trees. Explain the roles to the group.

Send the ember to one end of the area and have the fire fighters form a line on the opposite end facing the ember. The trees can then pick a spot, “taking root,” anywhere between the ember and the fire fighters.

Begin the game by shouting, “An ember has blown into the forest.” The ember can then begin tagging trees. A tagged tree becomes part of a forest fire and must link up with the ember, moving where the ember moves. Trees that have not been tagged
cannot run from the fire. Remind the students as trees they are rooted to their spot (until they become part of the forest fire). All tagged trees will join the chain of fire. Two or more burning trees may split from the main group as offshoots of the fire. However, the tagged trees cannot break off from the group individually.

Once the fire has begun to grow (to 4 or 5 trees) ask the fire fighters “Do you smell smoke?” They will answer “Yes!” and join the fray. The fire fighters then can begin to put out the fire. The blue bandanas represent water. The fire fighters can fight the fire by:

1) Removing fuels- Fire fighters can tag individual trees that have not joined the fire yet. These trees will be placed on the sideline.

2) Slowing down the fire- Fire fighters can tag fire with the blue bandannas. Fire that has been tagged may no longer run, but must walk in their pursuit of individual trees.

Once all individual trees are gone the game has ended. Count the number of tagged “fire” trees and compare to the number of trees on the sideline. Who won?

Point out the similarities from the game with real life situations

Adapted from Carlsbad Caverns National Park’s Teacher Guide: About Bats, Caves, & Deserts.
ACTIVITY 5
Ecosystems/Life Zones of the San Bernardino Mountains

Area:
End of Mill Peak Road, near crest of Mill Peak

Materials:
10-20 ten-inch pieces of string
pencils
paper

This activity is to acquaint students with the diversity of life. As expressed in the background information, California is made up of many remarkable ecosystems/life zones. Split the students into groups of three and give each group a piece of string. Tell the students that they will be on a ten-inch hike. Have the students observe and record as many interesting items, details, and organisms that they see while studying a ten-inch plot of ground (using the string as a measuring guide). Have the group reassemble and share the results.

After discussing what each group has found, walk the group over to the “lookout” area of Mill Peak. Below them, they will be able to see the different life zones that constitute the San Bernardino Mountains. Make the connection between the diversity found on a ten-inch hike, as compared to the wildlife and botanical diversity found between the different life zones. From this vantage point the effects of the Old Fire can be seen quite clearly, which leads the group into the next activity.
ACTIVITY 6
Healthy and Detrimental Benefits of Forest Fire: TEACHING POINT

Area:
End of Mill Peak Road, near the crest of Mill Peak

Materials:
None

Explain to the group that there are positive results from a forest fire. Ask the group if they can think of any (some of the positive effects will have been mentioned in ACTIVITY 3 when discussing adaptations). Several positive affects of forest fire are visible from this vantage point:

1) Knobcone pine in the valley below
2) The ash on the ground has begun to contribute to the soil, in the spring there will be many wildflowers appearing, capitalizing on the nutrient rich soil.
3) Small undergrowth is visible from here. The fire has created open space allowing ferns to grow, now that there are less tree canopies above blocking light.

There are negative aspects visible from here as well

1) The area to the southeast has lost a large amount of ponderosa pine, and stands of ponderosa were once dominant in this area. Trees that are better suited to the burnt area, such as oaks, are slowly replacing the pines, and changing the composition of the ecosystem.
2) To the southwest there are several homes visible that were situated very close to the fire. While these homes barely survived the Old Fire, many mountain residents were not as lucky.
ACTIVITY 7
Adaptations/Survival

Area:
Children’s Forest Lot (Upon Return)

TREE ROUND

After having returned from the hike, the group will investigate a tree round from a tree that had survived a forest fire. This tree round has a story to tell, just as each student has their own story of their lives. We can learn part of this tree’s story by looking at the rings. By counting the rings, the group can determine how old the tree was, and when it encountered forest fire. Have the group fill out the questions on the following page. For the purpose of these questions, assume that the tree died and was cut down this year.
TREE ROUND STUDENT SHEET

For the purpose of this activity, assume that the tree had died and was felled this year.

1) Counting the rings will show you the growth and age of a tree. Carefully count all the rings. How old is your tree?

My tree is ___________ years old.

2) Look for a fire scar on the round. Find out what year the fire burnt the tree. Count in from the outermost circle and subtract that number from the current year.

This tree burned in the year ___________.

3) Find the growth ring for the year that you were born. Using a ruler calculate the diameter of the tree in the year you were born.

I was born in _____________.
This tree was ____________ years old when I was born.
That year it was ______________ inches in diameter.

4) Rings that have large spaces in between them, represents years of large growth, due to healthy conditions, such as a good water supply.

___________ was one of the best years of growth for this tree.

___________ was one of the slowest years of growth for this tree.

Were the years following the fire(s) good or bad for the growth of the tree?
APPENDIX C

GREETINGS AND SAFETY ISSUES
GREETINGS AND SAFETY ISSUES

GREETINGS AND CHILDREN’S FOREST STAFF INTRODUCTIONS

The Fire Ecology Hike will begin at the Children’s Forest Visitor’s Information Center (VIC), where the Children’s Forest (CF) Naturalist will anxiously await the arrival of the visiting school. During this time the CF Naturalist should:

1) Unlock the VIC restroom
2) Double check first aid kit and walkie talkie
3) Double check amount of water. The naturalist should carry a few extra quarts incase of emergency.

Once the bus has pulled into the VIC and come to a complete stop, the CF Naturalist will enter the bus for introductions. After introductions of CF staff, volunteers, youth naturalists assisting, etc. the CF staff will then comment on the rules to follow while the visiting students are in the forest:

1) No running allowed at anytime, unless permission is specifically given by CF Staff. (i.e., during educational game, etc.)
2) Practice “leave no trace.” Everything that students/teachers bring into the forest must be taken out. This includes all food items (apples cores, banana peels, etc)
3) Stay on the trail with the group at all times
4) Respect plants and animals. Students are not allowed to pick at vegetation, smash insects, or remove items from the forest.

Safety Concerns for Fire Ecology Hike:

1) Caution concerning rattlesnakes: stay on trail, if student comes across a rattlesnake, slowly back away and alert Naturalist.
2) Students must stay behind the Naturalist and in front of the “sweep” (either additional CF staff personnel or teacher at rear) while hiking
3) Remind students that Keller Peak Road is an ACTIVE road and will occasionally receive automobile traffic
4) Dehydration- Address this issue with the group, reminding students to drink plenty of water along the trail
*While it is important to enforce the rules it is more important to explain WHY*

Students/Visitors respond better to rules if they are given a reason as to why they must follow them. Rather then simply telling students to stay on the trail, explain the danger of rattlesnake encounters, the damage done by hiking off trail, etc.

**PREHIKE PREPERATION**

After introductions have been made and rules explained, the students will be allowed to line up off the bus next to the park benches in front of the VIC. If necessary, double check that all student items were taken off the bus, as many times it will be a different district bus picking the students up at the conclusion of the hike. At this point the students may be allowed to use the restroom at the VIC. **Explain to the students that there will not be any modern toiletries on the hike.** The VIC restroom must be locked after all students/teachers/naturalists are finished before setting off on the fire ecology hike.

**INTRODUCTION OF THE NATIONAL CHILDREN’S FOREST AND THE CHILDREN’S FOREST ASSOCIATION**

Before the hike begins, the CF Naturalist will give a brief history of the National Children’s Forest, as well as an overview of the Children’s Forest Association and its programs.
APPENDIX D

CALIFORNIA SCIENCE STANDARDS
CORRELATING CALIFORNIA SCIENCE STANDARDS

As designed, the Fire Ecology Lesson Program will incorporate and meet many of the California science standard requirements developed for first through eighth grade. The fire ecology lesson plan will meet:

Fourth Grade-  Life Science
Standard 2 b & c
Standard 3 b
Investigation and Experimentation
Standard 6 a & f

Fifth Grade-  Investigation and Experimentation
Standard 6 a, g, h, & i

Sixth Grade-  Shaping Earth’s Surface
Standard 2 a & d
Heat-Thermal Energy-Physical Science
Standard 3 a & d
Energy in the Earth System
Standard 4 a, d, & e
Ecology
Standard 5 c-e
Investigation and Experimentation
Standard 7 d, e, g, & h

Seventh Grade-  Evolution
Standard 3 a & c
Earth and Life History
Standard 4 b
Structure and Function in Living Systems
Standard 5 f
Investigation and Experimentation
Standard 7 a & c

Eighth Grade-  Investigation and Experimentation
Standard 9 a & b
REFERENCES


