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No place like home: Using local surroundings and history to implement environmental education

Brian Craig Snow

NO PLACE LIKE HOME: USING LOCAL SURROUNDINGS AND HISTORY TO IMPLEMENT ENVIRONMENTAL EDUCATION

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

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ABSTRACT

The San Bernardino Mountains was used as an integrating teaching tool for teaching interdisciplinary lessons to grade four.

Background history of the San Bernardino Mountains is provided and includes how the mountains were formed, the native peoples, and the early European and American uses of the mountains. The interdisciplinary lessons utilize history of the San Bernardino Mountains and the current mountain ecology, while incorporating environmental education strategies. A resource list for teachers is provided.

ACKNOWLEDGMENTS

I would like to thank my wife, Tannah, for her love, support, patience, and hours of help in not only completing this project, but also in the course work for this project as well. I would also like to thank Dr. Darleen Stoner for her guidance, support, and expertise in teaching about the environment. Her continued vision and leadership have such far-reaching effects.

Finally, I would like to thank my Grandpa, Dick Snoddy, who first introduced me to the outdoors through fly-fishing - an introduction that so enriched my life.

DEDICATION

This project is dedicated to my five-year-old daughter, Taylor. May she find a world to grow up in that still has wild and natural places to explore, and may she find the peace and joy I have discovered in such places.

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CHAPTER ONE

INTRODUCTION

> There was a child went forth every day, and the first object he looked upon, that object he became, and that object became part of him for the day or a certain part of the day, or for many years or stretching cycles of years. The early lilacs became part of this child, and grass and white and red morning glories, and white and red clover, and the song of the phoebe-bird, and the third-month lambs and the sow's pink-faint litter, and the mare's foal, and the cow's calf. (Walt Whitman, as cited in Sheenan & Waidner, 1994, p. 10)

"May I go to Harvard after school?" I asked my Mom. "Harvard" was Harvard Park, and with permission granted I would set out on my bike on the mile-long journey to get there. Baseball and soccer fields covered most of the park, but these were not my goal. I was seeking the small area in the park that wasn't covered in grass; instead it remained the brushy, tumble weed covered terrain that reflected pre-park and pre-city development of Irvine topography. This outdoor "oasis," in the middle of a city, captured my imagination many afternoons as I explored each rock and crevice for lizards and king snakes, the objects of my desire. It was not only the capture of these wild creatures that captivated my ten-year-old mind; it was the sense of exploring.

This feeling continued on my trips in the summer to Colorado to visit my grandparents. Here I would also search for snakes and lizards, as well as fish for the small Brook Trout in the little creek outside my Grandpa's cabin.

These early outdoor experiences sparked an interest in adventures out-of-doors. To this day, I scuba dive, fish mountain streams, and hike mountain canyons and peaks. It also led to my decision, after finishing college and returning to where I grew up in southern California, to make my home in the San Bernardino Mountains. Here I share my backyard with birds, animals, and many different species of trees. I was also fortunate to find a calling as an educator, which has allowed me to work in these mountains, and to use them as a tool in my teaching.

In Earth in Mind (1994), David W. Orr wrote that love for nature begins early in the life and imagination of a child. He stated that if nature has not been experienced as a friendly place of adventure and excitement at a young age, it will not take hold as it might have had early age experiences taken place. Students living in the mountains have a unique opportunity for these experiences to occur, yet as a teacher here I have noticed that students often don't seem to understand, appreciate, or even acknowledge the beauty that surrounds them.

This project is designed to use the strategies of environmental education to teach fourth grade curriculum. Specific examples from the natural systems of the San Bernardino Mountains are used across the curriculum in an unit of lessons designed to not only teach the content, but to stimulate an awareness and knowledge of the natural world. By learning about the mountain's ecology, students will discover the importance of these natural systems, and have the knowledge, and hopefully, the interest to protect and preserve them.

CHAPTER TWO

REVIEW OF THE LITERATURE

Today, over six billion people are using the earth's natural resources. These same people are often knowingly or unknowingly abusing these resources by cutting forests, extracting minerals and energy supplies, eroding topsoil, polluting the air and water, creating hazardous waste, and disrupting natural areas at a rate unprecedented in the history of life on Earth. Other consequences include species extinction, desertification, pesticide contamination, increasing public health problems, starvation, shrinking green space, poverty, and loss of human life. Providing for people's needs and wants, as the pressures from overpopulation and development increase, is becoming increasingly difficult (Braus & Wood, 1993; Knapp, 1999). There are many consequences of environmental degradation. "Many experts fear that if the current rate of destruction continues, we will see the gradual breakdown of the very systems that support life on earth" (Braus & Wood, 1993, p. 2).

To combat these problems, a change in the goals of education must be enacted. Environmental education can help children gain the knowledge, skills, values, motivation and commitment they will need to manage and sustain the earth's resources and to take responsibility for maintaining environmental quality (Braus & Wood, 1993). Children are an important audience for Environmental Education because they are tomorrow's resource users and leaders (Braus & Wood, 1993).

The definition of environmental education has been evolving over time, and continues to be tinkered with. It got a big push at the United Nations (UN) Conference on the Human Environment in Stockholm, Sweden, where it was recommended that the UN establish an international environmental education program. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) followed up on the recommendation by sponsoring a series of environmental education workshops and conferences around the world. Representatives from member nations met in Belgrade, in the former Yugoslavia, in 1975, to outline the basic definition and goals of environmental education. In 1977, representatives from more than 60 nations gathered in Tbilisi, in the former Soviet Republic of Georgia, for a follow up to the Belgrade conference.

The following definition and objectives were ratified:

> Environmental education is a process aimed at developing a world population that is aware of, and concerned about, the total environmental and its associated problems, and which has the knowledge, attitudes, skills, motivation, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (Braus & Wood, 1993, p. 6)

Specifically, environmental education stresses these five objectives: awareness, knowledge, attitudes, skills, and participation (Braus & Wood, 1993; Disinger, 1997).

Having a working definition for environmental education is only the first step. Implementing these goals through educational efforts is the next step. Children are heavily influenced by the experiences they have and the attitudes of the adults in their lives. Many educators believe that small children possess attitudes of care and compassion for fellow creatures inherently. But the quality of our children's sense of wonder in the natural world and environmental awareness must be supported, channeled, and encouraged in order for them to fully develop into a respect for the complexity, beauty, and connectedness of their planet. If their parents, other family members, and teachers surround them with attitudes of compassion and concern for the planet, they have a better chance of growing up with a deep-rooted connectedness with the natural world (Sheehan & Waidner, 1994).

A generation ago, most Americans had ties to relatives still living off the land. Families visited their country relatives on summer trips as a routine part of life. Today, few urban residents have access to these land connections; to ride horses or be around cattle they must pay for a dude ranch experience. Some believe that young people have been alienated from the land by modern technology and a consumer-based society (Knapp, 1999). If we value what comes from living a rural childhood; playing in sagebrush rather than lawns, tending horses rather than hamsters, we must act to preserve the possibility of such a life (Nabhan & Trimble, 1994).

Steven Trimble recalls collecting leaves for a school project around his suburb house in the foothills of west Denver. The leaves were ironed between two sheets of wax paper and his mother helped in labeling them. "I remember the thrill of appropriating the object, the first step, and then, at the next level, of harvesting the power of its name" (Nabhan & Trimble, 1994, p. 25). These sources of power lay everywhere, unclaimed, unowned, there for the taking.

Native peoples, who still depend on the land for sustenance, acquire this power early. Their lives depend on learning the behavior of their prey animals and on their knowledge of medicinal and food plants. "This leads to power in an elemental way - an appreciation of the power of other lives" (Nabhan & Trimble, 1994, p. 25).

In developing what ecologist Aldo Leopold called the "land ethic," regard for the wilderness often comes last. First comes simple involvement, with what environmental psychologists Rachael and Stephen Kaplan call "nearby nature" (Nabhan & Trimble, 1994, p. 25). Early mundane experiences lay the foundation for what can develop into Edith Cobb's ideal; a living relationship between a person and a place, topophilia, rootedness, placeness, and knowing where home is (Nabhan & Trimble, 1994). During the ages of roughly 6-18 years, a second developmental stage in children's values of nature occurs, in which humanistic, symbolic, aesthetic, and knowledge components of the scientific value develop rapidly, while utilitarian, negativistic, and dominististic perspectives diminish in importance. In other words, the act of owning natural objects is becoming not as important as seeing, experiencing and learning about nature (Kahn, 2002).

In his book Children and Nature (2002), Peter H. Kahn talked about environmental generational amnesia. He stated that with each ensuing generation, the amount of environmental degradation increases, but each generation's youth takes that condition as the normal, non-degraded condition because they have nothing to compare it to. The natural environment encountered during childhood is the norm against which we measure environmental degradation later in our lives. "Environmental generational amnesia offers a different perspective on what many observers of the global human condition view as environmental complacency" (p. 107). People have a difficulty understanding in a direct, experiential way that we have environmental problems of any magnitude when what they see and hear about is what they have always seen. The fear is that as we continue to degrade nature, we will adapt to its loss as we have already (Kahn, 2002).

How can this problem be solved? There is no easy answer but it is important to realize that its roots lie in childhood and therein we must look for answers. The constructivist approach to education offers a starting point. Constructivist methodology is a theory that each learner actively constructs their own reality of knowing, and that students' knowledge is the result of these individual constructions of reality. These constructions are based on the fact that students bring their own past experiences, beliefs, cultural histories, and world- views unique to themselves, into the process of learning. Thus for order exists only in the mind of each individual the students must have the opportunity to create knowledge and understanding (Brooks, 1990).

But even with constructivist environmental education in place, the problem of environmental generational amnesia continues to persist. This is because by definition the problem arises because of an increasingly impoverished natural environment that limits the richness and diversity of a child's interactions with the natural world. Using historical information, specific to an area's ecological history, could be an effective educational tool, especially when it speaks to a children's sense of place, such as their own community. An old saying states that the failure to learn about history bounds one to repeat the mistakes of the past. Learning about the San Bernardino Mountains' history, and how that history relates to the environmental impacts of people using the mountain today, can help children avoid mistakes made in the past (Kahn, 2002).

"Teachers can use historical diaries and historical novels to convey a sense of the landscape of years past" (Kahn, 2002, p. 112). Assignments could involve comparisons and thought provoking exercises in the context of: this is how it was, this is how it is now, what can we do to change it back, what do we need to protect? Current problems and issues can be explored using both a current and historical perspective to explore solutions that might be best for the future of the area (Kahn, 2002). This gives students real world experiences in environmental problem solving.

An environmental problem is described as a threat or difficulty related to the environment. An environmental issue arises when there are disagreements by groups or individuals about what should be done about the problem. The beliefs and values of both sides must be analyzed for understanding of the issues involved. The students must be able to identify ecological consequences related to the issues and the various solutions in order to approach solutions in an informed manner (Volk, 1997).

"To the extent that the fostering of responsible environmental behavior is its goal, environmental education necessitates emphasis on the higher order thinking skills" (Disinger, 1977, p. 32). Real problems, studied or simulated, and topics and problems that can be adjusted to the developmental levels of students cut across the curriculum and enhance the integration of knowledge using higher order thinking skills (Disinger, 1977). Using current and historical information as a source of knowledge to explore these topics, issues, and problems, is consistent with the constructivist goal of the student creating their own reality through the exploration and experience, and is what environmental education is aiming for (Klein & Merritt, 1994).

CHAPTER THREE

BACKGROUND INFORMATION

Introduction

From the top of San Gorgonio peak at 11,502 feet, to the canyons, meadows, and streams below its lofty perch, the San Bernardino Mountains sit as an outdoor oasis amongst the urbanism below which is Southern California. The range is approximately 50 miles wide stretching from the Cajon Pass to the Coachella Valley. People have been drawn to these mountains for the same reasons as in other mountain ranges: economics, aesthetics, adventure, scientific, or escape from the busy life below. Today, approximately 38,600 people call the mountain home with thousands more arriving on weekends for temporary stays (United States Census Bureau, 2000). The story of these mountains, from their creation to the timeline of people using them, is long and interesting. The following is part of that story.

Geology

In the history of human kind, the knowledge of mountains is relatively new. For as long as people have thought about them at all, they have seemed to always exist, simply a part of the larger act of creation for which every society and faith has had its own explanation. Only 200 years ago, the rational and skeptical man Voltaire of France regarded his scientific friend Counte de Buffin's view that even the smallest of hills in France might not have always been there as preposterous. Buffin had become fascinated by the seashells he had discovered imbedded in rocks on these hillsides. How had they gotten there? After studying them he had become convinced that sea animals had once lived at the places where the mountains now stood. He proposed that soft sediments had covered them and hardened into rocks in shallow seas, and that later the rocks had been lifted high above sea level. Nonsense, said Voltaire, the shells were carried to the mountaintop by pilgrims and left there to be covered in mud after rain. Their friendship cooled as the two men argued the point (Milne & Milne, 1962).

While geology was in its infancy in Buffin and Voltaire's day, scientists of the time had a remarkable understanding of the solar system. They knew within a 4% to 5% error the earth's size, its distance from the sun, the length of the year, the size and nature of the moon, and the behavior of most of the planets. Thanks to Issac Newton, they even had an explanation for the force that held the whole system together. They knew a good deal less about the ground under their feet. Nathaniel Hawthorne, only a century ago, still had no idea he was taking poetic license when he described mountains as the undecaying monuments of the earth (Milne & Milne, 1962).

But once digging, sifting, and comparing did start at an ever increasing rate, the endless clues to the origin of mountains unveiled themselves. Because they project so high, and expose so many layers of rock and fossils, and wear away before our eyes at the hands of the forces of erosion and gravity, mountain's mysteries have been revealed. We have learned that there are four major ways in which mountains can be built: pushing together of the earth's surface which results in folded mountains; faulted mountains from underground pressure that forces one whole mass to break cleanly from another making one side rise and the other subside along a weakness (fault) in the earth's crust; volcanic action that results in a rush of material from deep in the earth in sufficient quantity to create a mountain; and finally volcanic activity that creates a dome mountain in which molten rock collects in a pocket underground that bulges to the earth's surface (Milne & Milne, 1962).

The San Bernardino Mountains, acting like a misbehaving child, rise up in a west to east pathway instead of the general northwest/southwest structural grain of California. Geologists place these mountains, along with the neighboring San Gabriel Mountains, in the Transverse Range province because of this westerly trend, transverse to the general northerly trend of the mountains in Southern California (Sharp & Glazner, 1993).

The San Bernardino Mountains began to uplift about two million years ago, making them very young in geological time, in contrast to the Rocky Mountains which are over 60 million years old. This uplift is being caused by a head-on collision between the Pacific Plate and the North American Plate. The San Andreas Fault forms the boundary between the two plates. The two plates slide past one another over most of the faults length, like two trains passing along opposite paths cut through the same canyon which makes it a right lateral fault (Sharp & Glazner, 1993). The Pacific Plate moves northwest relative to the North American Plate. However, from the northern end of the Coachella Valley to the southern end of the San Bernardino Valley, the San Andreas Fault turns to run in a more east/west direction. This kink or jog causes the motion of the two plates to result in a head-on collision rather then the side-by-side sliding that is seen along the rest of the fault. The collision of the two plates causes the land on either side of the fault to crumple and buckle up, like two vehicles hitting each other head on. The land to the south and west of the fault on the Pacific Plate moves toward San Francisco and Alaska and has crumpled to form the San Gabriel Mountains. The Cajon Pass, which marks the course of the San Andreas Fault, separates the two ranges (Robinson, 1989).

Other faults join the San Andreas Fault as it marks its course to the desert. The Mill Creek Fault, Helendale Fault, and Morongo Fault to the east all appear as a series of short fracture zones along the mountain range as well as other faults that slice through the mountains (Robinson, 1989). The San Bernardino Mountains are still rising. Stress along the two plates, built up as the two plates try to push past each other, can let loose with a sudden jerk. At these times, the plates may slide past each other by several feet. The mountains rise a little more with each quake as the uplifting helps to reduce the stress of the two colliding plates. It is the slippage of the plates that actually cause the mountains to rise. The quakes result from the energy released by the sudden slippage (Kooser & Reynolds, 1986; McJunkin, 1976; Stout, 1976).

Most of the rocks in the San Bernardino Mountains are the igneous rock granite. Igneous rocks were melted to magma and then cooled and therefore often referred to as volcanic rocks. The San Bernardino Mountains granite was formed between two hundred million and sixty million years ago. Granites cool slowly deep inside the earth's crust. The very slow rate of cooling allows large mineral crystals to form. Granite is made up of a variety of minerals and different types of granite vary in the amounts of these minerals, but the usual mixture includes quartz, feldspar, biotite mica, muscovite mica, and hornblende (Kooser & Reynolds, 1986; McJunkin, 1976; Stout, 1976).

Exposure to the elements of heat, water, and the freezing and thawing of ice makes the granite very crumbly in the San Bernardino Mountains. As exposed granite rock warms and cools over many years, the different kinds of mineral crystals expand at different rates, eventually breaking up the structure of the rock. Water freezing within the tiny cracks of the rock also breaks away pieces of the rock as it expands (Sharp & Glazner, 1993).

Besides granite, the San Bernardino Mountains also contain outcrops of metamorphic rocks which are rocks that have been altered by re-crystallization under intense heat and pressure deep in the earth, but not melted like igneous rocks. These rocks pre-date the cooling of the granitic magma. These metamorphic rocks include marble, quartzite and gneiss. There are also some basalt flows that are much younger than the granites but still pre-date the uplift of the modern San Bernardino Mountains (Sharp & Glazner, 1993).

Earliest Peoples

Many Thanksgiving holiday stories include the notion that America was discovered by the hero Columbus in 1492 and "settled" in 1620 by the now famous "pilgrims." In reality, people have lived on the North American continent for thousands of years (Loewen, 1995). There are signs that the first people arrived in what is now California more than 10,000 years ago. They may have come from the continent of Asia, crossing the Bering Strait into what is now Alaska and then moving south down the North American continent (<u>California Indian Fact Cards</u>, 1996).

When the first European explorers sailed along the California coast in the 1500s and 1600s, there were probably more than 300,000 people living in California. Some lived along the ocean coast; others lived in the valleys, desert, and mountain areas. These first

Californians did not have one name by which they called themselves. They did not consider themselves to belong to one group or tribe. Perhaps as many as 90 languages with more than 300 dialects were spoken. The people lived in small groups, seldom traveled far from their home area, and could only understand the languages of nearby groups (California Indian Fact Cards, 1996).

Many groups in early California referred to their own group by the word in their language that meant people. They often gave names to their neighbors which referred to the place where the neighbor lived. This often resulted in several different names being given to a single group as various neighbors called them by different names (California Indian Fact Cards, 1996). The names we use today for the different groups of California Indians have been chosen from the terms used by neighboring groups, or by the Spanish settlers who came in the late 1700s. Even within each major group, smaller groups were often given different names by either the Spanish or neighboring tribes (Johnston, 1965). The methods used by researchers to learn about these early Californians include talking to descendants of the early people, reading accounts by early explorers, such as Cabrillo, Drake, and Portola, and engaging in archeological study of village sites.

The lines dividing the territory where each group lived are not exactly known. Sometimes a geographical boundary such as a certain river or the crest of a mountain range is thought to be the boundary between two groups. In other cases there is no distinct feature and a group's territory is an approximation.

The earliest people we know about as a group of people using the San Bernardino Mountains was the Serrano. The Cahuilla's territory occupied the San Bernardino Valley, and it is likely they used the mountains as well (Kroeber et al., 1974). But it was the Serranos that seemed to have the most use. The Serranos were a small group, though their name is sometimes used to include several other groups whose languages were close to the Serrano language which is considered Southern California Shoshoniean. This includes the Vanyume of which little is known (Johnston, 1965).

The Serranos called themselves Tokhtom, which meant people or men in their language. The name Serrano is from the Spanish word for highland people or mountain people. Serrano settlements were located in a range of about 1500 feet elevation to over 11,000 feet, and included desert and mountain areas. There were more villages in the foothills, where there were streams and small lakes, than in the desert area where only a few places with water existed all year round. Each Serrano community, which usually consisted of one village, owned a creek or water hole and the land around it. The village was often located where the stream came out of the foothills (Kroeber et al., 1974).

The food the Serrano gathered depended on whether they lived in the desert or the foothills. Those in the foothills gathered acorns from the black oak trees as well as pinion nuts. The desert dwellers often traveled into the foothills to gather them as well as having honey mesquite, yucca roots, and cacti fruits. The nuts were stored in granaries built of willow poles and covered with tule reeds. Many animals of the foothills and mountains were used as food. Special hunting parties, using bows made of desert willow, mesquite, or ash and strung with sinew or agave fiber, went out to find deer, mountain sheep, and antelope (Johnston, 1994). Smaller game such as rabbits and other rodents were caught using traps or with curved throwing sticks. Some birds were also taken for food, quail being the most important (California Indian Fact Cards, 1996).

Insects, roots, bulbs, seeds including chia seeds, and wild berries rounded out the Serrano diet. Berries from the manzanita bush were abundant. The food was cooked either in earth ovens or by boiling it with water in baskets heated by hot stoves. Hand grinding stones called manos or pestles and flat milling stones or metates, both portable and bedrock, have been found throughout the region. Communal grinding areas with dozens of mortar holes are evidence of food preparation over many years. Acorn mush, the staple of the Serrano diet, was prepared by grinding the acorns and then boiling out the bitterness (Simpson, Haenszel, Reynolds, & Bowers, 1972).

The Serranos were a friendly, gentle, people who were warlike only under great provocation. They were divided into two basic sub-divisions, or moieties. These designations served as marriage guides and were known as the Tukum or Wildcats, and the Wahilyam or Coyotes. The basic living congregation was the village with small satellite camps outside. The leader of each village was called *Kika* and was determined by heredity. An assistant, called *Paha*, was in charge of ceremonies, and the *Teaka*, or singer was charged with knowing the myths of creation and songs of the clan. The *Huremite* was the healing *Shaman* whose power to heal was from visions or dreams (Johnston, 1965).

scrapers, and arrowheads. Yucca plant provided the fibers from which the Serrano made cord and string. Bags as well as nets and snares were made from the cord (Simpson et al., 1972).

Trade among the various Indian groups in Southern California depended somewhat on alliances and ally or enemy status. Trails ran throughout the various territories and generally trade was brisk in foods, beads, housewares, clothing, ornaments, and industrial materials. The shells that the Serrano used as money came from the Coastal Chumash. Obsidian, often used to make arrow or spear points, has been found at areas used by the Serrano suggesting trade with Owens Valley tribes where it can be found (Simpson, et al., 1972).

The Spanish often referred to the inverted cup-shaped and tule mat covered houses as "half-orange" in shape. The frame was of willow branches bent together and fastened at the top. Each family had their own house, which was used mostly for sleeping and storing of their belongings. Each house had a fire pit in the center although much of the cooking and other activities took place outside the house. Ramadas, thatched roofs supported by poles, were also built, probably to give shade. Each village had a sweathouse which was a large, round building partially underground and usually located near the stream or other water source. It was framed with willow poles, covered with tule reeds and earth, and had a fire built in the center which they would gather in, sweat from the hot air, and then go to the stream to wash off (Johnston, 1965). A large ceremonial house called a *Kitcaterate*, where the Kika lived, as well as small, round, tule covered granary and various natural caves or rock overhangs improved with tule or brush extensions, rounded out the typical village.

Europeans

In pursuit of army deserters, Pedro Fages, military commandant of Spanish Alta California, tracked their path as far as the Colorado desert. The desire to explore seized him evidently for he turned northwest ending up somewhere near present-day Hemet. He then turned north and traversed the low hills east of Riverside to enter the San Bernardino Valley. It was here that Captain Fages became the first European known to see the San Bernardino Mountains, looming to the north. He crossed the mountains somewhere in the vicinity of Cajon Pass and made his way northwestward to eventually arrive in Monterey (Beattie, 1951).

Fages describes the historic journey in a brief addendum to a diary he wrote while exploring the northern San Joaquin Valley a year later. Unfortunately, he did not write about his impression of the mountains (Robinson, 1989).

The missionary-explorer Fray Francisco Hermenegildo Garces followed Fages four years later, crossing the San Bernardino Mountains on his way from the lower Colorado River to Mission San Gabriel in 1776. He left a detailed diary. Garces followed the ancient Mojave trading trail from the Colorado River just north of present-day Needles to present-day Barstow. He then traveled across the Mojave river to the northern foot of the San Bernardinos. One account has Garces then traversing the mountains via Holcomb Valley, and another has him crossing the mountains farther west ascending Sawpit Canyon and then descending the ridge between Devil and Cable Canyons into the San Bernardino Valley. Perhaps because he had already seen so much wilderness and because colonization was not of interest to him, he didn't write of being particularly impressed with the valley or the mountains (Bellamy, 2000).

It wasn't until 1810 that the valley was explored with interest by priests from the San Gabriel Mission which was already well established. The coastal missions, in the meantime from 1769-1804, had been mostly founded and they grew in size and strength. The large mission livestock herds became targets for desert Indians. Mojave and Ute raiding parties often crossed the mountains via the Mojave trail or Cajon Pass which led to Spanish authorities to look for suitable sites for inland missions and forts to protect the coastal settlements. They were also interested in furthering the cause of the church as well as establishing a supply area for the larger mission (Bellamy, 2000).

"The Mission Period" is how the years following became known as in San Bernardino history. The mountains remained relatively untouched and the Indians were free to continue their activities unbothered by the immigration of foreigners. On May 20, 1810, Padre Dumetz, from the San Gabriel mission, ventured to the valley to the east to establish a thatch sheltered alter "Capilla" and supply station. It being the feast day of Saint Bernardine, the valley and eventually the mountains got their name (Bellamy, 2000).

The famous explorer Mormon mountain man Jedediah Smith came through the mountains over the Mojave Trail in 1826 and again in 1827. To the eventual dismay of Mexican authorities, Smith and his group of fur trappers became the first Americans to reach California overland. His destination was the San Gabriel mission which he reached on November 7, 1826. The San Bernardino Mountains were, on this first trip as well as his next, used only as a route of travel in and out of California (Robinson, 1989).

As padres started to establish mission ranchos around the San Bernardino Valley, the need for roof timbers began the earliest verified lumbering in the San Bernardino Mountains. The harvesting of trees would soon be the biggest lure to the mountains prior to the gold rush (Beattie, 1951). The mission era drew to a close with the enactment by the Mexican government of the Secularization Act of 1833. Franciscan padres were no longer masters of the vast mission lands or cattle on the lands in the valley. A time period of great land granted ranchos, six in the valley, followed. Trips into the mountains for timber, vaqueros rounding up cattle that had wandered into the mountain canyons or passes, and chasing marauding desert Indians who had raided the irresistible huge herds of cattle and horses on the ranchos in the valley, became the only uses of the mountains (Bellamy, 2000; Robinson, 1989).

The most famous of these livestock raiders was a Piute Chief named Walkara, the "hawk of the mountains." Raids were so regular that finally Governor Pio Pico commissioned Benjamin Wilson to lead a punitive expedition on a band of renegade Indians on the Mojave River. Wilson had purchased a part of Ranch Jurupa in 1843, became a cattle rancher, and married into a prominent Californio family becoming a Mexican citizen. He gathered a volunteer company of 81 men and sent most of them through the standard Cajon Pass route (Robinson, 1989). Wilson and 22 of the men went up the Santa Ana River canyon coming across unoccupied Indian villages as they reached present day Big Bear Lake. The most unusual feature of the area was the amount of huge grizzly bears. As was the custom in rodeo sports, the Californios circled the great bears and roped their necks and feet. Eleven of the large bears were killed (LaFuze, 1971). After his expedition to the Mojave River, Wilson wrote of his return through what he had named "Bear Valley." "On the return by way of Bear Lake, the same 22 men repeated the feat of bringing eleven bears to camp, making 22 killed on the trip. We all returned and had our rendezvous at my ranch at Jurupa" (Robinson, 1989, p. 12).

The San Bernardino Valley first became known to the Mormons through a group of young men recruited in the Midwest for Mexican war duty. Known as the Mormon Battalion, they made a tough trek across the desert southwest to California reaching the destination only after hostilities had ceased (Robinson, 1989). "The Mormon episode in the long saga of the San Bernardinos lasted only six years. But in those six years, these Latter Day Saints forever changed the face of the mountains" (Robinson, 1989, p. 19). They built the first road to the crest to reach the fall timber, opening up the high country and initiating large scale lumbering that would last.

Malcontents of the Mormon following in Salt Lake City had heard the reports of the impressive San Bernardino valley and were anxious to leave. "It is a popular misconception among Mormons today that the proposed move was another one of Brigham Young's appointed colonies and that those who were sent were going as missionaries" (Bellamy, 2000, p. 10). Evidence, however, indicates that Brigham Young was not enthusiastic, believing they were going to chase worldly riches including California gold. The caravan bound for San Bernardino from Utah left March 24, 1851. Brigham Young, expecting to see 20 or so members heading west found 150 wagons, 437 men, women and children, and a huge herd of cows, horses, oxen, and mules departing for the San Bernardino valley (Bellamy, 2000; Robinson, 1989).

Houses for the San Bernardino colony needed timber and it was to the mountains the Mormons looked. Mill Creek canyon was the first site of this lumbering but gave way to the lure of the large forests on the crest to the north, clearly visible from the valley below. First, a road would have to be built to reach the trees on the crest. In April 1852, Apostles Lyman and Rich, Bishop Crosby, and Charles Crismon who owned a portable steam saw mill, laid out the path of the road which would take a direct route to the timber areas using switchbacks. For 2-1/2 weeks, in true Mormon spirit, every able bodied male converged on what is now Waterman Canyon using axes, shovels, and driving teams of oxen to steadily carve out the road. Lyman estimated it required 1,000 "man-days" of strenuous labor to complete the 12 mile road that ran from San Bernardino up Waterman Canyon. This became the first public road in the mountains (Beattie, 1951).

Water and steam powered mills supplied lumber for not only San Bernardino, but the booming town of Los Angeles as California became a state in 1850 and San Bernardino

County was formed in 1853 (Robinson, 1989). The Mormon Era came to an abrupt end in 1857 when Brigham Young recalled his faithful to Salt Lake City. On the mountaintop, Mormon sawmill owners quickly sold their holdings as there were no shortage of buyers.

The lumbering era was just beginning and by the time the sawmills, many portable to be moved to uncut trees, finally quieted a half century later, the mountain trees would be mostly harvested. The lumbered area stretched from Sawpit Canyon in the west to Running Springs and Green Valley in the east with only isolated patches of tall forest remaining untouched (Bellamy, 2000; Robinson, 1989).

Gold Rush

Timber was the first magnet that lured people into the San Bernardino Mountains; gold was the second. The precious metal was reportedly found as early as 1857 and there was some prospecting activity in 1859, but not until William F. Holcomb made his famous discovery in Holcomb Valley in 1860 was there a real gold rush (Robinson, 1989).

The exact time gold was discovered in the San Bernardino Mountains is not known due to the fact prospectors, working singly and in small groups, drifted from place to place. The first newspaper account was from the Los Angeles Star, July 17, 1855, reporting that several people had just returned with gold samples from the San Bernardino Mountains. Various other newspaper accounts talked of some activity through 1859, with 1860 starting the time of real excitement (LaFuze, 1971; Robinson, 1989).

It is believed that the "rush" was triggered in May 1860, when prospector Bill Holcomb ventured into a valley north of Bear Valley in search of bear to hunt. The story goes that Holcomb and Jim Ware, members of a prospecting party in Bear Valley, crossed the ridge that separates the waters of the Santa Ana River from those of the Mojave River during a hunting trip, and shot two bears. The next day Holcomb and Ben Choteau, a Cherokee Indian, returned to retrieve the bears and in addition to obtaining the bear meat they discovered something more thrilling--gold! Within a week the entire Holcomb party had moved into the gold-laden basin later known as Holcomb Valley (LaFuze, 1971; Robinson, 1989).

One of the prospectors, Jack Martin, used gold dust to buy provisions from San Bernardino to Los Angeles sparking a Los Angeles newspaper article describing the gold find. This created a stampede of prospectors and by April 30, 1860, the Bear Valley mining district was formed. By the first of July, "Holcomb Valley" was swarming with prospectors. Placer mining was employed first and later they began working the quartz ledges. The upper "Holcomb" settlement became known as "Belleville," complete with saloons, dance halls, stores and cabins (LaFuze, 1971; Robinson, 1989).

Through most of the 1860s, mining activities involving hundreds of miners continued in Holcomb and Bear Valleys. At one time the population in Holcomb Valley alone was said to have reached 2000. These were years of stormy excitement. As many as 40 men and probably more met violent deaths during this frenzied period and there still stands the tree known as "Hangman's Tree." But gradually the placer gold gave out and the miners drifted away to new diggings elsewhere. By 1870, Belleview was a ghost town and Holcomb Valley's hectic era was history (Robinson, 1989; Schuiling, 1984).

By late 1861, quite a few stamp mills had been built, aiming at the quartz rock. Stamp mills used a device that was a heavy machine that delivered vertical, hammer-like blows with iron pounders, or stamps, lifted eight to twelve inches and then released to crash down on the gold bearing ore. A group of stamps, from 3 to 20, were synchronized on a cam shaft and powered by a single steam engine. These stamp mills were costly and usually required investor capital to build and run. The Mellus Mill, Mammoth, San Bernardino, Olio and Pine Tree Mill were the names of some of the mines. William "Uncle Billy" Rubottom took out 17 tons of quartz which assayed at $80 in gold per ton. Mining was an important economic enterprise in the San Bernardino Mountains until shortly after the turn of the century. No official estimate of the total yield in gold and silver has ever been made, although 20-25 million dollars has been guessed by some historians. The largest stamp mill contained 40 stamps, built by Lucky Baldwin in 1875. It was built in an area a little east of Holcomb Valley that came to be known as Gold Mountain. The area was worked quite a few times but never met the high expectations the big stamp mill had fulfilled. The quartz contained only low-grade ore although an estimate of about $600,000 in value was removed in its various operations. Considering Elias "Lucky" Baldwin invested at least $250,000 to get the mill running means he wasn't really lucky with this venture (Robinson, 1989).

Other starts and stops through the turn of the century even included overseas investors attempting to start up mills. During the depression years of the 1930s some of the old placers were reworked by unemployed men, some recovering $2-$4 a day. Re-workings occurred through 1955, but no real bonanza of the type seen in the Sierras was ever made (Robinson, 1989).

Cattle and Sheep

Cattle and sheep grazing in the San Bernardino Mountains started about the same time as the mining and lumber activities. At first in only small amounts, the number of animals swelled into the thousands by the 1880s. Cowboys on horseback drove livestock up dusty mountain trails and into the mountain meadows. These high country pastures harbored the cattle through the summer under the watchful eyes of the cowhands. Shepherds and their herds of sheep also roamed the mountains. Little Bear (Lake Arrowhead area) and Grass Valley were prime grazing areas on the western end and up the Santa Ana River corridor on the eastern end. Many of the miners and lumberman brought their animals along with them and were involved in grazing activity as well (Robinson, 1989).

Large ranches were also established, some along the foothills on all sides of the mountain range including the desert side, and some were established in the actual mountains. Foothill ranchers had annual migration cycles into and back out of the mountains. Big ranches included the Dunlap Ranch along the Mojave River which later became the Summit Valley and then Las Flores Ranch; the Altoona Ranch in eastern San Bernardino Valley; the IS Ranch, named after the brand used, in Bear Valley; Hitchcock Ranch in Holcomb Valley; Shay and Barker Ranch around Baldwin Lake; The Heart Bar Ranch along the upper valley (LaFuze, 1971; Robinson, 1989).

The IS Ranch was sold in 1928 to the Talmadge brothers who reigned as lords of the Bear Valley cattle business until 1943, with herds of over a thousand head. San Bernardino Mountain-raised livestock was used to feed not only the mountain populations, but also meat buyers from Los Angeles who would journey to Bear Valley to bid on the cattle chosen for slaughter. At the turn of the century, the U.S. Forest Service began to regulate the mountain cattle industry due to overgrazing. Soaring demand for beef during World War I temporarily canceled these limitations. By the end of the 1920s cattlemen found it difficult to return a profit as beef prices fell drastically (Robinson, 1989).

Land available for grazing diminished as Big Bear and Little Bear Valleys were dammed to form Big Bear Lake and

Lake Arrowhead. Resorts and residential development replaced the areas where cattle once freely roamed. Cattle lands became much more valuable when sold to developers, and the San Bernardino cattlemen went the way of the miner and lumberman (LaFuze, 1971; Robinson, 1989).

Nature

Ecology is defined as the science that deals with the interrelationships of living organisms and their environment (Bernhard in Farb, 1963; Focus on Earth Science, 2001). In the San Bernardino Mountains, people play a big role in this relationship. However, in this section only the natural organisms and systems will be examined.

The San Bernardino National Forest covers 818,999 acres within San Bernardino and Riverside counties in Southern California. The U.S. National Forest is administered under five ranger districts. For the purpose of this project, only the San Gorgonio district, which includes the mountains of the Cajon Pass all the way to Big Bear, is considered. This includes the management areas delineated by the U.S. Forest Service as Back Country, Front Country, Big Bear, Santa Ana, and San

Gorgonio Wilderness. This area includes 368,289 acres (United States Department of Agriculture [USDAb], 1988).

The mountain range rises steeply on the coastal side facing the Los Angeles Basin, and slopes more gradually to the north and east to the Mojave and Colorado deserts. The prevailing climate in Southern California is the Mediterranean type, with hot, dry summers and cool, moist winters varying for topography and elevation. Annual rainfall in the lowlands averages 16 inches and generally occurs from December through March. Temperatures are moderate with midday temperatures occasionally rising above 100 degrees in summer months and only a few nights below freezing. The higher elevations of the forest have a four-season year with an average annual precipitation of 30 inches. Winter snow, sometimes heavy, occurs above 5,000 feet. Annual rainfall in the lower elevations average 16 inches and is sparse on the desert side of the forest. Northeasterly, strong, dry Santa Ana winds are common in fall and winter months (USDAb, 1988).

Having many variations of elevation, topography and climate, the mountain range contains a wide diversity of plant species and communities. Although the San Bernardino Forest constitutes less than one percent of the land area of the state, over 25 percent of all plant species that occur naturally in California exist within its boundaries (USDAb, 1988).

South facing and west facing slopes below 5,500 feet have a dense cover of impenetrable woody chaparral. Above the chaparral, hardwoods and conifers dominate and from 5,500 feet to about 11,000 feet the conifer forest generally coincides with the winter snow zone. The conifer/woodland zone includes yellow pine or mixed conifer forests and live oak woodlands. Pinion and Juniper interspersed with shrub communities and pockets of Great Basin sagebrush dominate the rocky desert-facing slopes below the conifers. Below 4,000 feet this area becomes desert shrub communities. Riparian areas may cross several vegetation zones.

Approximately 70 percent of the forest's wildlife is at least partially dependent on the riparian habitats that make up less than one percent of the forest. The diversity of habitats supports many different life forms, from large predators such as the mountain lion to a small native fish called the speckled dace. An estimated 397 species of wildlife, including 75 mammals, 55 reptiles, 13 amphibians, and 254 birds potentially inhabit the Forest. Forty-three species of plants and 48 species of animals are managed under threatened, endangered, or sensitive status. Seven species are federally listed as endangered and eleven are state listed as threatened or endangered (USDAa, 1988).

The soils of the Forest are predominantly derived from granite rocks. Highly productive soils comprise approximately three percent of the Forest, moderately productive soils approximately ten percent, low productive soils 26 percent, very low productive soils 43 percent, and the remaining 18 percent are areas of rock outcroppings, rubbleland, riverwash, and water (USDAa, 1988).

People and Their Effect on Mountain Ecology

Introduction

The San Bernardino Mountains suffered from the pioneer attitude at the end of the nineteenth century which held that America's natural resources were inexhaustible, and that God created the resources for people to exploit as fast as they saw fit. The Indians had existed using the mountain's bounty for thousands of years. This environmentally balanced existence with the mountains changed with the first arrival of Europeans. Lumbering, mining, grazing, the harvesting of water for irrigation and power, and recreation uses dramatically changed the mountain (Robinson, 1989).

Lumbering

Tree cutting was the first people activity to really affect the mountain ecology. Clear-cut lumbering methods were the only methods used, and with no regard to its effects. "Early photographs show almost no trees standing" (Bellamy, 2000, p. 102). Fires, started at the lumber mills, were a constant battle for the lumber mills. Opposition to the clear-cutting and concern over fires caused by the lumber mills were the beginning of the end of high scale lumbering around 1911 and reduced lumbering to a minor economic enterprise thereafter. Examples of the effects of this lumbering can be seen in a fight between the San Bernardino Board of Trade, who appealed to President Theodore Roosevelt to condemn and stop the Brookings sawmill located in present day Running Springs. Not only under attack for the denuding of the forest, the Brookings were also accused of dumping sawdust from box making activities for valley fruit growers into streams. John Brookings stated as evidence for his case that one such creek had run water all year after the area around it had been cut, something no one had ever seen. But Ranger Francis Cuttle noted that Deep Creek had also run twice as full as it had ever run after the company had clear-cut the watershed area of that creek (Bellamy, 2000). These were an obvious result of there being no vegetation to prevent water from running unimpeded into the streams.

Fortunately, a second growth of the forest since those times has allowed today's forest visitors to not realize the mountain's lumbering past. The U.S. Forest Service, in 1953, went to a strategy of only selective timber cutting to weed out aged, burned, and diseased trees to provide for new growth, and large scale commercial lumbering became a thing of the past (Bellamy, 2000).

Mining

The General Mining Act of 1872 and the Organic Act of 1897 allowed for prospecting, locating, and developing of mineral resources within the San Bernardino National Forest. Leases issued by the Department of the Interior and activities has been associated with the leases administrated by the U.S. Forest Service (USDAa, 1988).

According to the USDA San Bernardino Forest Service's Final Environmental Impact Statement (1988), the U.S. Forest Service's objective is to encourage and facilitate orderly exploration and development of mineral and energy resources and to make sure that this is done in an environmentally acceptable manner. Currently four companies are mining high grade limestone used in such things as paper filler, pharmaceutical uses, pool sands, and as the main constituent for cement manufacturing. Graphite, tungsten, silver, gold, zinc, copper as well as 22 other mineral commodities exist in the mountains. Only limestone, gold, sand and gravel, and small quantities of building stones have much potential for commercial production. The demand for limestone is expected to stay strong and an estimated one million tons per year are extracted. Most of the rock is extracted using open pit methods. Despite the history of gold mining in the San Bernardino Mountains, today only small scale and weekend prospecting continues (USDAa, 1988).

Grazing

Sheep were becoming a problem as early as 1871. A local San Bernardino paper discussed a new sheep law which would prevent sheep herders from herding flocks across private lands. A loophole, however, allowed pasturing in unoccupied public lands. In effect the law protected valley landowners from overgrazing but declared open season on public lands in the mountains. Twenty years would pass before public opinion would rise to protect watersheds from the four-legged mowers. Meanwhile, many of the mountain's meadows were reduced to dust (Robinson, 1989). Another paper dated June 30, 1894 lamented the San Bernardino Mountains as,

> ...thicker with sheep than the locusts of older times and twice as destructive. There was not a green shrub to be seen. The young trees, especially the young oak, were eaten down to the earth. The water streams were all demoralized... (Robinson, 1989, p. 97)

These pressures led to forest agents being appointed to monitor what had become the San Bernardino Forest Reserve, proclaimed in 1893. In 1907, the San Bernardino Forest Reserve became the San Bernardino National Forest (LaFuze, 1971; Robinson, 1989).

Today, grazing still exists on a small scale and is listed as primarily a vegetation management tool by the U.S. Forest Service with there being grazing allotments for cattle, sheep, and horses. Livestock is moved from one area to another through grazing schedules developed in range allotment management plans. According to the U.S. Forest Service these plans are designed to meet physiological needs of forage plants, nutritional requirements of livestock, and multiple-use management constraints (USDAa, 1988).

The San Bernardino National Forest was originally created to protect the watershed lands. Uncontrolled logging, grazing, and wildfires had resulted in flooding and damage. Today approximately 195,000 acre-feet of water per year is yielded from National Forest lands and is mostly produced from December to March. Natural production is not the only source for the mountain's population. Water from the state water project from Northern California is also used at an approximately 25 percent local, 75 percent imported ratio (USDAa, 1988).

Harnessing Water

For $75,000, less than the amount of an engineering feasibility study today, Frank Brown accomplished one of the biggest alterations to the national environment the mountain had ever seen. To supply the city of Redlands and the many citrus growers therein, Brown looked to the waters of the San Bernardino Mountains. His efforts focused on Bear Valley and the stream that ran through it, noting that it was a nearly level valley with a narrow granite gap at the outlet of the valley. The area was perfect for a dam. The year was 1883 and Brown formed the Bear Valley Land and Water Company. It took considerable work and capital to buy up the land in the valley where the lake would form as well as the water rights to the stream and its tributaries, but Brown was able to do it. One snag was that the San Bernardino Valley had prior water rights from the Santa Ana River, the stream that the creek through Bear Valley joined in the canyon below the valley. However, an agreement was reached guaranteeing these valley users their rightful share of the water. The first Bear Valley water flowed through intake gates of the newly erected dam, down Bear Creek into the Santa Ana Canyon, and through a newly completed ditch from the mouth of the Santa Ana Canyon to Redlands on July 10, 1885, five years after Frank Brown's vision. The dam has been redone twice since the original dam. Today the lake holds 73,000 acre feet of water and fills to 2,973 acres, a much different landscape than the original Bear Valley (Robinson, 1989).

Meanwhile, interest in Little Bear Valley water was also materializing. As early as 1891 plans were well along to dam Little Bear Creek, Holcomb Creek, Crab Creek, Deep Creek and all the creeks between Deep and Hook's creek. The goal was again to impound water to sell to buyers on both sides of the mountains. By 1892 hundreds of workers were busy dynamiting, drilling, digging, and tunneling to bring the water of the valley's tributaries to Little Bear Valley where the dam would be built. Some of these tunnels were built and are still used; others were started but never completed. The ensuing dam on Little Bear Creek was worked on and off from 1893 until 1921 when the newly created lake reached full capacity in 1922. The name was changed to Lake Arrowhead at this time as well (Bellamy, 2000).

Hydroelectric Power

Harnessing mountain water to irrigate valley crops was not the only interest valley folks had with these waters. Hydroelectric energy from harnessing rushing water to produce electricity was in its infancy in Southern California as the 1890s opened. Redlands Electric Light & Power Company incorporated in October 1892, and like the earlier valley residents who had looked up to the mountains when it came time to build houses out of wood, the company was formed to try and harness mountain water to generate electricity for Redlands. First was the purchase of land in lower Mill Creek. A diversion dam was built, tunnels bored, and 7,520-foot penstock of 30 inch steel pipe was laid to the plant site, and a 40 by 90 foot stove powerhouse was constructed. Full operation commenced on September 7, 1893, bringing bright lights to Redlands (Robinson, 1989).

Demands for power were increasing in dramatic fashion, and so the company began looking for other potential water sources. The solution lied in the Santa

Ana River. An agreement with Bear Valley Irrigation allowed the company to "borrow" the water of the river between Bear Creek and the Santa Ana River canyon mouth, use it to generate power, and then return it. It took 18 tunnels as well as lots of other construction and it caught the eye of Edison Electric Company trying to power Los Angeles. The companies merged and soon San Bernardino stream water was producing electrical energy to serve Southern California (Robinson, 1989).

Recreation and Development

Marketable products were the initial resource of the San Bernardino Mountains causing federal oversight through the U.S. Forest Service. Today, recreation has become the dominant resource for the forest. "We have seen a steady decline in enterprises that take resources out of the mountains in favor of recreational activities and residential development in the mountains" (Robinson, 1989, p. 239). This change was subtle at first but became pronounced in the 1920s and accelerated dramatically after World War II. These changes have substantially altered the face of the San Bernardino Mountains. Residential subdivisions, shopping centers, people-made lakes, ski resorts, campgrounds, and other development now takes the place of the forested landscape once used by hunters, timber cutters, cattlemen, miners and native peoples (Robinson, 1989). The San Bernardino National Forest is one of the most heavily used in the nation, becoming an extremely valuable recreation base for urbanized Southern California. Hiking, fishing, nature study, downhill skiing, cross country skiing, snow play activities, camping, picnicking, hunting, off-highway vehicle use, horseback riding, lake activities, and recreational shooting are among the main recreational uses in the San Bernardino Mountains (USDAa, 1988).

"Traditionally National Forest recreation management incorporated a wide variety of activities to meet public demand, consistent with the capability of the land" (USDAa, 1988, p. III-47). The construction of developed sites, such as campgrounds, picnic areas, ski areas, and visitor centers have been undertaken for many years. Downhill skiing is one of the major privately developed recreational activities of the forest. There are five developed areas in the San Bernardino Mountains. Ski resorts have been expanding faster than other types of developed recreation sites (USDAa, 1988).

There are about 50 acres and 83 miles of roads and trails which are open to off highway vehicle (OHV) use. Demand for OHV opportunities have greatly increased in recent years. Increased OHV use has resulted in conflicts with other forest users including safety problems between different types of vehicles, illegal use of adjacent private land or off limits forest land, and adverse impacts on wildlife, soil, and water. Riparian areas and soil erosion have been affected by uncontrolled OHV use. The U.S. Forest Service goal is to provide this opportunity while managing OHV use to reduce conflicts and damage (USDAa, 1988).

Summer homes, lodges and resorts, and camps and private clubs, make up the other privately operated recreation facilities on National Forest land other than ski resorts. These are operated under term special use permits unless a future use determination identifies a higher public need. No new use permits have been issued in over 25 years (USDAa, 1988).

"The future of the mountain communities - and of the mountains themselves - is in the hands of the people who use them" (Robinson, 1989, p. 240). Mountain dwellers today face many of the same issues as seen in urbanized areas elsewhere and the growth has coincided with growth all over Southern California. To what extent the forest habitats and environment survive will depend on the choices made in the years to come and by future generations (Robinson, 1989).

CHAPTER FOUR

DESIGN OF THE PROJECT

This project was developed to create lessons and activities for a fourth grade classroom using specific ecological relationships, including people's effect on those relationships, from the San Bernardino Mountains. Appendix A contains 18 lessons, some of which were created by the author and others adapted from other environmental education sources to apply to this particular geographic region.

The activities and lessons included in this project are designed to meet the learning concepts as outlined by the California Department of Education's Content Area Standards for fourth grade as well as Rim of the World School District Expected Student Learning Results (ESLR's). Goals and techniques for environmental education were also used in developing the lessons.

The lessons include coverage in a variety of subjects including: Earth Science, Life Science, Geography, Social Studies, Mathematics, Physical Education, and Conservation. "The common wisdom is that it (environmental education) should be approached in an interdisciplinary manner and infused in all content areas" (Iozzi in

Disinger, 1997, p. 38). Most of the lessons can be taught in sessions of about one hour and all of the lessons can be adapted to be used in other grade levels or geographical regions. A list of teacher resources (Appendix B) for the San Bernardino Mountains is also included.

CHAPTER FIVE

IMPLICATIONS FOR EDUCATORS

The future sustainability of the human race depends on an understanding that all systems, including human systems, are connected. This project uses the goals of environmental education to develop lessons that support these goals. The lessons, if used in sequence, aim to progress through developing sensory experiences, to those designed to give knowledge and awareness in ecological concepts and relationships, to a final two lessons in which students explore real world issues. The sensory lessons occur by doing many activities outside. Students must feel this connection before an environmental ethic will take hold.

Without the knowledge of ecological principles, students will not have the understanding to analyze and make decisions concerning the environment, and thus these concepts comprise the content in the majority of the lessons. Historical information is then added to some of the lessons to give students a sense of place and develop critical thinking skills when comparing the past to the present, as well as developing attitudes and opinions on a course for the future. Studying examples that pertain to what students see every day surrounding them will give the concepts more meaning, and make it easier to relate to those same issues elsewhere.

The final two lessons are designed to apply the knowledge and awareness of the previous lessons to local issues. By looking at local issues, students develop critical and analytical thinking skills as well as problem solving and decision making skills. "Ideally, these issues would be local in nature at the early years, and expand into more regional, national, and international concerns at succeeding grade levels" (Volk, 1997, p. 49).

Many educators are facing the pressures of state testing and the expectation that these test scores will rise. The state tests for elementary grade levels often only test skills in math and language arts and so teachers are feeling pressure to only use science and social studies as "extras," to be used if there is some extra time after math and language arts. As already discussed, the results of this could be dire as we continue to face more and more environmental problems in our world. It is therefore important for the environmental educator to show how environmental education can be used as a tool for meeting these standards in the areas tested. The lessons included in Appendix A show how many standards can be met for math and language arts while learning about the local environment.

It is the children of today who could possibly face some of the biggest environmental decisions in the history of the planet. Global warming, overpopulation, the feeding of that population, and energy needs are all looming issues for generations to come. As educators, it is our responsibility to do the best job we can to prepare our students for this future. Environmental education provides students with the values, skills, and thinking strategies to meet the challenges of sustainability. By starting students with an understanding and awareness of that which is closest, the local area and community, these goals can be achieved by allowing students to care for what affects their daily lives.

APPENDIX A

INTERDISCIPLINARY LESSONS

Poetry of Forest Sights & Sounds

Objectives: Students will gain sensory knowledge via a walking field trip around the outside of the school boundaries. Students will then be able to create poems using creative expression, develop word relations, practice the use of parts of speech, and to experience poetic techniques.

Materials: Hand lens, paper, pencil, sample formats for various poem structures. Examples: Cinquain, Diamonte, Nouning

Curriculum Links: Language Arts, Life Science, Environmental Education

State Standards: Scientific progress is made by asking meaningful questions and conducting careful investigations.

Writing shows they consider the audience and purpose.

Select a focus, an organizational structure, and a point of view based upon purpose, audience, length, and format requirements.

Write fluidly and legibly in cursive or joined italic.

Procedures: Introduce various forms of poetry including samples. Take a walking field trip (hopefully to an undeveloped natural setting) in which students record natural things they see along the walk. Have each student select a place to sit quietly, continuing to focus on things they can view in the surroundings, and then have them concentrate on the natural sounds that can be heard. All observations are recorded.

Either at the sight or back in the classroom, have students choose a poem model to create a poem about something(s) they heard or saw.

Extensions/Options: The same experience can be used to have students write descriptive paragraphs, or to make metaphoric comparisons.

Poetry Styles:

<u>**Cinquain**</u>
Title in two syllables
Description of title in four syllables
Action in six syllables
Expression of feeling in eight syllables
Another word for the title in two syllables

Flower
Yellow, brightness
Pop up everywhere now
Reaching out to the honey bee
Fragrant

<u>**Nouning**</u>
Noun title
Two adjective
Three verbs
Phrase
Repeat noun

Honey Bee
Silent, rapid
Flies, looks, feeds
Busy in her work
Honey bee

<u>**Diamante**</u>
One word
Two descriptive words
3______ing, _______ed words
Four nouns/two about the first subject, two about the second
3______ing, _______ed words
Two descriptive words
One word (opposite of the first)

Fall
Crisp, Clear
Raking, Crunching, Jumping
Apples, Leaves, Buds, Daffodils
Planting, Smelling, Skipping
Warm, Fog
Spring

Tree Keys

Objectives: Students will be able to recognize the trees of the local area based on each tree's characteristics.

Materials: Tree keys

Curriculum Links: Life Science, Environmental Education, Language Arts

State Standards: All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:

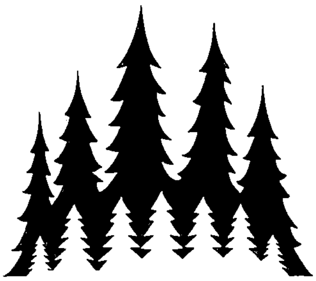
- plants are the primary source of matter and energy entering most food chains

Students read and understand grade-level-appropriate material. They draw upon a variety of comprehension strategies as needed.

Use appropriate strategies when reading for different purposes (e.g., full comprehension, **location of information**, personal enjoyment).

Follow multiple-step instructions in a basic technical manual (e.g., how to use computer commands or video games).

Procedures: Using a tree key, students in groups of four or five are placed at different trees in an outdoor site. The students use the key to try and figure out what tree they are looking at. The groups are then rotated between different trees. Back in the classroom, students will describe which of the trees was their favorite and why in paragraph form



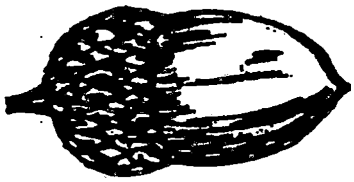
Forest Tree Key

If the tree is **deciduous**............go to page 2.

If the tree is **evergreen**............go to page 3.

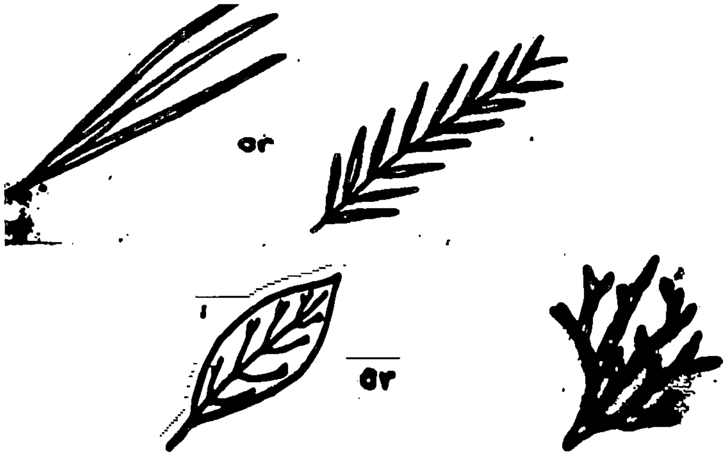
Page 1

If the leaves are lobed with one main vein and the fruit is an acorn...it is a **Black Oak**.



Page 2

If the tree has broad leaves or scale-like leaves.........go to page 4.

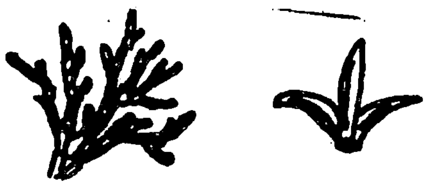


If the tree has needle-like leaves....go to page 5.

Page 3

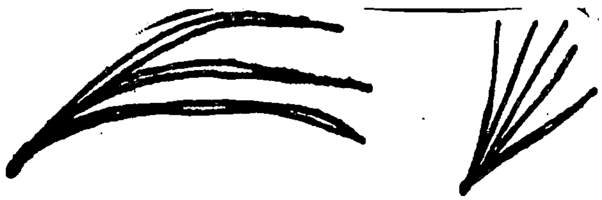
If the tree has broad leaves that are shiny green on top with green undersides and some leaves have prickly edges...it is a **Canyon Live Oak.**

If the tree has scale-like leaves and cinnamon-red bark that shreds easily...it is an **Incense Cedar.**



Page 4

If the needles are in bundles.........go to page 6

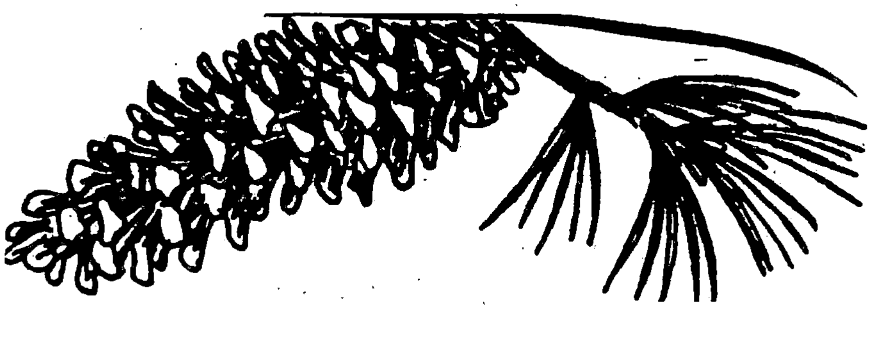


If the needles are single, 1-2" long with white lines on one side.....it is a **White Fir.**

Page 5

If the needles are in bundles of 3....go to page 7

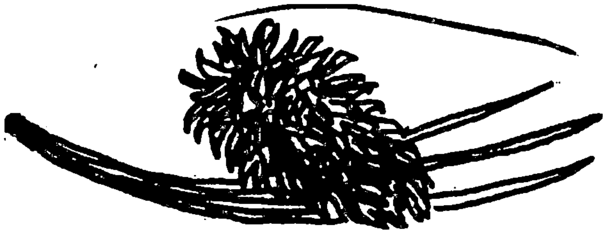
If the needles are in bundles of 5; needles are 2 ½-4" long; cones slender and 12-16" long....it is a **Sugar Pine.**



Page 6

If the needles are in bundles of 3, and if the cones are lightweight, less than 10" long.....go to page 8.

If the cones are heavyweight (8-10 lbs.) and the needles are bluish-green, 9-12" long it is a **Coulter Pine.**



Page 7

If the cones have inwardly curved spines 6-10" long; bark has a vanilla smell; and needles are bluish-green, 4-9 ½" long...it is a **Jeffery Pine.**

If cones are prickly, 3-6" long; bark is shaped like puzzle pieces; and needles are yellow-green, 5-8" long...it is a **Ponderosa Pine**

Page 8

What Are the Non-Living Elements Essential to an Ecosystem?

Objectives: Students will discover the non-living elements essential to an ecosystem.

Materials: Film canisters

Curriculum Links: Life Science, Environmental Education

State Standards: Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.

Procedures: Review the definition of environment and ecosystem.

Students, in groups, are allowed to explore the school grounds for non-living things that affect an ecosystem. Each group has four film canisters, each labeled with a letter (Land, Air, Water, and Sun - L.A.W.S.) that the non-living thing starts with. The students are not told what they are looking for (except that they are non-living, naturally occurring, and they effect an ecosystem, this would not include things that were once alive such as pine needles or leaves) and any examples that can be placed in the canister which match a letter should be (obviously sunlight would be one that could not be done). Groups are called back together to discuss what they found.

Once the non-living items are discovered discuss how they are different as to their amount in different ecosystems. This affects the living things (plants and animals) that live in that ecosystem (for example, desert vs. forest).

Census Takers

Objectives: Students will observe the local area ecology including the plants, trees, soil, and animals.

Students will make comparisons between different plots as to the amount of plants, trees, layers of soil, etc. observed.

Materials: Small planting shovels or soil corers.

Curriculum Links: Life Science, Environmental Education, Math, Geography, Social Science, Earth Science

State Standards: All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:

- plants are the primary source of matter and energy entering most food chains.
- producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.
- decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.

- for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- many plants depend on animals for pollination and seed dispersal while animals depend on plants for food and shelter.
- most microorganisms do not cause disease and many are beneficial.

Waves, wind, water and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know:

- natural processes, including freezing/thawing and growth of roots, cause rocks to break down into smaller pieces.

Scientific progress is made by asking meaningful questions and conducting careful investigations.

Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings.

Identify the mode(s) for sets of categorical data and the mode(s), median, and any apparent outliers for numerical data sets.

Students use map and globe skills to determine the absolute locations of places and interpret information available through the map's legend, scale, and symbolic representations.

Procedures: In small groups, students will be assigned a plot (approximately 10' x 10' depending on the amount of space available) to observe and record: types of trees - dead or alive, insects, other animals, signs of animals, and the exact number observed.

Comparisons will be made with each plot and totals for all plots recorded in graph form.

Averages will be calculated for each type and then applied to the surrounding area using a local topographical map.

Questions: Why a difference between plots?
What was the area like where the school was built?

Hitchhikers on Socks

Objectives: Students will be able to:

- describe the plant life cycle
- describe needs of plants
- recognize seeds and what the needs of seeds are
- describe different ways seeds get dispersed

Materials: An old sock
Used and cleaned cardboard orange juice, milk or similar container
Scissors to cut the container
Potting soil
Water

Curriculum Links: Life Science, Environmental Education (Math and Language Arts for extensions).

State Standards: All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:

- plants are the primary source of matter and energy entering most food chains.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- many plants depend on animals for pollination and seed dispersal while animals depend on plants for food and shelter.

Waves, wind, water and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know:

Procedures: Have students place an old sock over one of their shoes. Then have them walk through an area of brush, tall grass, weeds, etc. Carefully remove the sock. Fill the bottom of a used milk or juice carton with potting soil until the sock is covered. Add water and place in a sunny spot.

Extensions: Experiments can be made by having different spots for the plants to compare amounts of sunlight, water, etc. to growth rates.

- Sprouts can be measured, averages can be found

- Students can write an adventure story about a seed

How Were our Mountains Formed?

Objectives: Students will understand and demonstrate the forces that created the San Bernardino Mountains.

Materials: Graham Crackers, Peanut Butter, Wax Paper, Background Information

Curriculum Links: Earth Science, Environmental Education

State Standards: The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept, students know:

- some changes in the Earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Procedures: Students led in a discussion of continental drift and plate tectonics. Students will demonstrate understanding of how the San Bernardino Mountains were formed by imitating the North American and Pacific Plate movement using graham crackers on top of peanut butter.

A glob of peanut butter is spread on a piece of waxed paper for each student. Two graham crackers are then set on the peanut butter and can be manipulated to show three ways quake boundaries move including transform, divergent or convergent boundaries.

Background Information: See geology section of this project

NAME THAT ROCK

Objectives: Students will demonstrate knowledge of the rock cycle, the difference between rocks and minerals, observation skills, and the scientific method.

Students will be able to create a narrative piece of writing.

Students will be able to identify human uses of rocks including the minerals mined from the San Bernardino Mountains.

Materials: Background Information: Rock Cycle along with the Mining History of San Bernardino Mountains (see body of report along with resources in Appendix B). Rock and mineral identification flow charts (can be found at various sites on the internet).

Curriculum Links: Earth Science, Environmental Education, Social Science, Language Arts.

State Standards: The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept, students know:

- how to differentiate among igneous, sedimentary, and metamorphic rocks by their properties and methods of formation (the rock cycle).
- How to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals using a table of diagnostic properties.

Students write compositions that describe and explain familiar objects, events, and experiences. Student writing demonstrates a command of standard

American English and the drafting, research, and organizational strategies.

Write narratives:

- Relate ideas, observations, or recollections of an event or experience.
- Provide a context to enable the reader to imagine the world of the event or experience.
- Use concrete sensory details.
- Provide insight into why the selected event or experience is memorable.

Procedures: Students will review the properties of rocks, minerals, and the rock cycle and then go on a rock search around the school grounds. They will choose one rock to bring back to the classroom. After investigating using the rock and mineral classification guides to make a guess at what type of rock it is, they will create a fictional narrative story describing their rock's journey through the rock cycle until it ended up where the student found it.

Weathering and Erosion

Objectives: Students will identify and explain signs of weathering and erosion.
Identify natural vs. human influences

Materials: Hand Lens

Curriculum Links: Earth Science, Environmental Education, Social Science, Language Arts.

State Standards: Waves, wind, water and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know:

- some changes in the Earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
- natural processes, including freezing/thawing and growth of roots, cause rocks to break down into smaller pieces.

Students write clear, coherent sentences and paragraphs that develop a central idea. Their writing shows they consider the audience and purpose.

- Select a focus, an organizational structure, and a point of view based upon purpose, audience, length, and format requirements.

Procedures: Teacher directs a classroom discussion on the effects of weathering, erosion, and the processes that cause them; both natural and human influence. Ask for predictions on signs of weathering and erosion that might be seen around the school. Then take the class outside to look for signs. Look for places water has eroded natural surfaces such as hills and people made structures such as drainage areas. Students can use a hand lens to look closely. Outside stairways often show signs of wear. In natural areas around the school, have the students compare areas with more or less vegetation as to the amounts of erosion.

Students record their observations. Students are then asked to observe the hillsides around the community that have been affected by fire and hypothesize about how the loss of trees and vegetation will affect future erosion and weathering.

Timeline For a Community

Objectives: Students will learn about the local community and the effect of events over time as they have related to the environment.

Students will make a class timeline that shows the most important events.

Materials: Local community historical resources (for San Bernardino Mountains see Background Information in this project and list in Appendix B.)

Curriculum Links: Life Science, Earth Science, Social Science, Language Arts, Math (Geometry).

State Standards: Living organisms depend on one another and on their environment for survival.

Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings.

Use various reference materials as an aid to writing.

Students place key events and people of the historical era they are studying both as a chronological sequence and within a spatial context; they interpret timeliness.

Procedures: Students first practice making a timeline by creating one for their life. Suggest items such as birth, birthdays, starting school, and other events they feel have been important.

In cooperative groups, have each group research one aspect of history for the local area, recording the events and dates they feel were important including the effect on the environment. Each group shares their ideas and a class timeline is created, combining all the areas.

Discuss positives and negatives of those events on people and wildlife.

What Succeeds What?

Objectives: Students will identify successional stages in ecosystems based on plant/tree species by using historical information/photos of an area and compare to recent times. They will predict what the areas will look like in the future.

Materials: Background information on stages of succession (Project Learning Tree lesson "Nothing succeeds like succession"), Harcourt fourth grade science textbook. Historical information on the area found in the Background Information of this project and list in Appendix B.

Curriculum Links: Life Science, Environmental Education, Social Science, Earth Science, Language Arts

State Standards: Students read and understand grade-level-appropriate material. They draw upon a variety of comprehension strategies as needed.

Use appropriate strategies when reading for different purposes.

Compare and contrast information on the same topic after reading several passages or articles.

Distinguish between cause and effect and between fact and opinion in expository text.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.
- for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content of the other three strands, students should develop their own questions and perform investigations. Students will:

- differentiate observation from inference (interpretation), and know that scientists' explanations come partly from what they observe and partly from how they interpret their observations.

Waves, wind, water and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know:

some changes in the Earth are due to slow processes, such as erosion, and some changes are due to rapid

Students demonstrate an understanding of the physical and human geographic features that define places and regions in California.

Procedures: Using background information sources, students learn the stages of succession. Students then observe the area surrounding the school to form an opinion on what stage/stages it is in.

Discuss factors that might affect/alter succession at our site (disease, insects, fire, pollution, drought).

Explore historical information on the local early mining and timber activities. How was the area different? Make predictions for the areas affected by fire and bark beetles.

Background Information: All ecosystems - both water and land - change constantly. During succession, the plant life is continually changing. New species invade the forest. Some existing species are able to reproduce, others cannot compete for sun, soil, and water and do not reproduce and eventually disappear.

There are two types of succession:

<u>Primary succession</u>: occurs on bare, newly formed land.

- 1st Stage: pioneer plants are the first plants to invade a bare area. As they die and decay they add nutrients to the soil.
- 2nd Stage: mossy stage - Bits of organic matter and bird droppings become trapped in the dense moss. They add more nutrients to the slowly deepening soil.
- 3rd Stage: grassy stage – the soil is deep and rich enough to support flowering plants, bigger shrubs, bushes, grasses and small trees
- Last Stage: climax community – can stay the same for thousands of years if there are no disasters

<u>Secondary Succession</u>: return of a damaged ecosystem to its natural climax community. Fire speeds up secondary succession – it burns the dead leaves and branches on the forest floor releasing nutrients into the soil. Meadows of grasses sprout in the rich soil. Next come shrubs, open-canopied saplings, close canopied pole trees, mature trees, and old growth.

Dead and Alive

Objectives: Students will be able to

- compare logs to alive trees finding things they have in common
- contrast logs to alive trees finding things that are different

Materials: Hand Lens

Curriculum Links: Life Science, Environmental Education, Language Arts

State Standards: All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:

- plants are the primary source of matter and energy entering most food chains.
- producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.
- decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.
- for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- many plants depend on animals for pollination and seed dispersal while animals depend on plants for food and shelter.

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content of the other three strands, students should develop their own questions and perform investigations. Students will:

- differentiate observation from inference (interpretation), and know that scientists' explanations come partly from what they observe and partly from how they interpret their observations.

Procedures: Have students visit an area that has live trees and downed logs (good sized stumps could be used as well). Have the students record observations they see while observing both a live tree and a log. What kind of tree is/was it? The students should look for things growing on the wood; fungi, moss, lichens, flowers, plants, or trees growing from the log (seeds fall on them). They should also look for signs of decomposition; termites, sowbugs, carpenter ants, and wood roaches. Other insects such as centipedes and spiders might be using the loss of trees to find insects to eat. Some beetles and salamanders use logs for shelter. Some beetles, wasps and slugs use logs as nurseries by laying their eggs in them.

The students should then brainstorm the uses of trees by people and animals. In class, review a tree's lifecycle and show (with a sample) how to read the tree rings to determine the age of a tree.

Students should record their findings and then create a Venn diagram of similarities and differences between live trees and dead trees.

In what ways do people use trees to meet their needs in the same way animals do? (trees = oxygen, wood for shelter/houses, food (apple))

Students write a multi-paragraph comparison/contrast piece of writing describing their findings between live and dead trees.

Bark Beetles & Fire vs The Forest

Objectives: Students will understand the role of fire and bark beetles in a pine forest.

Materials: Background Information on bark beetles and fire.

Curriculum Links: Life Science, Environmental Education, Social Science,

State Standards: For any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

Procedures: (Students do previous lessons on habitats, tree keys, and are familiar with the area's animals and trees) In the classroom, the teacher demonstrates overcrowded conditions by moving students to sit closer and closer together while talking about the needs of plants and trees (water, sunlight, carbon dioxide from the air, nutrients from the soil). (Don't explain why you keep moving students closer and closer).

As it becomes harder and harder to function for the students, ask them if it is comfortable and if their "classroom" needs can be met while sitting so close together. Make comparisons with the forest and how trees also need space and compete for sunlight, water, and nutrients.

How could fire and bark beetles help to solve this problem in a forest? What animals benefit? How do they aide secondary succession?

Take a walk in the forest to observe evidence of bark beetle and fire (cats eye from lighting strikes). How will succession play a role in the future to change/repair this area?

Background Information: Almost every coniferous tree species grown in California has its community of bark beetles. They are always present in the forest but their numbers can increase dramatically under favorable conditions which reduce tree vigor. These unfavorable conditions include damaged root systems, overcrowding, pollution, or drought.

Bark Beetle: Bark beetles typically begin their attack on trees already weakened by some type of stress or other factors. The first insects to invade a tree emit odors into the air. These odors or chemical messages, sometimes in combination with odors from the attacked tree, attract large numbers of beetles. These beetles may then attack the trees nearby.

Beetles carry certain fungi which are deposited in the vascular system of the tree they attack. This fungi multiplies quickly and clogs the water-conducting tissue of the tree, which leads to death of the tree.

Both healthy and weakened trees can fall prey to the mass-attacking bark beetles. The large numbers of the insects attacking that particular tree may overwhelm normal defenses that the tree has. A drought-stressed tree may also be killed by fewer of the beetles than the healthy one.

Nearly all bark beetles feed and reproduce in the thin layer of the tree between the bark and the wood. After the beetles bore through, the female beetle then creates a "gallery" between the bark and the wood. Once this is done the female carves out small niches and lays a single egg in each. Each female normally lays several dozen eggs. Once these eggs have hatched, the larvae, like the adult beetles, feed by chewing "galleries" of their own. The transform inside the tree becoming adults and tunneling their way back out of the tree through the bark. They are then receptive to the odor messages sent by other beetles and the cycle begins again.

When the air temperatures begin to cool in the fall, the insects prepare to winter beneath the bark. Very little flight takes place during this time and not until spring do the beetles again take flight to new trees.

<u>Fire</u>: Despite the apparent devastation after a wild fire, fire is essential to the health of most ecosystems. There are many reasons for this in California. First is in chaparral and the closed-cone conifer communities. The seeds for these species need fire to germinate. The second reason is that the fires clear the forest of underbrush which opens up the forest floor to sunlight. The resulting growth of grasses, herbs, and shrubs provide food for many species of wildlife. Third, where the ground is littered with an accumulation of fallen branches and dry litter, fires reduce this and at the same time supply nutrients to the soil.

Periodic burns in an area help use up this fuel which means that a later fire will not be as intense and will be less destructive than a fire that occurs when fires are suppressed and debris accumulates on the forest floor. Last, but not the least important is when fire removes a dense stand of shrubs. This increases the water supply. With fewer plants absorbing the water, streams are fuller, which benefits many other types of plants and animals.

Is the Area Around our School a Habitat?

Objectives: Students will demonstrate knowledge of animal and plant needs, habitats and environments, by investigating and then concluding that the school grounds, surrounding area, and even the classroom are examples of habitats.

Materials: Hand Lens

Curriculum Links: Life Science, Environmental Education, Language Arts

State Standards: All organisms need energy and matter to live and grow. As a basis for understanding this concept, students know:

- plants are the primary source of matter and energy entering most food chains.
- producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.
- decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.
- for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- many plants depend on animals for pollination and seed dispersal while animals depend on plants for food and shelter.

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content of the other three strands, students should develop their own questions and perform investigations. Students will:

- differentiate observation from inference (interpretation), and know that scientists' explanations come partly from what they observe and partly from how they interpret their observations.

Students write clear, coherent sentences and paragraphs that develop a central idea. Their writing shows they consider the audience and purpose. Students progress through the stages of the writing process (e.g., prewriting, drafting, revising, editing successive versions).

Select a focus, an organizational structure, and a point of view based upon purpose, audience, length, and format requirements.

Procedures: Teacher led background coverage of animal and plant needs, habitats and the environment as places these needs are met in smaller habitats. Review the difference between the living and non-living elements in an environment.

Students are then placed in groups of four to five to find evidence of possible needs being available on the school grounds, surrounding areas, and in the classroom. Students hypothesize what animals could live where based on their findings using their observational evidence to support their conclusion.

Students write a persuasive piece of writing supporting their conclusion.

Where Does My Glass of Water Come From?

Objectives: Students will learn about the amount of fresh water on the earth, the water cycle, and how we, in our area, get our water.

Students will learn the historic uses of water from the San Bernardino Mountains including its use by the Serranos and early mountain and valley pioneers, for preparing and growing food, and for energy uses.

Materials: Background information on the San Bernardino Mountains. (See background in this report and Appendix B Resource list). Topography map of the local area.

Curriculum Links: Life Science, Environmental Education, Social Studies, Geography, Math

State Standards: Students solve problems involving addition, subtraction, multiplication, and division of whole numbers and understand the relationships among the operations.
Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings.
Identify the mode(s) for sets of categorical data and the mode(s), median, and any apparent outliers for numerical data sets.
Students demonstrate an understanding of the physical and human geographic features that define places and regions in Californa.

Procedures: Ask students where water comes from.
Go over the water cycle. Have each student crumple up a piece of paper into a ball. Spread the paper back out and

have them, using a blue pen, draw "rivers and streams" along the folds created by crumpling the paper where they think water would run. Using a spray bottle, spray water, starting from the highest points of the crumpled paper, so that the water runs down the paper. Students can see visually how watershed drainages work.

Using local topographical maps, observe the watersheds of the San Bernardino Mountains and how people have collected and stored water for our use using lakes (Big Bear Lake, Lake Gregory, Lake Arrowhead, and Lake Silverwood).

Using historical references compare how it is today compared to the past (no lakes, water used in the valley compared to now used on the mountain), and how the water is used. Discuss how much of our water comes from the local watershed vs. the state water project.

Many different comparisons can be made between the different months production for each well.

- The difference between state water use and local for different months, or years.
- Averages can be computed for monthly use.
- Price comparisons can be made for different years or months based on local water vs. state water price.

How can we conserve water during the highest use months?

Background Information: $\frac{3}{4}$ of the Earth's surface is covered in water, 97% of that water is in the oceans, 2% is frozen in ice caps and glaciers (not usable), 1% is fresh water with only .34% of that usable.

In the United States the average person uses 160 gallons of water per day.

In California 75% of the precipitation occurs in the Northern part of the state while 75% of the population lives in the Southern part of the state.

The California water project contains 1,300 reservoirs and lakes and thousands of miles of pipelines to bring the water from Northern California to Southern California (Clymire, 1994).

Per Gary Adams, manager of Alpine Water Users Association (AWUA), there are seven wells that AWUA use to supply the Twin Peaks area (Lake Arrowhead has a different water source). The wells pump from rechargeable groundwater. However, the wells are not able to supply all the water needed and so water is purchased from the state system which brings water to Lake Silverwood.

Graphs and figures can be obtained from AWUA showing each well's production per day or per month and totals for all the wells along with the amounts of water purchased from the state water system.

For example, in January 2003 AWUA purchased 2,102,400 gallons from the state and 1,297,047 gallons were used from the wells. In July of 2003 3,542,400 gallons were purchased from the state and 2,851,450 gallons of local water was used. For the whole of 2003 a total of 52,723,553 gallons were used for the community.

Where Should Our Tribe's Camp Be?

Objectives: Students will demonstrate their knowledge of the needs of people and how the local environment can meet those needs by choosing a local location for the "Grandview" (school name) branch of the Serranos.

Students will learn to read a variety of maps, learn about local trees, plants, and animals and how the Serranos used them.

Materials: Local maps including a topographical map
Background information on the Serranos and the local plants and animals they used (information can be found in the "background information" of this report).
Local wildlife and plant guides which are found in Appendix B of this report.

Curriculum Links: Social Studies, Geography, Earth Science, Life Science, Environmental Education, Language Arts.

State Standards: Students read and understand grade-level-appropriate material. They draw upon a variety of comprehension strategies as needed.

Use appropriate strategies when reading for different purposes.

All organisms (in this case people) need energy and matter to live and grow. As a basis for understanding this concept, students know:

- plants are the primary source of matter and energy entering most food chains.

- producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.

How to differentiate among igneous, sedimentary, and metamorphic rocks by their properties and methods of formation (the rock cycle).

How to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals using a table of diagnostic properties.

Using maps, charts and pictures to describe how communities in California vary in land use, vegetation, wildlife, climate, population density, architecture, services, and transportation.

Students demonstrate an understanding of the physical and human geographic features that define places and regions in California.

Procedures: Review with students the needs of all animals and compare to our needs (they are the same; food, water, oxygen, shelter, climate, space).

Using historical resources (see list and the background information in this project), students learn about the Serrano Indians' use of the San Bernardino Mountains and how they used the mountain area to meet their needs, including a local camp known as Rock Camp. Students, using local maps, compare the natural resources available at the Rock Camp location with areas close to our school. Students, in groups, decide where in our local area they would want to set up a camp for the "Grandview" branch of the Serranos.

Background Information: Archeologist dig by the San Bernardino County Museum at Rock Camp site found natural resources in the area which were used by the Serrano Indians. The items found were:

manos, metates, pestles, and mortars made from quartz monzonite and gneiss as well as quartzite hammerstones.

Milky quartz and quartz which were used to make cutting points and hunting points

Plants: deer grass, rushes, squaw bush, and willow which was used in basket making.

Mustang mint and mountain mint which was used in food flavoring.

Bitteroot, western choke cherries, squaw bush, wild roses, maripose lilies, wild onions, golden stars, violet, mustard family, clovers, miner's lettuce, dandelion, and bracken fern which was used for food by baking the bulbs or eating them raw, boiling, or roasting.

Trout on the Rise and Fall

(Adapted from Project WILD)

Objectives: Students will understand the needs of a trout and how those needs are met in their stream habitat.
Students will understand carrying capacity and its effect on trout populations as those needs become more or less available.
Students will learn about food chains and webs.
Students will understand ways in which people adversely affect trout habitats.

Materials: Bound playing cards: one set that show trout "needs," and one set that shows trout "wants."

Curriculum Links: Life Science, Physical Education, Environmental Education, Math

State Standards: All organisms need energy and matter to live and grow.

- producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs, and may compete with each other for resources in an ecosystem.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- ecosystems can be characterized in terms of their living and nonliving components.

Students organize, represent, and interpret numerical and categorical data and clearly communicate their findings.

Students use two-dimensional coordinate grids to represent points and graph lines and simple figures.

Procedures: Discuss the needs of trout and where trout live in the San Bernardino Mountains. Students will line up in two lines facing each other approximately 20 yards apart. One line of students have the set of cards for trout "needs" (the providers) and the other line has the trout "wants" cards (they are the trout).

The line with the "wants" cards (the trout) turns their back to the other line and chooses which card, or want, they want to fulfill for this round by rotating that card to the top. The providers line does the same, choosing which trout need they will provide. The lines then face each other again and the trout line, on command, runs toward the providers line and tries to match up with someone who choose the same trout need. If the trout finds a match they bring that student back to become a trout. If no match is made, that trout "dies" and becomes a provider (the set of cards is switched). Providers not chosen as a match by a trout stay as a provider.

One student can serve as the biologist and record the rises and falls of the trout population. Variations can be made by the teacher by inserting different scenarios that would affect the availability of the trout needs such as droughts, floods, dams, pollution, etc. Make sure the choices have already been made before disclosing the scenario.

For example, a fire burns the drainage causing a decrease in erosion controlling vegetation. A flood ensues wiping out available shelter trout use to avoid predators. Have half (for example) of those providers who chose shelter to sit out leaving the trout who chose that less chance of meeting that need. A decrease in trout will probably then occur.

Back in the classroom a graph can be made charting the rise and fall of the trout population in the game. Discuss how the different scenarios affected the population. Which things occur naturally and which are caused by people? What other animals are affected by the changes in the trout population?

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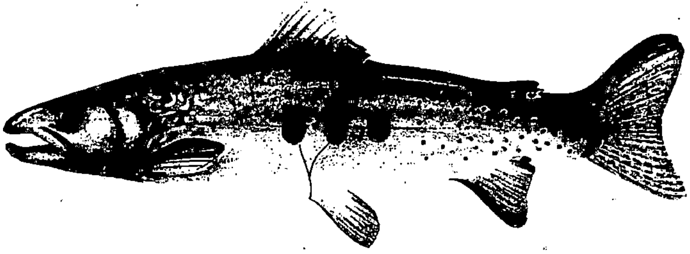

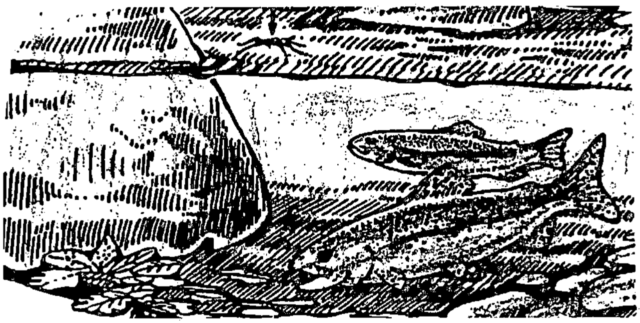

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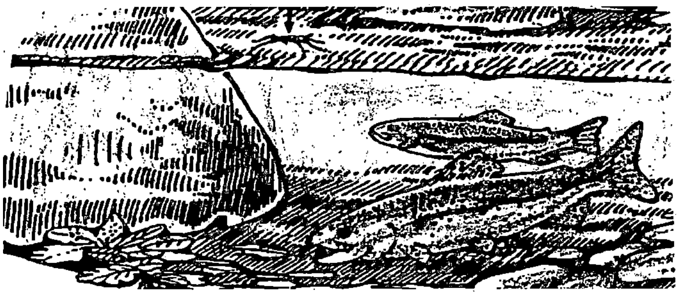

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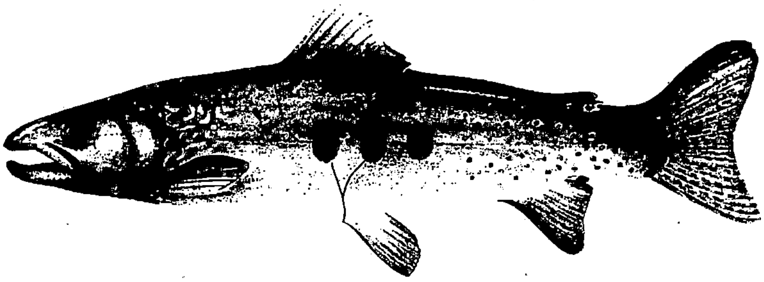

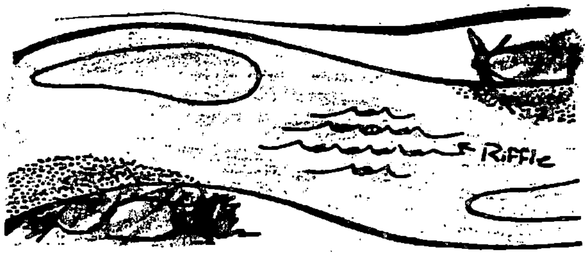

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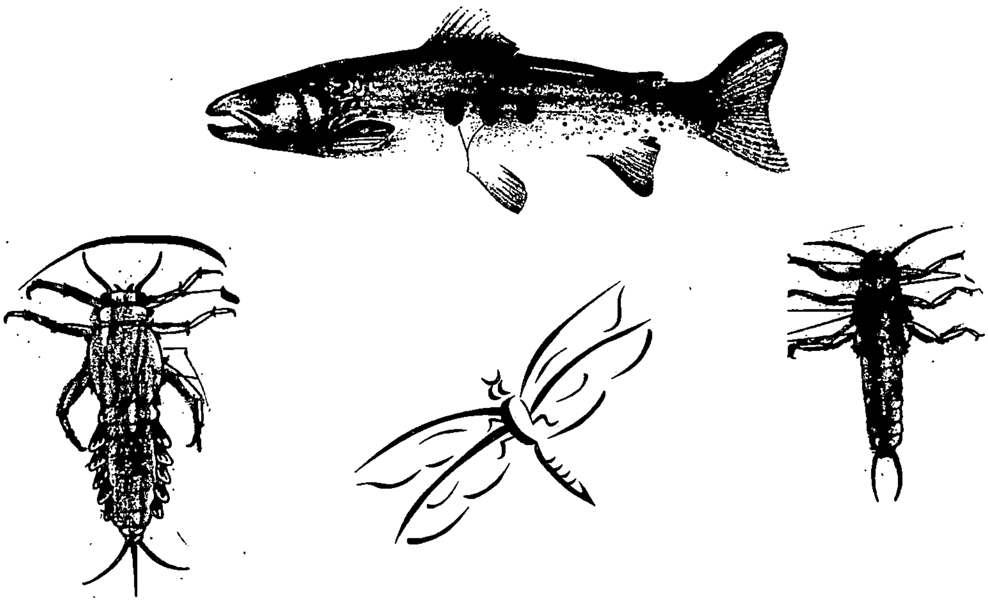

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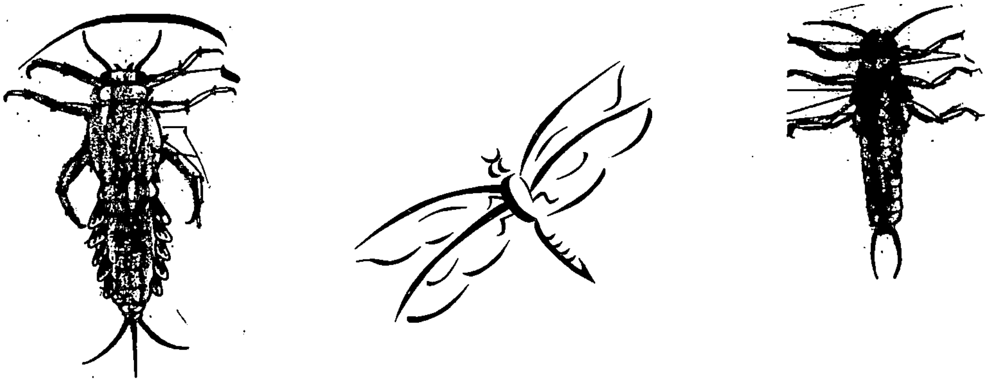

Trout vs Frog

Objectives: Students will be able to:

- Describe the life cycle of trout and the yellow legged tree frog.
- Describe the needs of trout and the yellow legged tree frog and how their habitat provides for these needs.
- Create a food chain and a food web that links the trout and frog (including how competition plays a role).
- Debate the role of introduced (stocked) trout plays on the status of the tree frog.

Materials: Background information on trout and the yellow legged tree frog.

Curriculum Links: Life Science, Environmental Science, Language Arts

State Standards: Use appropriate strategies when reading for different purposes.

Compare and contrast information on the same topic after reading several passages or articles.

Distinguish between cause and effect and between fact and opinion in expository text.

Students write and speak with a command of standard English conventions appropriate to this grade level.

All organisms need energy and matter to live and grow.

- producers and consumers are related in food chains and food webs, and may compete with each other for resources in an ecosystem.

Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept, students know:

- for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

Procedures: The teacher will lead whole group discussions on food chains, food webs, habitats, and needs of all animals. Specific examples using trout and yellow legged frogs will be used to reinforce the concepts. The teacher will divide students into cooperative groups to explore the problem of the yellow legged tree frog populations diminishing and the issues surrounding introduced (stocked) trout being a possible source of the demise of the yellow legged frog. Students will be introduced to a friendly style of debate and the groups will compose an argumentative stance on the side of the trout or frog. A classroom debate will be held.

Background Information: All animals have the same basic needs including: the need for the right climate, the need for oxygen, the need for food, the need for water and the need for shelter.

All animals belong to a food chain in which energy is passed through communities. A food chain shows how the consumers in our ecosystem are connected to one another according to what they eat. A food chain has several levels. At the base of every food chain are the producers – usually plants. Consumers make up all the other levels. First level consumers, called herbivores, eat the producers. Second level consumers, called carnivores, eat first level consumers. Third level consumers eat second level consumers and so on.

A food web shows the relationship of many different food chains in a single ecosystem.

Tree Frog:

Range: Once found throughout the mountains of California but now only found in 5% of high country lakes in John Muir Wilderness in the Eastern Sierra and 35% of lakes in Kings

Canyon National Park. There are fewer than 200 total in isolated locations in the San Bernardino, San Gabriel, and San Jacinto Mountains per Steve Loe, a United States Forest Service biologist.

Habitat: Lives between elevations of 7,000 and 12,000 feet. Requires deep lake or pond that will not freeze solid in the winter.

Size: Body is 2" - 3" long, and overall about the size of your hand.

Unusual Features: During winter in 32 degree water they essentially live in a state of suspended animation. Rarely venture far from water. It has no vocal sacs, so makes no noise.

Status: It is estimated that only 10% of historic populations still remain.

Local Status in the San Bernardino Mountains: According to Steve Loe, a United States Forest Service biologist, a small population exists (prior to the 2003 fire and 2004 flooding) in upper City Creek. Twelve had been removed prior to the fire and flood to provide for breeding population. There is fear that flooding took out the wild population. One frog was found in the Mill Creek drainage. Places in the San Bernardino and San Gabriel mountains that frogs have been found have natural barriers keeping trout out or there are no trout in the drainage.

Rainbow Trout:

Range: Found throughout the United States as well as cold water stream of South America, Europe, New Zealand, and Australia.

Habitat: From coastal streams to high elevation lakes and streams.

Size: 6 - 30 inches depending on the habitat.

Diet: Stream born as well as terrestrial insects are their main staple. They also eat other fish including their own species, crustaceans, frogs, and tadpoles.

A Friendly Debate Style:

Affirmative side makes an opening statement of the premise: For example, trout should not be stocked in high country lakes containing yellow legged frogs and those trout in the lakes should be removed.

Negative side makes an opening statement refuting the premise.

- Each side gets a turn to refute the case of the other side
- Each side gets a closing argument

No direct questioning is done from one side or the other.

How Will it Affect This Place?

Objectives: Students will use prior knowledge to examine environmental impact statements to determine:

- What the project is
- Are there environmental problems involved?
- What are the issues to the problems including the players and their beliefs and values?
- Who benefits from the project?
- Who/what will be affected?

Students will form an opinion for or against the project after analysis.

Materials: Copy of an Environmental Impact Statement (E.I.S.)on a current project in the local area.

Curriculum Links: Life Science, Earth Science, Environmental Education, Language Arts, Social Science

State Standards: Use appropriate strategies when reading for different purposes.

Compare and contrast information on the same topic after reading several passages or articles.

Distinguish between cause and effect and between fact and opinion in expository text.

Living organisms depend on one another and an their environment for survival.

Procedures: The teacher obtains a copy of a local E.I.S. (libraries often have a copy) and local newspaper articles (if any) on the proposed project. Read through them to help the students decide what the project is about, how it impacts the environment and whether this is a problem. (A problem would be if there is habitat loss for animals for instance). Brainstorm as a class what the issues for the problem would be (issues are differences in opinion as to the solution to the problem), who the players are that have the opinions on each side, and what their beliefs and values are concerning the problem.

Have each student write an opinion paragraph as if they were on each side of the issue. The paragraphs should clearly state why they feel how they do on the issue.

(Two examples in the Lake Arrowhead area are the Eagle Ridge Development in Blue Jay which has already been decided but had a lot of media coverage and not only an E.I.S. but also responses to it by local conservation groups. The other is a proposed camp development for the Royal Rangers in the Twin Peaks area. The E.I.S. is in the Blue Jay public library.)

APPENDIX B

SAN BERNARDINO MOUNTAIN RESOURCES

California Indians Fact Cards

Toucan Valley Publications, Inc.

California Indians

Kroeber, A., Driver, H., & Lounsbury, R.

Garland Publishing, Inc.

Champion Lodgepole Pine Trail

Big Bear Discovery Center

United States Department of Agriculture

Empire in the Sky

Keppler, Richard

PhotoWorks

From the Memories of Putnam Henck

Putnam Henck

McCluer Studio of Lake Arrowhead

Ghost Town Schoolmarm

Core, Tom

Jostens Printing and Publishing

A Guide to the Rare and Unusual Wildflowers of the Big Bear Valley Preserve

Krantz, Tim

Friends of the Big Bear Valley Preserve

Guide to the San Gorgonio Wilderness (Map)

United States Department of Agriculture

Guide to San Bernardino Mountains (Map)

Automobile Club of Southern California

Heritage of the Valley: San Bernardino's First Century

Beattie, G., & Pruitt, H.

Biobooks

Hiking in the San Bernardino Mountains

Manning, James and Jackie

J & J Publishing

The History of Big Bear Lake and the San Bernardino Mountains

Video

The Photoworks

Big Bear, CA

<u>My Mountain, My People Volume I: Arrowhead!</u>

Bellamy, S.

Little Bear Historical Conservative

<u>Points Unknown</u>

Keppler, R. & Bratton J.

Fifty-Three/Fifty Publications

<u>Rock Camp: San Bernardino Mountain Archaeological Excavation</u>

Simpson, R., Haenszel, A., Reynolds, R., & Bowers, D.

San Bernardino County Museum Association

<u>Saga of the San Bernardinos</u>

LaFuze, P.

San Bernardino County Museum Association

<u>The San Bernardinos</u>

Robinson, J.

Big Santa Anita Historical Society

<u>San Bernardino County: Land of Contrasts</u>

Windson Publications, Inc.

<u>San Bernardino Mountain Trails</u>

Robinson, John W.

Wilderness Press

San Bernardino National Forest (Map)
United States Department of Agriculture

San Bernardino National Forest: Heaps Peak Arboretum
Pamphlet from Heaps Peak Arboretum
Rim of the World Interpretive Association

San Bernardino National Forest Land and Resource Management Plan: Final Environmental Impact Statement
United States Department of Agriculture

San Bernardino National Forest Land and Resource Management Plan: Final Management Plan
United States Department of Agriculture

The Serrano Indians of Southern California
Johnston, F.
Maiki Museum Press

Wildflowers of the San Bernardino Mountains
San Bernardino Mountains Land Trust

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