The Joshua Tree (Yucca Brevifolia) Hotel a third and fourth grade elementary curriculum

Michelle Maresh

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THE JOSHUA TREE (YUCCA BREVIFOLIA) HOTEL
A THIRD AND FOURTH GRADE ELEMENTARY CURRICULUM

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 Option

by
Michelle Maresh
June 2000
THE JOSHUA TREE (YUCCA BREVIFOLIA) HOTEL
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Approved by:
Darleen K. Stoner, Ph.D.,
First Reader

Lorna Lang-Daggs, M.A.,
Joshua Tree National Park,
Second Reader

Date
ABSTRACT

Focusing primarily on the ecological relationships of the Joshua tree in Joshua Tree National Park, this teaching unit includes ten pre-visit, in-class lessons; Ranger-led lessons at Joshua Tree National Park Education Center; and ten post-visit, in-class lessons. Lessons are for students in grades three and four and formatted using the Breakthroughs Lesson strategies, based on the constructivist educational theory. The teacher background section addresses classification, structure, range, xerophytic adaptations, ecological relationships, and natural history of the Joshua tree.
ACKNOWLEDGMENTS

Thank you to Dr. Darleen K. Stoner for her patience, diligence, commitment and tenacity. Gratitude to Lorna Lang-Daggs for her positive attitude, resourcefulness, and her attention to detail. Much appreciation to Jim Cornett for his knowledge, assistance, and inspiration.
To:

Dave, Stacie, Jeremie, Amy and Kiersten,

My reasons for everything.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND INFORMATION</td>
<td>5</td>
</tr>
<tr>
<td>Description</td>
<td>5</td>
</tr>
<tr>
<td>Classification</td>
<td>6</td>
</tr>
<tr>
<td>Leaves, Flowers and Bark</td>
<td>7</td>
</tr>
<tr>
<td>Age</td>
<td>10</td>
</tr>
<tr>
<td>Beginnings</td>
<td>11</td>
</tr>
<tr>
<td>Range</td>
<td>12</td>
</tr>
<tr>
<td>Xerophytic Adaptation of the <em>Yucca brevifolia</em></td>
<td>14</td>
</tr>
<tr>
<td>Ecological Relationships</td>
<td>16</td>
</tr>
<tr>
<td>History</td>
<td>22</td>
</tr>
<tr>
<td>Identification and Naming</td>
<td>24</td>
</tr>
<tr>
<td>Twentieth Century Uses</td>
<td>27</td>
</tr>
<tr>
<td>DESIGN OF PROJECT</td>
<td>29</td>
</tr>
<tr>
<td>APPENDIX A: ISSUES, CONCEPTS AND STRATEGIES</td>
<td>30</td>
</tr>
<tr>
<td>APPENDIX B: PRE-VISIT LESSON</td>
<td>32</td>
</tr>
<tr>
<td>Lesson One: Establishing Prior Knowledge</td>
<td>32</td>
</tr>
<tr>
<td>Lesson Two: Literature Connection</td>
<td>34</td>
</tr>
<tr>
<td>Lesson Three: Habitats</td>
<td>39</td>
</tr>
<tr>
<td>Lesson Four: Healthy Habitats</td>
<td>42</td>
</tr>
<tr>
<td>Lesson Five: The Flow of Energy</td>
<td>44</td>
</tr>
<tr>
<td>Lesson Six: Food Chain</td>
<td>47</td>
</tr>
<tr>
<td>Lesson Seven: Life Cycle</td>
<td>55</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Fig. 1. Range of the Joshua Tree ....................... 13
INTRODUCTION

What is left of the unspoiled desert spaces are the last fragments of virgin nature remaining in many parts of the Southwest. They are hospitable to those who accord them due respect and who have the knowledge to enjoy the intimate little canyons, their wide sun-drenched plains, and the plants and animals that live there. They are deserving of preservation. (Cowles, 1977, p. 49)

Today, like yesterday, and the day before that, has been sunny and cloudless. The sun has gone down leaving behind it in the western sky only a glow. The stars have come out, not one by one, but in groups. The wind has come up as it does each night, and I would have it no different.

To me, it's no wonder that certain ancient species can live here. Animals and plants manage to survive on a quantity of water which would soon bring death by dehydration to those species of any other climate. The Joshua tree is one such ancient species.

I clearly remember seeing a Joshua tree for the first time. I was mesmerized as I looked out the car window of my parents' station wagon. I wondered what kind of tree could look so old and dead, yet be alive. I had never seen anything like it; it was so unique, almost too different. I was ten years old. At that time, I had a feeling I would return to find out more about this tree and the desert. And so I did.

I'm not sure if every life has a destiny, but I feel as if my life has been heading in this direction. I would move to the Mojave Desert, feel at peace, become an educator, be
inspired by teaching and the desert, discover my own environmental ethic, and write this master’s degree project. This project is a defining culmination of my years, as the Joshua tree is the defining plant of the Mojave Desert.

If a line is drawn around the distribution of this distinctive tree, that line pretty well marks out the marginal confines of the Mojave Desert (Jaeger, 1957).

The uniqueness of the Joshua tree in the Mojave Desert makes it deserving of preservation and due respect. The focus of this paper is to impart knowledge of the Joshua tree in its microhabitat to inspire both students and teachers to appreciate this tree and the environment in which it occurs.

The background section on the Joshua tree is meant to familiarize teachers with this unique tree so student questions can be answered. There are student lessons and activities to be used in the classroom. It is recommended by this author that teachers using this project make arrangements with Joshua Tree National Park Education Center for a field trip. The lessons the Rangers will use are included in this project. The user would find pre- and post-visit activities which, when used in tandem with the field trip, makes the students' learning a richer experience.

Students who live in the Mojave Desert have a rare opportunity to see the Joshua tree in its natural environment. By learning about this tree and understanding its role in the desert habitat, students will discover the worth of this unique tree for themselves, possibly ensuring a future of preservation for the Joshua tree.
In an effort to best facilitate this discovery, this unit has been designed for seven through ten year olds, (third and fourth graders). Strommen, McKinney & Merritt (1983) suggest that children go through developmental levels in acquiring perspective on issues. At level 2, (seven through ten years old), children become aware that others think or feel differently than they, not because of different information, but because each have their own values and interests. The more time children have to interact with each other about their interests, the greater value they place on an issue, and the opinions of their peers.

Skillful questioning by the teacher guides social interaction, and according to Fogarty (1999, p. 76), enables students to gain an internal value and personal investment in their own opinions which deepens the understanding. The lessons in this unit plan are designed for student interaction, thus increasing concept understanding.

To better facilitate concept understanding, the lessons in this unit are structured so that students become active learners. Each lesson builds upon the previous lesson’s concept or objective. Breakthroughs Lesson strategies have been utilized because this strategy promotes thinking, connecting ideas, organizing information and restructuring ideas.

Breakthroughs Lesson strategies encourage students to think strategically and use a varied repertoire of thinking skills by using graphic organizers. The use of graphic organizers allow students to interpret, connect, summarize
and assimilate new ideas and concepts. Students are more able to comprehend educational experiences and apply these to real world experiences when information is presented using the Breakthroughs Lessons (Jones, Tinzmann, & Thelean, 1992).

At age seven, children enter Piaget's concrete operational stage. "This is a time when children are first capable of reasoning logically, particularly when information is extended in a logical order" (Strommen, et al., p. 45). Breakthroughs Lessons strategies promote thinking and reasoning. The idea of building upon previous knowledge is the basis for how students learn called constructivism.

According to Klein and Merritt (1994),

...constructivism is based on (a) knowledge is actively constructed by the cognizing subject, not passively received from the environment, and (b) coming to know is an adaptive process that organizes one's experiential world; it does not discover an independent, pre-existing world outside of the knower. (p. 211)

According to Klein and Merritt (1994), there are four main components of a constructivist lesson.

1. Introduction of a real-life problem by the students or teacher for the students to resolve,
2. Student-centered instruction facilitated by the teacher,
3. Productive group interaction during the learning process, and
4. Authentic assessment and demonstration of student progress. (p.16)

This unit is designed specifically for the developmental readiness of children ages seven to ten. The goal is to empower the students to gain meaning through social interaction, creative manipulation of concepts, teacher guidance and real world experience.
BACKGROUND INFORMATION

Description

Yucca brevifolia, commonly known as the Joshua tree, is an aborescent monocotyledonous evergreen tree, considered to be the most characteristic plant of the Mojave Desert. According to Munz (1974), the Joshua tree belongs to the family Agavacea, genus Yucca, species brevifolia. It is also closely related to a number of evergreen rosette species in the deserts of North America belonging to the genera Agave, Dasylirion, and Nolina. All of these species possess an evergreen rosette that lives for several to many years prior to the formation of terminal inflorescence (Smith, Hartstock & Nobel, 1983).

The Jepson Manual classifies the Joshua tree in the family Liliaceae, lily, genus yucca, species brevifolia (Hickman, 1993). The Joshua tree does not fit neatly into either family. Currently, the botanists, naturalists and educators at Joshua Tree National Park use the Jepson Manual classification.
Classification

The Lily Family (*Liliaceae*) has more than four thousand species. They don't look like lilies at all, however. This family is characterized as bulbous perennial plants, native to the northern hemisphere (Cayne, et al., 1994).

Yuccas are native to southern North America, Central America, Bermuda, and the West Indies. There are about 30 species of yucca found in central and southwestern North America. These include the soaptree yucca (*Yucca elata*), which reaches a height of about 40 feet; the torrey yucca (*Yucca torreyi*), also called the "Spanish bayonet," which has stiff, fleshy leaves with needle sharp tips; and the giant yucca (*Yucca carnerosana*), also called the "giant dagger," which is a massive thick-stemmed plant. The most spectacular of the plant genus, is the Joshua tree (*Yucca brevifolia*) (Benton, 1977).

The word 'yucca' is derived from a common native name for cassava or manihot, a food plant from South America from which tapioca is produced. The Joshua tree and the South American plants actually have nothing in common, and it is probably a fluke of history that the two became confused (Benton, 1977). *Brevifolia* refers to the fact that its leaves are shorter than other yucca species.
**Leaves, Flowers and Bark**

The genus *Yucca* is distinguished as large plants with thick, tail-shaped branches. The leaves have a serrated edge and are thin, narrow, rigid, and pointed (Benton, 1977). The leaves of the Joshua tree are clustered at the ends of branches. The creamy white or greenish base is firmly attached to the trunk. The blade is seven to twelve inches long when fully grown, with the upper surface flattened, or concave at the tip. The lower end of the blade is convex. The very tip of the blade is lemon-yellow. The shape of the leaves of the Joshua tree protect the plant from animals, as well as prevent evaporation. The size and shape of the leaves disrupt air current around the tree which limits the amount of water loss (Peattie, Wyman, & Landacre, 1991).

The cluster of flowers is called an inflorescence. The flowers are formed in a terminal panicle or raceme. The inflorescence is densely crowded in a branched cluster. The flowers are one-half to two and three-quarters inches long (Peattie, et al., 1991). The petals and sepals are fleshy and are a dull green to sage green. The cream and rose colored petals are united at the base and are do not fully open, even at the height of bloom (Gossard, 1992).

"The flower has six stamens. The filaments are club shaped at the tip and are stiff and flattened against the ovary at the base. When opened, they emit a slight musty odor similar to that of a toadstool" (Peattie, et al., 1991, p. 306). The style is short and thick, terminating in three small erect stigmas. Flowering is irregular; there is little
every spring, but there comes 'yucca years' when most of the trees of a given region will bloom heavily. This flowering process depends on maturity, not the height of an individual tree, and does depend on the amount of rainfall and temperature (Gossard, 1992).

Inside the blossom, there is an ovary. This contains the future seeds of the Joshua tree. As the pod matures, the blossom petals curl back until the fully grown ovary or pod is exposed. When the seeds are ripe, the petals fall away. The pod eventually opens releasing the seeds.

The fruit of the Joshua tree is approximately the size of a chicken egg. The fruit is moist until the seeds mature. At that time, the fruit is dry. The individual fruits which grow to be two and one-half to four inches long, one and three-quarter inches thick, are plump throughout, with the apex angled with the remnants of the style. The cream to greenish colored fruit eventually turns reddish brown or nearly black. The numerous seeds are half the diameter of a dime. Once fully ripened, they will drop quickly, and, as light as they are, will roll and tumble with the desert winds, shaking out seeds as they go (Gossard, 1992).

The reproduction ratio of Joshua tree seedlings is very limited. Each tree can bear several hundred or just one pod and each pod contains about 200 seeds (Gossard, 1992). The majority of the seeds become food for rodents and other wildlife. Only a very small percentage of a Joshua tree’s seeds take root. Even fewer survive the first ten years.
When flowering does occur, the terminal bud thereafter dies; then the first branching takes place immediately below the point of flowering. When this branch has flowered, the same thing happens again. And so the yucca forks, and forks again, thus its appearance. The branches become, in time, so heavy and far from the stem, they weigh the main bough, eventually falling to the desert sands below. Thus, the Joshua tree is considered to be a self-pruning tree (Peattie, et al., 1991).

The bark-like outer covering of the Joshua tree is gray or reddish brown. It is rough and broken by deep narrow fissures and crosschecks of conspicuous looking plates (Larson, 1977). The trunk on young trees is thatched with thick, gray, reflexed leaves. Leaves that are more than four years old tend to lose their stiffness and start to droop, finally dying and becoming part of the bristling thatch that covers a good portion of the plant. These reflexed leaves act as a protective covering for the trunk by decreasing evaporation (Smith, et al., 1983). Many of these older leaves become silver gray and shaggy looking, eventually falling away to expose the rind (Gossard, 1992).

Like palms, Joshua trees have no solid cylinder of wood and hence no growth rings; rather it is composed of pith. Because the Joshua tree has no concentric growth rings, it is difficult to determine the exact age (Munz, 1974).
Age

It is thought the infancy, early, middle, and older ages of the Joshua tree can be distinguished by the height and amount of branching. Very old trees may have hundreds of branchlets, and develop a trunk four feet in diameter, and heights up to 40 feet are known. Forty feet is an unusual height; thirty feet is more common. The trunk is between one and three-and-a-half feet in diameter. The age range of the Joshua tree is still highly speculative. Most authorities agree Joshua trees may live to be several hundred years of age, but there seems to be no definite information (Gossard, 1992). However, recent studies are showing the average age could be 150 years (Cornett, 1999).
Beginnings

The Joshua tree begins as a tender shoot slipping gracefully through the desert sands—initially appearing to be a single blade of grass. Nearly all of these shoots are devoured by herbivores. The successful trees are those that sprout beneath a shrub, which becomes its "nursery plant." "A Joshua tree can grow under these protecting plants for three to four years before it emerges from its canopy and eventually replaces it" (Benton, 1977, p. 13).

Dispersal of the Joshua tree happens by wind, rodents or birds, and subterranean stems which push outward from the main trunk like bamboo runners. It is the sprouting from these runners that accounts for new growth around the parent tree. "Young trees are unbranched until they are mature enough to flower; some branch as small as four feet; others wait until as high as thirty feet" (Bakker, 1984, p. 306).
Range

In ancient times, when water was more abundant, Joshua trees were in a different place than they are today. Evidence of this is seen in the fossil remains and dung of the extinct, giant yucca-feeding ground sloth (*Nothrothrtium*) in areas of southern Nevada where the tree is no longer found (Benton, 1977). Today, Joshua trees are found in the high desert, between 2,100 and 7,000 feet. Their occurrence marks the southernmost boundary of the Mojave Desert on the slopes of the little San Bernardino Mountains, where Joshua Tree National Park is located. They are found in the extreme southwestern corner of Utah and west-central Arizona. The northern limit has been found north of Goldfield, Nevada, almost to Tonopah (Darlington, 1996).

Joshua trees are found nowhere else in the world. In portions of the Mojave desert, the Joshua trees form forests where they are the dominant plant of the area. Joshua trees are found in alluvial soils which are sandy, loamy, and relatively deep. They thrive best on flatlands where drainage is slow (Cornett, 1999).
Fig. 1. Range of the Joshua Tree (Yucca brevifolia)
Xerophytic Adaptation of the Yucca Brevifolia

The plant's water relation and water management systems are adapted to cope with soils that are well drained and have low nutrition levels and high evaporation rates. Prevention of water loss through transpiration and evaporation are the key to the anatomical and physiological adaptations of the Joshua tree. Drought tolerant plants are known as xerophytes, meaning "dry plants" (Peattie, et al., 1991). The large size of the Joshua tree in areas relatively devoid of any other large plant species suggests it is quite tolerant of temperature extremes.

The large leaf surface area maintained throughout the year in some of the driest habitat in North America suggests that the Joshua tree is well adapted to seasonal water stress (Smith, et al., 1983). The spiny leaves of the Joshua tree are covered with a thick cuticle, which reflects light and therefore keeps the plant cooler. This covering helps keep transpiration to a minimum, as well as to lower the evaporation rate of the plant. Transpiration occurs when the stomata open releasing water vapor into the air. In colder months, when soil water potential is low, transpiration is also low. However, during summer months when temperatures rise and water is at its seasonal low, transpiration is almost nonexistent. Because temperatures vary by season, transpiration takes place at different times of the day. In winter, transpiration occurs midday, while during summer, it happens early morning. The exception to this is during the
occasional, wet, late summer months when transpiration again occurs midday (Smith, et al., 1983).

The angle of the leaves is important. On the typical Joshua tree, the uppermost 11% of the leaves are oriented within 30° of vertical; the middle 83% are between 30° and 60° of vertical; and the lowermost 6% are within 39° of horizontal (Smith, et al., 1983). "The tendency of leaves to become more horizontal with age, and be located further down the rosette, together with a non-overlapping leaf arrangement, allows for effective light penetration into the rosette and a decrease in transpiration. This canopy arrangement also allows the tree to optimize light utilization for carbon dioxide exchange" (Smith, et al., 1983).

The stiff, gray, dead leaves encompass the trunk, reducing wind velocity on the living cells underneath, which keeps water loss to a minimum (Smith, et al., 1983).

The root system of the Joshua tree is shallow, growing close to the ground to take advantage of surface moisture. The roots are short, tough, and cord-like. They are limited to a base around the trunk. These roots also serve as an anchor against strong desert winds, although not always effectively (Gossard, 1992). Many trees die due to being uprooted by strong wind gusts.
Ecological Relationships

A number of organisms spend much of their lives in or close to a single Joshua tree. Some are so dependent, that they might not exist except for its presence (Bakker, 1984). The most amazing relationship within this habitat is that of the dependency with the pronuba moth, also referred to as the Yucca moth (*Tegeticula paradoxa*). This classic example of mutual dependence exists between the Joshua tree and this moth. If there were no moth, there might not be any Joshua trees. First discovered in 1876 by Charles Valentine Riley, the female moth exchanges the placement of pollen on the stigma for a small share of fertile seeds to ensure a food supply for her young (Buchman & Nabhan, 1996).

Pronuba moths are crepuscular, flying at dusk, where they are attracted to the white yucca blossoms (Bakker, 1984). The female moth visits the flower at night and gathers the sticky pollen from one flower, rolls it into a ball, flies to another flower, and ascends the pistil to force the ball of pollen into the tubular stigma. She then lays four or five eggs within the ovary walls by use of her ovipositor, a needlelike egg laying organ. Her young are then assured of a food supply when they need it. It is essential that the ovules be fertilized if a ripe supply of food is to be available for her young. About half of the fruit is consumed by the hatched larvae. This is the main and perhaps the only way a Joshua tree blossom is fertilized, and a pronuba reproduces. The remarkable idea here is that there is no
other known instance of a insect which seems to pollinate the flowers so deliberately (Buchman & Nabhan, 1996).

In July of 1995, ecologist Walter Whitford of the Environmental Protection Agency and his coworkers said they figured out how the Joshua tree keeps the moth dependent.

After spending 30 nights out in the desert armed with flashlights and note pads, watching moths come and go, the team discovered the tree’s trick: it recklessly aborts a vast number of its fruits. A shocking 90 percent of the flowers die before producing fruits. And there’s no telling which ones. The moth is left with only one option: it must spread its favors around in the hope that one of its little grubs will luck into a future fruit. The moths can’t afford to put all their eggs into one basket—and so the yucca gets what it needs from the moth it feeds. It’s a strategy that evolved over millions of years to keep the moth and the plant happy. (Mestel, 1995, p. 89)

Another insect which relies upon the Joshua tree is the yucca butterfly (Megathymus yucca navajo). With a two-inch wingspread, its larva feed on young Joshua tree plants that have developed from runners.

The female butterfly seems to know that if she lays her eggs on the small-rooted, small-stemmed plant which spring from seeds there will be no food there for her larvae. In some uncanny way, she is able to distinguish between the seedling plants and the runner plants. (Jaeger, 1965, p. 182)

The seedling does not have much of a root system and the young larva can not burrow deep enough to survive, so the parent chooses the plant produced by the runner (Benton, 1977). The female butterfly deposits her egg, and a larva, after hatching, burrows to the base of the leaf. It consumes
the heart of the young plant before burrowing down into the root system. It enlarges and extends its burrows in the root as the young plant dies. Then the larva build an extension chamber up through the center of the dead plant. Within this chamber, in mid-September, the larva stops eating and covers itself with a white, flaky substance. It remains pupating, through January or February, and comes out of the chamber in late March or April (Gossard, 1992).

The Joshua tree is also a host plant for the Yucca boring weevil (Scyphophorus yuccae). Using the Joshua tree to propagate, it becomes a member of the food chain by serving as a morsel for the insect devouring birds, reptiles and some mammals. This weevil bores holes through the growing tip of the stem, causing injury to the plant, which is one of the causes of branching in the Joshua tree (Benton, 1977).

A reptile which is closely associated with the Joshua tree is the yucca night lizard (Xanthusia vigilis), another dependent dweller in this microhabitat. The common name implies nocturnal behavior, but diurnal is more accurate (Bakker, 1984).

These lizards do occur elsewhere; however, they are typically found in the Joshua tree forest. The smallest of American lizards, it has chameleon qualities, changing from its dark brown to a light hue to hide in the moonlight. Xantusia makes it home in the masses of overlapping dried leaf spears covering much of the deadfall where it can survive upon ants, termites, beetles, and other insects that
live in or on the tree. Living near the tree, the yucca night lizard attracts snakes who will feed upon it; which in turn, attracts the nocturnal predatory birds and other animals (Larson, 1977). The food chain of this microhabitat now becomes apparent.

The fallen limbs of the Joshua tree are easily penetrated and become home for a variety of desert animals. Woodrats climb among the dead leaves, gnawing on the trunk to provide debris for their burrows. They also eat the new Joshua tree sprouts and use them for nest building. Antelope ground squirrels, mice, and kangaroo rats become meals for the red-tailed hawk who perches and nests in the Joshua tree.

At least twenty-five desert birds are known to nest in the Joshua tree. As observed by Wilson C. Hanna, ornithologist of Colton, California, they are: Bullock’s oriole, white-rumped shrike, costa hummingbird, desert sparrow hawk, Western red-tailed hawk, American raven, Pacific horned owl, long-eared owl, Pasadena screech owl, Western gnat catcher, California house finch, Brewer’s blackbird, Arkansas kingbird, San Diego titmouse, Western lark sparrow, cactus woodpecker, red-shafted flicker, Western bluebird, Northern cactus wren, Baird’s wren. (Schoenherr, 1995, p. 456)

The Scott’s oriole is the bird most closely associated with the Joshua tree. The male, with one slender white wing bar, is almost entirely black. Its underparts, rump and outer tail feathers are bright lemon yellow. The female’s coloring is similar with a more lime yellow coloration and dusky streaks on its back. This robin-sized bird, 7 to 8 inches from beak to tail in length, feeds on available
fruits, including those of cactus, and has been observed taking nectar (MacMahon, 1988).

The Scott's oriole may be so closely associated to the Joshua tree because of its nest. They do not always build their nests in Joshua trees, but it is by far their favorite location (Jaeger, 1957). When at an elevation where Joshua trees are not found, the mojave yucca (Yucca shidigera) or Spanish bayonet (Yucca baccata) are chosen as nesting sites.

The Joshua tree offers sure anchorage for its half-hanging, cup-shaped nest as well as some or most of the fibers used in the building. Built three to ten feet above the ground at the junction of a branch and main trunk, the nest is often hidden from view. It is usually hidden not only by the leaves, but by other dead leaves around the trunk. The nest is built in late April or May after they have migrated northward from their winter grounds in Mexico (Cornett, 1987). Three or four blueish-white eggs, spotted with dispersed markings of chocolate and light black-brown, form the set. By mid-May the young birds have generally left the nest. A second breed for the season is not uncommon, especially if the first set has been disturbed or destroyed or in case of availability of food source (Jaeger, 1957).

The song of the Scott's oriole resembles that of a series of rising and falling flutelike notes. Few birds sing more incessantly than orioles as they fly from the top of one Joshua tree to the next. The males are the chief performers, but now and again near a nest the female will sing, only
The ladder-backed woodpecker, *Picoides scalaris* is a small zebra-backed bird with a small black ear patch and face stripe. This woodpecker drills holes in the dead trunk or branches of the Joshua tree. Since the Joshua tree has the softest "bark" of any desert tree, the inside is the ideal place for making a nest. This bird is best identified by its sharp, high-pitched "pik" call (MacMahon, 1988). The woodpeckers eat termites, and termites are constant associates of Joshua trees (Schoenherr, 1995).
History

In the Mojave desert region, there were two Indian cultures, the Shoshonean and the Mohavean... All of the Shoshonean desert territories away from the Colorado river were very thinly populated, and probably not more than 2,500 individuals occupied the entire area. Their food consisted largely of numerous seeds, particularly of desert sand grass, and chia, pinon nuts, mesquite beans, sun dried prickly pear joints, Joshua tree buds roasted on the open fire. (Jaeger, 1957, p. 137)

The Serrano and Chemehuevi Indians of the Mojave desert depended on their desert environment to meet their needs. Plants provided food, shelter, clothing, fuel, and medicines. The tribes could meet all their needs by gathering local vegetation. The Joshua tree is one plant the indigenous peoples utilized as a resource. The Joshua tree buds were gathered and and placed in cooking pits and then eaten hot. "Persons who have eaten these buds say the the taste is sweet. Which is not surprising since scientists have since determined the buds have a high sugar content" (Gossard, 1992, p. 66). The pods were also used to make a type of porridge.

The Joshua tree was known as "humwichawa" or possibly "hunuvat chi'ya" to the Cahuilla Indians who used the fibers to make sandals or nets (Bean & Saubel, 1972). To these early dwellers, the value of the Joshua tree was not confined to providing food. The small pencil thin roots produced a number of red-hued strands that were woven into baskets. When pounded into powder, the roots produced a reddish dye
used for decorating. Buried beneath a slow burning fire for days, these same roots produced a permanent black dye (Gossard, 1992)

Roots and stems were also thoroughly pounded to make a soapy substance. This lathered into an antiseptic shampoo called saponin that could also be rubbed on wounds to promote healing. "In some instances, women took the saponin for menstrual problems, including cramps. Recent tests have shown that the root contains a significant amount of the female hormone desorycorcerone used in many gynecology treatments" (Gossard, 1992, p. 65).
Identification and Naming

The Joshua tree has been given many names by travelers who attempted to compare this unique tree with trees more familiar to them. When Spanish explorers first entered into the Mojave desert, they found a land that was far different from their European homeland.

The first known written account of a Joshua tree was by the Spanish Captain, Pedro Fages, in 1772. Fages was responsible for finding and capturing Indian deserters from Mission San Gabriel. In his journal, Fages drew sketches and wrote of groves of date palms or pala groves (Cates, 1984).

In 1827 the American scout, Jedediah Smith, an educated man for his time, kept precise notes of his travels. He compared the Joshua tree to pear trees and named them the dirk pear tree because in size and shape it resembled the pear tree, but with leaves like the blade of a dirk (Cates, 1984).

In 1844, John C. Fremont, a topographic engineer and commissioned Army officer, was searching for the Spanish Trail on which to return east. He was an amateur botanist who made observations of much of the flora he saw on his travels. As he and his group entered the northwestern portion of what is known today as the Antelope Valley, he wrote:

We were struck by the appearance of Yucca trees, which gave a strange and southern character to the country and suited well with the dry and desert region we were approaching. Associated with the dry and barren sands, their stiff and ungraceful forms makes them to the traveler the most repulsive trees in the vegetable kingdom. (O’Neal, 1981, p.171)
It is the Mormons, if legends be true, who derived inspiration from this plant, and in doing so, gave it its common name. There are many versions of the story, but Dennis H. Stovall, writing in the December 1938 issue of Desert Magazine, claims to have discovered the specific incident leading to the naming of the Joshua tree. Stovall wrote:

...a band of Mormon colonists under the leadership of Elisha Hunt, in the year 1851, was crossing the Mojave Desert enroute from Utah to San Bernardino, California. A hot sun foretelling the approach of summer, shimmered overhead, draining the energy from humans and animals alike. As if by a miracle a cloud rolled in front of the sun just as the party approached a Joshua tree forest. The leader exclaimed, "Look brethren! The sky is no longer like brazen brass. God has sent the clouds. It is as if the sun stood still - as Joshua commanded. These green trees are lifting their arms to heaven in supplication. We shall call them Joshua trees. (Gates, 1984, pp. 17 & 18)

And so the legend relates, the pilgrims took this tree to be a symbol of their salvation. The use of the title Joshua tree was not seen in print until the 1920s and 1930s. Prior to that it was called the Yucca tree, Yucca Palm, Yucca cactus, or Tree Yucca (Peattie, et al., 1991).

In 1974, Munz, calls a Joshua tree stand "an outstanding example of so strange and beautiful forest." Scientifically, however, he placed the Joshua tree in the Agavacea family, genus yucca, species brevifolia. The Jepson Manual of 1993 classifies the Joshua tree in the family Liliaceae (lily), genus Yucca, species brevifolia. Yucca brevifolia, commonly
known as the Joshua tree, has intrigued scientists, artists and poets through the years. Others have seen the tree as a way to get rich.
**Twentieth Century Uses**

Humans have found many uses for the Joshua tree. Early pioneers in the Mojave desert used the trunks to build fences and corrals. An example of this may been seen today at the Desert Queen Ranch in Joshua Tree National Park. Twentieth century uses of the Joshua tree were more entrepreneurial than those of the American Indians, Spanish or pioneers. One creative gentlemen was said to have added ground up Joshua wood to cause beer to foam more rapidly and to create a fluffier meringue from egg-whites (O'Neal, 1981).

An English visitor to the Mojave convinced himself that the Joshua wood, because it was so pulpy, could be converted into paper.

In 1884, a Los Angeles newspaper announced that the Atlantic and Pacific Fibre Company was accepting a limited number of serious investors for the production of the new "California Cactus Paper" (Cates, 1984). Two versions exist as to the fate of this venture. One version is that by the time enough bales had been produced to fulfill the contract, the time limit had expired. The buyer refused to accept the time delay and canceled. The bales remained on a dock in Los Angeles Harbor, where they eventually spoiled and were dumped into the ocean. The other story has the pulp stored inside the hold of a ship that encountered fierce Atlantic storms. By the time the ship reached Britain, the bales mildewed and had to be dumped. Regardless of which story is true, the venture became a financial fiasco (Gossard, 1992).
Other enterprises were to use the light weight pulp as medical splints and as artificial limbs. Another potential entrepreneur thought to use the thin strips of bark as veneer wall covering in place of wall paper. Such attempts to capitalize on the Joshua tree were probably honest attempts at making a profit (Gossard, 1992).

The Joshua trees of Antelope Valley were the subject of a fraudulent real estate promotion. In 1885 the railroad began a promotion of southern California. Towns in the Inland Empire were using citrus groves to promote the sales of their lands.

With this in mind, the promoters did some creative pruning of the Joshuas, shaping them into a certain degree of uniformity then shipped out a car load of cheap wind-fall oranges and, on the end of the bayonet-like leaves, impaled the citrus fruit...Many lots were sold that day and the would-be developers took off with the money. No deeds were recorded and the sad little oranges on the Joshua trees withered as did the dreams of who bought into this desert citrus utopia. (Gossard, 1992, p.73)

Considering some of the schemes devised to exploit the Joshua tree, it’s a wonder it survives today. But, survive it does as the majestic, mis-shapened, lonely, ungraceful, inspirational symbol of the Mojave desert.
DESIGN OF PROJECT

This unit is divided into three parts. The first portion consists of ten lessons which are designed for classroom use. After each lesson, students are encouraged to write in a personal journal. Journals provide students with an opportunity to evaluate what they have learned and to summarize what they have learned from that particular lesson. Students should also be encouraged to make a list of new words and concepts they have learned and their meanings.

The second section is for in-park use and is dedicated to observing the Joshua tree in its natural habitat, Joshua Tree National Park. It is recommended teachers take their students on a field trip. Arrangements can be made through, Joshua Tree National Park, Education Office, located at Black Rock Canyon Campground. If that is not possible, it is recommended students view the video, "Joshua Tree National Park" and take a nature walk to an undisturbed area where students can visit a Joshua tree. The video is available for a two-week loan from the Joshua Tree National Park, Education Office, located at Black Rock Canyon Campground. Or for purchase at Joshua Tree National Park Visitors' Center in Twenty-Nine Palms.

The final section is to be used after the field trip as a post-visit activity. The Culminating Activity allows students to envision the future of Joshua Tree National Park and the role they can play in their vision.
This unit is designed to focus on the following issues:

- The Joshua Tree Habitat
- A Healthy Desert
- Our responsibility to the desert

The science concepts incorporated into this unit are:

- Plants and animals have structures that serve different functions in growth, survival, and reproduction.
- All organisms need energy and matter to live and grow.
- Organisms can survive only in environments in which their needs can be met.
- Living organisms depend on one another and on their environment for survival.

The social studies concepts in this unit are:

- Identifying geographical features found in their local region
- Tracing the ways in which people have used the resources of the local region and modified the physical environment
- Examine the interaction of human beings and their physical environment, the use of land, and ecosystem changes in selected locales and regions.
The following strategies, which encourage students to use creative and critical thinking processes, should be utilized when teaching this unit.

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<thead>
<tr>
<th>Thinking Processes</th>
<th>Thinking Strategies</th>
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<tr>
<td>◇ Problem Solving</td>
<td>◇ Dialoguing ◇ Classify</td>
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<td>◇ Creative Thinking</td>
<td>◇ Predict ◇ Infer</td>
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<td>◇ Composing</td>
<td>◇ Recall ◇ Extend</td>
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<td>◇ Concept Formation</td>
<td>◇ Order ◇ Summarize</td>
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<th>Questioning Strategies</th>
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<td>◇ What if...? ◇ What might...?</td>
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<td>◇ Why do...? ◇ How might...?</td>
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<td>◇ Why is it likely/unlikely...?</td>
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<td>◇ Is it possible...?</td>
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These strategies will allow students to:

- Express, evaluate, and reevaluate their own opinions and comprehension;
- Expand their understanding of the given topic;
- Seek out and consider alternative viewpoints;
- Experience the dilemma of others by sorting through and weighing similar issues;
- Refine their understanding by accommodating and considering alternative perspectives and
- Demonstrate their understanding by considering relevant facts and issues.
APPENDIX B: PRE-VISIT LESSONS

Lesson One:

Establishing Prior Knowledge

Connective Theme: Adaptation is an inherited or acquired structure or function serving to fit a plant to its environment.

Purpose: To make students aware that plants and animals have structures that serve different functions in growth, survival, and reproduction.

Objective: Students will be able to understand that the shapes and structures of the Joshua tree are adaptations for survival and have functions.

Materials:
Blank white paper, pencil, crayons
Blank paper for journal writing.

Activity: Students should be given a blank sheet of white paper and instructed to draw and label a Joshua tree and its surrounding environment within about 5 feet including as many details as they can think of. They should be encouraged to draw animals, insects, etc. After this lesson, and subsequent lessons, students should be given an opportunity to write in their journals.
Bridge: After they have drawn and labeled their tree, they should write one or two paragraphs describing the tree, the details they have chosen to insert and the function or purpose of each item. This writing activity gives students a chance to write and draw about what they "know" about the tree and its surrounding area.

Save this activity as students will use this in their evaluation to correct any misconceptions they may have.
Lesson Two:

Literature Connection

Connective Theme: The interaction of human beings changes their physical environment, the land, and ecosystem in selected locales and regions.

Purpose: To encourage students to think about how they feel about the Joshua tree by using literature to stimulate dialog. Students will be relying on previous observations of Joshua trees in their neighborhoods or trips to Joshua Tree National Park.

Objective: Students will be able to:

• Begin to put into words their thoughts and feelings about the Joshua tree.
• Compare their thoughts and feelings with those of other students.
• Begin to visualize the Joshua tree in its natural habitat.

Materials:

• Duplicate Lesson 2, Pre-Visit Student Activity pages 1 & 2. One for each student.
• Pens or pencils.
Pre-Visit Activity Worksheet 1, Lesson 2

The Joshua tree ... is a clown, a villain, an elusive fairy, a grandfather, a witch — in fact it is everything and anything you wish to make of it.
—Randall Henderson, 1968

The Desert's Worth
The end of the night signals the dance with the dew
In a moment the sun will arise; this chance will be through.
Many creatures slink away, having been up through the night. Others begin to stir, to stretch, to scurry into the light.

The quail darts about, seemingly late for some meeting. As the birds in the trees call out their morning greeting.

Joshua trees stand tall, reaching up to the sky. Their shadows move slowly as the sun travels by.

I never get tired of watching this scene. The desert so beautiful, enchanting, serene.

There are many things to admire on this earth. And daily our deserts prove their unending worth.

Tiffany L. Keune, Yucca Valley, 1999
Activity: Read the two pieces of literature in Lesson 2 to the students. You may want to read each piece several times over so the students can grasp the vocabulary to emphasize the mood each author is trying to convey.

Lead students in a discussion about:

- How do they think the authors feel about the desert and the Joshua tree.
- What words do the authors use to convey a feeling?
- Do both authors feel the same way about the desert and the Joshua tree?
- Do students agree or disagree with the authors descriptions?
- What does the author of *The Desert's Worth* mean by 'worth'?
- What value is there in the desert?
- Do they agree with the human-like qualities Henderson gives to the Joshua tree?

Ask students to write on Lesson 2, Pre-Visit Activity page 2, descriptive words about the tree. Limit students to five minutes.

Bridge: After the five minutes of individual writing, have students share their word trees and discuss why they chose the words they did. Display these visual word trees in the classroom, saving them for a later activity.
**Evaluation:** Each student should have successfully filled in their tree with ideas and descriptive words.

**Extension:**

Language Arts: Students could classify their words into parts of speech. For example nouns, adjectives or verbs.

Science: Discuss with students the type of animal the author is referring to when she writes:

"Many creatures slink away, having been up through the night. Others begin to stir, to stretch, to scurry into the light."

**Teacher Notes:**

Nocturnal animals are active mainly during the night. Desert animals exhibit this behavior as a way of escaping the heat.

Diurnal animals are active mainly during the day time. These animals have adapted to the heat by being able to keep themselves cool or require less water.

Crepuscular animals are active at dusk and just before sunrise.
Pre-Visit Activity, Worksheet 2, Lesson 2

Name

Directions: In the space, write as many words as you can think of to describe this tree.
Lesson Three:

Habitats

Connective Theme: Organisms can survive only in environments in which their needs can be met.

Purpose: To make students aware of how their habitat meets their needs and how desert animals needs are met within that habitat.

Objective: Student will be able to
• Identify the four elements of a habitat; Space, food, shelter, water
• Identify three elements in a desert environment that can be used as shelter for an animal.
• Identify three elements in a desert environment that can be used as food for an animal.

Materials:
• Blank sheet of paper for each student.
• Copies of Pre-Visit Worksheet page 3, Lesson 3.

Activity: Put two words on the chalkboard so that a list can be made under each: Need - Want. Ask students what they need in order to live. To help students thoroughly understand this concept, ask if they would still be alive if they did not have _______? Needs: we cannot live without. Wants:
would like to have, but can survive without. Students will brainstorm things they need or want. They will then, on Pre-Visit Worksheet Page 3, Lesson 3, divide this list into things needed for survival. Limited English students should be encouraged to draw pictures.

Students will probably report they would need their electronic games, television, etc. The teacher should ask students what if there were no electricity? What do you think we would do then? Guide students through this process of elimination with questions such as; How would you protect yourself from the weather? The more difficult of the concepts for students to grasp is the need for space. Asking questions about where they would put their shelter: this will lead them to conclude they need ground area or space. Encourage students to understand further this by confining a group of students to a space. Tell them they would have to live there for the rest of their lives. You would supply them with food, water and shelter. Could they stay in that space for the rest of their lives?

**Bridge:** Students should draw a map of their school and mark the location of food, water, shelter and space to determine it is a good habitat. Their map should include a key with symbols to identify where each need can be met.
Pre-Visit Worksheet 3, Lesson 3

Name ______________________________________

Things I need.  Things I want.

What 4 things are necessary for my survival?
Lesson Four:  
Healthy Habitats

Connective Theme: Organisms can survive only in environments in which their needs can be met.

Purpose: To make students aware of what desert animals’ habitats are and the importance of keeping it healthy.

Objective: Student will be able to:
• Identify the four elements desert animals need to survive.
• Identify how the Joshua tree provides these elements for many desert animals.

Materials:
Blank paper for drawing

Activity: Students have identified, from the previous lesson, the four elements they need for their survival. Ask if they think all animals need the same four elements and why. Explain to students that these four elements make up a habitat. Ask them to consider which of these four elements a Joshua tree could provide an animal. Ask students which animals they think use the Joshua tree for their habitat. Question students about the effect a fire that burned Joshua trees would have on these animals. Although fires occur in
nature, many fires are caused by humans. Fire is an example of how naturally a healthy habitat changes to unhealthy for the animals that relied upon the Joshua tree. Solicit from students examples of what human actions can cause a habitat unhealthy.

**Bridge:** Ask students to look around their neighborhood for evidence of animals and animal habitats on or near Joshua trees. Instruct them to draw pictures and describe what evidence they’ve seen of an unhealthy habitat. Discuss which of these may have been caused by humans.

**Evaluation:** Students pictures should confirm they understand the concept that people and animals need the same four things: space, shelter, food and water. They should also show evidence of unhealthy conditions on or near the Joshua trees.
Lesson Five:
The Flow of Energy

Connective Theme: All organisms need energy and matter to live and grow.

Purpose: The sun is the origin of energy. Plants receive the energy from the sun. Plants then are the primary source of energy entering food chains.

Objective: Students should understand that the sun is the primary source of all energy used in an ecosystem.

Materials: Pre-Visit Worksheet 4, Lesson 5

Activity: Explain that the sun is the primary source of energy. Green leaves contain chlorophyll. The leaves take carbon dioxide from the air, and the roots take in water and nutrients from the soil. It is the energy from the sun that causes the chlorophyll to change the water and carbon dioxide into the food plants need to grow.

Herbivores eat plants. Carnivores then eat the plant-eating animals. Energy from the food the herbivore took in is transferred to the carnivore. The energy which started with the plant eaten by the herbivore, changes form as it travels through the ecosystem, but none has been created or destroyed. Provide students with Pre-Visit Worksheet 4, Lesson 5.
The sun provides energy for all living things on earth. As you sit quietly or sleep, your heart is beating and you are breathing. These activities require energy. The energy you need comes from the food you eat. And where did the energy come from that is in the food you eat? From the sun. Plants make and store energy from the sun. Some animals eat the plants, thereby getting energy from the plants. Some animals eat plant-eating animals to get their energy. This is a simple food chain.

Of the total amount of sunlight, only a small amount reaches the earth. The larger amount is reflected into the atmosphere in the form of heat. Sunlight is the primary source of all energy used in an ecosystem. Follow the flow of energy as it moves through the ecosystem. Then fill in the boxes below the definitions with examples of plants and animals. You may use words or pictures.

Energy »»»»» flows from the sun.

Energy »»»» flows from the sun.

- Green Plant Eater
- Plant Eater (consumer)
- Meat Eater (consumer)
**Bridge:** Students should once again return to their vocabulary trees and add any vocabulary words they wish to. They should also return to their trees and identify that the termite is a decomposer.

**Evaluation:** Using the worksheet, check to see if students have correctly placed plants and animals in the chain.
Lesson Six:
Food Chain

Connective Theme: Plants are the primary source of matter and energy entering most food chains.

Purpose: To make students aware that the Joshua tree is the primary source in this desert food web.

Objective: Students will understand the food web supported by the Joshua tree.

Materials:
Pre-Visit Worksheets 5-9, Lesson 6
Pre-Visit Worksheets 10, Lesson 6

Activity: Students should read Student Activity pages, Lesson 5. This explains the concepts needed to understand the food chain. Students should be asked to draw their own picture of the food chain based on the picture and their reading. Teachers should be sure to explain to students that a ‘food web’ is not a ‘food chain.’ A food chain is simple where as a web is more complex.
Extension Activity: Have students predict what would happen to this food chain if one (example: night lizard) of the animals no longer existed. Discuss with students the importance of balance.

Bridge: Remind students of the four basic needs for survival. Ask if they can explain how the animals rely upon the Joshua tree for these things. You may want to group the students and assign one animal to each group. Have students write in their journals what they have learned.

Evaluation: Were the students able to show they understood the connection between the animals and the tree? Did the adequately describe how the needs of each animal are met?

Science Extension: Ask students to describe a desert food chain. An example of this would be:

    grass--> rabbit--> coyote
The Joshua Tree

HABITAT

The Joshua tree uses the energy from the sun, the nutrients from the soil, and rain water to grow. The desert is an area that receives little rain and has soil with very little nutrients. Nutrients are what the plant gets from the soil to grow. The Joshua tree doesn't need much water. It has adapted to the desert environment. The Joshua tree lives in the Mojave desert because that is where its needs are met. It could not grow in the cold or tropical rain forest. It has adapted to its desert environment.

ADAPTATIONS

Plants have adaptations or special features. Adaptations makes it easier for the plants to survive. The shape of the leaves, the leave's coating, the flowers and the root system all are the special features or adaptations of the Joshua tree which make it easier for it to survive in the Mojave desert.

One of the adaptations of the Joshua tree that is easy to see is its leaves. The leaves of the Joshua tree and most desert plants have a thick waxy coating. This is so water is not lost in the hot sun. They store water in the fleshy tissue of their sharp edged leaves.

The sharp-edged shape of the leaves helps to keep
Pre-Visit Worksheet 6, Lesson 6

animals from eating the Joshua tree. The leaves of the Joshua tree are 7 to 12 inches long when fully grown. They are different shades of green and clustered at the ends of the branches.

If the Joshua tree flowers, it depends on the amount of rain that has fallen. Flowering only when a plant has had enough water is an adaptation of desert plants. Because of this, Joshua trees don't flower every year, but when they do, it's in March through May. The flowers on the Joshua tree form at the end of these branches, between the leaves. The flowers are tulip-like and are white or cream colored. The petals feel like they have a wax coating and smell clean and earthy.

ANIMALS

Plants and animals that are found in a specific place or habitat live in a community. Just like humans, members of communities rely on each other. The Joshua tree community is a small one with members such as the night lizard, night snake, wood rat, pronuba moth, Scott's oriole, red-tailed hawk, and termites. They may feed on the plant or each other, but these animals depend on the Joshua tree for spaces to live, hide, and reproduce.

Animals such as the wood rat and termite eat only plants. They are called herbivores. Others, such as the red-tailed hawk and night snake, eat other animals and are called carnivores.
One way that members of a community are linked is through a **food chain**. The food chain of the Joshua tree looks like this:
The beetle eats the Joshua tree, and the lizard eats the beetle.

Joshua tree ►►►►►► Beetle ►►►►►► Lizard
Pre-Visit Worksheet 8, Lesson 6

In the Joshua tree community, the pronuba moth has a very special relationship with the tree. If there were no moth, there would be no Joshua tree. The moth relies only on the Joshua tree for food for its young. And, the Joshua tree relies completely on the moth to pollinate its flowers. When the moth pollinates the flowers, it fertilizes the growing seeds. Some of these seeds will grow to be new Joshua trees.

The desert night lizard makes its home under the dead leaves and inside decaying fallen branches where the termite lives. This light brown lizard eats the termites, the boring weevil and the pronuba moth. One to four lizards can live in one tree. The lizard is a source of food for the night snake and the red-tailed hawk. The hawk will eat the night snake and the wood rat. The wood rats build their nests at the base of the Joshua tree from sticks and fallen branches.

In, under and around the Joshua tree, these animals all have their four basic needs provided for: food, water, shelter and space.

When a community has enough space and food it is in balance. Any change in this will upset the balance. For example, if the tree burns in a fire, the animals that need that tree will either die or have to find food and shelter in a new place. A new food chain would have to be made, and that is not simple.
Vocabulary

carnivore - an animal that eats only flesh or meat.

community - a group of plants and animals that live together in one place.

desert - dry, sandy, or rocky area that receives little rain.

food web - a way of showing simple relationships between living things in a community, based on eating habits.

herbivore - an animal that eats only plants.

nutrients - the chemicals and minerals that are used by plants to grow.

omnivore - an animal that eats both plants and meat.

pollinate - to fertilize the flower of a plant.
Pre-Visit Worksheet 10, Lesson 6

Name

Find and circle the vocabulary words from Lesson six. The words read up, down, forward, backward and on a diagonal.

```
a e s t  n e i r  t u n f
d t c o m m u n i t y o
a a t a p a d m m o y o
p n h t r a r c d h t d
t i a m c n o y e e s c
l l p y u t i t s r o h
m l t s r y m v s m r a
o o c e l l m o o i e i
p p s v t d u e t r v n
y e r e s t y r o e e e
d h h e r b i v o r e m
```
Lesson Seven:

Life Cycle

Connective Theme: a) Producers and consumers (herbivores, carnivores, omnivores, and decomposes) are related in food chains, and may compete with each other for resources in an ecosystem. b) Decomposers, including many fungi, insects, and microorganisms, use matter from dead plants and animals.

Purpose: Students will gain an understanding of the connection between the animals and the Joshua tree. They should be able to explain the relationship of producers and consumers (herbivores, carnivores, omnivores, and decomposers) in the Joshua tree habitat.

Objective: Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms.

Materials: Refer back to Pre-Visit Worksheets 5-9, Lesson 6. Pre-Visit Worksheet 11, Lesson 7.

Activity: Teacher should have students refer back to the Student Activity pages from the previous lesson and then list the following vocabulary words on the board: producers, consumers, decomposers, herbivores, carnivores, and omnivores.
producer: plants that make their own food from: water, nutrients from the soil, and energy, almost always from the sun.

c consumer: organisms that depend on other organisms for food.

decomposer - organism that feeds on dead organic materials causing in to breakdown into inorganic material.

herbivore: an animal that eats only plants.

carnivore: an animal that eats only other animals.

omnivore: an animal that eats both plants and flesh.

Discuss these definitions with the students asking for examples of each. Include in the discussion the fact that decomposers are not always insects. Mushrooms, bacteria, molds, fungi and worms are examples of non-insect decomposers you may want to use. Share and explain to students the "Life Cycle of the Joshua Tree" worksheet. Ask if they can think of any animal they have just learned about that would belong in any of the steps.

Group students and ask them to complete the blanks of the worksheet with the list of animals who depend upon the Joshua tree. Students may want to use their notes from the previous lessons. Students should also identify each step as producer, consumer, or decomposer.
Bridge: Have students share with the rest of the class their cycles. Encourage students to imagine what would happen if this cycle were interrupted.

Evaluation: Check to see that students have correctly identified decomposers, consumers, producers, carnivores, omnivores and herbivores. Use Worksheet Pre-Visit Activity
Complete the steps of the life cycle of the Joshua tree using the paragraph below.

The desert and the Joshua tree depend on a natural circle of life called a cycle. This life cycle occurs continuously, and each step is important. As green plants grow, they use nutrients from the soil, sun and water. Some animals eat these plants. Larger animals then eat those animals. After a while, animals die, and their bodies decay. Plants also die and decay. This puts natural nutrients back into the soil.
Green plants use nutrients from the soil to grow.

1. Decaying bodies and wastes add nutrients to the soil.

2. Some animals eat plants.

3. Larger animals eat smaller ones.

4. Animals and plants die and then decay.

5. Extension: Students may want to write a cause and effect paper on an interrupted cycle. They should come up with their own causes and effects.
Worksheet 15, Pre-Visit Worksheet 12, Lessons 5, 6 & 7 Review

Name ____________________________________________________________

Use the vocabulary words from Lessons 5, 6 & 7 to complete the following sentences.

1. A ________________ is an animal that eats only the flesh or meat of other animals.

2. A ________________ is a way of showing a simple relationship in a community, based on eating habits.

3. To fertilize the flower of a plant an insect will ________________ the flower.

4. An animal that eats only plants is an ________________.

5. A dry, sandy, or rocky area that receives little rain is a ________________ biome.

6. A ________________ is a group of plants and animals that live together in one place.

7. The chemicals and minerals that are used by plants to grow are _________________________.

60
Teacher Pre-Visit Worksheet 12, Lessons 5, 6 & 7 Review

Name __________________________

Use the vocabulary words from Lessons 5, 6 & 7 to complete the following sentences.

1. A carnivore is an animal that eats only the flesh or meat of other animals.

2. A food chain is a way of showing a simple relationship in a community, based on eating habits.

3. To fertilize the flower of a plant an insect will pollinate the flower.

4. An animal that eats only plants is an herbivore.

5. A dry, sandy, or rocky area that receives little rain is a desert biome.

6. A community is a group of plants and animals that live together in one place.

7. The chemicals and minerals that are used by plants to grow are nutrients.
Lesson Eight:

Animals of the Joshua Tree

Connective Theme: Plants and animals have structures that serve different functions in growth, survival, and reproduction.

Purpose: Students will be aware of the differing physical adaptations of animals that rely upon the Joshua tree.

Objective: Students will be able to identify at least four physical adaptations animals have in order to survive in the Joshua tree community.

Materials: Student Activity pages, Lesson 8

Activity: Students should be asked what adaptations they have which help them survive. How do animals do the same things they do to survive? An example would be, teeth for chewing. They should then compare their physical attributes for survival, with those of animals. Example: the Red-tailed hawk has a sharp beak for tearing flesh. Humans have teeth that chew the food.

Students should then be grouped. Each group will be given a description card of a particular animal. They will then be asked to draw a picture of their group's animal
making sure they include the physical attributes, claws, teeth, wings, etc., each animal has to survive in the desert. Students should include the physical characteristics of the animal including size, color, shape. Remind students that to survive, they must have all four of the elements for survival met. An additional element of this activity could be to have students identify how each particular adaptation helps survival in the desert environment.
### Animal Descriptions

#### Termite
A termite is a light-colored insect that lives in and eats dead wood. The termite digests dead wood with the bacterium in its intestines. This process returns minerals to the soil. The termite is eaten by the desert night lizard and birds that live around the Joshua tree.

#### Yucca Night Lizard
The Yucca night lizard lives in the dead leaves and branches of the Joshua tree. This light brown lizard can change to a dark brown. It eats termites, boring weevils and yucca moths. It feeds in the early morning and late at night. The lizard is food for the red-tailed hawk and the screech owl.

#### Wood Rat
The wood rat builds huge nests in the shade from fallen leaves from the Joshua tree and other nearby plants. The wood rat eats small plants, cactus and fallen fruits. It is a very fast runner and able to maneuver in and out of small places. It is eaten by the red-tailed hawk and the owl.
Scott's Oriole
This yellow and black bird builds its cone shaped nest under the branches of the Joshua tree from the fibers of the leaves. This bird eats seeds, insects and the petals and nectar from the Joshua tree's flowers.

Ladder-backed Woodpecker
This bird makes its home in the soft dry wood of the standing dead Joshua trees. It likes the dead trees because it can use its beak to make a nest in the tree easier. Its name comes from the very dark brown and light brown striped along its back. The woodpecker eats insects and seeds. It also eats insects from live trees.

Evaluation: Have students correctly included each physical characteristic? Do they understand that different animals have different characteristics?
Bridge: Students should give an informal oral report to the rest of their class about that group's animal. They should be given an opportunity to answer questions from other class members. Comparing their drawings, students should conclude that all of these animals have adapted to the desert environment. Each have special traits that allow them to survive.

Extension: Students can compare animals from other habitats and their adaptations. Students may think of, perhaps the polar bear and its coat of white and discuss why it could not live in the desert. Use examples of many animals (whales, porcupines, seagulls) from other habitats and discuss why they could not live in the desert.
Lesson Nine:

Mutualism and the Joshua Tree

Connective Theme: a)Living organisms depend on one another and on their environment for survival. b) Organisms can survive only in environments in which their needs can be met.

Purpose: Many plants depend on animals for pollination and seed dispersal. Animals depend on plants for food and shelter.

Objective: Students will understand the concept of mutualism and be able to apply it to the Joshua tree’s relationship with the yucca moth.


Activity: Students will look at the picture of the yucca moth pollinating the flower of the Joshua tree. Ask students what they see and what can conclude is happening in the picture? Read the following to the students:

The story of the Yucca or Pronuba moth and the Joshua tree is a classic example of mutualism. Mutualism is when two organisms depend on each other for survival and both benefits. In this
case, the tree and the moth.

Lilies, like all flowers, need to be pollinated so they may reproduce, or make seeds for new trees. The Joshua tree is a member of the Lily family. Insects, rather than wind, do this job because of the nature of the pollen. Instead of being dusty and dry like the pollen of a pine tree, the pollen of the lily is sticky and needs an insect to do the specific job of transporting the pollen from one flower to the next.

Yucca moths fly at dusk when it is attracted to the white yucca blossoms. Collecting pollen from one flower and working it into a tiny ball, the female moth fly to other flowers to get more and more of the sticky pollen until she has the right amount. While she’s doing this flying about, pollen is sticking to her feet. When she goes from flower to flower she tracks the sticky pollen from one to the next.

Now she prepares to lay her eggs. She does this by using her ovipositor, a needle-like, egg laying organ, into the style. The style is the tube in the center of the flower. Down the tube she pushes her pollen ball until it reaches the ovary. The
ovary is the part of the flower where ovules are waiting to be pollinated and become seeds.

With her ovipositor, she pokes a hole in the ovary where the ovules are. These pollinated ovules will now become seeds. When the pollinated ovules are becoming seeds, the moth’s eggs will hatch into a worm-form called larvae. They eat only a few of the ovules until they are strong enough to fly away. The only way the Joshua tree can change the ovules to seeds is if the moth pollinates.

The moth must have the Joshua tree to lay its eggs in and the Joshua tree must be pollinated by the moth so it may make seeds to reproduce. In this relationship, both organisms depend on each other and benefit. This is mutualism.

Using the Flower of the Joshua tree diagram, Pre-Visit Worksheet 15, Lesson 9, students should draw a 4 step diagram showing they understand the steps of the process. You may need to read the paragraphs to the students again. Students should be good listeners during this activity.

Evaluation: After they’ve shown they understand the steps through drawing, students will write a sentence explaining each step of the process. They should use words such as
first, second, third, showing they understand the order of events.

Extension: Students can write a cause and effect paragraph based on the facts in the article. Or, they can write a story as if they are a reporter, reporting the events of the great mutualistic relationship.

Bridge: Students should look back on their first drawings of the Joshua tree and see if there’s anything they’d like to add to their drawing. This is a good point in the unit to take a second look at their vocabulary trees. Perhaps they might want to add more words. As always, at the end of each lesson, students should be encouraged to write in their journals what they’ve learned.
The female Yucca moth (*tegeticula*) pollinates the Joshua tree flower.
Lesson Ten:
Joshua Trees for Sale

Connective Theme: Tracing the ways in which people have used the resources of the local region and modified the physical environment.

Purpose: To examine the interaction of human beings and their physical environment; the use of land, building of cities, and ecosystem changes in selected locales and regions.

Objective: Students should see that the Joshua tree can be useful commercially without damaging the habitat.


Activity: Ask students to respond to the following:
The Joshua tree is a natural resource. A natural resource is something found in nature that is valued by humans. If you were asked to put a price on the Joshua tree, how much would you say it’s worth?

Explain to students that natural resources are often used for commercial purposes. Commercial use of natural products are when things are made and sold for a profit. The focus is on sales appeal, rather than natural beauty. Solicit from students examples such as cotton for their clothing, the
wood the desks are made of, even the metal of their pencils all come from nature and are used by humans to make a profit. Read the following from Helen Gossard’s 1992 book, The Joshua Tree, (p.70) to the students about past commercial uses of the Joshua tree.

An English visitor to the Antelope Valley became convinced he was the right person. While touring the area he became interested in the strange looking ‘desert palm trees’ especially after hearing the wood was very pulpy. Convinced that under the right circumstances, the Joshua tree could be converted into paper, he contacted some of his colleagues residing in Los Angeles and the United Kingdom. They too became excited about the possibility of a fortune. In 1884, a Los Angeles newspaper announced that the Atlantic and Pacific Fiber company...was now accepting a limited number of investors for the production of a new ‘California Cactus Paper’. Crews of Chinese laborers were brought to the Antelope Valley to cut down Joshua trees. Some of the trees were converted into pulp while other Joshua tree logs were exhibited at agricultural fairs across the country... Eventually, the company shipped the baled pulp to Los Angeles for shipment to England...

Two versions exist as to the fate of this venture. One states that by the time enough bales had been produced to fulfill the contract, the time limit had expired. The buyer refused to accept the delay and the bales remained on a dock at Los Angeles Harbor where they spoiled and were dumped into the ocean. The other story is that the pulp was stored inside the hold of a ship that encountered fierce Atlantic storms. Although the ship and crew survived the storm, much of the cargo did not. By the time the bales reached its British port in November 1885, the dampened bales had become so mildewed, they had to be dumped. The business was a financial disaster. Everyone involved lost a great deal of money.
Another promising venture at commercializing the Joshua tree proved equally frustrating. Among the lessons early settlers learned from the Indians was to use the wood of the Joshua tree to make splints for those injured. Settlers also discovered that the wood, similar to Balsa, could easily be whittled and made into some artificial limbs. It was also used to raise the soles of shoes making it suitable for orthopedic uses.

In 1892 a factory was built for the purpose of using Joshua tree wood to manufacture splints and other orthopedic supplies. However, the products were never fully accepted by the medical profession. Some theorize it was because the wood could not be sterilized. Another financial disaster.

The woody exterior of the Joshua tree trunk is easily peeled away and the rind removed in sheets. One person thought to use these thin strips as wall covering in place of wall paper. A special machine was designed to shave the tree limbs and trunks as one would peel an apple. A thin strip of the Joshua wood came off in one long roll. The wood was attractive, but very pale and efforts to paint or stain it failed because the wood soaked up the paint. Not only did it consume too much paint, but when it dried, it shrank and shriveled while still on the walls.

Time after time the effort to commercialize the Joshua tree proved futile.

Discuss with students why they think these ventures failed. What could these people have done to prevent the loss of so much money, but more importantly, the loss of so many Joshua trees? How is the Joshua tree used for commercial purposes today? (Calendars, television commercials, post cards, sight seeing, etc.) The towns of Morongo Valley, Yucca Valley, Joshua Tree, Twentynine Palms, and cities of the lower desert, use these trees for commercial gain. The uniqueness and remoteness of the tree is
used in advertising to attract visitors to the area and Joshua Tree National Park. Visitors travel here from all over the world come to see this unique and wondrous desert plant. The people that own the nearby hotels, restaurants, and other business rely on the money these visitors spend.

**Bridge:** Ask students to think of when or were they have seen the Joshua tree used for commercial purposes. Have students draw a brochure trying to "sell" the Joshua tree in its natural habitat. Students should concentrate on attracting visitors to come and see this unique, desert beauty in its natural habitat. Display these in the classroom or around the school to share what students have learned so far about the Joshua tree.

**Evaluation:** Have students shown, through their brochures, a respect and understanding of the Joshua tree?
APPENDIX C: THE JOSHUA TREE HOTEL

This portion of this educational unit is for in-park use at Black Rock Canyon Campground and Nature Center. Arrangements for a field trip can be made by calling or writing:

Joshua Tree National Park
Black Rock Canyon Education Center
9800 Black Rock Canyon Rd.
Yucca Valley, CA. 92284
(760) 365-2371

Please note that these are ranger-guided lessons. Teacher responsibility is included. Park staff will coordinate lessons according to this plan; however, teachers are ultimately responsible for their students at all times while at Joshua Tree National Park.

Timing: 3 hours

Grade Level: 3rd - 4th

Type of Program: Natural History

Theme: The Joshua Tree is a unique tree that many desert animals depend upon for survival.
Goal: To help students understand the importance of the Joshua Tree in the Mojave Desert ecosystem and how other animals depend upon this tree.

Objectives: Students will be able to:
1. Identify three animals that depend upon the Joshua tree and how those animals used the tree for survival.
2. Explain the Joshua tree life cycle.
3. Explain where a Joshua tree can be found and why.
4. Look closely at a Joshua tree and explain how certain animals, people and other plants relate to that tree.

Materials: Teacher will need to bring: Thermometer, watch, emergency phone number for each student
Students Need to Have: lunch, water, walking shoes, appropriate dress for weather
Park Staff Will Bring: paper, workbook, boards, pencils, rulers, magnifying glasses, measuring devices

Summary of the program: Students learn about the Joshua Tree and how this plant provides food, shelter, recreation, and a meeting place for the animals in the desert ecosystem; much like a hotel provides for humans. This will be accomplished through hiking and exploring what animals use "Lily," a stuffed Joshua tree. For the afternoon, students will be working with their chaperones in groups completing a worksheet about a Joshua Tree.
For post-visit activity three, teachers should note arrival and departure time and temperature.

**Timing:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Hike</td>
<td>90 minutes</td>
</tr>
<tr>
<td>Lily and Her Friends</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Lunch</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Adopt a Joshua Tree Activity</td>
<td>30-40 minutes</td>
</tr>
<tr>
<td>Review</td>
<td>10 minutes</td>
</tr>
<tr>
<td><strong>Total Time</strong></td>
<td><strong>4 hours</strong></td>
</tr>
</tbody>
</table>

**Important Information:** Students need to be separated into groups and assigned a chaperone. Chaperones will be responsible for helping students complete activities.

**Pre-Visit Activities:** In order to make this trip as enriching as possible for the students, prior to your trip, students should have been given the opportunity to complete the pre-visit unit. If this is not possible, at a minimum, students should complete the following:

**Lesson One:** Describe a Joshua Tree. Students do a prewrite on what they "know" about the tree, its habitat, shapes and surrounding area.

**Lesson Two:** Draw - it. Prior to the trip students should draw the Joshua tree with as many details as they can include.
Lesson Three: What's In a Hotel. Students list what a hotel provides to humans.

**Introduction:** (30 minutes) Upon arrival, a National Park Ranger will assemble students into the large room and have them sit on the floor in the center. The Ranger will:

- Ask how many of the pre-visit activities from the unit students were able to complete.
- Begin a list of adjectives, preferably one from each student, describing the Joshua tree.
- Ask for volunteers to identify any of the animals they see on the posters.
- Solicit comments from students about the animals.

A discussion will follow where the Ranger will write each animal's name on the board and, next to it, list the things that animal needs in order to survive. The Ranger will share interesting facts about the animals to build on the students' knowledge.

When the list is complete, students will identify the similarities of the lists. Students will then be led to conclude that these are the elements of a healthy habitat: food, water, shelter, space. Students will be asked how humans provide for these same needs. The group will then discuss how these needs can be met at their home or in a hotel. For some animals, the Joshua tree is similar to a hotel.
Activity One: Healthy Habitat Hike (90 minutes)
Prior to leaving the Visitors' Center, the Rangers will discuss the trail rules.
1. Stay on trail.
2. Stay with your group.
3. When we stop, it's time to gather and talk.
4. Take only pictures, leave only footprints.

Explain to students they are going to go on a habitat hike. During their hike they will stop often. While stopped they should be listening carefully to the Park Ranger. The Rangers will explain many interesting facts about the Joshua tree. While walking, students should use only their eyes and be looking for signs of animals and animal habitats. Chaperones will take a trash bag to hold any trash picked up along the way. Students should not touch or disturb anything.

Activity Two: "Lily" and Her Friends (30 minutes)
After the hike, students will return to the Nature Center. "Lily" will be set up without her friends. Students will share some of the things they learned about the Joshua tree on their hike. The Ranger will then put animals on "Lily" and ask students how each animal uses her or depends upon her for their survival. Students will be asked how "Lily" is like a hotel.
Lunch (30 minutes) When lunch time is through, chaperones and students should scan the area to make sure no trash has been left about.

Activity Three: Take a Closer Look (45 minutes)

Students will need their clipboards, pencil, lens, and workbook. Students will, in their groups, find a Joshua tree and become an expert on that tree. Groups are to find and carefully observe their Joshua tree within the assigned area only. They will study the tree and complete their workbooks. Remind students that only they can answer questions about their tree.

In their workbooks, students are asked to:

* Draw a picture of their tree, including small details.
* Observe whether or not their tree is alive and what led them to this conclusion.
* Answer as to the health of the tree.
* Draw a picture of a leaf and describe its smell.
* Notice if the tree has any fruits, nuts, or seeds and what they look like.
* Describe what the “bark” feels like.
* Notice if there are any signs of animal life including insects.
* Look for holes, nests, or trails.
* Measure the tree’s height, circumference, and estimate age.
* Give the tree a name and birthplace.
* Identify one interesting thing about their tree.
Activity Four: Sharing (20 minutes)

Students will reassemble in the large room. Students will then be given an opportunity to share and compare notes about their group's tree.

Activity Five: Conclusion (5 - 15 minutes)

The Ranger will discuss with the students why National Parks are good places for habitat protection. The Ranger at this point will, time permitting, give a brief history of Joshua Tree National Park.

Evaluation: Back at school, have students redo the prewrite and draw-it Pre-Visit activities to include information they learned on their trip.
APPENDIX D: POST-VISIT LESSONS

Lesson One:

Hotel Joshua Tree

Students draw a Joshua Tree and add the animals that depend on the tree for survival. They should write a few paragraphs describing how a Joshua tree is like a hotel.

Lesson Two:

Draw-it, Describe-it

Students should be given a clean sheet of paper and be asked to re-do Pre-visit Activity Two. They will draw and describe the Joshua tree using their notes and observations from the trip as well as their vocabulary tree. This should be used as post-unit evaluation.
**Lesson Three:**

**Write-it**

**Purpose:** Reading old diaries is one way researchers learn about the past. Explain to students that diaries are usually personal and private. For the purpose of this assignment, students are going to be writing as if they are scientists recording the event for future generations.

**Objective:** Students should be able to differentiate fact from opinion.

**Materials:** Notes from field trip where teacher noted arrival and departure time and temperature. Student workbooks from trip.

**Activity:** The teacher should begin by writing two sentences on the board about the weather the day of the trip. One should be an objective statement (a fact). For example, April 19, the day of our field trip to Joshua Tree National Park, the temperature was 72 degrees. The other sentence should be a subjective statement (an opinion). For example, April 19, the day of our field trip to Joshua Tree National Park, it was a beautiful, warm day. Ask the students which sentence tells a fact (something that is true and can be proven), and which is an opinion (something someone thinks or feels).
Explain to the students that they are going to be writing as if they are scientist. Ask if they think a scientist would write about facts or their opinions. Scientist write their observations based on facts.

Students should be encouraged to use their workbook from the day's trip to help them with this assignment. The teacher should discuss with the students factual events from the day. Time of arrival, departure, temperature, number of people, Ranger's name, width of their tree, etc. Students should organize these facts based on chronological order using Post-Visit Worksheet 16, Lesson Three. Using words such as first, second, last should be encouraged. Once students have completed their prewriting activity, they should move on to a first draft. Encourage students to edit their writing for spelling and grammar errors, but the goal should be understanding the order of events. A neatly written, final draft should be used for evaluation.

**Evaluation:** Students' writing should not include opinions, but be factual. The order of events from the day's trip should be correct. Check to see that students understand the difference between fact and opinion.
Post-Visit Worksheet 16, Lesson 3

Name_____________________________________

List events from the day's trip in the order they happened. You may not need all the lines. After writing them in order, rewrite these facts neatly in the paragraph form.

1. _________________________________________

2. _________________________________________

3. _________________________________________

4. _________________________________________

5. _________________________________________

6. _________________________________________

7. _________________________________________

8. _________________________________________

9. _________________________________________

10. __________________________________________
Lesson Four:
Human Impact

Connective Theme: People have used the resources of the local region and modified the physical environment.

Purpose: Students will infer that humans and animals share the same space.

Objective: Students will understand that the actions of humans have an impact on wildlife.

Materials: Post-visit Activity Four worksheets, pages 14 & 15. Blank paper for writing

Activity: One: Students should be given Worksheet 17 and asked to fill in as many spaces as they can. They will list ways the particular people might help or harm Joshua Tree National Park.

Two: Students should be given Worksheet 18. They will fill in the circles describing activities that take place in the National Park by both humans and animals. Then have students answer the questions at the bottom of the worksheet. What does the final question on Worksheet 18 lead students to conclude? Discuss with students how animals need Joshua Tree National Park, humans use it. Then, discuss how human activity can have an affect on animal activity.
Students should write a paragraph about their discussion. The teacher should ask students to consider which human activity could have a greater impact on an animal's activities.

**Bridge:** How do humans help or harm the desert habitat of Joshua Tree National Park? What can students do to help Joshua Tree National Park?

**Extension:** Have students predict what they think Joshua Tree National Park will be like when students are 40 years old.

**Culminating Activity:** Students should draw a picture of what they envision Joshua Tree National Park looking like forty years from now. Have students write one paragraph describing what they can do to ensure this vision.
Think of ways these people might help or harm Joshua Tree National Park. An example has been done for you.

<table>
<thead>
<tr>
<th>Person</th>
<th>Ways to Help</th>
<th>Ways to Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camper</td>
<td>The camper appreciates the beauty of the Park. They stay in areas set aside for people and pick-up trash.</td>
<td>Smoke from campfires pollutes the air and could cause fires.</td>
</tr>
<tr>
<td>Rock Climber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>You</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Animals and human both use Joshua Tree National Park. In each circle, write a human or animal activity beneath the heading. Then answer the questions below.

**Joshua Tree National Park**

Which of the animal activities you listed is a need?

Which of the animal activities you listed is a want?

Which of the human activities you listed is a need?

Which of the human activities you listed is a want?

Which group, humans or animals need Joshua Tree National Park?
Adopt a Joshua Tree

Official Tree Name

Birthplace

Circumference  Height  Age
(How big around)  (how high)

Identifying Characteristics

Adopted By  Date

One Especially Interesting Thing About My Tree is:

Name
In your group, find a Joshua Tree and sketch your tree in the space below. Remember to look for details and draw them in your picture.

Write a poem or a few sentences describing your tree.

Questions about your tree. Be sure to answer!

Is your tree alive? How can you tell? Is it healthy?

In what ways are people helping or hurting your tree?

Draw a picture of a leaf from your tree. How does the leaf smell?

Does your tree have any fruits, nuts, seeds? What do they look like?

How does the bark of your tree feel?

Are any animals on or near your tree? Don’t forget to look for insects, spiders, and other small animals.

Look for holes, nests, trails, and other animal signs. How do animals depend on your tree?

BIBLIOGRAPHY


