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Mojave Desert issues: A high school curriculum

Bruce William Bridenbecker

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MOJAVE DESERT ISSUES: A HIGH SCHOOL 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
Bruce William Bridenbecker
June 1997
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Approved by:

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ABSTRACT

Mojave Desert Issues is a high school curriculum designed to use environmental issues as a learning tool. In this curriculum students analyze players and positions, beliefs and values, and propose solutions to real-life environmental issues. The issues were chosen by staff from the four National Parks located in the Mojave Desert. Death Valley National Park staff chose groundwater encroachment; Joshua Tree National Park staff chose the establishment of the Eagle Mountain Landfill; Lake Mead National Recreation Area staff chose the impact of wild burros on park ecosystems; and Mojave National Preserve staff chose accessibility in wilderness areas. After the development of the curriculum, each of the lessons were reviewed by National Park Service personnel and field tested at local schools.
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DEDICATION

Dedicated with love to my wife Robin,
My children Charity, Moroni, Hope, and Faith,
To every Desert Rat
that has gone before and will follow me,
And of course to the God who made us all.
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INTRODUCTION

As the fingers of daylight disappear into a brilliant reddish-orange sunset, I hear the familiar call of the Gambel's Quail. Their cries echo from nearby yuccas as they prepare for the encroaching nightfall. Joshua Trees silhouette the landscape, and the distant howl of a coyote offers a serenity that one can only experience in the majesty of the Mojave Desert.

"Many people say that they 'love' the desert, but few of them love it enough to live there. Most people 'love' the desert by driving through it in air-conditioned cars, 'experiencing' its grandeur" (Reisner, 1986, p. 4). As suggested by this quote, few people would disagree that the desert suffers from an image problem. A vast majority visualize it as a barren waste land whose sole purpose of existence is to wreck havoc on those poor souls who have the misfortune of being forced to traverse it. Many view it as a gigantic, indestructible playground. Some are beginning to view it as a fragile ecosystem whose delicate balance is rapidly approaching crisis. Finally, there is that rare breed of individual who openly embraces the area and covets the designation "desert rat." It is from the last two perspectives that I approached Mojave Desert issues.

As a graduate student, I wanted to gain a thorough understanding of major issues facing the Mojave Desert. As a teacher, I wanted to guide others into not only a basic appreciation of the desert, but also into an understanding of some important issues that it is currently facing. It is
from these perceptions, and the desire of the National Park Service to develop a Mojave Desert issues curriculum for high school students, that this project emerged.

Once the focus was established I began to learn as much as I could about the area’s natural history, geology, biology, natural resources, use, and human dependence and impact on the desert. Early on the scope narrowed from Mojave Desert issues to a single issue chosen by each of the four desert areas overseen by the National Park Service in the study area. Each one chose its own issue: 1) Death Valley National Park staff chose ground water encroachment; 2) Joshua Tree National Park staff chose the adjacent Eagle Mountain Landfill; 3) Lake Mead National Recreation Area staff chose to address wild burro management; and 4) Mojave National Preserve staff chose accessibility and its impact on local land-holders and visitors.

Before these issues could be addressed, background information needed to be presented. This was accomplished through the development of a seven part curriculum. Each part was designed to build upon its predecessor resulting in a culminating activity which engaged students in the learning process as they constructed new knowledge and ideas. In the end, I became the collator of information from many sources, and the designer of a desert curriculum. It was an immense task of which I hope the end result is students who are aware and knowledgeable about the environment, the ecology, and some of the issues facing the Mojave Desert. Further, it is my desire that students accept the challenge of taking
action, realizing that they can make a difference.

As is the case in any research project, for me this has been a time of immersion in a multi-faceted topic which extended far beyond the scope of this work. It has rejuvenated my "love" for the desert and enhanced my appreciation for those that work with it in their many and varied capacities. It has reiterated the complex ecological and political nature of deserts and the difficult task for those responsible for the stewardship of it.

I believe the information gathered here will benefit both students and educators alike. Because the target audience is primarily composed of desert dwellers, the benefits of this curriculum can not be overrated. My desire is that this curriculum will touch the reader's life in such a way that the reader will "buy into" the environmental ethic and become a steward of the earth.
HISTORICAL PERSPECTIVE

Geology
In its simplest definition, geology means the study of the earth. Norris and Webb (1990) have described it as the physics, the chemistry, and the biology of the earth over time. This definition makes it a third-order science or one which is dependent upon the more basic sciences. Because geologic history goes back the furthest in time it is the best place to begin any discussion on Mojave Desert History.

California is divided into a number of geomorphic provinces (Figure 1). A geomorphic province is defined as a topographic-geologic grouping of convenience based primarily on landforms, structure, and erosional history (Norris & Webb, 1990). Each province tells its own piece of the geologic story and when these pieces are put together they paint a picture of an earth in which continents collide and rip apart.

Figure 1 The Geomorphic Provinces of California
The Southeastern Provinces include the Mojave Desert, the Colorado Desert, and the Basin and Range. The region around Lake Mead, which includes Southern Nevada and Northeastern Arizona, is considered part of the Basin and Range Province. The following synopsis focuses on these provinces.

In the Mojave Desert, the pages of geologic history go back about 1.8 billion years to the Precambrian Era (Sharp & Glazner, 1993). The Precambrian Era consumes approximately 90% of geologic time, yet very little is known about it. In fact, it covers a time period from 4.6 billion years ago to 570 million years ago. During the Precambrian igneous rocks called granites, formed as magma, crystallized and cooled. Metamorphic rocks called schist and gneiss, also formed as preexisting rocks, recrystallized at temperatures and pressures which were not high enough to allow remelting. Together, these rocks formed the core of an ancient continent about which little is known because only small remnants of it outcrop in the Mojave Desert.

Toward the end of the Precambrian Era, or about 800 million years ago, a piece of the continent broke away causing a new ocean basin to form. This new basin began to fill with sediments which formed through the mechanical breakup and chemical decomposition of other rocks. Next, the sediments compacted, cemented, and formed sedimentary rocks. In some places these rocks became very thick as in the Providence Mountains (Sharp & Glazner, 1993).

Deposition continued along the ancient coastline
throughout much of the Paleozoic Era. The Paleozoic, which means ancient life, lasted from 570 to 240 million years ago. During this time organisms were mainly sea dwellers, and the Mojave Desert was drowned in a shallow sea which extended from Southern Nevada to Northern Utah (Stewart, 1980). This sea slowly took on a greater and greater load of sediment as sea level fluctuated, sometimes moving as far inland as the Grand Canyon (Fiero, 1986).

The Mesozoic Era, or middle life, began about 230 million years ago and lasted until 66 million years ago. This was when dinosaurs ruled the earth and a gigantic supercontinent called Pangaea began to separate into two large landmasses called Laurasia and Gondwanaland. Gondwanaland eventually broke apart to form South America and Africa, while Laurasia broke apart to form North America, Europe, and Asia.

During this time a subduction boundary was formed as the edge of the ocean basin was forced underneath the new western edge of North America. This caused volcanism and generated a north-south chain of volcanoes along what is now California. The granites of the Sierra Nevada Mountains, Peninsular Ranges, San Bernardino Mountains, and the Mojave Desert are the roots of these old volcanoes (Norris & Webb, 1990). Much of the land now associated with California was built during this period of volcanism, and the Mojave Desert rose from the sea and dried out. As subduction occurred along the edge of the continent, sediments from the bottom of the sea were scraped off and literally crashed against the continent’s
edge. This formed the Coast Ranges (Sharp & Glazner, 1993). Construction of the mountain ranges continued for another 19 million years and then the volcanism stopped.

The time period from 85 to 25 million years ago is also a period of dramatic change. Unfortunately, the exact nature of the change is not quite clear because there are very few rocks of this age found in the Mojave Desert. It is during this gap that the Cenozoic Era began.

The Cenozoic Era, or recent life, began about 65 million years ago with mass extinctions. It is divided into shorter time units called epochs because much of the rock record of this era is preserved, making the creation of subdivisions easier.

During the Miocene Epoch, or 25 million years ago, another massive blast of volcanism and faulting occurred. The plates reorganized, subduction stopped, and the San Andreas transform margin formed. This wave of volcanism slowly moved from the south to the north. It took 10 to 15 million years for it to migrate from Baja California to Las Vegas (Sharp & Glazner, 1993). North of the wave, volcanoes formed; south of it, the San Andreas Fault Zone continued to grow.

The faulting associated with the wave of volcanism was a peculiar type in which the crust stretches dramatically. Death Valley is stretching like this today (Hunt, 1975). Depressions produced during the stretching, which occurred during the Miocene, usually filled up with lakes and sediments due to a wetter climate. This stretching is
responsible for forming the Basin and Range Province. It is from these Basin and Range roots that the present day Mojave Desert emerged.

Most geologists believe the Mojave Block, which encompasses most of the Mojave Desert, formed 25 million years ago or during the Miocene Epoch (Figure 2). It is presumed that movements associated with the San Andreas Fault, the Garlock Fault, and their predecessors, are responsible for its formation (Norris & Webb, 1990).

![Figure 2 Location of the Mojave Block](image)

Now that the geological history of the Mojave Desert has been reconstructed, it is necessary to move on to the closely related field of geography. Often these two disciplines overlap and such is the case with this project. For that reason it was decided to limit the geology section to tectonic history and incorporate the geomorphology, or study of the development of the landforms, into the geography section.
Geography

Geography is defined as the study of all aspects of the earth's surface including its natural subdivisions, the distribution and differentiation of areas, and human relationships to their environment (Bates & Jackson, 1980). This section of the project will deal with the first two aspects of that definition. The third part of the definition will be discussed in the Human Use and Impact section.

The question, "What is a desert?" requires more than a simple response. When asking others to define desert one would probably get many different answers. A dictionary or glossary would describe it as an area where evaporation exceeds precipitation and the average precipitation is less than 10 inches (25 cm) a year. One of the best ways to define desert is to list its characteristics. They are: 1) low and often irregular patterns of precipitation; 2) periods of prolonged high temperatures; 3) extreme temperature fluctuations; 4) low humidity; 5) high percentage of possible sunlight received; 6) soils high in minerals and low in organic material; and 7) extreme erosion of the ground surface by wind and water (Larson, 1977).

Deserts cover approximately one-seventh of the earth's land surface or approximately 8 million square miles (20,718,400 square kilometers) (Larson, 1977). They are not haphazardly placed and their occurrence is shaped by the factors that produce them. The major world's deserts occur in two belts ringing the globe largely between 15 and 35 degrees latitude (McKnight, 1993). This corresponds to the
Tropic of Cancer in the Northern Hemisphere and the Tropic of Capricorn in the Southern Hemisphere. It is only because more land surface occurs in the Northern Hemisphere that it has more desert.

Most geographers divide the world’s deserts into four major subdivisions based on how each desert is formed: 1) subtropical deserts; 2) rain shadow deserts; 3) interior deserts; and 4) coastal deserts. Each of these will be described in the following paragraphs.

Subtropical deserts form as a result of complex global air-circulation patterns caused by the rotation of the earth on its axis and the seasonal tilting of the earth in relationship to the sun. When air is heated at the equator it ascends and is replaced by inrushing air. As the air moves upward it is gradually cooled. Cool air has a lower saturation point and is capable of holding less moisture than warm air. As the air cools, it releases its excess moisture producing the tropics. The ascending air flows toward the poles and begins to heat up. As this happens it descends in the subtropical zones of high pressure near the Tropics of Cancer and Capricorn. As air temperature increases so also does its ability to retain and absorb moisture. This in turn produces a dry or arid climate. North and south of the desert latitudes, the air again ascends, producing moisture. At the poles the air descends again.

Rain shadow deserts form on the leeward side of mountain ranges. In these areas, moisture-laden air encounters a mountain mass and is forced upward. The ascending air is
cooled and releases moisture on the windward side. Once over the summit, air descends on the leeward side, warms up, and absorbs moisture. Often, the windward side of a mountain range will be occupied by a heavy woodland area, while the leeward side and the areas far beyond are occupied by a desert.

Interior deserts are caused by their remoteness from oceanic moisture sources. Areas lying deep within a continent may become desert simply because air currents reaching them have already traveled vast land distances and have lost the moisture which they once carried.

Coastal deserts form when onshore winds, combining with cold ocean currents flowing from the poles, flow close to shore. Air moving across the frigid currents is cooled which allows the air to hold very little moisture when it arrives over the land. This type of desert often has early morning fog but very little rain.

Although the four types of deserts can be found in the North American Desert, the rain shadow is the predominant type. The North American Desert can be subdivided in the following members: 1) the Great Basin; 2) the Mojave; 3) the Sonoran; and 4) the Chihuahuan (Figure 3).

Locating the precise boundaries for three of the four deserts is difficult because each one grades into its neighbor. In fact, along much of its boundaries the North American Desert gradually grades into other climate zones.

The Mojave is the smallest of the four American Deserts. It covers 54,000 square miles (139,849 square kilometers) and
Figure 3 North American Deserts

has an average elevation range of 2000 - 4000 feet (610-1219 meters) (Larson, 1977). The lowest point is at -282 feet (-86 meters) but there are many places which reach elevations in excess of 5000 feet (1524 meters). For that reason the Mojave is often referred to as the high desert (Larson, 1977).

Extending eastward from the Sierra Nevada Mountains to beyond the Colorado River the Mojave blends northward into the Great Basin Desert and southward into the Sonoran Desert at the San Bernardino Mountains (Figure 4). Flanked by these mountains on the south and west the Mojave is primarily a rain shadow desert.

For the most part, the desert's topography resembles that of the Basin and Range Province with numerous north-south trending mountain ranges. A higher percentage of area is covered by mountains in the Mojave than the Great Basin.
Figure 4 The Mojave Desert (Larson, 1977). The mountain ranges lose the familiar north-south orientation traveling toward the south and west. Eventually, there appears to be no discernible trend whatsoever. As this occurs valleys become wider, and mountains become small hills. These are the remnants of ancient mountains which have literally entombed themselves in their own debris.

The lowest point in most of the basins is a dry lake bed or playa, which is fed by dry washes, or arroyos. Formed by waters, arroyos look like dry stream beds, but rapidly become raging waterways when flash flooding occurs. A flash flood can swiftly carry large amounts of rocks, boulders, branches, sand, and silt. The author has been chased by a five foot (1.5 meter) wall of water thundering down one of these washes and later returned to note that the wash was 10 feet (3.1
meters) deeper than before the ordeal.

An exotic river is one that flows into a dry region bringing water from somewhere else (McKnight, 1993). Such is the case with the Colorado River which flows through the eastern section of the Mojave. There are two rivers which can be called Mojave's own; they are the Mojave and the Amargosa. The Mojave River begins in the San Bernardino Mountains and flows north for approximately 100 miles (161 kilometers) where it sinks into the desert floor at one of the numerous playas. The Amargosa River begins as a desert spring and ends in Death Valley. Most of the basins in the Mojave do not interconnect. Such was not always the case because during the last ice-age the Mojave was a wet, lake-dotted area. The lakes were joined together by a network of rivers and filled with the progenitors of the desert pupfish.

Precipitation decreases in the Mojave Desert from the west to the east. This is primarily due to air flow patterns formed by the Tehachapi, San Gabriel, San Bernardino, and the San Jacinto Mountains (Rae, 1989). The western portion receives about five inches (12.7 centimeters) annual precipitation while the eastern portion receives about two inches (5.1 centimeters) (Larson, 1977). Rainfall is received primarily in the winter months although occasional summer thunderstorms occur in scattered locations. Snow sometimes falls in the higher elevations but seldom stays for any length of time.

Winds play an important role in any desert. The Mojave is no exception. Air movement occurs to accommodate
temperature differences between mountains and the warmer desert floors (Rae, 1989). This causes the ever-present afternoon winds that usually dissipate by nightfall. Winds act as strong agents of erosion and help form desert pavement.

Desert pavement is the cemented-together surface of closely fitted rocks, pebbles, gravel, and other materials. This hard, flat surface is caused by a combination of wind and rain moving the small rocks and flushing away the fine soil (Rae, 1989). More often than not the rocks that compose desert pavement are coated with a shiny, dark brown coating called desert varnish. Desert varnish takes a long time to form and is made up of wind blown clay and metallic oxides. Maganese-oxidizing bacteria cement the clays and other minerals to rock surfaces where little organic material is present and alternating wetting and drying occurs (Norris & Webb, 1990).

Now that the geography of the Mojave Desert has been described, it is necessary to move on to the closely related field of ecology. Often these two disciplines overlap, and such is the case in this project. For that reason it was decided to limit the geography section to the physical development of the desert and incorporate anything dealing with life into the ecology section.

Ecology

In its simplest use ecology is defined as the scientific study of organisms in their natural surroundings (Kaufman & Franz, 1993). Although many branches of science help us
understand the physical, chemical, and biological processes of our environment, the natural science of ecology concentrates on the way those processes interact as a system (Kaufman & Franz, 1993). It is this holistic approach to both the biotic and abiotic factors that makes ecology unique.

Ecology is studied at many levels: 1) individual; 2) species; 3) population; 4) habitat; 5) community; 6) ecosystem; 7) biome; and 8) biosphere. An individual is a single member of a species. A species includes all organisms of a particular kind that are capable of producing viable offsprings. A population is a distinct group of a species that live and interact in the same geographic area. A habitat is the place where an organism or population lives. A community includes all of the populations of organisms that live and interact with one another in a given area in a given time. A community and its interactions with the physical environment compose an ecosystem. Many ecosystems taken together in a large area of the earth are referred to as a biome. The union of all terrestrial and aquatic ecosystems is known as the biosphere. This section will focus on the community aspect of ecology (Kaufman & Franz, 1993).

Most people tend to think of deserts as barren wastelands, devoid of life except a cactus or two. Unknown to most desert travelers, most desert areas support diverse populations of plants and animals. The varied landforms and range of altitudes, along with the localized presence of water, create a number of specific ecological communities.
Rae (1989) divided the Mojave into five different communities: 1) Joshua Tree Woodland; 2) Low Desert Scrub; 3) Desert Dry Woodland; 4) Pinyon-Juniper Woodland; and 5) Riparian Woodlands and Marshes.

The Joshua Tree Woodland is found at altitudes ranging from 2500 - 4000 feet (762 - 1219 meters) on well-drained desert slopes. Its primary member, the Joshua Tree, provides shelter for many small desert animals such as the kangaroo rat, desert wood rat, and ground squirrels. Many Joshua Trees are approximately 1000 years old, but it is believed that the species has been growing in the Mojave Desert for 2 million years (Gossard, 1992). The Tegeticula or yucca moth serves as the main progenitor of the plant. Many types of birds, including pinyon jay, loggerhead shrike, and Scott's oriole, make nests in its branches. Originally thought to be a member of the lily family, the Joshua Tree is now considered a member of the Desert Agave Family (Gossard, 1992). Reptiles associated with this community include the chuckwalla, desert night lizard, and desert tortoise. Other plants found in association with the Joshua Tree Woodland include barrel cactus, chollas, hedgehog cactus, beavertail cactus, Mojave yucca, California juniper, Utah juniper, spiny tetradyymia, desert bunch grass, galleta bladder sage, creosote bush, and buckwheat.

The Low Desert Scrub community’s most common member is the creosote bush. It is one of the most drought-tolerent plants found in the desert and is capable of shedding leaves and branches to conserve water. Often found in low, dry
valleys at elevations between 2000 - 3000 feet (610 - 915 meters), the plant is widely spaced due to an extensive root system. It has a distinct odor and is thought of as one of the oldest plants in the desert. Creosote bushes growing in Soggy Dry Lake are estimated to be over 10,000 years old (Larson, 1977). Animals associated with this community include ground squirrels, jack rabbits, kangaroo rats, and pocket mice. Reptiles include the zebra-tailed lizard, the iguana, and the desert tortoise. Common birds include the roadrunner, Costa's hummingbird, common raven, cactus wren, and the black-throated sparrow. Other plants found in association with the Low Desert Scrub include bottlebrush, desert mallow, ocotillo, burrobush, indigo bush, dye bush, desert lily, Bigelow's cholla, silver cholla, teddy bear cholla, buckthorn cholla, and pincushion.

The Dry Desert Woodland communities are found wherever waterways are found. They are usually found in valleys beneath the mountains which quickly fill with water during flash floods. Plants that are found in this community include desert willow, mesquite, cat's claw, desert holly, desert almond, and many of the ephemeral wildflowers. Common animals include the jackrabbit, desert cottontail, ground squirrel, desert woodrat, cactus mouse, roadrunner, several lizards, sidewinder, and desert tortoise.

The Pinyon-Juniper Woodland is found on desert mountains at elevations between 3500 - 6000 feet (1067 - 1829 meters). Plants that are found in this community include pinyon pine, California juniper, Utah juniper, scrub oak, black bush, box...
thorn, Mojave yucca, silver cholla, and desert bunch grass. Common animals include the coyote, jack rabbit, California ground squirrel, pocket gopher, and pinion mouse. Birds associated with this community include the woodpecker, pinyon jay, rock wren, black-throated gray warbler, and the gray vireo.

The Riparian Woodlands and Marshes communities are found in areas where a year-round water supply exists. Plants that are found in this community include the cottonwood, willow, mesquite, and an exotic or introduced species the tamarisk. These areas attract large bird populations, many of which are migratory, and any other desert animal that requires water for survival.

Mojave Desert vegetation is dominated by low, widely spaced shrubs. Vegetation in the northern half is mostly sagebrush which gradually grades into creosote bush as one travels south. Eventually, the creosote bush dominates the landscape and becomes the primary type of vegetation in the southern section of the Mojave Desert. Nearly one quarter of all the plants are endemics or are confined to a particular place (Larson, 1977).

Now that the ecology of the Mojave Desert has been described it is necessary to move on to human use and impact. Humans have been in the Mojave for a short period of time, but yet have made a dramatic impact upon it. For that reason it was decided that human history would be a separate section in this project.
Human Use and Impact

During much of its early history the Mojave Desert was untouched by humans. From about the middle of the Pleistocene Epoch (500,000 years ago) until the Holocene Epoch (10,000 years ago), the Mojave was filled with a series of lakes. These lakes were connected by the Mojave River, the Amargosa River, and the Owens River. It is on the shores of these ancient lakes that the earliest human artifacts have been found. There is some controversy as to the age of the artifacts. Some believe that humans first inhabited the Mojave as early as 200,000 years ago, but authorities are in agreement that by 10,000 years ago humans were definitely present (Rae, 1989).

During the time that the lakes were present, streams fringed with marshes covered the Mojave. A large variety of wildlife and edible plants were supported by these ecosystems. Humans hunted with spears and darts, fished, and gathered edible plants.

As the climate became hotter and the lakes dried up, humans changed their lifestyle. As game became scarce, humans were forced to migrate and supplement their diet by gathering plants and seeds for food. Migration patterns were dictated by seasonal changes, with winter spent at lower elevations and summer spent at higher elevations. This new lifestyle resulted in trade with other Native American groups which led to widespread use of the bow and arrow, grinding tools, baskets, and pottery.
It is estimated that approximately 300,000 Native Americans lived in the area surrounding the Mojave Desert prior to the arrival of the Spanish Explorers (Schad, 1988). They include the Chemehuevi, Mohave, Serrano, Shoshone, Southern Piute, and the Serrano nations. These nations consisted of close-knit extended family units which were independent of one another except for intermarriage and trade. Each of them had a high respect for the rights of others, and a peaceful coexistence usually prevailed.

In their quest for riches, the Spanish began to explore the areas north of Mexico. Traveling through the desert proved to be less difficult than traveling over mountain ranges. The local Natives possessed little wealth and as a result were largely left alone by the Spanish explorers (Rae, 1989).

The founding of the missions in California led to increased travel across the desert, and the establishment of the Spanish Trail, part of which became known as the Mojave Road. Father Francesco Garces is considered by most to be the first to cross the Mojave. Led by three Mohave Native Americans in 1776 he traveled from Piute Springs over the Providence Mountains through the Kelso Dunes to Soda Lake. This route later became part of the Mojave Road (Rae, 1989).

In the early 1800s, American trappers or mountain men began to arrive in the Mojave. Men, such as Jedediah Strong Smith, Kit Carson, and John C. Fremont, traveled through the Mojave. Fremont’s pilgrimage is one of the most widely documented because of his journal entries. His descriptions
of the Joshua Tree and other desert life were quite accurate yet reflect the feeling of that time period that the desert was an obstacle which one wanted to get through as quickly and safely as possible (Rae, 1989).

Native populations were as wary of the intruders on their lands as the pioneers were of them. During this time there were many fierce clashes between the two groups. This resulted in a series of army outposts, Fort Piute, Camp Rock Springs, and Camp Cody, to name a few. By the late 1860s, the native populations made peace and most of the outposts were abandoned (Rae, 1989). This, however, was not the end of military use of the Mojave Desert.

Many of the early settlers were miners who were encouraged by the General Mining Law of 1872 and the dream of riches. Since the desert was so obviously lacking in resources to support life, many believed it must be hiding untold riches beneath its surface. The discovery of gold, silver, zinc, copper, and iron helped perpetuate this philosophy, and would-be millionaires scoured the desert in search of wealth. Boom towns sprang up close to the mines, only to be reclaimed by the desert once the ore ran out and the people left. The only mining which has been consistently profitable is borax and other rare earth deposits (Rae, 1989).

Another early group of settlers was the rancher. When they came to the Mojave it had adequate rainfall to provide good grazing during the fall and winter. It is believed that cattle were first brought to the Mojave to feed the army and
miners. In the early 1900s, there were still a number of successful operations. As the Mojave continued to became more arid, vegetation disappeared, and ranching became unprofitable. In spite of this, it is still practiced by a small group of ranchers (Rae, 1989).

The railroads played a key role in the development of the Mojave. They provided the supplies that kept the mines, homesteads, and ranches operating and served as a means of shipping ore and beef. Up until the early 1900s they flourished (Rae, 1989).

Much of the present day Mojave is classified as public land either in the form of state and national parks, multiple use lands, or military reservations. Except for military uses, this has resulted in much of the Mojave serving as a recreational facility. There is a growing concern that those venturing into it need to be aware of and practice their responsibility of being stewards of the earth (Rae, 1989).

Humans have made an impact on the Mojave. Joshua Trees have been logged to make cactus paper (Gossard, 1992); mines have exposed the inner parts of the earth; urbanization has continued its cyclic nature; water has been transported away; rivers have been rerouted; and humans have come to play. Still the Mojave Desert lives on. The real question is: how will future generations view our use of this precious resource?
GOALS AND OBJECTIVES

The primary goal of the project was to create a Mojave Desert issues curriculum for secondary students that followed the format of Project Learning Tree’s *Focus on Forests*. Project Learning Tree recently developed *Focus on Forests* as a secondary environmental education program that focuses on learning through issue analysis. A second goal was to develop the project for use by the four National Parks located in the Mojave Desert. This was accomplished by developing seven units that covered varying aspects of the desert, such as desert formation, desert ownership, desert management, Mojave Desert endangered species, human history of the Mojave Desert, the four issues, and taking action. The project is meant to increase students knowledge of and concern for the Mojave Desert and the communities that it supports.

DESIGN OF PROJECT

Mojave Desert Issues was designed to be used either in part or in its entirety by educators who want secondary students to learn about the Mojave Desert. The culminating activities are real-life environmental issues which seek to teach students *how* to think about environmental dilemmas, rather than *what* to think. When combined with the “action taking” methods of the final unit, these activities prepare students to consider possible solutions about environmental issues and provide a mechanism for trying these solutions.

As students participate in environmental issue activities, they gain insight into the complexity of these
issues through examining the players and their positions, beliefs and values, and by proposing potential solutions. Each activity is designed to enable students to think objectively about environmental issues.

The status of environmental issues is constantly changing because of research, new technologies, legislation, and compromise so the activity examples may not necessarily reflect current understanding of the issue. Educators can have students research the particular issues presented in this curriculum to update the information as a learning extension, or they can have them choose issues that are of concern in the local community or state.

The Mojave Desert Issues curriculum is not designed to be an all-inclusive or comprehensive curriculum. Instead, it is designed to offer educators the flexibility to choose single units or to teach the entire curriculum. Educators are invited to fill in gaps with content that relates to their community, expertise, interests, or needs of their students.

Each unit is organized into three major sections: 1) Background Information which provides an overview of the unit’s basic concepts; 2) Teacher’s Guide which is divided into objectives, materials, subjects, skills, method, time considerations, and extensions; and 3) Student Activities which enhance specific aspects of the unit.

For the language arts connection, students are asked to keep a journal. A journal is a personal record of a student’s reactions to learning experiences, and is an
excellent way to develop ideas for future assignments. Students are encouraged to include illustrations or drawings in their journal as a means of expressing concepts.

RESULTS AND DISCUSSION

The curriculum was reviewed by National Park Service (NPS) personnel prior to field testing by educators. NPS comments were limited to technical information. These comments were incorporated into the original material and a corrected manuscript was mailed to NPS selected educators.

Nine educators were selected to field test the curriculum. Three educators field tested two units and one tested all seven units. The educator who field tested all seven units was the only one who tested an issue's component. They tested the Eagle Mountain Landfill issue. Each of these four educators returned the manuscript with comments and corrections. Three of the nine educators returned the manuscript with comments and corrections but were unable to field test the curriculum. Two of the nine educators did not offer comment or return the manuscript.

Personnel from the Bureau of Land Management (BLM) also reviewed the curriculum as part of the field testing procedure. They returned their manuscript with comments and corrections.

The curriculum was well received by all reviewers and input from field testing was incorporated into a final draft which was delivered to the NPS for publication. The curriculum is expected to be published and available for use by educators in October of 1997.
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Introduction

Mojave Desert Issues was designed to be used either in part or in its entirety by educators who want students to learn about the Mojave Desert. The culminating activities are real-life environmental issues which seek to teach students how to think about environmental dilemmas, rather than what to think. When combined with the "action taking" methods of the final unit, these activities prepare students to consider possible solutions about environmental issues and provide a mechanism for trying these solutions.

As students participate in environmental issues activities they gain insight into their complexity through examining the players and their positions, beliefs and values, and by arriving at potential solutions that help clarify how environmental issues affect deserts. Each activity is designed to enable students to think objectively about environmental issues.

The status of environmental issues is constantly changing because of research, new technologies, legislation, and compromise so the activity examples may not necessarily reflect current understanding of the issue. You can have students research the particular issues presented in this curriculum to update the information as a learning extension, or you can have them choose issues that are of concern in their local community or state, making the issues more relevant to them.

Organization and Design of the Units

The Mojave Desert Issues curriculum is not designed to be an all-inclusive or comprehensive curriculum. Instead, it is designed to offer educators the flexibility to choose single units or to teach the entire curriculum. Educators are invited to fill in gaps with content that relates to their community, expertise, interests, or needs of their students.

Each unit is organized into three major sections: 1) Background Information which provides an overview of the unit's basic concepts; 2) Teacher's Guide which is divided into objectives, materials, subjects, skills, method, time considerations, and extensions; and 3) Student Activities which enhance specific aspects of the unit.

For the language arts connection, students are asked to keep a journal. A journal is a personal record of a student's reactions to learning experiences, and is an excellent way to develop ideas for future assignments. Students are encouraged to include illustrations or
drawings in their journal as a means of expressing concepts.

Constructivist Theory of Learning

The Mojave Desert Issues curriculum uses the constructivist theory of learning which recognizes that students construct new understandings by combining previous understandings with new discoveries. With this in mind, the lessons are designed to begin with brainstorming sessions to determine what students already know about an issue. These brainstorming sessions provide opportunities for teachers to guide students toward new discovery and scientific understanding based on assessing initial knowledge and interest of students.

The following techniques will help educators implement constructivist learning: 1) whenever possible use a local emphasis for activities; 2) ask students their ideas about concepts before beginning instruction to assess prior knowledge; 3) guide students' learning with words such as "classify," "analyze," and "predict;" 4) allow students' thinking to guide lessons; 5) adapt curriculum based on needs of and responses by students; 6) have students use primary sources, as well as manipulative materials; 7) ask open-ended questions; and 8) encourage students to ask questions of other students.

Cooperative Learning

Cooperative learning is an instructional method in which students work together in small groups to achieve common goals. Cooperative learning can encourage skills of cooperation and communication and be a valuable addition to the learning experience.

Used appropriately, cooperative learning can motivate students, promote active learning, foster respect, improve language skills, and increase teacher effectiveness. The essential feature of cooperative learning is that the success of one student helps other students be successful. It helps promote equality of all students by encouraging them to cooperate with each other to complete projects.

This is accomplished through organizing students into small teams that work together to accomplish academic and non-academic tasks while, at the same time, developing important social skills. Steps include: 1) formation through careful selection of members; 2) assignment of roles which includes: a recorder who writes group's answers and reports answers to the entire class; a facilitator who organizes the group's work, makes sure each does their job, and interacts with the teacher for group questions or problems; an artist who draws illustrations or
diagrams for the group; and a researcher who looks up unknown words or topics as required; 3) the development and posting of classroom rules (Everyone must participate and help others; Everyone listens to others; and Each student does the assigned task); 4) encourage students to practice positive social skills; 5) state directions clearly; 6) monitor groups; and 7) evaluate outcomes and debrief after each lesson; by asking questions (Did everyone in the group participate?; How could you encourage someone to participate?; How did you help your group during the activity?; and What could you do to make your group work better together?).

**Problem Solving**

Emphasizing a problem solving approach to learning promotes the development of skills such as identifying problems, determining desired outcomes, selecting possible solutions, choosing strategies, testing solutions, evaluating outcomes, revising and repeating steps, and predicting new problems. Environmental action is one of the most important components in this curriculum. When students work together on an action project, they develop a sense of belonging and self-esteem, and strengthen the feeling that they can make a difference and, in fact, contribute towards positive change.

**Teaching Controversial Issues**

Controversy can provide opportunities for increasing the quality of students' thinking and ability to solve problems. It can be intellectually stimulating. As long as students clearly understand that issues are controversial precisely because they are too complex to have clear-cut right or wrong solutions, they can focus on the process of clarifying their own viewpoints through debate and reflection.

**Talking About Bias**

Before beginning any action project students need to be informed that information may be presented in a biased way. Bias is defined as exhibiting a highly personal and unreasonable distortion of judgment. Most of the time, a biased article does not discuss opposing views of an issue. If other views are presented, they are often left incomplete. It is difficult to get all the information about an issue, but it is important to know all sides to an issue before making a decision.

**Consensus**

Usually it is necessary to make compromises when arriving at solutions to issues. This is often achieved through reaching a
consensus. One way to help achieve consensus is to have everyone rank the ideas that have been presented with a number. For example, if there are six ideas, each person would rank the choices from one to six, with six being the first choice. Total the number of points given for each idea; the one with the highest score represents the majority viewpoint. This technique is especially helpful when you have a large group trying to reach consensus.

**Environmentalist Versus Environmental Educator**

Before beginning an environmental project, it is important for educators to understand the difference between an environmentalist and an environmental educator. An environmentalist is one who frequently advocates a position concerning an environmental issue. On the other hand, an environmental educator is one who uses information and educational processes to help people analyze the differing points of view usually present in an environmental issue so that they can arrive at their own solution. Environmental educators should be "value-free" when enabling others in the decision-making process. Thus, when you are assisting students in examining all points of view, you need to be an environmental educator and not share your own values and decision on the issue.
# Unit I: What Makes A Desert Special?

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Unit I: What Makes A Desert Special?

Background Information

As the fingers of daylight disappear into a brilliant reddish-orange sunset, you hear the familiar calls of the Gambel’s quail. Their cries echo from nearby yuccas as they prepare for encroaching nightfall. Joshua trees silhouette the landscape, and the distant cry of a coyote offers a serenity that one can only experience in the majesty of the Mojave Desert.

Yet with all its grandeur, few people would disagree that the desert suffers from an image problem. Some visualize it as a barren waste-land whose sole purpose of existence is to wreck havoc on those poor souls who have the misfortune of being forced to traverse it. Many view the desert as a gigantic, indestructible playground. Some view it as a retreat from the hustle and bustle of everyday life. In reality the desert is a fragile ecosystem whose delicate balance is rapidly approaching crisis.

What is a Desert?

When asking others to define a desert one would probably get many different answers. A dictionary or glossary would describe it as an area where evaporation exceeds precipitation, the average precipitation being less than 10 inches (25 cm) a year. There are deserts in arctic regions, but this lesson is not going to describe them. This lesson will discuss high temperature deserts. One of the best ways to define a high temperature desert is to list its characteristics. They are: 1) low and often irregular patterns of precipitation; 2) periods of prolonged high temperatures; 3) extreme temperature fluctuations; 4) low humidity; 5) high percentage of possible sunlight received; 6) soils high in minerals and low in organic material; and 7) extreme erosion of the ground surface by wind and water.

Where Are the World’s Deserts Located?

Deserts cover approximately one-seventh of the earth’s land surface or about 8,000,000 miles$^2$ (20,718,400 km$^2$). They are not randomly placed and their locations are a direct result of complex global air-circulation patterns. Most of the world’s deserts occur in two belts which encircle the globe between 15 and 35 degrees latitude (Figure 1). This corresponds to the Tropic of Cancer in the Northern Hemisphere and the Tropic of Capricorn in the Southern Hemisphere.
What Are the Different Types of Deserts?

Most geographers divide the world's deserts into four major subdivisions based on how they form. They are: 1) subtropical deserts; 2) rain shadow deserts; 3) interior deserts; and 4) coastal deserts.

Subtropical deserts form as a result of complex global air-circulation patterns caused by the rotation of the earth on its axis and the seasonal tilting of the earth in its relationship to the sun. When air is heated at the equator it rises and is replaced by inrushing cooler air. As warm air rises it is gradually cooled. Cool air holds less moisture than warm air, so as it cools excess moisture is released. This is what causes tropical rainforests. As the air continues to flow toward the poles it rises and begins to heat up. Once it is heated the air will sink until it reaches the Tropics of Cancer and Capricorn. As air temperature increases, its ability to retain and absorb moisture also increases. This produces a dry or arid climate. As the air continues to move north and south of the desert latitudes, it rises and produces moisture. After rising, the air moves toward the poles where it descends once again (Figure 2). The Sahara Desert is an example of a subtropical desert.

Rain shadow deserts form when mountain ranges are parallel to moist, coastal areas. Winds moving inland cool as air is forced to rise over the mountains. Clouds form and moisture falls on the slopes facing the winds. That is why these slopes are called the windward side of
Falling air, high pressure, deserts

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Figure 2 Equatorial Rainforests and Subtropical Deserts

mountains. When the winds move over the summit and down the leeward side, they are very dry. Dry, descending air prevents additional clouds and precipitation from forming. Unless another source of moisture enters the picture, a rain shadow desert forms. The windward side of mountain ranges is usually occupied by heavy woodland areas, while the leeward side and the areas far beyond are usually occupied by deserts (Figure 3). The Mojave Desert is an example of a rain shadow desert.

Interior deserts form because of their remoteness from oceanic moisture sources. Areas lying deep within a continent often become deserts simply because air currents reaching them have lost all of their moisture while traveling long distances. The Gobi Desert is an example of an interior desert.

Coastal deserts form when cold ocean currents, which flow close to the shore, influence winds. Air moving across the frigid currents is cooled causing it to release moisture. When the air reaches the land it is relatively dry. This type of desert usually has early morning fog and very little rain. The Namib Desert is an example of a coastal desert.

What is the North American Desert?

Although all four types of desert can be found in the North American Desert, the rain shadow desert is the predominant type. The
North American Desert can be subdivided in the following members: 1) the Great Basin Desert (rain shadow); 2) the Mojave Desert (rain shadow, subtropical); 3) the Sonoran Desert (coastal, rain shadow, subtropical); and 4) the Chihuahuan Desert (interior, subtropical) (Figure 4).
Locating precise boundaries for three of the four deserts is difficult because each one grades into its neighbor.

**What About the Mojave Desert?**

The Mojave is the smallest of the four North American Deserts. It covers 54,000 miles\(^2\) (139,849 km\(^2\)) and has an average elevation range of 2000 - 4000 feet (610 - 1219 m). The lowest point in Death Valley National Park is 282 feet below sea level (-86 m), but there are many places with elevations in excess of 5000 feet (1524 m). For that reason the Mojave is often referred to as a high desert.

Extending eastward from the Sierra Nevada Mountains to beyond the Colorado River, the Mojave blends northward into the Great Basin Desert and southward into the Sonoran Desert (Figure 5). Flanked by mountains on the south and west the Mojave is primarily a rain shadow desert.

![Figure 5 Location of the Mojave Desert](image)

For the most part, the Mojave Desert consists of basins bounded by mountain ranges. Relief is the difference in elevation between the high and low points on a land surface. Basins are narrow and mountain ranges have a lot of relief in the northern part of the Mojave Desert. In the southern part of the Mojave Desert, basins are wide and mountain
ranges have very little relief. This is due, in part, to large alluvial fans which fill the basins with material that has eroded from the mountain ranges.

The lowest point in most of the basins is a dry lake bed, or playa, which is fed by dry washes, or arroyos. Formed by water, arroyos look like dry stream beds, but rapidly become raging waterways when flash flooding occurs. A flash flood can swiftly carry large amounts of rocks, boulders, branches, sand, and silt down-stream. Many desert explorers have been chased by a wall of water thundering down one of these washes.

During the last ice-age (Pleistocene) the Mojave Desert was a wet, lake-dotted area (Figure 6). The lakes were joined together by a network of rivers and filled with the progenitors of the desert pupfish. Between 10 to 20 thousand years ago, humans came to the shores of these lakes to hunt and fish. Today, the lakes and the rivers that connected them are gone and water rarely flows between basins.

Figure 6 Pleistocene Lakes of the Mojave Desert

An exotic river is one that flows into a dry region bringing water from somewhere else. The Colorado River, which flows through the eastern section of the Mojave, is considered an exotic river. There
are two rivers which can be called Mojave's own; they are the Mojave and the Amargosa. The Mojave River begins in the San Bernardino Mountains and flows north for approximately 100 miles (161 km) where it sinks into the desert floor at one of the numerous playas. The Amargosa River begins as a desert spring in western Nevada and flows into the southern part of Death Valley.

Precipitation decreases in the Mojave Desert from the west to the east. This is caused by air flow patterns and the rain shadow effect of the Transverse Ranges, Peninsular Ranges, Coast Ranges, and Sierra Nevada Mountains (Figure 7). The western portion receives about 5 inches (12.7 cm) annual precipitation while the eastern portion receives about 2 inches (5.1 cm) annual precipitation. Rainfall is received primarily in the winter months although occasional summer thunderstorms occur in scattered locations. Snow sometimes falls in the higher elevations but seldom stays for any length of time.

Figure 7
Location of Mountain Ranges Causing the Rain Shadow Effect in the Mojave Desert

Winds play an important role in all deserts. The Mojave Desert is no exception and is known for its wind storms. Wind occurs as warm air rises and cool air rushes in to replace it. In the Mojave Desert this equalizes temperature differences between the mountain ranges and the basins. This causes the ever-present afternoon winds that usually
dissipate by nightfall. Winds act as strong agents of erosion and help form the desert landscape.

**What About the Plants and Animals?**

Many people tend to think of deserts as *barren* wastelands, devoid of life except a cactus or two. Unknown to most desert travelers, deserts support diverse *populations* of plants and animals. The varied landforms and range of altitudes, along with the localized presence of water, create a number of specific *ecological communities*. An *ecological community* includes all of the *populations* of organisms that interact in a given area at a given time.

Mojave Desert vegetation is dominated by low, widely spaced shrubs. Vegetation in the extreme northern section is sagebrush, which quickly grades into creosote bush as one travels south. The creosote bush dominates the landscape and is the primary type of vegetation in the Mojave Desert. The Joshua tree and yucca are usually found on well drained slopes at elevations between 2500 - 4000 feet (762 - 1219 meters). These strange looking plants have always intrigued visitors. Juniper and pinyon pines can be found at elevations between 3500 - 6000 feet (1067 - 1829 meters). Nearly one quarter of all the plants found in the Mojave Desert are *endemic* (confined to a particular place).

Desert animals are among the most unique in the world and have devised ways to survive in its harsh environment. For some animals this is accomplished through being *crepuscular* (active at dawn and dusk). For other animals this is accomplished through obtaining necessary moisture from their food. These adaptations allow many different types of animals to live in the desert. In fact, rainforests are the only ecosystem with a higher rate of diversity than deserts.

**Glossary**

1. **alluvial fan** - a fan-shaped water-formed deposit of broken down rock material that extends from the base of a mountain outward toward the center of a basin.
2. **arid** - a climate which has very little rainfall.
3. **arroyo** - a channel of a dry river or wash.
4. **barren** - lacking vegetation
5. **basin** - a low area in which sediments have accumulated.
6. **crepuscular** - active at dawn and/or dusk.
7. **ecological communities** - all of the populations of organisms that interact in a given area at a given time.
8. **ecosystem** - the interaction of all living things with their physical environment.
9. **endemic** - belonging exclusively or confined to a particular place.
10. **exotic river** - a river that flows into a dry region bringing water from elsewhere.
11. **flash flood** - a sudden, rising flood caused by heavy rainfall.
12. **leeward** - the direction toward which the winds are blowing.
13. **playa** - a dry, vegetation-free, flat area at the lowest part of an undrained desert basin.
14. **Pleistocene** - the time period between 2.5 million and 5 thousand years ago; often referred to as the ice age.
15. **populations** - a group within a single species which can and do freely interbreed.
16. **precipitation** - water received directly from the clouds as rain, hail, sleet, or snow.
17. **progenitors** - ancestors
18. **relief** - the difference in elevation between the high and low points on a land surface.
19. **summit** - the top of a mountain.
20. **windward** - the direction from which the wind is blowing.
Teacher's Guide
Lesson 1: Introduction to the Unit

Objectives:
1. Students will participate in the Pre part of a Pre/Post Survey.
2. Students will list their feelings about deserts.
3. Students will begin a journal on their feelings about the material that they have learned.

Materials:
Activity I: What Do You Think? (duplicate for students), student journals.

Subjects:
Science, social science, language arts, economics.

Skills:
Analyzing, categorizing, evaluating, writing.

Method:
1. Have students do Activity I: What Do You Think? This is designed to be a Pre/Post activity to see what they already know and what they have learned. Collect and keep these surveys for future reference.
2. Next, find out what students know about the desert by using a brainstorming session. Write the term "desert" on the board and solicit all responses. Discuss responses, highlighting the ones related to the background information to be presented in the next lesson.
3. The language arts connection includes the keeping of a journal. Students should be asked to keep a journal for this and all of the following units. Remind students that a journal is a personal record of their reactions to the learning experiences. Students should begin each entry with a date, but the rest of their record may be as informal as they wish. Entries do not need to be of any set length. Students should be reminded that a journal is an excellent way to develop ideas for future assignments and that illustrations or drawings are great ways to express concepts.
4. Ask students to include the following in their journal: 1) reactions to what they read and talked about; 2) reflections on the make-up of the desert; and 3) ideas on why a desert is important.

Time Considerations:
1. Survey: 15-20 minutes.
2. Brainstorming session: 15-20 minutes.
3. Journaling instructions: 5-10 minutes.
4. Journaling: 10 minutes.

**Extension:**
Have students predict what they think the unit will be about and make note of it in their journal. At the end of the unit have them compare the actual unit to their predictions. Ask them to write these comparisons in their journal.

**Lesson 2: What is a Desert?**

**Objectives:**
1. Students will define "desert" by listing its characteristics: low precipitation, long periods of high temperatures, extreme temperature fluctuations, low humidity, receiving 90% of possible sunlight, soils high in minerals but low in humus, and high erosion rates.
2. Students will use maps to locate regions on the earth where deserts occur.
3. Students will describe the four types of deserts: subtropical, rain shadow, interior, and coastal.
4. Students will divide the North American Desert into its four components: Great Basin, Mojave, Sonoran, and Chihuahuan.
5. Students will describe the following Mojave Desert characteristics: size, elevation, location, and relief.
6. Students will define the following Mojave Desert features: playa, arroyo, exotic river, and alluvial fan.
7. Students will list two characteristics which allow animals to survive in the Mojave Desert.

**Materials:**
Activity II: Rain Shadow Deserts (duplicate for students),
Activity III: North American Deserts Word Search (duplicate for students),
Activity IV: What Makes A Desert Special? Network Tree (duplicate for students),
Figures 1-7 (enlarge and make overhead transparencies, if desired),
World atlas,
student journals.

**Subjects:**
Geography, geology, biology, ecology, math, language arts, art.

**Skills:**
Writing, computing, graphing, analyzing, categorizing, evaluating.
Method:
1. Present the background information to students. One of the best ways to do this is to make overheads of Figures 1 through 7 in the teacher's guide. Students should take notes. As an alternative, duplicate the background information for students to read. Then discuss in class.
2. Activity II could be done either after all the background information has been presented or after the section in the background information, "What Are The Different Types Of Deserts?"
3. Students could do Activity III as a review of the material.
4. Activity IV can be done as either a review of the material or an on-going, concept-building tool. The second method is preferred because you can assist students in organizing the material as it is being presented.
5. For closure, students should work on their journal entries. Remind students that a journal is a personal record of their reactions to the learning experiences. Students should begin each entry with a date, but the rest of their record may be as informal as they wish. Entries do not need to be of any set length. Students should be reminded that a journal is an excellent way to develop ideas for future assignments and that illustrations or drawings are great ways to express concepts. This would be an excellent time to discuss journal entries that reflect upon the learning experience.
6. Ask students to include the following in their journal: 1) reactions to what they read and talked about; 2) reflections on the make-up of the desert; and 3) ideas on why a desert is important.

Time Considerations:
1. Presentation: 30-40 minutes.
2. Activity II: 30-40 minutes.
3. Activity III: 15-20 minutes (could be a homework assignment).
4. Activity IV: 30 minutes.

Extensions:
1. Have groups of students describe the Sahara (subtropical), Namib (coastal), and Gobi (interior) deserts. Once this is completed, compare each to the Mojave (rain shadow) desert.
2. Have students describe the ice cap climate (polar desert) and compare it to the Mojave (rain shadow) desert.
Figure 1 Locations of the World's Deserts

Figure 2 Equatorial Rainforests and Subtropical Deserts
Figure 3 Rain Shadow Desert

Figure 4 Subdivisions of the North American Desert
Figure 5 Location of the Mojave Desert

Figure 6 Pleistocene Lakes of the Mojave Desert
Figure 7
Location of Mountain Ranges Causing the Rain Shadow Effect in the Mojave Desert
Activity I: What Do You Think?

Each of the categories in question 1 has five choices. Please circle the one that you feel best describes your feelings. Use the following key to determine your response: 1 Strongly Agree; 2 Agree; 3 Satisfactory; 4 Disagree; 5 Strongly Disagree.

1. Do you agree or disagree with the following desert-related statements?
   A. The natural resources of the desert enhance the quality of my lifestyle.
      1 2 3 4 5

   B. The natural resources of the desert are important to the nation’s economy.
      1 2 3 4 5

   C. The natural resources of the desert are important to the local economy.
      1 2 3 4 5

   D. I am well informed about issues regarding deserts in the Southwestern United States.
      1 2 3 4 5

   E. I am well informed about deserts in other parts of the world.
      1 2 3 4 5

2. Please rate five things deserts provide that you think are important. Use 1 as the most important; use 2 as the next most important; etc.
   ____ food
   ____ landfills
   ____ medicine
   ____ beauty
   ____ beauty products
   ____ precious minerals
   ____ military training sites
   ____ winter resorts
   ____ recreation
   ____ plant and wildlife habitat
   ____ renewable energy sources
   ____ climate control
   ____ open spaces
   ____ rare earth elements
   ____ state and national parks
   ____ peace and solitude
3. Please put a check next to one or more desert topics that you would like to learn more about. Circle the one topic that interests you the most.

- [ ] desert management
- [ ] desert ecology
- [ ] desert-related careers
- [ ] environmental issues
- [ ] Joshua trees/plant life
- [ ] desert land ownership
- [ ] cultural history (People who lived in the desert)
- [ ] desertification (creation of desert through human impact and/or climate changes)
- [ ] threatened and endangered species that live in or depend on the desert.
- [ ] other (please describe)

4. How many days a year do you visit the desert to hike, bike, camp, rock climb, hunt, ride off-road vehicles, observe wildlife, or do some other activities?

- [ ] 0
- [ ] 1-5
- [ ] 6-15
- [ ] 15-30
- [ ] more than 30

5. How close is the desert to where you live?

- [ ] live in the desert
- [ ] less than a mile away
- [ ] between 1-10 miles away
- [ ] between 11-20 miles away
- [ ] more than 20 miles away
- [ ] not sure

6. Which of the following words or phrases could you explain to a friend? (Please check only the ones that you are confident about.)

- [ ] The difference between public and private desert lands.
- [ ] The difference between the Bureau of Land Management and National Park Service management styles.
- [ ] Rain shadow desert
- [ ] Exotic river
- [ ] Endangered species versus threatened species
- [ ] Chemehuevi
- [ ] Wilderness areas
- [ ] Endemic
- [ ] Multi-use areas
- [ ] Ethnocentric
- [ ] Soil conservation

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Activity II: Rain Shadow Deserts

Part 1
Review the processes which form rain shadow deserts by filling in the diagram.

Formation of Rain Shadow Deserts

Part 2
Below is a listing by month of rainfall totals at Bear Valley Dam at Big Bear Lake and Headquarters at Joshua Tree National Park (JTPN) for 1995.

<table>
<thead>
<tr>
<th>Month</th>
<th>Bear Valley Dam</th>
<th>JTNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>23.67 in (60.1 cm)</td>
<td>2.13 in (5.4 cm)</td>
</tr>
<tr>
<td>February</td>
<td>9.20 in (23.4 cm)</td>
<td>0.86 in (2.2 cm)</td>
</tr>
<tr>
<td>March</td>
<td>10.65 in (27.1 cm)</td>
<td>0.29 in (.74 cm)</td>
</tr>
<tr>
<td>April</td>
<td>0.91 in (2.3 cm)</td>
<td>0.18 in (.45 cm)</td>
</tr>
<tr>
<td>May</td>
<td>0.97 in (2.4 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
<tr>
<td>June</td>
<td>0.25 in (.64 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
<tr>
<td>July</td>
<td>0.24 in (.61 cm)</td>
<td>0.07 in (.18 cm)</td>
</tr>
<tr>
<td>August</td>
<td>1.27 in (3.23 cm)</td>
<td>0.03 in (.08 cm)</td>
</tr>
<tr>
<td>September</td>
<td>0.02 in (.05 cm)</td>
<td>0.13 in (.33 cm)</td>
</tr>
<tr>
<td>October</td>
<td>0.00 in (0 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
<tr>
<td>November</td>
<td>0.00 in (0 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
<tr>
<td>December</td>
<td>1.82 in (4.6 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
</tbody>
</table>

Totals | 49.00 in (124.5 cm) | 3.69 in (9.37 cm) |
Use the monthly rainfall totals from the previous page to make bar graphs. Label each graph and plot the data on it. Color in the squares to make the graph easier to read.
Part 3
Putting It All Together

1. Compare the rates of rainfall from each site for each month. Based on your comparison is it possible that Mount San Gorgonio is the rain shadow for JTNP? Explain your answer.

2. During the month of September the rainfall is higher in JTNP than Bear Valley Dam. If Mount San Gorgonio is the rain shadow why do you think this occurred? Explain your answer.

3. Using the total rainfall numbers, calculate how many times more rain fell at Bear Valley Dam than JTNP. Does this support the theory that Mount San Gorgonio is the rain shadow for JTNP? Explain your answer.

4. Now that you have analyzed rain shadow deserts, draw a diagram of an imaginary desert which is of rain shadow origin. Label the air currents and estimate the rainfall on the summit, the leeward side, and the windward side of the diagram. Be creative and make the best drawing possible.
Part 1
Review the processes which form rain shadow deserts by filling in the diagram.

**Windward Side**
**Leeward Side**

**MOIST AIR**
**DRY AIR**

**Formation of Rain Shadow Deserts**

Part 2
Below is a listing by month of rainfall totals at Bear Valley Dam at Big Bear Lake and Headquarters at Joshua Tree National Park (JTPN) for 1995.

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<td>10.65 in (27.1 cm)</td>
<td>0.29 in (0.74 cm)</td>
</tr>
<tr>
<td>April</td>
<td>0.91 in (2.3 cm)</td>
<td>0.18 in (0.45 cm)</td>
</tr>
<tr>
<td>May</td>
<td>0.97 in (2.4 cm)</td>
<td>0.00 in (0 cm)</td>
</tr>
<tr>
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</tbody>
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**Totals**
49.00 in (124.5 cm) 3.69 in (9.37 cm)
Use the monthly rainfall totals from the previous page to make bar graphs. Label each graph and plot the data on it. Color in the squares to make the graph easier to read.

<table>
<thead>
<tr>
<th>Month</th>
<th>At Bear Valley Dam</th>
<th>At Joshua Tree National Park</th>
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<tbody>
<tr>
<td>J</td>
<td>0.0</td>
<td>0.0</td>
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</tbody>
</table>

Average Monthly Rainfall

To make the graph easier to read, label each graph and plot the data on it. Color in the squares to make the graph easier to read.
Part 3
Putting It All Together

1. Compare the rates of rainfall from each site for each month. Based on your comparison is it possible that Mount San Gorgonio is the rain shadow for JTNP? Explain your answer.
   Yes, it is possible that Mount San Gorgonio is the rain shadow for JTNP. Explanations will vary but should state that storms come from the west and lose most of their moisture before coming to JTNP.

2. During the month of September the rainfall is higher in JTNP than Bear Valley Dam. If Mount San Gorgonio is the rain shadow why do you think this occurred? Explain your answer.
   During the summer most of the rainfall received in the Mojave Desert comes from the south via storms coming up from Baja, California.

3. Using the total rainfall numbers, calculate how many times more rain falls at Bear Valley Dam than JTNP. Does this support the theory that Mount San Gorgonio is the rain shadow for JTNP? Explain your answer.
   \[ 49.00 + 3.69 = 13.28 \text{ (Rounded off)} \]. With a little over 13 times as much moisture as JTNP, San Gorgonio Mountain is most likely the rain shadow for JTNP.

4. Now that you have analyzed rain shadow deserts, draw a diagram of an imaginary desert which is of rain shadow origin. Label the air currents and estimate the rainfall on the summit, the leeward side, and the windward side of the diagram. Be creative and make the best drawing possible.
   Student’s diagrams should look like Figure 3 Rain Shadow Desert. Students should include rainfall totals from Bear Valley Dam and JTNP and estimate what occurs between them. The major decrease should begin at the summit.
Part 1

In each of the following statements, a term has been scrambled. Unscramble the term and write it on the line provided.

___ 1. A river that flows into a dry region bringing water from somewhere else is said to be an _iextoc_ _vrine_.

___ 2. The _hahanuiuc_ desert covers parts of Texas, New Mexico, and mainland Mexico.

___ 3. The most northern member of the Northern American Desert is called the _ertga sbian_.

___ 4. _iard_ is another way of saying dry.

___ 5. The _oepnltecies_ is the geological time period in which many lakes covered the Mojave.

___ 6. A _apyla_ is a dry lake bed found in desert basins.

___ 7. A _nria dswhoa_ desert forms because clouds have already lost their moisture by rising over the mountains.

___ 8. _dmecein_ plants are confined to a particular place.

___ 9. Deserts usually form on the _erwldea_ side of a mountain.

___ 10. A _lptoapouin_ includes individuals of a particular species with definable group characteristics.

___ 11. _scaolat_ deserts form by wind blowing over cold ocean currents.

___ 12. The _jvmaoe_ is the smallest of the four American Deserts.

___ 13. _psrucbltaio_ deserts form as a result of air circulation and the seasonal tilting of the earth.

___ 14. An _orayro_ is another name for dry desert washes.

___ 15. A _msutmi_ is another name for the top of a mountain.

___ 16. An _rionerti_ desert forms when air masses have lost all of their moisture because of traveling long distances.

___ 17. The _dwnadwi_ side of a mountain is often heavily forested.

___ 18. An ecological _mncitouwmy_ is a population of organisms that interact in a given area in a given time.

___ 19. The _onsaorn_ desert occupies California, Arizona, and parts of Mexico.

___ 20. A _sdrete_ receives very little precipitation.
Part 2

Now find each unscrambled term in the hidden word puzzle below. The terms can be written horizontally, vertically, or diagonally and forward and backward. Circle each term as you find it.

A E A N I S A B T A E R G A T
C R C Y P B Z P L A A Y R R W
H C R D A L N E P M R I E D O
I O T O R L E L I E D S A R D
H M V L Y A P I V H E U Y A A
U M O C H O W I S D N C T W H
A U O C A L R E L T X U A D S
H N O M X C C S E A O X Z N N
U I O A I I N S Q L T C M I I
A T O T M A U Q S E Z S E W A
N Y O E R M C U E A V Z A N R
V X D O M Z S D Z O L A G O E
E N N I R O I R E T N I J G C
E O T N O I T A L U P O P O X
S F B L A C I P O R T B U S M
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>exotic river</strong></td>
<td>A river that flows into a dry region bringing water from somewhere else is said to be an exotic river.</td>
</tr>
<tr>
<td><strong>Chihuahuan</strong></td>
<td>The Chihuahuan desert covers parts of Texas, New Mexico, and mainland Mexico.</td>
</tr>
<tr>
<td><strong>Great Basin</strong></td>
<td>The most northern member of the Northern American Desert is called the Great Basin.</td>
</tr>
<tr>
<td><strong>Arid</strong></td>
<td>Arid is another way of saying dry.</td>
</tr>
<tr>
<td><strong>Pleistocene</strong></td>
<td>The Pleistocene is the geological time period in which many lakes covered the Mojave.</td>
</tr>
<tr>
<td><strong>playa</strong></td>
<td>A playa is a dry lake bed found in desert basins.</td>
</tr>
<tr>
<td><strong>rain shadow</strong></td>
<td>A rain shadow desert forms when clouds lose their moisture by rising over the mountains.</td>
</tr>
<tr>
<td><strong>Endemic</strong></td>
<td>Endemic plants are confined to a particular place.</td>
</tr>
<tr>
<td><strong>leeward</strong></td>
<td>Deserts usually form on the leeward side of a mountain.</td>
</tr>
<tr>
<td><strong>population</strong></td>
<td>A population includes individuals of a particular species with definable group characteristics.</td>
</tr>
<tr>
<td><strong>Coastal</strong></td>
<td>Coastal deserts form by wind blowing over cold ocean currents.</td>
</tr>
<tr>
<td><strong>Mojave</strong></td>
<td>The Mojave is the smallest of the four American Deserts.</td>
</tr>
<tr>
<td><strong>Subtropical</strong></td>
<td>Subtropical deserts form as a result of air circulation and the seasonal tilting of the earth.</td>
</tr>
<tr>
<td><strong>arroyo</strong></td>
<td>An arroyo is another name for dry desert washes.</td>
</tr>
<tr>
<td><strong>summit</strong></td>
<td>A summit is another name for the top of a mountain.</td>
</tr>
<tr>
<td><strong>interior</strong></td>
<td>An interior desert forms when air masses have lost all of their moisture because of traveling long distances.</td>
</tr>
<tr>
<td><strong>windward</strong></td>
<td>The windward side of a mountain is often heavily forested.</td>
</tr>
<tr>
<td><strong>community</strong></td>
<td>An ecological community is a population of organisms that interact in a given area in a given time.</td>
</tr>
<tr>
<td><strong>Sonoran</strong></td>
<td>The Sonoran desert occupies California, Arizona, and parts of Mexico.</td>
</tr>
<tr>
<td><strong>desert</strong></td>
<td>A desert receives very little precipitation.</td>
</tr>
</tbody>
</table>
Part 2
Now find each unscrambled term in the hidden word puzzle below. The terms can be written horizontally, vertically, or diagonally and forward and backward. Circle each term as you find it.
Activity IV: What Makes A Desert Special? Network Tree

DESERTS

location

Tropic of Tropic of

desert types

Mojave (Characteristics)

types of North American deserts

characteristics
Activity IV: What Makes A Desert Special? Network Tree

**DESERTS**

- **location**
  - Tropic of Capricorn
  - Tropic of Cancer
  - subtropical
  - coastal
  - interior
- **desert types**
  - rain shadow
- **types of North American deserts**
  - Sonoran
  - Great Basin
  - Chihuahuan
- **Mojave (Characteristics)**
  - rain shadow
  - alluvial
- **plants and animals**
- **rivers**
- **arroyo**
- **playa**

**characteristics**

- extreme erosion
- low precipitation
- low humus, high mineral soil
- absorbs maximum sunlight
- low humidity
- temperature fluctuations
- high temperatures
- humidity
- precipitation
- arroyo
- playa
Unit II: Who Owns The Mojave Desert?

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<td>Methods</td>
<td>71</td>
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<td>Time Considerations</td>
<td>71</td>
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<td>Activity: Who Owns the Mojave Desert?</td>
<td>72</td>
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<tr>
<td>Activity: Who Owns the Mojave Desert? (Key)</td>
<td>76</td>
</tr>
</tbody>
</table>
Unit II: Who Owns The Mojave Desert?

Background Information

Most of the Mojave Desert is owned by the American public and managed by federal, state, and county agencies. This did not happen by accident and is a result of agreements between federal and state governments concerning statehood. The purpose of this unit is to categorize land ownership of the Mojave Desert. Land management practices will be described in the next unit.

Ownership Categories

There are three major categories of land ownership in the Mojave Desert: the federal government; private concerns; and state and local governments. The federal government category includes all of the agencies that manage land in the Mojave Desert. Private concerns include corporate and individual landholders. Because state and local governments own a small percentage (2%), they have been grouped together.

Although the largest portion of the Mojave Desert is located in southern California, it extends into southern Nevada and northeastern Arizona. It encompasses approximately 22,450,977 acres (9,085,910.4 ha). The largest land owner is the federal government which owns 18,879,789 acres (7,640,650.6 ha). Private landowners are the second largest group, owning 3,119,603 acres (1,262,503.2 ha). State and local entities are the smallest group with 451,585 acres (182,754.8 ha). Figure 1 shows ownership distribution.

Federal Land Ownership

Federal lands in the Mojave Desert are managed by six groups: Bureau of Land Management; National Park Service; Department of Defense; Bureau of Indian Affairs; Bureau of Reclamation, and U.S. Fish and Wildlife Service. The latter three agencies own 5688 acres (2301.9 ha) or less than .03% of the land.

The Bureau of Land Management (BLM) manages 9,153,625 acres (3,704,472 ha). The National Park Service (NPS) manages 7,065,581 acres (2,859,440.6 ha). The Department of Defense (DOD) manages 2,654,895 acres (1,074,436 ha). Figure 2 shows the distribution of federal land, by managing agency, for the Mojave Desert.

National Park Service

The National Park Service management area is divided into four distinct units in the Mojave Desert. They are Death Valley National
Figure 1 Mojave Desert Land Ownership

Park with 3,367,627 acres (1,362,878.7 ha); Joshua Tree National Park with 793,995 acres (321,329.8 ha); Lake Mead National Recreation Area with 1,484,159 acres (600,639.2 ha), and Mojave National Preserve with 1,419,800 acres (574,593.1 ha). Figure 3 shows the distribution of Federal land that is managed by the National Park Service in the Mojave Desert.

Figure 2 Distribution of Federal Land by Managing Agency.

Federal 84%
Private 14%
State/Local 2%
Figure 3
Mojave Desert Land Managed by the National Park Service
Teacher’s Guide
Lesson: Who Owns the Mojave Desert?

Objective:
Students will gain an understanding of Mojave Desert ownership by categorizing land ownership.

Materials:
Mojave Desert Land Ownership (duplicate for students),
Land Ownership Activity (duplicate for students),
Student Journals.

Subjects:
Social sciences, language arts, math.

Skills:
Analyzing, interpreting, categorizing, predicting, and writing.

Method:
2. Tell students that they will be utilizing data tables to discover who owns the desert.
3. Have students complete the Land Ownership Activity.
4. Have students reflect on what they found in relationship to their initial responses.
5. Once the project is completed, have students journal about their feelings on land ownership in the Mojave Desert. Remind them that there is not a right or wrong answer for this activity.

Time Considerations:
1. Overview of Mojave Desert land ownership: 20-30 minutes.
2. Activity: 20-40 minutes.
Activity: Who Owns the Mojave Desert?

Use the information from the following three tables on land ownership in the Mojave Desert to construct three bar graphs and answer the questions. The bar graphs provided are for data in acres.

<table>
<thead>
<tr>
<th>Land Owner</th>
<th>Acres (In Millions)</th>
<th>Hectares (In Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Government</td>
<td>18.9</td>
<td>7.6</td>
</tr>
<tr>
<td>Private</td>
<td>3.1</td>
<td>1.3</td>
</tr>
<tr>
<td>State/Local</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22.5</strong></td>
<td><strong>9.1</strong></td>
</tr>
</tbody>
</table>

*Table 1 Mojave Desert Land Ownership Categories*

<table>
<thead>
<tr>
<th>Federal Agency</th>
<th>Acres (In Millions)</th>
<th>Hectares (In Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bureau of Land Management</td>
<td>9.2</td>
<td>3.7</td>
</tr>
<tr>
<td>National Park Service</td>
<td>7</td>
<td>2.8</td>
</tr>
<tr>
<td>Department of Defense</td>
<td>2.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Other *</td>
<td>0.0006</td>
<td>0.0002</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18.9006</strong></td>
<td><strong>7.6002</strong></td>
</tr>
</tbody>
</table>

*Table 2 Mojave Desert Federal Land Managing Agencies*

*Other = Bureau of Indian Affairs, Bureau of Reclamation, U.S. Fish and Wildlife Service.*

<table>
<thead>
<tr>
<th>National Park</th>
<th>Acres (In Millions)</th>
<th>Hectares (In Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death Valley</td>
<td>3.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Lake Mead</td>
<td>1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Mojave Preserve</td>
<td>1.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Joshua Tree</td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.1</strong></td>
<td><strong>2.8</strong></td>
</tr>
</tbody>
</table>

*Table 3 Mojave Desert Land Managed by the National Park Service*

Figures are rounded.
Graph 1 Mojave Desert Land Ownership Categories

Federal Government  Private Landowners  State/Local Governments

Millions of Acres
Graph 2: Mojave Desert Federal Land Managing Agencies

Graph 3: Mojave Desert Land Managed by the National Park Service
Questions

1. Using the information from Table 1, calculate the percentage of the Mojave Desert that is owned by the federal government.

2. Using the information from Table 1, calculate the ratio of federal land to private land. Explain what this means.

3. Were you surprised to find out how much of the Mojave Desert is owned by the federal government? Explain your answer.

4. Rank the land ownership of the following federal agencies and National Parks. Write 1 in front of the one with the most acreage first; write 2 in front of the second largest; etc.

   _____ Joshua Tree National Park
   _____ Lake Mead National Recreational Area
   _____ National Park Service
   _____ Department of Defense
   _____ Mojave National Preserve
   _____ Death Valley National Park
   _____ Bureau of Land Management
**Activity: Who Owns the Mojave Desert?**

Use the information from the following three tables on land ownership in the Mojave Desert to construct three bar graphs and answer the questions. The bar graphs provided are for data in acres.

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<td>1.3</td>
</tr>
<tr>
<td>State/Local</td>
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<td>0.2</td>
</tr>
<tr>
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<td><strong>22.5</strong></td>
<td><strong>9.1</strong></td>
</tr>
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<tr>
<td>Department of Defense</td>
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<tr>
<td>Other *</td>
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<td>0.0002</td>
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<tr>
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*Table 2 Mojave Desert Federal Land Managing Agencies*

*Other = Bureau of Indian Affairs, Bureau of Reclamation, U.S. Fish and Wildlife Service.*

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*Table 3 Mojave Desert Land Managed by the National Park Service*

Figures are rounded
Graph 1: Mojave Desert Land Ownership Categories

Federal Government

Private Landowners

State/Local Governments
Graph 2: Mojave Desert Federal Land Managing Agencies

Graph 3: Mojave Desert Land Managed by the National Park Service
Questions

1. Using the information from Table 1, calculate the percentage of the Mojave Desert that is owned by the federal government.
   
   \[ \frac{18.9}{22.5} \times 100 = 84\% \]

2. Using the information from Table 1, calculate the ratio of federal land to private land. Explain what this means.
   
   \[ \frac{18.9}{3.1} = 6.1 \text{ times or } 6:1. \]
   
   For every acre of private land there is 6.1 acres of federal land.

3. Were you surprised to find out how much of the Mojave Desert is owned by the federal government? Explain your answer.
   
   Answers will vary but must have an adequate explanation.

4. Rank the land ownership of the following federal agencies and National Parks. List the one with the most acreage first, the second largest second, the third largest third, and the smallest one last.
   
   7. Joshua Tree National Park
   5. Lake Mead National Recreational Area
   2. National Park Service
   4. Department of Defense
   6. Mojave National Preserve
   3. Death Valley National Park
   1. Bureau of Land Management
Unit III: How Are Deserts Managed?

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Unit III: How are Deserts Managed?

Background Information

Over 86% of the Mojave Desert is owned by the American public and managed by federal, state, and county agencies. Because federal agencies manage the largest percentage of land in the Mojave Desert and have specific missions, their management practices will be emphasized in this unit.

Congress is responsible for establishing specific management purposes for all federal lands. Each federal agency has a different mission which has resulted in different management styles. The Bureau of Land Management (BLM), National Park Service (NPS), and the Department of Defense (DOD) are the primary federal land management agencies in the Mojave Desert.

Department of the Interior

The Bureau of Land Management (BLM), National Park Service (NPS), and U.S. Fish and Wildlife Service (FWS) are all agencies of the Department of the Interior (DOI). Each agency reports to the Secretary of the Interior, a Cabinet level position appointed by the President. Each agency has a separate and distinct mission as provided for in law by Congress. The BLM administers the public domain lands of the West under a multiple use mission. The NPS administers park units with a mission to preserve them unimpaired for the enjoyment of present and future generations. The FWS manages national wildlife refuges and administers the Endangered Species Act, Migratory Birds Treaty Act, and other wildlife regulations within other areas.

Bureau of Land Management

The Bureau of Land Management’s (BLM) mission is to provide for a wide variety of public land use without compromising the long-term health and diversity of the land. This is to be accomplished without sacrificing significant natural, cultural, or historical values. As a result, the BLM focuses its management on multiple use and maintaining long-term health of the land. Multiple use includes land use regulation and enforcement; range management; resource conservation; forest management; fish and wildlife management; wild horse and burro management; cultural resource management; outdoor recreation; wilderness management; environmental management; energy and mineral management; public land surveys; and fire protection.
National Park Service

The National Park Service (NPS) was created by the NPS Organic Act of 1916. This act states that the primary purpose of park units is to preserve the scenery, natural and historic objects, wildlife, and to provide for the enjoyment of each of these while leaving them undisturbed so that future generations may enjoy them. The emphasis is on preserving the resource. As a result, the NPS focuses its management on preservation of the site while still allowing use and enjoyment of the area.

Fish and Wildlife Service

The mission of the U.S. Fish and Wildlife Service (FWS) is to conserve, protect, and enhance fish and wildlife and their habitats. Even though the FWS manages a small area near Ash Meadows in the Mojave Desert, it plays a key role in Mojave Desert land management because it assists other agencies in implementing plans for the recovery of species listed as threatened or endangered.

Department of Defense

The Army, Air Force, Navy, and Marine Corps, all part of the Department of Defense, report to the Secretary of Defense, a Cabinet level position appointed by the President. Each of the armed forces has large land holdings in the Mojave Desert. The basic military mission is to maintain national defense readiness through ongoing activities that include training exercises and testing of weapons systems. As a result, military land management practices focus on national defense preparedness while preserving and maintaining sustainability of the land.

State, County, and City Agencies

The California Department of Parks and Recreation manages several units in the Mojave Desert. Its mission is to provide for the health, inspiration, and education of the people of California. This is accomplished through preserving the state’s extraordinary biological diversity, protecting valued natural and cultural resources, and creating opportunities for high quality outdoor recreation. Because of the emphasis on preservation, its management style is similar to the NPS.

Most county agencies and municipalities provide services for the citizens who reside in their jurisdiction. These services include planning and developing roads, towns, sewage disposal plants, parks,
etc. Because of limited resources they may not have mission statements, but may have codes that directly relate to land management practices.

**Ecosystem Management**

Land managers realized that focusing on one issue at a time such as wildlife, recreation, or cultural resources is ineffective. This led to the development of ecosystem management, which is the integration of ecological, economic, and social principles to manage biological and physical systems in a manner that safeguards the long-term ecological **sustainability**, natural diversity, and productivity of the landscape. Thus, land managers think of individual resources as interrelated parts of systems rather than as single components that stop at agency boundaries.

As local land managers developed ecosystem management plans for the Mojave Desert, they realized the need for coordination and cooperation among federal, state, regional, and local agencies. The result has been the development of a plan for collaborative management of the California desert.

The plan is called the Mojave Desert Ecosystem Initiative (MDEI). Its mission is to design, build, and use a scientific data base that can reliably yield the data necessary to allow land management agencies to base their decisions on facts that will enhance the Mojave Desert ecosystem while supporting sustainable economics, communities, and national defense preparedness.

The MDEI is a model for the sharing and integration of data from a long list of participants. The military installations in the Mojave Desert will provide resources and personnel to help meet scientific goals. The U.S. Geological Service (USGS) will provide geological and **topographical** data, as well as experience in developing similar resource management systems. The Biological Resources Division of the USGS will provide research methods, scientific expertise, and existing and ongoing research within the ecosystem. The National Park Service will provide personnel and resources in current and previously obtained scientific research. The Bureau of Land Management will serve as the management forum through which scientific data can be readily integrated into land use/management decisions. The U.S. Fish and Wildlife Service will provide technical assistance in locating and determining threatened, endangered, and sensitive species and their habitats, as well as oversight and support in permitting and accomplishing data
acquisition. The U.S. Bureau of Mines will provide information on distribution of minerals and related **geomorphological** data. The U.S. Army Topographical Engineering Center will provide mapping, **remote sensing**, a computer data base, and data acquisition expertise.

The information will be used to develop scientifically-based land use management programs for the Mojave Desert. Figure 1 shows the current management hierarchy of the MDEI.

**Glossary**

1. **bioregional** - refers to land management plans which cover large areas and include all living and nonliving things.
2. **ecosystem** - a grouping of plants, animals, and other living organisms interacting with each other and with their environment in such a way as to perpetuate the grouping more or less indefinitely.
3. **ecosystem management** - a management system designed for a specific ecosystem.
4. **geomorphological** - pertaining or related to the classification, description, nature, origin, and development of present landforms.
5. **habitat** - the specific environment or geographic region in which an organism lives.
6. **multiple use** - a land management plan which provides for a wide variety of land usage.
7. **municipality** - a city, town, or other district possessing governing authority.
8. **physiographic map** - a map which uses symbols to show local features of the earth's surface.
9. **public domain lands** - lands that are owned jointly by the American public and managed by either federal, state, or local authorities.
10. **recovery** - refers to a plan which rebuilds populations of endangered species to a point where they are no longer on the brink of extinction.
11. **remote sensing** - the collection of data about an object by a recording device not in immediate contact with it. Includes the use of cameras, infrared detectors, radar, etc.
12. **sustainability** - a harmony of natural systems in which they maintain their health and integrity indefinitely.
13. **topographical** - pertaining or related to the general configuration of the land's surface.
14. **unimpaired** - refers to preserving the land in its original form and character.

**Collaborative Management In The California Desert**

<table>
<thead>
<tr>
<th>Department of Interior</th>
<th>Department of Defense</th>
<th>State/Local Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bureau of Land Management</td>
<td>Fort Irwin - Army</td>
<td>State Parks (Mojave &amp; Colorado Desert Districts)</td>
</tr>
<tr>
<td>National Park Service</td>
<td>China Lake Naval Weapons Center - Navy</td>
<td>Districts)</td>
</tr>
<tr>
<td>(Death Valley, Joshua Tree, Lake Mead, Mojave Preserve)</td>
<td>Marine Corps Air Ground Combat Center</td>
<td>CA Fish &amp; Game</td>
</tr>
<tr>
<td>Fish and Wildlife Service</td>
<td>Edwards Air Force Base</td>
<td>CALTRANS</td>
</tr>
<tr>
<td></td>
<td>Chocolate Mountains - Navy</td>
<td>Counties (Imperial, Inyo, Riverside, San Bernardino, Los Angeles)</td>
</tr>
</tbody>
</table>

**Interagency Work Groups**
- Science/Data Management
- Fire Management
- Law Enforcement/Visitor Safety
- Restoration/Rehabilitation
- Wilderness
- Visitor Services/Information
- Cultural Resources

**California Desertwide Assessments**
- Physical, Cultural, Natural, Administrative, Data Management

**Bioregional Plans**
- West Mojave Desert
- Eastern Mojave Desert
- Northern Mojave Desert
- Northern/Eastern Colorado Desert
- Coachella Valley
- Western Colorado Desert
- Peninsular Range

**Site Specific Management Plans**
- Military Installation
- National Park General Management Plans
- Fish & Wildlife Refuge Plans
- Recovery Plans
- Bureau of Land Management Activity Plans

**Figure 1 Management Hierarchy of Mojave Desert Ecosystem Initiative**
Lesson 1: How are Deserts Managed?

Objectives:
Students will gain an understanding of the management of the desert by:
a. writing down the mission and management style of the public agencies
   that manage the Mojave Desert.
b. defining ecosystem management.
c. listing the agencies involved in the Mojave Desert Ecosystem
   Initiative and describing the task that each one has agreed to
   perform.

Materials:
Overview of Desert Management Practices (duplicate for students),
Figure 1 Management Hierarchy of Mojave Desert Ecosystem Initiative
(make transparency for overhead projector),
Activity I: Mojave Desert Ecosystem Initiative Network Tree (duplicate
for students).

Subjects:
Social sciences, language arts, science.

Skills:
Analyzing, categorizing, predicting, and writing.

Method:
1. Define land management as the act of handling, directing, or
   controlling land use. Ask students what they know about land
   management of the desert. List their responses on the board.
2. Present the Overview of Desert Management Practices and glossary to
   students. Emphasize ecosystem management and the partners involved.
3. Have students complete Activity I: Mojave Desert Ecosystem Initiative
   Network Tree based on the notes from the presentation.

Time Considerations:
2. Activity I: 10-20 minutes.

Lesson 2: How are Deserts Managed?

Objectives:
1. Students will develop a Mojave Desert land use plan from a
   physiographic map.
2. Students will compare their land use plan to actual land use in the
   Mojave Desert.
3. Students will journal their feelings on the activity.
Materials:
Activity II: Land Use Exercise (duplicate for students),
Maps of California, Nevada, and Arizona,
Student Journals.

Subjects:
Social sciences, language arts, science, art, math.

Skills:
Analyzing, interpreting, categorizing, predicting, and writing.

Method:
1. Have students complete Activity II: Land Use Exercise according to
   the instructions in the handout. This should be done in cooperative
   groups of 3-4 students. Remind students that there is not a single,
   definitive answer to the exercise and that they must justify their
   decisions.
2. Have groups briefly share their plans.
3. Have students journal their feelings about this project.

Time Considerations:
1. Activity II: 40-50 minutes.
2. Sharing: 20-30 minutes.
Activity I: Mojave Desert Ecosystem Initiative Network Tree
This network tree will help you identify the agencies and other partners participating in the Mojave Desert Ecosystem Initiative, a collaborative management plan for the California desert.
Activity I: Mojave Desert Ecosystem Initiative Network Tree

This network tree will help you identify the agencies and other partners participating in the Mojave Desert Ecosystem Initiative, a collaborative management plan for the California desert.
Activity II: Land Use Planning

Undeveloped land has many potential uses. A desert could be a vast depository for refuse, a recreational site, a unique ecosystem which should be preserved, or a place to live.

With a group of 3 or 4 students consider the undeveloped Mojave Desert and devise a use plan for it. You will need to take into consideration the mission of all agencies that will be involved and designate the land to each agency that best reflects its management style. You will also need to provide for private land ownership. Private ownership includes both commercial and residential development. The development of a road and rail system will also need to be accomplished. Once this has been completed, each group will present its plan to the class.

Lands owned by the federal government and managed by the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Service, and the military are managed for specific purposes, based on a mission statement. As a result, management styles vary.

Mission Statements of Government Agencies

1. Bureau of Land Management (BLM) - To provide for a wide variety of land use without compromising the long-term health and diversity of the land. Includes range management, fish and wildlife management, cultural resource management, outdoor recreation, wilderness management, environmental management, energy and mineral management, public land surveys, and fire protection.

2. National Park Service (NPS) - To provide for the preservation of scenery, natural and historic objects, and wildlife in such a manner that they remain undisturbed so that future generations may also enjoy them. The NPS has several designations, which include national parks, national monuments, and national preserves. National parks contain a variety of resources and encompass large land or water areas to help provide adequate protection of the resource. National monuments preserve at least one nationally significant natural or cultural feature, are usually smaller than a national park, and lack the diversity of resources. National preserves differ from National Parks in that preserves allow certain activities such as hunting, grazing, and mining.
3. **U.S. Fish and Wildlife Service (FWS)** - To conserve, protect, and enhance fish and wildlife and their habitats for the benefit of all. Key responsibility lies in implementation and enforcement of endangered species laws. Land ownership can occur as wildlife preserves, but its primary function is to assist others in developing recovery plans.

4. **Military** - To provide for national defense by maintaining readiness through ongoing activities that include training exercises and testing of weapons systems. Your group must consider use by the Army, Air Force, Navy, and Marines. The Army needs an armor training facility. The Air Force and Navy need air space for testing new types of aircraft and weapons systems. The Marines need an area where they can train both ground troops and aviators. Each of the four branches of the military will need its own site.

5. **State and county** - In this exercise, their mission is to develop a road system and to locate municipalities. These local partners will need to interact with federal agencies.

**Commercial and Private Land Owners**

1. **Commercial Land Owners** - This group includes ranchers, farmers, miners, railroads, and business owners. Each will need to lease or buy land from the federal government in order to conduct business.

2. **Private Land Owners** - This includes the individual land owner.

**Instructions**

1. Use the **Physiographic Map** of the Mojave Desert (Figure 1) as the base map for your project.

2. Use the following list of features, taken from the map, as a guide to determine how to divide the land. Death Valley; limestone cavern in Providence Mountains; Devil's Playground (sand dunes); lava flows; Colorado River; Hoover (Boulder) Dam; Lake Mead; Soda Lake (dry); China Lake (dry); Silver Lake (dry); Searles Lake (dry); large Joshua Tree woodland located between the Bullion and San Bernardino mountain ranges; gold deposits in the Bullion, Granite, and Tehachapi mountain ranges; and Antelope Valley grasslands.

3. Be sure to plan for use by the BLM, NPS, FWS, Military, commercial concerns, and private landowners. Remember that the NPS has several different designations that you may use.
4. Mountain ranges are indicated on the map. The white area between them is relatively flat and suitable for habitation and other human use.

5. Each group should plan for the development of municipalities and private land ownership. Established municipalities include, but are not limited to Bakersfield, Barstow, Los Angeles, and Las Vegas.

6. Each group should plan a road and railroad system through the area.

7. Use the following color code to indicate which agency manages each area: BLM - yellow; NPS - purple; FWS - green; military - pink; roads - black; railroads - brown; commercial land - white; private land - tan.

8. Once you have completed your desert use map, present it to the class.

9. After all of the groups have presented their plans, compare them with yours.

10. After you have compared plans, your teacher will show you a map of the Mojave Desert (Figure 2). Compare the actual land usage with your plan.

11. Write about your land use planning experience in your journal. How has it changed your view on how the desert is managed?
Figure 1. Physiographic Map of the Mojave Desert.
Figure 2 Current Map of Mojave Desert
## Unit IV: Endangered Species - What Are The Choices?

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Unit IV: Endangered Species - What Are The Choices?

Background Information

An endangered species is a plant or animal in danger of becoming extinct throughout all or a large part of its range. The United States Fish and Wildlife Service manages this nation's endangered species program, including developing and maintaining the federal list of endangered and threatened species. Each state has a program as well. In this unit students will have an opportunity to explore the causes of extinction and get a first hand look at an endangered species, the Mohave tui chub.

Extinction Is Forever

Extinction is a natural evolutionary process. Throughout the history of the world different types of plants and animals have emerged, flourished, and then disappeared. The reason for extinction is not always clear but appears to be linked to climate changes, disease, overpopulation, or competition for food. Sometimes a combination of these factors is the cause for extinction.

Unfortunately, the activities of humans are in some cases, directly responsible for the extinction of species. Many of the disappearing plants and animals have never been studied and classified, so we are unaware of the role they play in the earth's web of life. The major problem with this is that once they are gone they can not be studied because extinction is forever.

The Endangered Species Act

In 1973 the United States established the Endangered Species Act to prevent extinction and to grant the federal government the authority to protect certain species of plants and animals along with their habitats. The Act protects listed species from "harm or take." "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. It can be considered "take" even if it is unintentional or accidental. There are both civil and criminal penalties which may include fines and/or imprisonment.

The United States Fish and Wildlife Service (FWS) is responsible for managing and enforcing the nation's endangered species program. This includes the listing of species. FWS must follow a strict legal process to propose and list species. Once a species is proposed it is called a candidate. Unfortunately, there are so many candidates that
the system has become backlogged, and a species may become extinct while waiting to get on the official list.

States have their own endangered species lists which may be slightly different than the federal list. Each state's fish and game agency is responsible for carrying out the enforcement of its plan.

**Classifications**

There are three classifications into which at-risk species fall. They are **rare**, **threatened**, and **endangered**. A **rare species**, a status only used for plants, is one that has such a small **population** throughout its **range** that it could become endangered if its current environment is further harmed. A **threatened** species is not in immediate danger of extinction but is likely to become endangered if it isn't protected because its numbers are low or declining. An **endangered** species is one that is in immediate danger of becoming extinct throughout all or part of its **range** unless special protective measures are taken.

**Major Causes of Extinction**

Plants and animals are becoming extinct at a higher rate than ever before due to the activities of people. Four major reasons for extinction are; introducing **exotic** or non-native species into native habitat, destruction of habitats, overhunting, and pollution.

Animals are more prone to extinction if they interfere in some way with people's activities; migrate; have very specific food or nesting requirements; are sensitive to changes; have low birth rates or small families, and long pregnancies; or are naturally rare.

**Extinction and the Mojave Desert**

The Mojave Desert has a wide variety of habitats. This makes it home to many different plants and animals. Adaptations of desert plants and animals allow them to live successfully in the desert environment.

Most desert animals have developed strategies for surviving in the heat. The most prevalent strategies are being **crepuscular** which means being active in the evening or morning, or being **nocturnal** which means being active at night when the desert is coolest. Another adaptation is the **assimilation** of moisture from food. A fourth adaptation is called **estivation**, a form of warm weather hibernation.

Most desert plants are **ephemeral**, **perennial**, or **endemic**. **Ephemeral** plants have a short growing season. They grow quickly, flower, produce seeds for the next generation, and die. Seeds may lie
dormant for many years before sprouting. **Perennial** plants grow for many years. They resist dry periods by becoming dormant and may appear dead. They flower in the spring and then shed all or part of their leaves when the temperatures rise. **Endemic** plants grow in a limited or restricted area.

Any minor change in the desert **habitat** which upsets the delicate balance can have devastating effects on the life there. People have played a major role in altering habitats by pumping groundwater, constructing buildings and roads, grazing domestic stock, mining, farming, recreating, and doing a host of other activities. Each time a habitat is altered, extinction might occur. It would be unrealistic to ask people to stop all activities which alter habitats. What can be asked is that people take into consideration the impact their activities have on an area. This is important because humans are part of the habitat and all living things are connected and interdependent.

**Glossary**

1. **assimilation** - to take in and incorporate as one’s own; absorb.
2. **biodiversity** - the variety of life forms that inhabit the earth.
3. **candidate** - a species that is being considered for inclusion on the endangered species list.
4. **crepuscular** - active at dawn or dusk.
5. **ecosystem** - a system of interdependent and interacting living organisms and their immediate physical, chemical, and biological environments.
6. **endangered species** - one that is in serious danger of becoming extinct throughout all or a significant portion of its range unless special protective measures are taken.
7. **endemic** - plants which grow in a limited or restricted area.
8. **ephemeral** - plants which complete their life cycle in a very short time.
9. **estivation** - warm weather hibernation.
10. **exotic species** - non-native, something that did not exist in an area before being introduced by human influence.
11. **habitat** - the specific environment or geographical region in which a species is found.
12. **indicator species** - a species that is monitored and whose condition is used to indicate the overall health of an ecosystem.
13. **nocturnal** - active by night.
14. **perennial** - a plant which persists in whole or in part from year to year and flowers in more than one year.

15. **population** - individuals of a particular species with definable group characteristics.


17. **rare species** - one that has such a small population throughout its range that it could become endangered if its current environment is further harmed (a status used only for plants).

18. **threatened species** - one that is not in immediate danger of extinction but is likely to become endangered if it isn’t protected because its numbers are low or declining.
Teacher's Guide
Lesson 1: Introduction to the Unit

Objectives:
1. Students will assess their thoughts on endangered species by responding to a question about the types of animals they feel are important to save.
2. Students will arrive at a consensus about whether to preserve an endangered species or to build a recreation center.

Materials:
Endangered Species - What are the choices? (duplicate for students).

Subjects:
Science, social sciences, language arts.

Skills:
Analyzing, interpreting, categorizing, predicting, writing.

Method:
1. Write the following question on the board.
   Which of the following do you think is most important to save?
   a. animals that are very beautiful
   b. large animals, such as whales, grizzly bears, and bighorn sheep
   c. a fish that lives in weedy lakes
   d. a plant with blue flowers that only grows in certain sandy areas
   e. a rat that lives where people often want to build
   Have students briefly discuss and list their responses.

2. Write the following issue on the board.
   Your town is thinking of building a recreation center in your neighborhood. But the proposed site is the home of an endangered lizard, and building the center might wipe out the lizard. Do you think it is okay for the recreation center to be built on that site? Explain your answer.
   Would you feel differently if there were an endangered plant living on the site where the center might be built? What if it was an endangered fly? Explain your answer.

3. Divide students into groups of 3-4. Tell them to discuss their responses to the issue and to be prepared to present their choices and rationales to the class.

4. Ask the groups to briefly share their choices and rationales to the class.

5. After all groups have presented their choices and rationales, guide
the class into reaching a consensus about building the recreation center. Explain that this is one of the techniques used to arrive at solutions for issues concerning endangered species. One way to help achieve consensus is to have everyone rank the ideas that have been presented with a number. For example, if there are six ideas, each person would rank the choices from 1 to 6 with 6 being the first choice. Total the number of points given for each idea; the one with the highest score represents the majority viewpoint. This technique is especially helpful when you have a large group trying to reach consensus.

6. Present Endangered Species - What Are The Choices? (Background Information) to students. One of the best ways to do this is to duplicate it and let them read it. After this is completed, discuss it with the class. As an alternative, it can be presented to the class while they take notes.

Time Considerations:
1. Introduction: 5-10 minutes.
2. Group discussions, presentations: 20-30 minutes.
3. Background information: 10-15 minutes.

Lesson 2: A look at an Endangered Species

Objective:
Students will develop a plan to reintroduce the Mojave tui chub, an endangered species, back into its native habitat.

Materials:
Activity: The Mohave Tui Chub - Endangered Species (duplicate for students),
student journals.

Subjects:
Science, social sciences, language arts.

Skills:
Analyzing, categorizing, predicting, decision making, evaluating, researching.

Method:
1. Give each student a copy of Activity: The Mohave Tui Chub - Endangered Species. Once this has been done, divide them into cooperative learning groups of 4-5. Tell the class that each group is to use the provided information and any outside resource necessary to construct and present a plan to reintroduce the fish into its
native habitat. **Note:** Instead of the Mohave tui chub, your students may wish to research another Mojave Desert endangered species, from the following list.

<table>
<thead>
<tr>
<th>Animals</th>
<th>Status</th>
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<tr>
<td>Arroyo toad</td>
<td>Endangered</td>
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<tr>
<td>Bald eagle</td>
<td>Endangered</td>
</tr>
<tr>
<td>California brown pelican</td>
<td>Endangered</td>
</tr>
<tr>
<td>Least Bell’s vireo</td>
<td>Endangered</td>
</tr>
<tr>
<td>Peregrine falcon</td>
<td>Endangered</td>
</tr>
<tr>
<td>Southwestern willow flycatcher</td>
<td>Endangered</td>
</tr>
<tr>
<td>Yuma clapper rail</td>
<td>Endangered</td>
</tr>
<tr>
<td>Desert pupfish</td>
<td>Endangered</td>
</tr>
<tr>
<td>Unarmored three spine stickleback</td>
<td>Endangered</td>
</tr>
<tr>
<td>Razorback sucker</td>
<td>Endangered</td>
</tr>
<tr>
<td>Stephens’ kangaroo rat</td>
<td>Endangered</td>
</tr>
<tr>
<td>Desert tortoise</td>
<td>Threatened</td>
</tr>
<tr>
<td>Inyo California towhee</td>
<td>Threatened</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plants</th>
<th>Status</th>
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<td>Cushenbury buckwheat</td>
<td>Endangered</td>
</tr>
<tr>
<td>Cushenbury milkvetch</td>
<td>Endangered</td>
</tr>
<tr>
<td>Slender-petaled thelypodium</td>
<td>Endangered</td>
</tr>
<tr>
<td>Bird-footed checkerbloom</td>
<td>Endangered</td>
</tr>
<tr>
<td>Slender-horned spineflower</td>
<td>Endangered</td>
</tr>
<tr>
<td>Parish’s daisy</td>
<td>Threatened</td>
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A list of questions to guide their learning in either option includes: 1) What would be a description of this species’ lifestyle?; 2) What characteristics of this species contributed toward it being endangered or threatened?; 3) How is the natural habitat of the endangered species threatened? (brief description of causes); 4) What steps have been taken to protect this habitat?; 5) What agencies, individuals, or groups might assist the research to the threats to the habitat of the endangered species?; 6) How could we (as students) educate the community about the threats to the habitat of the endangered species? (list plans for the neighborhood, school, and community); and 7) What other steps might we, as students, take to protect the habitat of the endangered species? (list the steps).

Once all the plans have been presented, guide students into a class consensus, or general agreement, for each species. Use this
consensus as the "class plan."
3. Have students revisit the first question regarding animals that are important to save. Have their feelings changed? Students should journal how they feel about saving plant and animal species. Remind students that a journal is a personal record of their reactions to the learning experiences.

**Time Considerations:**
1. Mohave tui chub activity: 40-50 minutes.

**Extensions:**
1. Have students contact appropriate federal and state agencies to find out about how they plan to help the Mohave tui chub or other selected endangered species. Once this is completed have students send the class plan to the appropriate agencies.
2. Have the class actually carry out their plans to help an endangered Mojave Desert species (See Unit VII on Taking Action).
Your assignment is to construct and present a plan to reintroduce the Mohave tui chub into its native habitat. Use the following information and other available materials to accomplish this task.

Mohave Tui Chub
Gila bicolor mohavensis

Description and Natural History

Mohave tui chub are chunky fish, 2-8 inches (5-20 cm) long, with scales and short, rounded fins. Their heads are broad, and they have a short snout and small mouth. Olive-brown above and silvery white underneath, the Mohave tui chub glistens with a metallic sheen in bright sunlight. The fish eat aquatic insects and their larvae; small, benthic invertebrates; plankton; and detritus. This makes them opportunistic feeders, meaning that they eat both plants and animals. Mohave tui chub live in weedy, near-shore areas of lakes, in the shallow areas of streams flowing out of lakes, and in mineral springs.

Even though water conditions fluctuate widely in Mohave tui chub pools during winter and spring flooding and summertime evaporation, they are not very tolerant of changes in temperature and salinity. They are unable to withstand water temperatures above 97°F (36°C) and retreat to deeper waters during the warmest hours. In winter, when water temperatures drop to 54°F (12°C), the fish stop feeding and move down to the pool bottom to await warmer temperatures. From late spring to early fall, they emerge and devour large quantities of food. This is probably done to store energy for the cold periods.
Breeding occurs in March or April when water temperatures warm to 64°F (18°C); some females spawn again in the fall. Females release their eggs over aquatic plants, primarily ditch grass. The fertilized eggs adhere to the vegetation, hatching in less than 9 days. The young fish form schools, but they spread out and become more solitary as adults.

**Distribution**

The Mohave tui chub is the only known fish native to the Mojave River. Historically, it occurred from the headwaters in the San Bernardino Mountains to Soda Lake near the southern end of Death Valley. Only three pools of water now contain these species in the wild. All of them are near Soda Springs in San Bernardino County. There have been successful transplants of this population into the China Lake Naval Weapons Center and the Desert Research Station Pond at Barstow. For those who would like to see Mohave tui chub, there is a population in a pond at the California Desert Information Center in Barstow.

**Potential Conflicts**

Construction of dams and reservoirs, along with competition with non-native species, are threats to this species. Extensive interbreeding with the Arroyo chub, which was introduced in the 1930s for sportfishing, resulted in the reduction of the Mohave tui chub from most of its historical range. The feasibility of removing Arroyo chub from the Mojave River and restocking Mohave tui chub to their native river is being studied, but could prove challenging because reservoirs and dams have changed the Mojave River’s natural flow. These changes have resulted in conditions which now favor introduced fish.

**Current Status**

The Mohave tui chub is listed as endangered both federally and by the State of California.
Unit V: How Have Various People Viewed The Mojave Desert?

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Unit V: How Have Various People Viewed The Mojave Desert?

Background Information

Mojave is spelled two ways in this unit; Mojave or Mohave. When you see Mojave it refers to the area occupied by the desert, and when you see Mohave it refers to a Native American tribe.

The region occupied today by the Mojave Desert has not always been arid. Movement of the North American continent has resulted in climate changes. During the last 2.5 million years, the area has changed from a series of interconnected lakes to a desert.

The Mojave Desert has been used by many different groups of people through time. During this time the climate has changed and become more arid. This change has influenced the lifestyles of local human inhabitants.

Early Human History

The exact time that humans first came to live in the area now occupied by the Mojave Desert is not known. Evidence indicates that the area has been used by humans for the last 10,000 years. Early humans lived on the shores of lakes and the climate was cool and moist. Streams and marshes covered the area and a large number of game animals and edible plants were present. Humans established a hunting culture where they used spears and darts to fish and hunt large game animals such as mammoths, mastodons, and bison; they also gathered edible plants.

As the climate became hotter and the lakes dried up, humans changed their lifestyle. As game became scarce, humans were forced to migrate and supplement their diet by gathering plants and seeds for food. Migration patterns were dictated by seasonal changes, with winter spent at lower elevations and summer spent at higher elevations. This new lifestyle resulted in trade with other Native American groups which led to widespread use of the bow and arrow, grinding tools, baskets, and pottery.

Native Americans

The Chemehuevi, Mohave, Serrano, and Shoshone were the Native American groups which occupied the Mojave Desert when the first Anglos arrived. Each of these groups occupied a fairly large, exclusive territory. A peaceful coexistence usually prevailed since each group had a high respect for the rights of others. Each group was further subdivided into close-knit extended family units which were independent
of one another except for trade and intermarriage. The make-up of these units would change from season to season or as need arose. This resulted in loose-knit bands instead of tribes.

**Spanish Explorers**

Pedro Pages is considered the first Anglo to enter the Mojave Desert. In 1772, he was the Spanish army officer in charge of a detail dispatched to find and return some deserters from the presidio of San Diego; it is possible that these fugitives were actually the first to cross the desert. Although the criminals were never found, Pages traveled north toward the San Bernardino Valley, crossing the mountains near Cajon Pass. He then made his way into the Mojave Desert to the southern tip of the San Joaquin Valley, and ultimately to his home in Monterey, CA.

Father Francesco Garces was next and is considered the first Anglo to enter the interior of the Mojave Desert. Led by three Mohave Native Americans in 1776 he traveled from Piute Springs over the Providence Mountains and north of the Kelso Dunes to Soda Lake. This route became known as the Mohave Indian Trail.

**American Explorers**

In 1826, Jedediah Smith used the Mohave Indian Trail to cross the Mojave Desert. Kit Carson used the same trail in the 1830s and again in 1844 when he served as a guide for Captain John Fremont. Fremont was on an information gathering expedition and kept detailed journals on the geology, botany, and geography of the region.

As more people came to the Mojave Desert, the Indian trail became known as the Mojave Road. Increased usage resulted in hostilities with local Native Americans. This resulted in the establishment of a series of army posts. By 1870, hostilities ceased and the posts were abandoned.

**Mining**

Many of the early settlers were miners who believed that since the desert was so visibly lacking in resources to support life, it must be hiding untold riches beneath its surface. The discovery of gold, silver, zinc, copper, and iron strengthened this belief, and would-be millionaires scoured the desert in search of wealth. Boom towns sprang up close to the mines, only to be reclaimed by the desert once the ore ran out and the people left. The only mining which has been consistently profitable is borax and rare earth deposits.
Ranching

Ranchers came to the Mojave Desert in the mid-1800s. At that time there was adequate rainfall which provided ample browse during the fall and winter. Cattle were first brought to the area to feed the army and miners. As the Mojave Desert’s climate continued to change, vegetation became scarcer and ranching has become unprofitable. In spite of this, a small group of ranchers still graze cattle on open range in the Mojave Desert.

Railroads

Railroads played a key role in the development of the Mojave Desert. They provided the supplies that kept the mines, homesteads, and ranches operating. They also served as a means of shipping ore and beef. Most of the routes are still in use.

Homesteading

During the 1900s, a series of homestead acts brought an influx of settlers. Early homesteaders often came to the desert because of poor health or to get away from city life. During the Great Depression some came out to the desert to try and live off the land. The desert could not sustain them and most of the homesteads were abandoned.

The Small Tract Act of 1938 offered five-acre “Jackrabbit” homesteads on vacant, surveyed public land. These tracts were intended to be used for health and/or recreational purposes. A person wishing to acquire one of these tracts could lease it for five years. If at the end of the lease a cabin had been built on the property, the land could be purchased for a small fee. Average price was about $20 per acre. Many of these homesteads were built, but few became permanent residences. In 1950 the law changed and this ended homesteading in the Mojave Desert.

Military Use

The Mojave Desert has had a military presence since the 1800s. Since World War II it has provided a training area for desert warfare. The military’s use of the desert is not limited to the land itself. Its airspace is considered prime for testing and training flights. Because of this, low-flying military aircraft are frequently seen and heard.

Recreational Use

Today, people do not need to spend most of their time obtaining basic survival needs, thus there is more time for recreation. Recreational activities in the Mojave Desert include hiking, camping,
off-road vehicle travel, hunting, biking, bird watching, and a host of others. Some of these activities take their toll on native plants and animals. Finding a balance between engaging in these activities and protecting the delicate desert biome is one of the greatest challenges that public agencies, which manage a large portion of the Mojave Desert, encounter.

**Glossary**

1. **Anglo** - an individual of European descent.
2. **arid** - a climate that is lacking in moisture; dry.
3. **biome** - a group of ecosystems that are related by having a similar type of vegetation governed by similar climatic conditions.
4. **bison** - scientific name for buffalo.
5. **browse** - leaves, young shoots, and other vegetation.
7. **mammoth** - a large, hairy, extinct species of elephant.
8. **mastodon** - a hairy, extinct species of elephant.
9. **presidio** - a military fort.
10. **rare earth** - metals which have oxidized and are used in various industries including aerospace.
Teacher's Guide
Lesson: Humans and the Mojave Desert

Objectives:
1. Students will learn about human history in the Mojave Desert by completing a network tree.
2. Students will read a Mohave Nation folk tale about Amboy Crater and use it as guide to create their own folk tale.

Materials:
Background Information (optional to duplicate for students),
Activity I: Humans and the Mojave Desert Network Tree (duplicate for students),
Activity II: Legends, Folk Tales, and Stories (duplicate for students),
student journals.

Subjects:
Social sciences, language arts.

Skills:
Analyzing, interpreting, categorizing, predicting, writing, synthesizing and creating.

Method:
1. Ask students what they know about the history of the Mojave Desert. List their responses on the board.
2. Duplicate the background information for students to read. When completed, discuss it with the class. As an alternative, present it in lecture format to students while they take notes.
3. Give each student a copy of Activity I: Humans and the Mojave Desert. Instruct them to complete the network tree based on the background information.
4. Have students compare the network tree about the history of the Mojave Desert to their initial responses about what they knew. Were there misconceptions? What did students find most interesting? What would they like to know more about?
5. Introduce the folk tales activity. Tell students that desert inhabitants often interpreted their experiences and feeling for the land through oral and written communication. The folk tale was often used by Native Americans. Folk tales are stories that explain a natural phenomena or observable characteristic of an animal or human. Tell students that they will be reading a folk tale about the formation of Amboy Crater.
6. Give each student a copy of Activity II: Legends, Folk Tales, and Stories. Have them read the story AH MOTT KAH PEE THOYAH. After students have read the story ask them the following questions.
   1. On what was the story based?
   2. What parts of the story were based upon real events?
   3. What parts of the story were based upon events that were not real?
   4. What other types of events would be good for developing folk tales?
7. Ask students what they think might be other events or characteristics of an animal or human that a folk tale might be based.
8. Tell students that they will write their own folk tale. Before writing, each student should tell you what event was chosen, and describe the real and not real parts.
9. Once students have completed the activity, divide them into groups of 3-4 and have them read each other their stories. Tell them to choose the best story from each group to share with the class.
10. Have students journal their feelings about creating folk tales.

**Time Considerations:**
1. Background Information: 5-10 minutes.
2. Activity I: 10-15 minutes.
3. Activity II: 30-40 minutes.

**Extensions:**
1. Have students locate and share other Mojave Desert folklore, legends, and myths.
2. Have students read the journals of Captain John Fremont, Pedro Fages, or Father Francesco Garces and report their findings to the class.
Activity I: Humans and the Mojave Desert

Network Tree

Use the background information to complete the following concept map.
Activity I: Humans and the Mojave Desert

Network Tree

Use the background information to complete the following concept map.
Activity II: Legends, Folk Tales, and Stories

In this activity, you will read the Mohave Indian story about the Origin of the Amboy Crater. Amboy Crater is an extinct volcano located 5 miles west of the town of Amboy. It is 2000 years old and can be seen by looking south while traveling on Highway 66.

AH MOTT KAH PEE THOYAH

A long time ago the people had various ways of making their living. Some of them fished, some were hunters, etc. There was a hunter by the name of AH MOTT KAH PEE THOYAH (he can go down under the earth). That is related to the way he hunted for a living. He hunted birds and rabbits and he used fire in the strange method he pursued his hunting. He would go to any thick forest or brush and would build a fire in a circle all around the thick brush or trees - carefully built so no animals could escape from the fiery trap.

Then he went to the center of the place that the fire was encircling and sang a song that caused him to sink into the earth. Here is his song: AH MOTT KAH PEE THOYAH, KAH PEE THOYAH, EEHAH VEE ROPES, AH MOTT THEE THON EETHON EE EE. This means "When my name is sung I go farther and farther down into the ground." When the song was finished the first time he sank down into the ground above his knees. Then he repeated the the song four times and he was out of sight under the ground. When he thought the fire had burned itself out he then came up out of the ground and he would find lots of rabbits, deer, mountain sheep, etc., that had stayed in the brush that were cooked and ready to eat. He would gather all that he desired and then be on his way home. After he had used up all the meat from the last kill he would then start out and find a new location to hunt. That was his method of hunting.

One time after he had performed his hunting process and had come back up out of the ground he found a fox there looking over all the dead animals. AH MOTT KAH PEE THOYAH said, "You may have all you want, Mr. Fox. I'm giving you all you want." The fox shook his head and said "No! That stuff stinks. I don't eat such smelly stuff. I hunt and I kill in my own way." Then the fox thanked the fire hunter and left, but, before he left he asked, "What do you sing and how do you hunt with fire?"

AH MOTT KAH PEE THOYAH told him that he simply started a fire around himself in a complete circle and then sang a song four times and that caused him to go under the ground so he wouldn't get burned. The fox said, "Just for curiosity's sake, I'd like to have you demonstrate for me." So to accommodate him the hunter sang song for him, and the fox memorized the song and went on his way without taking any of the food he had been offered.

The next day the fox decided that now since he knew the secret to the fire hunter's success he would hunt the same way. So he picked out as his location to hunt the land just south of Amboy, California, where the volcanic crater is located today. He worked fast, and got the fire thoroughly started all around him, then he went in to the center of the ring of fire and began to sing the song that AH MOTT KAH PEE THOYAH had
taught him the day before. But, he didn't go down a single inch into the ground. In desperation, he repeated the song four times and still nothing happened. In death he was still making a tremendous effort to send himself down into the ground just like the fire hunter had done, for just as you have probably surmised, the fire had gotten out of control and cremated the fox on the spot.

But, the fire didn't stop. It kept burning more and more and soon the earth itself started to burn. Then the rocks began to burn and the rocks melted and flowed over the desert like a stream of boiling tar. The melted rock kept running until it reached Newberry, and it didn't stop there. It even kept on running until it reached Barstow.

AH MOTT KAH PEE THOYAH came along and saw what had happened and he stopped the fire. When the fire had subsided there was a great big crater left and is still there today. Then the fire hunter changed himself into a little worm and he is in this form yet today.

Whenever you happen to be around sand hills or around any sandy place, you can easily find the marks on top of the sand where he travels around under the sand. Also, you will find little crater-shaped holes where he gets down under the ground looking for insects. Now he still goes down - not head first - but backwards into the sand, just as he did when he was a man.

This is a very true story, but if you don't believe it, just look around sandy places and you can see the tiny craters. Then try to find the little worm AH MOTT KAH PEE THOYAH. He is there but you won't find him for he is already buried under the earth and is laughing at you.


**Assignment**

Native American lore does not fit everyone's cultural viewpoint of reality so there are some things that you may not understand from the story that you just read. Keep in mind that people hearing your stories hundreds of years from now may not understand what you were originally trying to say.

Now that you have read the Mohave Nation version of how Amboy Crater was formed, you are ready to try your hand at composing your own story. The only rule is that it must explain a natural phenomena or animal behavior. Examples of natural phenomena could include the formation of volcanoes, mountains, lakes, or other prominent features; descriptions of why earthquakes or landslides occur; or an explanation of what makes lightning or wind. An example of a specific animal behavior could include an explanation of why raccoons wash their food before eating it. Before you begin writing, check with your teacher to make sure that your topic is okay. Be creative.
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Unit VI: What Are The Choices?

Background Information

We ask a lot of our deserts. We expect them to provide beautiful surroundings for recreation and wildlife habitats. At the same time, we might expect them to provide for grazing, mining, landfill sites, and a host of other activities. As the population grows and more people use the deserts, it is becoming difficult to satisfy all of our needs.

In this unit, students will read and discuss information on one of the four Mojave Desert issues provided. They will use this information to propose solutions to these real-life problems. Each issue will have the following six components: problem; issue; players and positions; beliefs; values; and solutions.

Components of an Environmental Issue

Most interactions between you and the environment are complex. A simple task such as eating is the result of a long chain of events. Many of these events deal with the consumption of resources. These in turn deal with environmental concerns which sometimes evolve into environmental issues. In this unit, environmental issues are divided into the following components.

PROBLEM: A condition in which something we value or think is important is at risk. Environmental problems involve the interaction of humans and the environment and also threaten some aspect of human well being or something humans value. A problem might include what to do in the aftermath of a natural disaster such as a flood or earthquake, or what to do with the refuse of large metropolitan areas.

ISSUE: A problem, or its solution, for which differing beliefs and values exist, usually involving two or more parties who do not agree. In many cases, environmental problems remain unsolved because those involved are unable to agree on how to solve the problem. It is important that students understand the different beliefs and values of the disagreeing parties; if they do not, they will not understand the concept of an environmental issue.

PLAYERS AND POSITIONS: The individuals and/or groups that are involved in an issue, and where they stand on the issue.

BELIEFS: The ideas about an issue which are held to be true by the players. They do not have to be true, the players just need to believe that they are. A belief is strongly tied to the player’s values.
VALUES: The relative worth a player places on something. Values are often drawn from personal experiences and background. Table 1 is a list of value descriptors. Each definition describes a specific value. The definitions, as well as the list itself, should not be considered complete.

SOLUTIONS: The various strategies proposed to resolve an issue. A solution is acceptable when the public is involved in the decision-making process, the interested public sectors reach a compromise, the compromise meets objectives for managing the resource, and the compromise conforms to law.

<table>
<thead>
<tr>
<th>Value</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Aesthetic</td>
<td>the appreciation of form, composition, and color through the human senses.</td>
</tr>
<tr>
<td>Ecological</td>
<td>pertaining to natural biological systems and principles.</td>
</tr>
<tr>
<td>Economic</td>
<td>the use and exchange of money, materials, and/or services.</td>
</tr>
<tr>
<td>Educational</td>
<td>concerning the accumulation, use, and communication of knowledge.</td>
</tr>
<tr>
<td>Egocentric</td>
<td>pertaining to a focus on self-centered needs and fulfillment.</td>
</tr>
<tr>
<td>Environmental</td>
<td>pertaining to human activities in terms of quality of natural resources, e.g., plant and animal species, air, water, soil, etc.</td>
</tr>
<tr>
<td>Ethical/Moral</td>
<td>pertaining to present and future human responsibilities, rights and wrongs, and ethical standards.</td>
</tr>
<tr>
<td>Ethnocentric</td>
<td>pertaining to a focus on the fulfillment of ethnic/cultural goals.</td>
</tr>
<tr>
<td>Health &amp; Safety</td>
<td>the maintenance of positive human physical conditions.</td>
</tr>
<tr>
<td>Legal</td>
<td>relating to national, state, or local laws; law enforcement; law suits.</td>
</tr>
<tr>
<td>Political</td>
<td>the activities, functions, and policies of governments and their agents.</td>
</tr>
<tr>
<td>Recreational</td>
<td>pertaining to human leisure activities.</td>
</tr>
<tr>
<td>Religious</td>
<td>the use of belief systems based on faith or dogma.</td>
</tr>
<tr>
<td>Scientific</td>
<td>concerning the process of empirical research; knowledge gained by systematic study.</td>
</tr>
<tr>
<td>Social</td>
<td>pertaining to shared human empathy, feelings, and status.</td>
</tr>
<tr>
<td>Technological</td>
<td>concerning the use of technology for human/societal goals.</td>
</tr>
</tbody>
</table>

Teacher’s Guide

Lessons for Selected Environmental Issues

Determine which of the four issues, each as a different activity, is best suited for your class. The issues are groundwater of Death Valley, Eagle Mountain Landfill, the impact of burros on Lake Mead National Recreation Area, and accessibility in the Mojave Preserve. It is suggested that you choose an issue that has relevance to your students.

Objectives:
1. Students will analyze and propose one or more solutions to an environmental issue.
2. Students will journal their feelings about proposals to resolve environmental issues.

Materials: (Select as appropriate for issue chosen)
Activity I: The Groundwater of Death Valley (duplicate for students),
Activity II: Eagle Mountain Landfill (duplicate for students),
Activity III: The Burros of Lake Mead (duplicate for students),
Activity IV: Accessibility in the Mojave Preserve (duplicate for students),
Analysis of The Groundwater of Death Valley (teacher’s guide),
Analysis of Eagle Mountain Landfill (teacher’s guide),
Analysis of The Burros of Lake Mead (teacher’s guide),
Analysis of Accessibility in the Mojave Preserve (teacher’s guide),
student journals.

Subjects:
Social sciences, science, language arts.

Skills:
Analyzing, comparing and contrasting, defining problems, identifying attributes and components, interpreting, synthesizing, and creating.

Method:
1. Explain that a good way to understand an issue is to identify its components. As a class, go over the components of an environmental issue (problem, issue, players and positions, beliefs, values, and solutions).
2. Next, divide the class into groups of four students and give each person a copy of the activity. Each activity is based on a real environmental issue.
3. Give students time to read the activity.
4. Explain that each group should identify the components of the issue and propose a solution for it. They are to designate a spokesperson who will identify the components of the issue and share the group's solution with the rest of the class. Each group should be ready to explain how this solution was selected. Point out that there is not a right or wrong answer and that usually the only workable solution is a compromise. You can assess students' performance by observing how well each group linked its solution with the beliefs and values of the players involved in the issue.

5. After all the groups have made presentations, have the class come up with the pros and cons of each proposed solution. If possible, guide the students in suggesting solutions that might combine two or more of the original proposed solutions and have the students vote on a possible solution. It is very likely that not all students will agree on one solution, so more than one solution may be the outcome.

6. Have students journal their feelings about the proposed solution.

**Time Considerations:**
1. Components Of An Environmental Issue: 10-20 minutes.
2. Group Preparation: 40-50 minutes.
3. Presentations: 50 minutes
4. Class Solution: 15-20 minutes or longer.

**Extension:**
After completing one issue, you could have the students repeat the lesson using a different issue.

**NOTE:** The players and positions are based on a review of available references and may not accurately represent all of those involved in a particular issue. The beliefs and values provided in the teacher's guide are based on interpretations of available references. These interpretations are not necessarily complete and are meant only as examples to assist the teacher in helping students explore the issue. Also, the solutions suggested in the teacher's guide are not meant to be the only possibilities.
Almost everyone knows that water runs down hill. With an elevation of -282 feet (-88 m), Death Valley has the lowest elevation in the region. This makes Death Valley the discharge point for most of the groundwater in the region. The drainage area that provides groundwater to Death Valley is referred to as the Death Valley Groundwater Flow System.

The Death Valley Groundwater Flow System covers 15,800 square miles (40,922 square kilometers) which includes most of southern Nevada and a large portion of southeastern California. Although it is surrounded by mountain ranges the principle recharge areas are located in the northeastern part of the region.

The northern mountainous areas receive the greatest precipitation which is the major source of water in the Death Valley Groundwater Flow System. Groundwater flows from these recharge areas by passing through the fractures and pore spaces of the rocks in the system. These rocks include fractured volcanic rocks, limestones, dolomites, and alluvium or valley fill materials.

Groundwater flows from recharge areas toward natural discharge areas such as springs, seeps, and playas. At these discharge areas most of the water is lost through evaporation and transpiration by plants. In the Death Valley Groundwater Flow System natural discharge occurs near Beatty, Ash Meadows, Tecopa, and at the edges of Death Valley playa. These discharge areas provide essential habitat for plants and wildlife and supply water for human use.

Changes in groundwater systems are indicated by variations in water levels in wells and in flow rates at springs. In the Death Valley groundwater system these are caused by changes in precipitation which affects recharge rates in the mountainous areas or by pumping groundwater from wells. Pumping too much water from wells causes groundwater levels to decline and springs to decrease their flow rates. This usually indicates that there is a decrease in the water storage capacity of the groundwater system.

Death Valley National Park staff are concerned about the negative impacts of pumping too much water on the park’s water rights and water related resources. To ensure the protection of the groundwater that supplies the springs in the park, the United States Geological Survey
and several consulting firms have conducted studies on the Death Valley Groundwater Flow System. The studies indicate that: 1) the Death Valley groundwater system encompasses a large area; 2) discharge rates equal recharge rates; 3) a major change in either discharge or recharge rates would have an impact on the park; and 4) any pumping of groundwater should be closely monitored to ensure that the groundwater is not overdrafted. Park officials believe that the largest threat to its water resources is from the appropriation of water for mining and other forms of development outside their boundaries. Several entities including the City of Las Vegas (Las Vegas Valley Water District now the Southern Nevada Water Authority) have made application to withdraw water from and adjacent to the groundwater system and Death Valley National Park has responded by filing protests to them.

The Southern Nevada Water Authority (SNWA) is concerned about providing water to all of its customers which now includes 1,000,000 residents as well as the hotels and casinos. Las Vegas now has 10 of the world's largest hotels and in two years will have 14 of the world's largest hotels. The service area for the SNWA is one of the fastest growing areas in the country and the demand for water is high. The Las Vegas area's water problems stem principally from the unequal distribution of water from the Colorado River. Because southern Nevada had a small population and little promise of growth at the time the Colorado River Agreement was written, Nevada receives less water than Arizona and California. In 1989 SNWA, seeking additional water, applied to the Nevada State Engineer for all previously unappropriated water rights in a large part of the state. The vast area that would be affected by those water rights would impact the Death Valley Groundwater Flow System. Although SNWA is diligently seeking water from other sources, if they are unsuccessful they will pursue these applications.

Recently an organization called Amargosa Resources Corporation filed applications for large quantities of groundwater from the Amargosa Valley which is currently 220% over appropriated. The corporation further requested the State Engineer revoke all water permits in the valley which have not been used for a period of five years (a condition of a water permit) to make water available for their applications.

The Amargosa Water Committee is a group of farmers concerned about having their water rights forfeited and/or taken away by the State Department of Water Resources. They believe that the Amargosa Resources
Corporation is trying to repeat the actions of Los Angeles and have adopted the slogan "Remember the Owens Valley." Recently, every farmer had to prove in hearings that they were using their agricultural water rights. In order to keep their water rights, they are now forced to use every drop of water available to them.

Canyon Resources has begun a cyanide heap leach gold mining operation at the Briggs Mine 2 miles (3.2 km) from the west boundary of Death Valley National Park. Cyanide processing requires a lot of water and Canyon Resources has a permit to pump 1 billion gallons (3.785 billion liters) of water a year for ten years. Company personnel state that their withdrawal of water will not have a major impact on the groundwater in Death Valley National Park.

The Timbisha Shoshone Tribe has been federally recognized since 1983 but owns no land. Section 705b of the California Desert Protection Act of 1994 requested that the Secretary of the Interior conduct a study to identify lands suitable for a reservation. Tribal leaders state that in the past the Federal Government has taken their lands and water rights and asks that at least part of them be returned. After the NPS informed the Timbisha no land within Death Valley National Park would probably be deemed suitable for a reservation discussions broke down and there has not been a resolution of the issue. In response, tribal leaders have requested that President Clinton intervene and honor Section 705b. The Timbisha are also opposed to the Briggs Mine, stating that it is on ancestral land and will deplete water resources in the Panamint Mountains. They filed a lawsuit with the State of California to halt mining and a protest with the U.S. Department of the Interior concerning the lack of direct consultation with tribal leaders about the impact of the mine before approving the permit.
What Are The Issue's Components?

PROBLEM:

ISSUE:

PLAYERS AND POSITIONS:

BELIEFS/VALUES:

SOLUTIONS:
Analysis of the Groundwater of Death Valley
Teacher’s Guide

PROBLEM:
The loss of natural springs, wildlife habitats, and potable water supplies in Death Valley National Park by groundwater removal.

ISSUE:
Should there be set limits on groundwater withdrawal from the Death Valley groundwater system and how do individual water rights compare with those of the federal government and large municipalities?

PLAYERS AND POSITIONS:
1. The National Park Service (NPS) staff does not want an increase in pumping water from the Death Valley groundwater flow system.
2. The Southern Nevada Water Authority (SNWA) wants to obtain more water either by pumping large amounts of water from the Death Valley groundwater system or getting more Colorado River water.
3. Amargosa Resources wants to obtain water rights to sell to others. They have asked the State Engineer to forfeit unused water rights in the Amargosa Valley.
4. The Amargosa Water Committee wants to keep their water rights and continue to pump water from the Death Valley groundwater system at a higher rate than in the past so that they can keep them.
5. Canyon Resources wants to continue pumping water at the present rate for its cyanide processing operation and maintains that it has the right to extract ore from the Briggs Mine.
6. The Timbisha Shoshone Tribe wants ownership of ancestral lands and attached water rights in and around Death Valley National Park.

BELIEFS/VALUES:
1. National Park Service personnel believe they are responsible for the preservation of natural resources and the local ecosystem. They believe that this includes the groundwater that flows into the park. Their beliefs might be based on aesthetic, ecological, educational, environmental, legal, political, recreational, and scientific values.
2. Southern Nevada Water Authority personnel believe they are responsible for providing water for their customers. Their beliefs might be based on economic, educational, ethical/moral, health and safety, legal, scientific, and technological values.
3. Amargosa Resources personnel believe they have the right to obtain any unused water rights in the Amargosa Valley through forfeiture.
Their beliefs might be based on economic, legal, and political values.

4. Amargosa Water Committee members believe SNWA and the federal government are trying to take away their water rights. Their beliefs might be based on economic, ethical/moral, legal, political, and social values.

5. Canyon Resources personnel believe they are operating a legal mining venture. Their beliefs might be based on economic, legal, and technological values.

6. Timbisha Shoshone Tribal members believe they should be able to live on ancestral lands and have the rights associated with living on their own land. Their beliefs might be based on aesthetic, ecological, environmental, ethical/moral, legal, political, and religious values.

SOLUTIONS:

Solutions will vary from group to group. Remind students there is not a right or wrong solution and that most solutions result in a compromise which meets the objectives for managing the resource.
Activity II: Eagle Mountain Landfill

The site for the proposed Eagle Mountain Landfill was originally named the Iron Chief Mine and owned by the Southern Pacific Railroad. It was bought by the Henry J. Kaiser Corporation in 1943. As time went by the Kaiser Corporation increased ore extraction, constructed a railroad spur to the mine site, and established a townsite for employees. Kaiser Corporation also built a steel mill in Fontana, 150 miles (249.4 km) west in San Bernardino County, to process the iron ore into steel. The mine closed in 1983 when the Kaiser Corporation went bankrupt due to a drop in the price of iron ore. A series of large open pits still exist at the site.

In 1989 Mine Reclamation Corporation (MRC) submitted a proposal to use the abandoned mine site as a landfill. There are two components to the proposal: the development of a nonhazardous municipal solid waste landfill, and the renovation and repopulation of Eagle Mountain townsite. Most of the refuse would be transported by rail from Los Angeles, Orange, Riverside, San Bernardino, Santa Barbara, San Diego, and Ventura counties. MRC estimates that the site will hold 708 million tons (719,328 million kg) of solid waste and that it would take 117 years to fill at the rate of 20,000 tons per day (20,320,000 kg).

The proposed site is bordered on the north, west, and southwest by Joshua Tree National Park (JTNP) and the Eagle Mountains, and on the east and southeast by Chuckwalla Valley. JTNP's southern boundary is 1.5 miles (2.4 km) from the site. The proposed landfill covers 4654 acres (1883.5 ha) but only 2164 acres (875.8 ha) would be used for actual waste disposal. The remaining 2490 acres (1007.7 ha) would be used as a buffer zone.

Mine Reclamation Corporation (MRC) states that the landfill will create over 1200 new jobs, that it will replace unsafe landfills, and that it will take the place of landfills that have either closed or will close in the near future. MRC also states that cities and counties need new places to deposit their solid waste and that the project will generate an average of 11.8 million dollars a year for the first 20 years for Riverside County. MRC plans to put in a multi-layered liner to prevent leakage of toxic liquids into the water table. In order to ensure that visitors to Joshua Tree National Park will be unaware of the landfill, MRC agrees to: 1) cover the refuse with soil on a daily basis.
so that odors will not be noticeable; 2) establish visibility-monitoring
stations so that changes in air pollution levels will be recorded; 3)
shield all lights; 4) ensure that there will be no wind-blown debris; 5)
establish raven/predator monitoring for a minimum of 10 years; 6) fence
all active sites; 7) install new water sources for bighorn sheep; 8)
provide funding for an Environmental Mitigation Trust for acquisition,
research, monitoring, and increased management; 9) monitor water
withdrawal; 10) monitor noise; and 11) provide office and living space
at the landfill site so that park service personnel can monitor landfill
activities and perform research.

Joshua Tree National Park (JTNP) personnel are concerned about
negative impacts on the park’s ecosystems, wilderness values, and air
and water quality. The landfill will be located next to one of the more
remote, pristine areas of the park. Wildlife specialists know that
landfills attract ravens who transport refuse and prey on baby
tortoises. Other concerns include the destruction of some habitat of
the bighorn sheep, the California leaf-nosed bat, and the desert
tortoise.

Bureau of Land Management (BLM) personnel have to approve a land
exchange and right of way access with Kaiser for the project to go
forward. The BLM is the Federal agency responsible for the
Environmental Impact Statement.

The Riverside County Board of Supervisors are elected officials
who have voted to approve the permit for the landfill. They are also
responsible for zoning variances in the vicinity of the landfill.

Members of Desert Environmental Response Team (DERT), an
environmental citizens group, cite possible groundwater contamination,
potential air pollution, and being located next door to a national park
as their major concerns about the establishment of the landfill. They
question the motives of a large corporation who wants to dump refuse
from distant cities into the desert. They believe that desert
communities have small populations, are politically weaker than large
cities, and may not have the political clout to prevent the
establishment of the landfill.

The president of the Desert Water Agency states that the landfill
will repair the massive scar on the desert landscape caused by the ore
extraction mining. He believes that it will not harm the local water
table.
Eagle Mountain Landfill Opposition Coalition is concerned about the desert becoming a wasteland for southern California cities. The coalition states that the exhaust from trash-hauling trains and trucks will increase air pollution and that MRC will be unable to prevent blowing trash. Groundwater pollution is also of major concern.

A group of residents from Lake Tamarisk, which is close to the landfill site, feels that it will be good for the local economy and favor it for that reason.

The Desert Citizens Against Pollution group states that there is no way that MRC can keep its promises to the national park or any of its other neighbors. This group is convinced that increased air and water pollution will be caused by the establishment of the landfill.

What Are The Issue’s Components?

PROBLEM:

ISSUE:

PLAYERS AND POSITIONS:

BELIEFS/VALUES:

SOLUTIONS:
Analysis of Eagle Mountain Landfill
Teacher’s Guide

PROBLEM:
What should be done with the open pit mine at Eagle Mountain? or What should be done with refuse from cities in southern California?

ISSUE:
Should the abandoned mine site at Eagle Mountain become a nonhazardous municipal solid waste landfill?

PLAYERS AND POSITIONS:
1. Mine Reclamation Corporation (MRC) wants to establish the landfill.
2. Joshua Tree National Park (JTNP) does not want the landfill unless MRC can assure that it will not adversely affect the park.
3. Bureau of Land Management (BLM) wants to approve the land exchange and accept the Environmental Impact Statement for the establishment of the landfill.
4. Riverside County Board of Supervisors must accept or deny the permit and zoning changes for the landfill. They have not yet established an official position.
5. Desert Environmental Response Team (DERT) does not want the landfill to be approved.
6. The president of the Desert Water Agency wants the landfill to be approved.
7. Eagle Mountain Landfill Opposition Coalition does not want the landfill approved.
8. A group of Lake Tamarisk residents wants the landfill approved.
9. The Desert Citizens Against Pollution group does not want the landfill approved.

BELIEFS/VALUES: (Student answers might reflect some of the following)
1. Mine Reclamation Corporation (MRC) believes the landfill can be constructed without any negative impact on the surrounding area. MRC’s values might be characterized as economic, educational, environmental, health and safety, political, scientific, and technological.
2. Joshua Tree National Park personnel believe they are responsible for the preservation of natural resources and the local ecosystem. Their beliefs might be based on aesthetic, ecological, educational, environmental, political, recreational, and scientific values.
3. Bureau of Land Management personnel do not come out in favor or against the landfill itself but are concerned with the land exchange and right of way issues. Their beliefs might be based on economic, ethical/moral, health and safety, political, and technological values.

4. Riverside County Board of Supervisors believes they are to make decisions that will benefit the majority of people in the county. Their beliefs might be based on ecological, environmental, ethical/moral, health and safety, legal, and political values.

5. Desert Environmental Response Team (DERT) members believes the landfill will cause an increase in air and water pollution, the site is too close to a national park, and MRC wants to profit at the expense of the local landholders. DERT displays aesthetic, ecological, environmental, educational, ethical/moral, health and safety, legal, and scientific values.

6. The president of the Desert Water Agency believes the landfill will heal an ugly scar and it will not harm the local water table. He displays aesthetic, educational, environmental, scientific, and technological values.

7. The Eagle Mountain Landfill Opposition Coalition members believe the desert is becoming a dumping ground for other areas and the landfill will increase both air and water pollution in the area. They display aesthetic, ecological, environmental, ethical/moral, and health and safety values.

8. The group of residents from Lake Tamarisk believe the development of the landfill will be good for the local economy. They display economic, egocentric, and political values.

9. The Desert Citizens Against Pollution group believes MRC can not keep its promises about keeping all refuse out of JTNP, and MRC can not prevent air and water pollution at the site. They display aesthetic, ecological, environmental, ethical/moral, and health and safety values.

**SOLUTIONS:**

Solutions will vary from group to group. Remind students that there is not a right or wrong solution and that most solutions result in a compromise that meets the objectives for managing the resource. There are several possible solutions, including 1) no action which would leave the site as is; 2) reduce the volume of daily accepted waste which would...
increase the lifespan of the landfill; 3) bring in all refuse by rail which would prohibit any trucking of solid waste to the site; and 4) locate alternative landfill sites that are not near national parks, wilderness areas, or pristine endangered desert tortoise populations.
Activity III: The Burros of Lake Mead

The burros which live in the vicinity of Lake Mead National Recreation Area are descendants of the Nubian and Somali wild ass (*Equus asinus*) of northeastern Africa. They were domesticated over 5000 years ago in Africa and used as beasts of burden. Spanish explorers brought burros to North America in the 16th century. Burros proved valuable as pack animals and a means of transportation during the settlement of the southwest. Their use increased during the 1850s as prospectors searched for gold and silver. As other forms of transportation began to be used and mining declined, burro use decreased. Either through escaping from captivity or through abandonment, many burros ended up fending for themselves in the desert. They adapted quite well and multiplied quickly.

Today, there are so many burros that they are having a negative impact on the area, and National Park officials are facing the dilemma of what to do with them. Some of the negative impacts of large populations of burros include extensive trail networks which cause soil compaction and increased soil erosion, damage to vegetation through trampling and overgrazing, and the pollution of water sources by their feces and urine. If nothing is done, burros will continue to widen their impact in other areas.

The purpose of national parks is to provide the opportunity to enjoy and benefit from natural environments which have evolved through natural processes while maintaining minimal human impact. According to National Park Service (NPS) management policies, burros are exotic (non-native) and are not a necessary part of the desert ecosystem because they were introduced into the area as a result of deliberate or accidental action by humans.

The purpose of the Bureau of Land Management (BLM) is to provide for the multiple use and sustainability of the land for the American people. Congress passed a law which identifies the burro as a living symbol of the historic and pioneer spirit of the West. The law states that burros contribute to the diversity of life forms within the nation, enrich the lives of the American people, and are fast disappearing from the scene. This law requires the BLM to protect burros on public land managed by them. BLM managed land is adjacent to NPS managed land at Lake Mead National Recreation Area.
A group called Wild Burro Rescue, an animal protection organization, wants to assist in the design of a rescue plan for burros to prevent the sale of wild burros for slaughter or any other management plan that would result in death. The group would like to see burros monitored and managed in national parks. This would require a change in NPS policy regarding exotic species.

The Maricopa Audubon Society advocates the removal of all burros from Lake Mead National Recreation Area and adjacent Bureau of Land Management lands. This group strongly endorses all efforts to remove as many burros as possible.

Some residents of Chloride, Arizona believe that the boundary to Lake Mead National Recreation Area includes already existing burros in their natural habitat and that these burros should be left alone. They feel the biggest threat to the habitat is cattle who are grazing where the burros reside.

The Wild Horse Organized Assistance group would like to see burro controlling measures such as fencing and zero burro zones. Zero burro zones are defined as the removal of all burros from areas with sensitive resources and critical habitats. The group wants to be sure the safety of the burro is considered when removal is necessary.

A group of citizens in Bullhead City, Arizona feels that all of the burros should be removed from Lake Mead National Recreation Area as they are destroying the natural beauty and habitat of native plants and animals. The citizens feel burros will not be wiped out because the Bureau of Land Management is required to maintain herds on their lands.

Arizona Desert Bighorn Sheep Society members feel that all burros should be removed from public land but realize the difficulty of keeping burros from neighboring BLM managed herds from entering portions of Lake Mead National Recreation Area. They would like to see the elimination of burros from areas where they pose a threat to natural resources or public safety and fencing of sections of the park to prevent entry by burros.
What Are the Issue's Components?

PROBLEM:

ISSUE:

PLAYERS AND POSITIONS:

BELIEFS/VALUES:

SOLUTIONS:
Analysis of the Burros of Lake Mead
Teacher’s Guide

PROBLEM:
The degradation of land and habitats by burros in the Lake Mead National Recreation Area.

ISSUE:
Should the National Park Service totally remove the burros, establish burro-free zones, monitor and manage the burros, or abandon burro management in the Lake Mead National Recreation Area.

PLAYERS AND POSITIONS:
1. The National Park Service’s (NPS) management policies do not recognize the burro as a native or historic species and they cause extreme resource damage. The NPS wants to stop the damage done by burros.
2. The Bureau of Land Management’s management policies provide for the protection of the burro under federal law. The BLM maintains viable herds of burros.
3. Wild Burro Rescue would like to see the NPS change its policies on burros or remove them in a manner that does not harm them.
4. The Maricopa Audubon Society would like to see all of the burros removed using any method necessary.
5. A group of citizens from Chloride, Arizona would like to see the burros left alone.
6. The Wild Horse Organized Assistance would like to see the park service establish burro-free zones.
7. A group of citizens from Bullhead City, Arizona would like to see all of the burros removed from the recreation area.
8. The Arizona Desert Bighorn Sheep Society would like to see all burros removed but recognize that BLM burros frequently cross jurisdictional boundaries. They would like the establishment of zero burro zones.

BELIEFS/VALUES:
1. National Park Service personnel believe in preservation of natural resources. This belief is based on aesthetic, ecological, educational, environmental, legal, political, recreational, and scientific values.
2. Bureau of Land Management personnel believe in managing the land for the use of all while maintaining sustainability. They display
aesthetic, ecological, economic, educational, environmental, legal, political, recreational, and scientific values.

3. The Wild Burro Rescue group believes in animal protection and the rights of the burros to live in the recreational area. Their members display environmental, and ethical/moral values.

4. Members of the Maricopa Audubon Society believe burros are not part of the natural habitat and should be removed. They display aesthetic, ecological, and environmental values.

5. The group of residents from Chloride, Arizona believes the burros were there before the recreation area was, are part of the habitat, and thus should be left alone. This group believes local ranchers want the burros out so they can graze their cattle on public lands. This group displays ecological, environmental, and ethical/moral values.

6. The Wild Horse Organized Assistance group believes the best plan includes fencing and limiting the access of burros. This group also believes during the removal process the burros' safety is of utmost importance. This group displays environmental, and ethical/moral values.

7. The group of citizens from Bullhead City believes burros are destroying the recreation area and should all be removed. These citizens display aesthetic, economic, environmental, and recreational values.

8. The Arizona Desert Bighorn Sheep Society believes burros are destroying the habitat of bighorn sheep and should be removed. They also believe that total removal is out of the question and the park should establish zero burro zones. Their beliefs might be based on aesthetic, ecological, environmental, and political values.

**SOLUTIONS:**
Solutions will vary from group to group. Remind students that there is not a right or wrong solution and that most solutions result in a compromise that meets the objectives for managing the resource.
Activity IV: Accessibility in the Mojave Preserve

On October 31, 1994 the California Desert Protection Act became law. One of the things it did was create the 1.4 million acre (574,593 ha) Mojave National Preserve (MNP) which is located in the heart of the Mojave Desert. Because Interstate Highways 15 and 40 compose most of its northern and southern boundaries and there is an existing network of roads in the preserve it has the best accessibility of any park in the region.

The primary difference between a National Park and a National Preserve is that preserves allow certain activities such as hunting. Both are created by an Act of Congress. The MNP displays a unique set of ecosystems and transitional desert zones because it is located at the juncture of the Mojave, Great Basin, and Sonoran deserts. Congress recognized this when establishing the MNP and stated "the Mojave Desert area possesses outstanding natural, cultural, historical, and recreational values meriting statutory designation and recognition as a unit of the National Park System." As a result, the National Park Service (NPS) is charged with protecting and preserving the land for the enjoyment of current and future generations.

A major provision of the California Desert Protection Act was the creation of 3,667,020 acres (1,484,043 ha) of wilderness. Of the 3,667,020 acres (1,484,043 ha) 695,000 acres (281,267 ha) are in the MNP. There are 22 wilderness areas in the MNP. Most of the centers of these wilderness areas are within 5 miles (8 km) from existing roads which makes these wilderness areas some of the most accessible in the nation.

According to the 1964 Wilderness Act, wilderness areas include lands that appear natural or undisturbed; offer a feeling of quiet or solitude; contain ecological, geological, or other features of scientific, scenic, or historic value; and cover at least 5000 acres (2024 ha). In wilderness areas people are visitors who do not remain. All wilderness areas have specific restrictions which include no bicycles, hang gliders, motorized or mechanized vehicles, equipment, boats, or aircraft. NPS managed wilderness areas have specific restrictions including: no target shooting; no horses or other recreational livestock without a permit; no pets; and no collecting of firewood, rocks and minerals, plants, or any other artifacts.
Motor vehicles are allowed in the MNP as long as they travel on established roads and are "street" legal. One of the favorite routes of off-highway vehicle (OHV) enthusiasts is the Mojave Road. The Mojave Road follows the route first used by Native Americans and early explorers to cross the Mojave Desert. Access is available along the entire length of the road. Another favorite route of OHV enthusiasts is the East Mojave Heritage Trail which crosses wilderness areas on both NPS and BLM land. These crossings have been closed down leaving the East Mojave Heritage Trail with gaps.

Both mining and grazing are authorized under the California Desert Protection Act in the MNP. Mining claims in place prior to October 31, 1994 can continue if there are valid existing rights and NPS grants approval for new plans of operation. Congress specifically stated the number of authorized grazing permits is to remain at the same level as was in place on October 31, 1994. Ranchers who want grazing permits must also obtain NPS approval. Since the establishment of the MNP, the NPS has issued grazing permits and approved mining plans of operation.

Citizens who own land in National Park Units are referred to as inholders. Legislation provides them "the right of adequate access for the reasonable use and enjoyment of their lands." The California Desert Protection Act limited the number of inholders in the MNP by excluding Lanfair Valley, where the majority of land owners live, from the preserve. This is the first time that Congress has excluded land within the boundaries of a National Park Unit from their jurisdiction. Congress literally formed an "island" of private land, under San Bernardino County jurisdiction, in the heart of the MNP. Even with this unique provision, which excludes them from being inholders, Lanfair Valley Property Owners Association members want assurance that they will have access to their land even if they must cross wilderness.

National Park Service (NPS) personnel are concerned about following the directives established in the California Desert Protection Act and are investigating the best ways to implement them. Besides providing for the preservation of natural resources and local ecosystems for the enjoyment of present and future generations the NPS is directed to oversee mining and grazing, establish regulations for hunting; and ensure the rights of private landholders.

Citizens For Mojave National Park is a group of citizens whose goal is to have the Mojave National Preserve (MNP) become a national
park. This group was established in 1977 and has been a driving force in having the MNP become part of the National Park System. In the past, these citizens monitored the actions of the Bureau of Land Management (BLM). Now they continue to monitor the actions of the National Park Service (NPS). This group wants to ensure that accessibility in wilderness is limited to pack animal, horseback riding, or walking; and would like the law changed so hunting, mining, and grazing is prohibited in the MNP.

The Friends Of The Mojave Road is a group of citizens who developed and maintained this historic route through the Mojave Desert. These citizens also developed the East Mojave Heritage Trail. While they are pleased with accessibility over the entire length of the Mojave Road, they are disappointed with closure of the sections of the East Mojave Heritage Trail which cross wilderness areas.

The California Desert Coalition is an off-highway vehicle support group which is concerned about accessibility. These citizens state that in 1964 the United States Geological Service defined five classes of road. They are 1) primary highway, federal and state; 2) secondary highway, state and county; 3) light duty, paved or improved; 4) unimproved, unsurfaced, including track roads in desert areas designated on maps by two parallel dashes; and 5) trails or roads passable only with a 4-wheel-drive vehicle, also often called jeep trails. The Coalition states that with the establishment of wilderness areas, the last two classes of road have been done away with so that the government can create "roadless" wilderness areas. This group also states that the passage of the California Desert Protection Act was another ploy by the federal government to limit accessibility on public lands.

San Bernardino County is considering taking legal action against the BLM and the NPS to claim old, established roads as public right-of-way under the provisions of Revised Statute 2477 (R.S. 2477). R.S. 2477 was originally passed by Congress as Section 8 of the Mining Act of 1866 and states "The right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted." Even though R.S. 2477 was repealed in 1976, any existing rights-of-way granted by it are still valid. The intention of the law was to provide for access roads to mines, which would later become public roadways. Many counties throughout the southwest are using R.S. 2477 as a means to claim access through designated wilderness. San Bernardino County is
following this precedent and claiming public right-of-way on many old, established roads which cross sections of newly created wilderness.

What Are The Issue’s Components?

PROBLEM:

ISSUE:

PLAYERS AND POSITIONS:

BELIEFS/VALUES:

SOLUTIONS:

143
Analysis of Accessibility in the Mojave Preserve
Teacher’s Guide

PROBLEM:
The protection of wilderness areas in the Mojave National Preserve.

ISSUE:
Should people with mining interests, grazing interests, hunting interests, recreational interests, and land ownership within the boundaries of the Mojave National Preserve continue to have access even if they must cross designated wilderness areas to do so?

PLAYERS AND POSITIONS:
1. The Lanfair Valley Property Owners Association wants continued access to property even if owners must cross wilderness.
2. The National Park Service will allow accessibility as provided for by law.
3. The Citizens For Mojave National Park want the Preserve to become a National Park; strict limitations on accessibility in designated wilderness areas; and to change the law so that mining, grazing, and hunting would be prohibited.
4. The Friends Of The Mojave Road want the East Mojave Heritage Trail to remain open along its entire route.
5. The California Desert Coalition wants all established desert roads open and disagrees with the road classification criteria used by the NPS.
6. San Bernardino County wants old, established roads kept open even if they cross designated wilderness areas.

BELIEFS AND VALUES:
1. The Lanfair Valley Property Owners Association believes that because property owners were there before the NPS, they should have continued access to their property even if it means crossing designated wilderness areas. Its beliefs might be based on economic, legal, political, and recreational values.
2. National Park Service personnel believe they are responsible for the preservation of natural resources, cultural resources, and local ecosystems. They believe this includes monitoring and restricting accessibility to places within wilderness areas. Their beliefs might be based on aesthetic, ecological, educational, environmental, legal, political, recreational, and scientific values.
3. The Citizens for Mojave National Park group believes that the Mojave Desert is a unique place; that it should receive national park status; that wilderness areas should be accessed only by pack animal, horseback, or on foot; and that mining, grazing, and hunting should be prohibited in the MNP. Its beliefs might be based on aesthetic, ecological, educational, environmental, legal, and political values.

4. The Friends of the Mojave Road group believes the best way to appreciate the beauty and culture of the area is to experience it. This group believes the East Mojave Heritage Trail offers this experience and wants accessibility along its entire length. They believe that the classification of established roads is unclear and needs to be defined. Their beliefs might be based on aesthetic, educational, environmental, ethical/moral, legal, recreational, and social values.

5. The California Desert Coalition group believes the federal government is deliberately limiting access to public lands by calling them wilderness areas. They believe that the classification of established roads is unclear and needs to be defined. Their beliefs might be based on economic, legal, political, and recreational values.

6. San Bernardino County personnel believe they have the right-of-way on old, existing roads as provided by law. Their beliefs might be based on economic, legal, and political values.

SOLUTIONS:
Solutions will vary from group to group. Remind students that there is not a right or wrong solution and that most solutions result in a compromise that meets the objectives for managing the resource.
Unit VII: What Can We Do?

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Unit VII: What Can We Do?

Background Information

Before you begin with the environmental action project, it is important to understand the difference between an environmentalist and an environmental educator. An environmentalist advocates a position concerning an environmental issue. On the other hand, an environmental educator uses information and educational processes to help people analyze differing points of view usually present in an environmental issue so they can arrive at their own solution. Environmental educators should be "value-free" when enabling others in the decision-making process. Thus, when you are assisting students in examining all points of view you need to be an environmental educator and not share your own values and decisions on the issue.

Making a Difference

Now that your students have categorized players and positions, beliefs and values, and arrived at possible solutions for a Mojave Desert Issue, they are ready to decide if they want to utilize their skills in deciding on possible actions they could take. It is important to let your students know they really can make a difference. There are many action stories where groups of students have made a difference. Sharing one of these true stories might help students realize they too can make a difference.

One action story involves a group of students at a Needles, California elementary school who adopted the desert tortoise. After a period of in depth research, they became "Tortoise Talkers" and took their message to other schools, school board meetings, and community gatherings. They made posters, submitted articles to the local newspaper, made a video, and raised funds through aluminum can drives and selling T-shirts. In a proposal which they presented to the Bureau of Land Management, they suggested the development of an open-use area for off-highway vehicles so these vehicles would not damage the tortoises’ habitat.

Another action story involved a group of students at a Barstow, California elementary school who learned about local desert flora and fauna. As a result, they decided to plant an outdoor area for viewing desert plants at their school. After receiving a small grant from a local service organization, the students planted a "desert garden" which they proudly display to others.
If these local elementary schools can make a difference, imagine what a high school class can do. A group in New Orleans, Louisiana started an oil recycling program to help prevent water pollution. Another group in Miami, Florida developed a butterfly garden, a pond, an organic vegetable garden, and planted over 1,000 plants and shrubs at various locations throughout their school. Still another group in Spokane, Washington took an undeveloped park and turned it into a wildlife field study area. Your students’ actions can make a difference and create a true success story too.

**Action Approaches**

Even though each action project is unique, the majority fall into one or more of the following categories: the educate and inform approach, the persuasive approach, the economic approach, the hands-on or ecomanagement approach, and the political action approach.

Educate and inform projects focus on teaching others about an issue. This can be accomplished through any method of communication such as plays, songs, or workshops. Convincing others to support your course of action can be accomplished through creating posters, conducting debates, or writing letters to the editor of the local newspaper. Strategies that encourage consumers to shop with the environment in mind or to raise funds to support a specific organization that focuses on your issue are examples of the economic approach. Projects that physically improve the environment, such as planting trees, landscaping school grounds, or cleaning up the local neighborhood are examples of the ecomanagement approach. Contacting local lawmakers through letter writing or attending public meetings are examples of the political action approach.

**Steps to Action**

The first step is to find an issue. Your students might use one of the four major issues addressed in this guide. If they do not choose one of the issues in this curriculum guide, the next step involves creating a list of possibilities and narrowing the choice. This is accomplished through brainstorming sessions to list issues and researching possible issues that are currently in the news. Be sure to use an issue from the Mojave Desert. One of the best ways to find an issue is to have students collect information from newspapers, magazines, local interest groups, or anywhere else. Remind students that action projects do not need to address something that is widely
Students should think about projects they might find interesting, and how much time they have. They will need to be asked questions like: Is the project very complicated? Will we have access to information and resources? and Will the project require a lot of outside help? Once they have addressed all of these things they should be ready to make their choice.

The next step involves learning everything about the issue of choice. Allow students enough time to research not only the issue, but everything related to it. This is best accomplished by assigning tasks to cooperative learning groups. Then organize presentations and class discussions that allow students to analyze players and positions, beliefs and values, and possible solutions.

Next, guide the students into creating an action plan by having them decide on a desired solution. Remind students they should understand all sides of an issue before deciding on a strategy. Once the action plan is completed, guide them into developing specific actions and a possible timeline. Reviewing the chart "Some Action Methods to Consider" (Table 1) may help in deciding on possible actions. Clearly list the tasks that need to be accomplished in order to meet each objective.

Assist students in understanding how people, organizations, businesses, and government can work together to solve environmental problems by reviewing the Action Matrix (Table 2). Then help students evaluate the impact of their own activities related to their selected environmental action project by completing Activity I: The Action Matrix.

Now it is time for action. Remind students to keep careful records of what they have done, when they did it, who they contacted, and so on. They also need to keep track of who is doing what so that efforts are not duplicated. They will need to periodically access the project to see where they are and if they are on track. Having to rethink or change a desired solution and objectives may be necessary.

Successes, no matter how small, should be publicized. It is very important that every student realize that all tasks, no matter how trivial they seem, are important and that any tasks which are done inadequately can impact the entire project.
<table>
<thead>
<tr>
<th>Table 1 Some Action Methods to Consider</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Letter Writing</strong></td>
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<tr>
<td>- to gain information</td>
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<tr>
<td>- to identify a problem that requires a solution</td>
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<tr>
<td>- to request help from an agency, organization, or business</td>
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<tr>
<td>- to thank people for their support of an issue</td>
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<tr>
<td><strong>Interviewing by telephone or in person</strong></td>
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<tr>
<td>- to gather information, both facts and opinions</td>
</tr>
<tr>
<td>- to ask someone to assist you</td>
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<tr>
<td><strong>Conduct a survey</strong></td>
</tr>
<tr>
<td>- to collect opinions</td>
</tr>
<tr>
<td>- to collect facts from people</td>
</tr>
<tr>
<td>- to make people aware of a problem</td>
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<tr>
<td>- to find out who will support or oppose an action</td>
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<tr>
<td><strong>Write petitions</strong></td>
</tr>
<tr>
<td>- to find out how many people would sign in support</td>
</tr>
<tr>
<td>- to obtain written support</td>
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<tr>
<td>** Obtain a proclamation**</td>
</tr>
<tr>
<td>- to garner recognition from a mayor, city council, or governor for your efforts</td>
</tr>
<tr>
<td>- to alert others to a special event you are holding</td>
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<tr>
<td><strong>Serve on a community committee</strong></td>
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<tr>
<td>- to gain student representation</td>
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<tr>
<td><strong>Educate others</strong></td>
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<tr>
<td>- prepare a flyer that can be mailed or student delivered throughout the community</td>
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<tr>
<td>- prepare a play that can be given to other students</td>
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<tr>
<td>- prepare a display for a local mall</td>
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<tr>
<td><strong>Get media coverage</strong></td>
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<tr>
<td>- contact local radio stations, television stations, and newspapers</td>
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<tr>
<td>- prepare and send news releases to media</td>
</tr>
<tr>
<td>- create public service announcements (PSAs)</td>
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<tr>
<td>- hold a press conference</td>
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<tr>
<td><strong>Do fund raising</strong></td>
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<tr>
<td>- sell products or commercially prepared food</td>
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<tr>
<td>- have a yard sale</td>
</tr>
<tr>
<td>- hold a dance, fair, or carwash</td>
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<tr>
<td>- ask for cash donations from local businesses</td>
</tr>
<tr>
<td>- ask for in-kind donations of time and materials</td>
</tr>
<tr>
<td>- apply for a grant from the government or a corporation</td>
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</tbody>
</table>

As the action project draws to a close, it is time to begin assessing it. This is an excellent time to have students evaluate the success of the project and to evaluate feelings about their involvement. Activity II: Discussion Questions for Assessing Projects is designed to help them with this process. Students should analyze any long-term
impact their project could have by relooking at the action matrix. A group discussion that allows students to reflect upon their feelings is the best place to begin this process.

**How To Use The Action Matrix**

The action matrix is a helpful tool for students trying to predict the possible impacts of their actions. Possible uses of the matrix include the following.

**Filling in the Cells:** The exercise of completing the matrix can give students a sense of diversity of possible actions.

**Developing an Action Strategy:** Students can use this matrix to plan their approach to an issue, and to help decide what problem-solvers they want to influence.

**Mapping Specific Cases:** Students can dissect an approach into its specific actions and demonstrate that environmental issues are not solved by one action or one party. Most environmental successes are a combination of small steps that build on each other.

**Analyzing the Dynamics of Action:** In their action plan, students may discover gaps. Also in evaluating their efforts, they can discuss potential barriers in the way of a project, and can keep referring to the matrix both during and after a project.

The vertical axis lists categories of people and organizations with the potential to "solve" environmental issues. Since these parties do not usually take action on their own, but are prompted by the actions of "motivators," the horizontal axis lists the same players in that role. The matrix is then filled with examples of actions taken by motivators to prompt responses from problem-solvers. For example, "students write letters to a business" could be an entry at the intersection of individual motivators and business (cell 13). If the students' letters were encouraged by an environmental organization's newsletter, that action would be reflected in the entry, "provide information," at the intersection of environmental organization motivators and individual problem-solvers (cell 2). The categories listed as motivators and problem-solvers could be different than those presently listed to better reflect the nature of the problems your students are tackling.

Adapted with permission from Martha C. Monroe, first published in *Setting the Environmental Education Agenda for the 90s* (pages 141-147) by North American Association for Environmental Education, 1990.
<table>
<thead>
<tr>
<th>PROBLEM-SOLVERS</th>
<th>MOTIVATORS'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>Environmental Organization</td>
</tr>
<tr>
<td>Individual 1</td>
<td>Educate yourself</td>
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<tr>
<td></td>
<td>Change lifestyle</td>
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<tr>
<td></td>
<td>Write letters to the newspaper</td>
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<td></td>
<td>Teach and talk to others</td>
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<tr>
<td>Individual 2</td>
<td>Provide information</td>
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<tr>
<td></td>
<td>Persuade</td>
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<tr>
<td></td>
<td>Advertise</td>
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<td>Create educational materials</td>
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<td>Individual 3</td>
<td>Regulate</td>
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<td>Tax</td>
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<td>Provide incentives</td>
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<td>Individual 4</td>
<td>Provide jobs</td>
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<td>Advertise</td>
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<td>Make and limit options</td>
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<td>Environmental Organization 5</td>
<td>Join group</td>
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<td>Write letters</td>
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<td>Give money</td>
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<td>Elect leaders</td>
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<td></td>
<td>Become a leader</td>
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<td>Influence group's agenda</td>
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<td>Environmental Organization 6</td>
<td>Build coalitions</td>
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<td></td>
<td>Persuade people</td>
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<td>Inform people</td>
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<td>Create networks</td>
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<td>Environmental Organization 7</td>
<td>Research</td>
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<td>Lobby</td>
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<td>Regulate</td>
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<td></td>
<td>Give grants</td>
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<td>Obtain tax status</td>
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<td>Government 9</td>
<td>Vote</td>
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<td>Write letters to a legislator</td>
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<td>Run for office</td>
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<td>Raise funds</td>
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<td>Speak at public hearings</td>
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<td>Government 10</td>
<td>Research</td>
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<td>Monitor</td>
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<td>Lobby</td>
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<td>Bring lawsuits</td>
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<td>Endorse</td>
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<td>Speak at public hearings</td>
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<td>Government 11</td>
<td>Make appointments</td>
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<td>Give grants</td>
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<td>Charge fees</td>
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<td>Provide checks and balances</td>
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<td>Implement regulations</td>
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<td>Government 12</td>
<td>Provide jobs</td>
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<td>File lawsuits</td>
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<td>Lobby</td>
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<td>Give money</td>
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<td>Advertise</td>
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<td>Operate as a PAC*</td>
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<td>Business 13</td>
<td>Buy product</td>
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<td>Boycott product</td>
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<td>Write letters</td>
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<td>Buy stock</td>
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<td>Invest</td>
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<td>Report violations</td>
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<td>Draw media attention</td>
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<td>Collect data</td>
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<td>Survey</td>
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<td>File lawsuit</td>
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<td>Lead boycott</td>
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<td>Create incentives</td>
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<td>Provide information</td>
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<td>Monitor</td>
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<td>Business 15</td>
<td>Create incentives</td>
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<td></td>
<td>File lawsuit</td>
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<td>Fine</td>
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<td>Regulate</td>
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<td>License</td>
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<td>Contract</td>
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<td>Zone</td>
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<td>Business 16</td>
<td>Compete with price</td>
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<td>Compete with quality</td>
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<td>File lawsuit</td>
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<td>Advertise</td>
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<td></td>
<td>Share technology</td>
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<td>Cooperate</td>
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</tbody>
</table>

*PROBLEM-SOLVERS: People and organizations who can take action to solve environmental problems and who are prompted by the actions of motivators.

*MOTIVATORS: People and organizations whose actions motivate problem-solvers.

*PAC: Political action committee.
Teacher's Guide
Lesson: Taking Action

Objectives:
1. Students will develop and implement an action plan for a Mojave Desert issue.
2. Students will assess and evaluate their class action project.

Materials:
Table 1: Some Action Methods to Consider (optional as overhead or duplicate for students),
Table 2: The Action Matrix (make overhead and/or duplicate for students),
Activity I: The Action Matrix (duplicate for students),
Activity II: Discussion Questions for Assessing Projects (duplicate for students),
Background Information,
Student Journals.

Subjects:
Social sciences, language arts, science, art, math.

Skills:
Analyzing, interpreting, categorizing, predicting, and writing.

Method:
1. Ask students to brainstorm a list of possible Mojave Desert issues. Then ask them to seek out other local issues by reading the newspaper or watching local news stories.
2. After reviewing possible issues, ask students if they would like to select an issue to develop a strategy to contribute toward the solution. (Now would be a good time to share some true action stories so that the students can see that their actions could make a difference!) If the answer is yes, you are ready to proceed.
3. Use the Steps to Action section of the background information to assist students in developing and implementing a class action plan for a Mojave Desert issue. It is best to have the entire class focus on one issue. Be sure students learn about all the players, positions, beliefs, and values before selecting a solution for action.
4. Guide the students in selecting one or more solution strategies based on the length of time available. You may find the list provided as Table 1 Some Action Methods to Consider to be helpful in selecting
strategies that can be completed within your time frame.

5. Guide students in understanding the Action Matrix (Table 2) as a way to see how people, organizations, businesses, and government can work together to solve environmental problems.

6. Have students complete Activity I: the Action Matrix. This will help them evaluate options, develop action strategies, and analyze the dynamics of action for their own project.

7. Once students have completed the Action Matrix, it is time to implement the plan. Be sure to monitor student progress and keep them on task throughout the process.

8. As the project draws to a close have students participate in Activity II: Discussion Questions for Assessing Projects. This should be done in cooperative groups of 3-4. Each group should share their findings with the class. Use the group findings to compile a class assessment.

9. Once the assessment has been completed have students prepare journal entries which reflect upon the entire experience.

**Time Considerations:**

1. Background Information: 5-10 minutes.
3. Activity I: 10-20 minutes.
4. Implementation of Action Plan: 2-8 weeks (or longer).
5. Activity II: 20-30 minutes.
**Activity I: The Action Matrix**

Use this matrix to evaluate your proposed strategy for taking action. If necessary, change the categories under motivators and problem-solvers to fit your action strategy.

<table>
<thead>
<tr>
<th>PROBLEM-SOLVERS</th>
<th>Individual</th>
<th>Environmental Organization</th>
<th>Government</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Environmental Organization</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
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<tr>
<td>Government</td>
<td>9</td>
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<td>11</td>
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<tr>
<td>Business</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
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</tbody>
</table>

*PROBLEM-SOLVERS*: People and organizations who can take action to solve environmental problems and who are prompted by the actions of motivators.

*MOTIVATORS*: People and organizations whose actions motivate problem-solvers.
Activity II: Discussion Questions for Assessing Projects

1. What did you want to accomplish?

2. What did your project accomplish? Explain. (Be sure to describe the project’s accomplishments, even if they were not all part of the original objectives.)

3. What was the most successful part of your project? What was the least successful part?

4. Who was influenced or motivated by your actions? Who might those people, in turn, now influence? What would you like to see them do?

5. If you repeated the project, what, if anything, would you do differently and why?

6. How did you feel when you worked with others?

7. Have your feelings and opinions about the issue you worked on changed since you began the project? If so, how?

8. What are your new strengths or talents that you’ll be able to apply to other situations that you would like to change?

9. What advice would you give to other students who are planning an action project?

10. Would you get involved in another environmental action project? Why or why not?
REFERENCES


