Grades
9-12

National Park Service

Santa Monica Mountains National Recreation Area

National Park Labs

Studies of Wildland Fire Ecology

Welcome…

to National Park Labs: Studies of Wildland Fire Ecology. This is one of five *National Park Labs* programs designed to enhance science, math, and technology studies at the high school level. The five programs are:

- *Studies of Wildland Fire Ecology* at Santa Monica Mountains National Recreation Area
- *The Chihuahuan Desert Lab* at Carlsbad Caverns and Guadalupe Mountains National Parks
- *Water Under Fire* at Lowell National Historical Park
- *National Park Labs at the Presidio and at Milagra Ridge* at Golden Gate National Recreational Area
- *Bridging the Watershed: An Educational Partnership Between Potomac Area Parks and Schools*

The *National Park Labs* program is the first national effort to develop opportunities for high school students in the national parks. The size and scope of this program is possible because of Toyota USA Foundation's and the National Park Foundation's active interest in supporting science and mathematics education in addition to the national parks.

Enclosed you will find a teacher's guide and a CD-ROM that contains an electronic version of the teacher's guide, student activity scenarios, and additional background information.

Santa Monica Mountains National Recreation Area's education staff is interested in your comments and suggestions for improvement. To comment, find out more about the program, obtain the most current field protocols or schedule a program please contact us at 805-498-0305 or 805-370-2348. The field protocols are also at (www.nps.gov/samo/educate//Fire%20Website/index.htm). Thank you for your interest in Santa Monica Mountains National Recreation Area.

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NATIONAL PARK FOUNDATION

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Table of Contents

Background Information

Santa Monica Mountain National Recreation Area's **National Park Labs: Studies of Wildland Fire Ecology** is one of five National Park Labs models designed to enhance science, math and technology studies at the high school level. The program provides students with the opportunity to study wildland fire ecology in the recreation area and provides both students and teachers with practical curriculum-based scientific experiences that build appreciation for park resources. Students are also exposed to career opportunities in resource management, science, math, and technology. The program is designed to meet high school Core Concepts for Integrated/Coordinated Science I and II curriculum.

All National Park Labs models include the following components:

- Curriculum Development
- Teacher Training
- Student Field Trips
- Evaluation

A national evaluation assessed the efforts of each of the National Park Labs models and the overall effectiveness of the National Park Labs program.

Why Fire Ecology?

All the land within the Santa Monica Mountains has burned at least once since fires began to be mapped in the early 1900s. As part of a Mediterranean biome, this occurrence is a natural component of the Santa Monica Mountains ecosystem. Each year, Los Angeles and Ventura county residents living adjacent to, and within, this ecosystem experience "fire season" and the heightened awareness of the possibility of wildfire.

The local perception of fire and the influence of the media greatly affect the National Park Service's (and other agencies') management of the land and decisions made in the event of wildfire. As a result, the curriculum focuses on the role of fire as part of this Mediterranean biome; the ingredients, conditions, and behavior of fire; how it affects the vegetation, soil and water of the area; and finally, on human influence including the use of prescribed fire, wildland/urban interface, conflict resolution, and the media.

Because the curriculum strives to teach a more comprehensive understanding of National Park Service resources and fire, it is our hope that it will create a more informed public view and, ultimately, stewardship of the land.

Overview

Within this package you will find a CD-ROM that contains student scenario activities as well as an electronic version of the printed materials that are included in this notebook. The curriculum is progressive and builds on the knowledge of each prior lesson.

The teacher materials provided are broken down into three parts:
1. ***Teacher Guidelines*** that provide the concept, objective, method, materials, duration, and procedure for conducting the lesson.
2. ***Student Handout*** that provides information about the lesson topic.
3. ***Student Investigation Worksheet*** with activities and questions pertaining to the lesson.

The following gives a brief overview of the lessons:

The lessons **Biomes of the World** and **Mediterranean Biome** introduce students to the study of biomes with emphasis on the Mediterranean biome of Southern California. The study continues with **A Closer Look** which teaches about the ecosystem of the Santa Monica Mountains — the best local example of a Mediterranean biome. Through the lessons students will be able to explain the features of a biome, determine the biome of their local area, explain the features of a Mediterranean biome, and identify where the Santa Monica Mountains exist in relation to their school/home.

In **Ingredients of a Fire** and **Conditions for a Fire**, students become more familiar with one of the components of a Mediterranean biome – *fire*. They conduct in-class labs to learn the three ingredients of fire, the chemical reaction that takes place to produce oxidation and combustion, what determines "fire season," and how specific heat plays a role in plant moisture levels.

To determine the influence of plant moisture levels and weather on fire behavior, the lessons **Fire & Plants** and **Fire Behavior & Weather** have students conducting in-class labs to gather, identify, and graph plant moisture levels of local plants and conducting a dry air/transpiration lab to identify the effects of wind and relative humidity on those levels. The GLOBE Atmosphere Investigation is also conducted to prepare students for completing the same lab in the field.

The next two lessons use GLOBE investigation labs to prepare students for their field investigation. **Fire & Soil** and **Fire & Water** help students determine how a fire affects the soil and water of an area.

The next lesson, **Field Study Evaluation**, is a post-field study evaluation that provides questions for students to help them evaluate data collected in the field. Students will evaluate the effects of fire, the conditions for fire, and then will compare the data collected to what they have learned about a Mediterranean biome.

The next three lessons introduce the topic of human influence on the local biome and what land managers have to consider to ensure a healthy ecosystem. **Prescribed Fire** explains the guidelines for a Burn Plan as students determine what they think were the breakdowns in a plan involving the Cerro Grande Prescribed Fire. **Wildland/Urban Interface** brings up land management issues that arise when homes and businesses are shared with open space. Students read through a scenario and determine the problem, issue, and stakeholders involved. **Wildfire & the Media** explains how the media plays an important role in how a wildfire is perceived and public opinion is formed. Students review samples of wildfire reporting and determine which words sensationalize and influence by distorting the truth.

The final lesson, **Santa Monica Mountains National Recreation Area—Your Park**, serves to assess students' understanding of what they have learned, to describe the value of the Santa Monica Mountains, and to evaluate the impact people have on them.

Biomes of the World

Concept
The terrestrial components of the Earth can be broken down into distinctive groupings called biomes.

Objective
Students will be able to explain the features of a biome and the relationship of each biome to another, plus determine the biome of their local area.

Method
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

Materials
–Student Handout
–Student Investigation Worksheet

Duration
Up to one class session

Procedure

1. Ask the students to read the *Biomes of the World* handout.

2. Discuss the various characteristics of a biome.

3. Ask students to examine the different biomes on the *1–Student Investigation Worksheet* and determine which biome best describes the one found in Southern California. Using the worksheet, have students write their answer and explain their choice.

4. Have students present their choices.

5. Discuss with the students how the characteristics of a Mediterranean biome fit the example in Southern California. Discuss why, in the city, the most noticeable characteristics are climate and location. Discuss why, in the city, it is harder to determine the biome by plants, soil, and animals only.

Key Words

Adaptation	Biome	Biosphere
Biota	Coniferous	Deciduous
Geology	Latitude	Nocturnal
Organic	Terrestrial	

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Biomes of the World

When looking at life on Earth (the biosphere), the terrestrial components of the Earth can be broken down into distinctive groupings, known as **biomes**. Biomes are mainly distinguished from one another by climate, soil, and vegetation (plant life). These characteristics together support a collection of animal life. The *biota* (plants and animals) of each biome have similar characteristics throughout the world.

The following features distinguish one biome from another:

Climate

The characteristics of a biome are determined by temperature and rainfall.

Example: Tropical Rain Forests have year-round rainfall with warm temperatures ideal for lush, leafy plant growth. A Boreal Forest (evergreen coniferous) has plants and trees that must endure cold, snowy weather in winter and little rain in the summer. The plant life of each of these areas is significantly different as each has adapted to survive the area's climate conditions.

Soil

Certain soil types characterize a biome. Soils are very important because they determine what types of plants will grow within a biome. They are influenced by the parent-rock geology and the climate.

Example: The soils of a Temperate Broadleaf biome are characterized by a dark brown, slightly acid soil. This is due to the heavy tree cover of the biome and its warm, wet summers that cause a buildup of organic materials forming a loamy soil.

Vegetation

The plant life of biomes is dependent on the soil and climate of the area. Plants adapt to specific conditions by changing such characteristics as leaf shape and size.

Example: Adapting to the long, dry summer conditions, the chaparral plants of the Mediterranean biome are woody shrubs containing small, thick, waxy leaves capable of retaining water moisture.

Biomes of the World

Animals

Climate, soil, and vegetation all help determine the animal life and adaptations of the animals to a biome.

Example: Burrowing, nocturnal animals are typical of a Desert biome, having adapted to hot daytime temperatures.

Location

Some biomes have similar location patterns around the world. Similar biomes are often found at the same latitude around the world.

Example: Various Desert biomes around the world are located between 20˚ and 30˚ latitude, including Chihuahuan Desert in Mexico, Sahara Desert in North Africa, and Great Indian Desert in India. Altitude similarities exist as well. Ascending a tall mountain, the higher in altitude you climb, the cooler the temperature, the thinner the air, and the longer the winter. Several different climates exist on one mountain, so different biomes can exist as well.

Example: As one climbs in altitude, a Temperate Deciduous Forest biome (broadleaf deciduous trees) can change to a Boreal Forest biome (evergreen pine trees) and eventually become a Tundra biome (treeless and cold).

Student Worksheet

Biomes of the World

Investigation

A. Look through the list of some of the world's biomes and their major characteristics. Based on your experience, determine which biome best describes Southern California.

	Tropical Rain Forests	Tropical Savannah	Desert
Climate	High temperatures and rainfall Rainfall: 60"to 160"a year.	High temperatures year-round, with 4 to 8 months of drought.	Day: high temperatures. Night: extreme cold. Little rain.
Soil	Rapid decomposition. Nutrient poor, acidic with high levels of aluminum and iron oxides. Reddish in color.	Acidic. Reddish in color.	High content of salt. Sand is common. Light brown, gray in color.
Vegetation	Complex forest with as many as five layers. Broad–leaf evergreens and vines.	Grassland with scattered trees. Acacia, baobab, palm and grasses.	Low-level shrubs, cactus.
Animals	Apes, monkeys, leopards.	Giraffe, antelope, lion.	Reptiles, snakes and burrowing rodents.
Location	Low-lying areas near the equator, between 10° North and South latitude.	Often on either side of rain forests, located on the African and South American continents.	Various locations including west coasts between 20° to 30° latitude, interiors of continents, and the leeward side of high mountain ranges.

	Mediterranean	Temperate Grassland	Temperate Deciduous Forest
Climate	Six months each: hot, dry summers; cool, moist winters.	Warm to hot summers, cool to very cold winters.	Warm summers, cold winters. Abundant rain year-round.
Soil	Thin rocky soils on hillsides.	Typically alkaline soils. Blackish in color.	Rich in organic materials. Slightly acidic surface soil. Dark brown in color.
Vegetation	Chaparral adapted to fire. Evergreen shrubs characterized by small, waxy leaves.	Short grasses.	Primarily deciduous trees: oak, hickory, maple, and ash.
Animals	Deer, rabbit, mountain lion.	Depending on continent: bison, camels, elephants.	Deer, bear, squirrel, raccoon.
Location	Western coastal regions located between 30° to 40,° North and South latitude.	Near desert areas, mid-latitude in North America, South America, Eurasia, South Africa.	Northern hemisphere locations in Eastern North America, West/Central Europe and Eastern Asia.

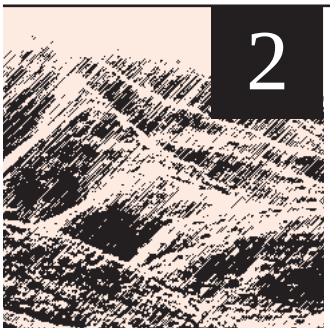
Biomes of the World

Investigation

cont.

	Boreal Forest *(Evergreen Coniferous)*	Alpine Tundra	Arctic Tundra
Climate	Cool summers, extremely cold winters.	Variable temperatures that increase with elevation. Intense sunlight + ultraviolet exposure.	Long, cold winters with little rainfall.
Soil	Low decomposition rate. Acidic soils; black on the surface.	Rocky, with little nutrients. Greyish in color.	Rocky, with little nutrients. Frozen. Greyish in color.
Vegetation	Evergreen, cone-bearing trees; few deciduous trees	Lichen, mosses, dwarf trees.	Treeless, low shrubs, mosses and lichen.
Animals	Moose, bear, wolf, porcupine.	Mountain goat, marmot, elk.	Caribou, musk ox, polar bears.
Location	The largest terrestrial biome. A broad belt across North America, Europe and Asia. Also located at high latitudes.	Upper altitudes of mountain ranges.	High latitudes of the Northern Hemisphere in a belt around the Arctic Ocean.

B. Which biome did you choose? Explain your answer.



2

Mediterranean Biome

Concept
A Mediterranean biome has characteristics that occur in select regions around the world.

Objective
Students will be able to explain the features of a Mediterranean biome and identify the global distribution of the biome.

Method
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

Materials
–Student Handout
–Student Investigation Worksheet

Duration
Up to one class session

Procedure

1. Ask the students to read the *Mediterranean Biome* handout.

2. Discuss the various characteristics of the biome.

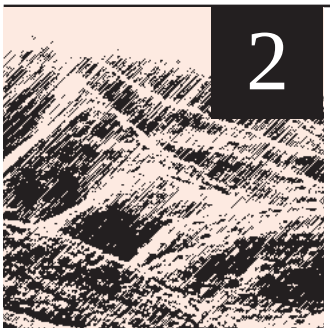
3. Ask students to examine the map on the *2–Student Investigation Worksheet* and answer the questions.

4. Have students present their answers.

5. Discuss with the students the characteristics of a Mediterranean biome and how location and climate play a role in soil and plant life. Introduce the characteristics of fire.

Key Words

Aromatic	Chaparral	Continent	Degraded
Dormant	Drought	Flammable	Marine
Precipitation	Regeneration		



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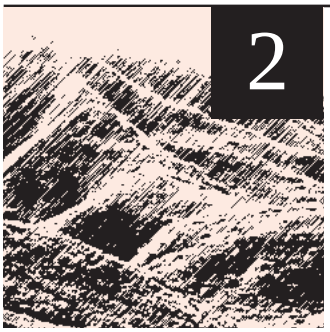
Mediterranean Biome

Location plays a unique role for the Mediterranean biome, as these regions occur only in select places around the globe. They are found roughly between 30° and 40° north and south latitude and are located on the western coasts of continents where the land is influenced by cold offshore ocean currents. Only 5% of the world's biomes are Mediterranean, and therefore one of the most threatened. The locations where this biome occur are: Southern California, Central Chile, Mediterranean Sea borderlands, Capetown area of South Africa, and south-western Australia.

A Mediterranean biome's climate has a mild, rainy season that coincides with winter. Its total annual precipitation ranges between 12" to 15" along the coast, and up to 40" in higher elevations. Marine air from the ocean moderates temperatures along the coast, with fog characterizing early summer. The hot, dry, summer season has average temperatures that range from 75° to 90.° The hottest months in Southern California are August and September. The temperatures of this biome are similar to those of the subtropics, moderated by its location to the sea, and by fogs associated with the cold ocean currents.

Hot, dry periods influence this biome's plant type characteristically made up of woody shrubs adapted to withstand drought. In most regions, these shrubs are evergreen and typically have small, thick, waxy leaves designed to retain moisture. Aromatic herbs, such as sage, are typical. In California these types of plants are known as *chaparral*; *maquis* in the Mediterranean; in Chile they are known as *matorral*; and in Australia they are called *mallee scrub*. Many of these plants develop on thin, rocky, degraded soils and contain highly flammable oils.

These oils are among a variety of characteristics that make this biome highly susceptible to fire. In fact, these plants are specifically adapted to fire to ensure regeneration. For example, many sprout from underground roots after a fire and have seeds that can lie dormant until a hot fire allows their seed coat to crack. Some plants are reactivated into growth by the addition of nutrients from burned vegetation, that are added to the soil; and the shape of certain plants protects the inner growth buds from destruction during hot fires.



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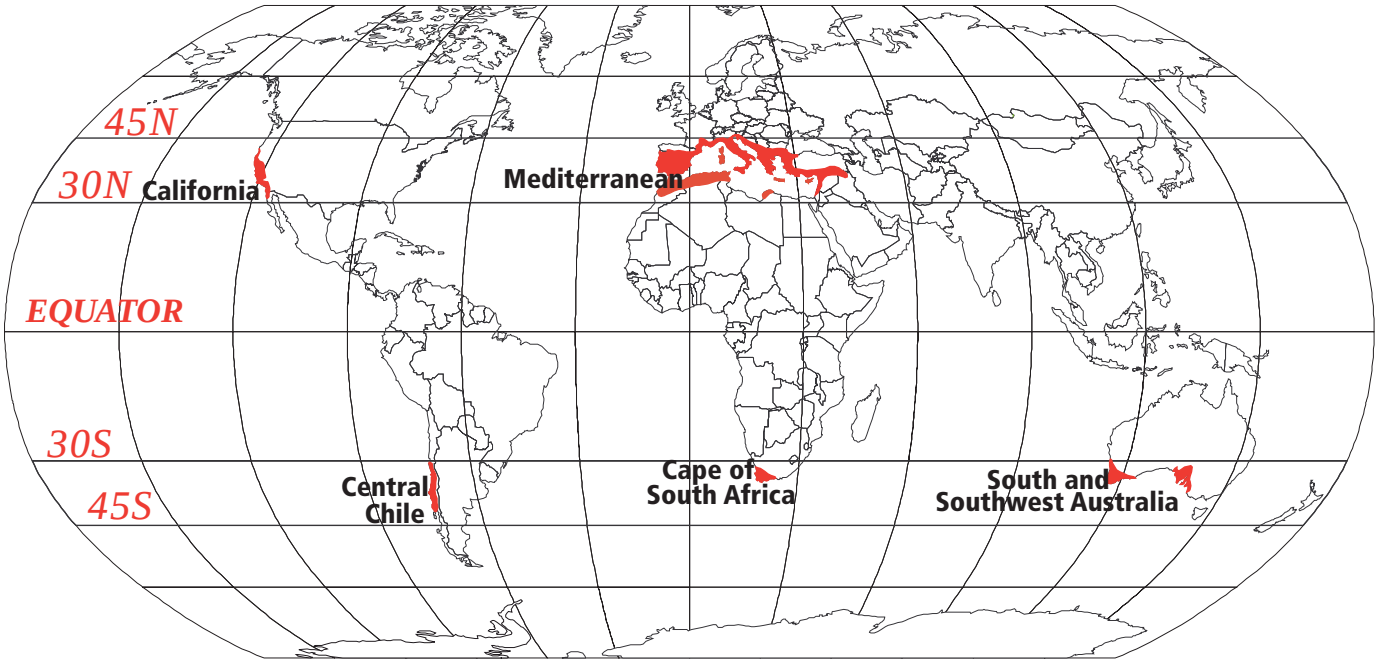
Student Worksheet

Mediterranean Biome

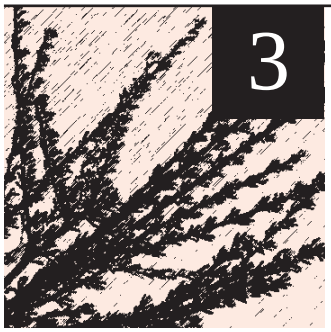
Investigation



A. Describe the global distribution pattern of the Mediterranean biome:

B. Describe the climate of the Mediterranean biome:

C. What role does climate play in determining the characteristics of the plant life?



3

Closer to Home

Concept
The Santa Monica Mountains are an example of a Mediterranean biome located adjacent to metropolitan Los Angeles.

Objective
Students will be able to identify where the Santa Monica Mountains exist in relation to their school/home and explain how the location characteristics of these mountains compare to those of other Mediterranean regions.

Method
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

Materials
–Student Handout
–Student Investigation Worksheet

Duration
Up to one class session

Procedure

1. Ask the students to read the *Closer to Home* handout.

2. Discuss the various characteristics of the Santa Monica Mountains and how they compare to a Mediterranean biome.

3. Ask students to examine the map on the *3–Student Investigation Worksheet* and answer the questions.

4. Have students present their answers.

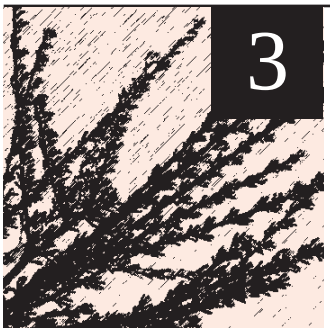
5. Discuss with the students the location of the Santa Monica Mountains in relation to their own school/home.

Extensions

Map & Compass exercises. Try the following website link:
www.mapping.USGS.gov/education/

Key Words

Aspect	Ecosystem	Elevation
Erosion	Flora	Metropolitan
Nutrient	Proximity	Species



3

Closer to Home

The best example of a Mediterranean biome here in Southern California exists in the Santa Monica Mountains just adjacent to Los Angeles. In 1978, because these mountains and adjacent seashore exhibit the components of a Mediterranean biome, Congress established Santa Monica Mountains National Recreation Area – a unit of the National Park System – to protect the resources of this unique ecosystem.

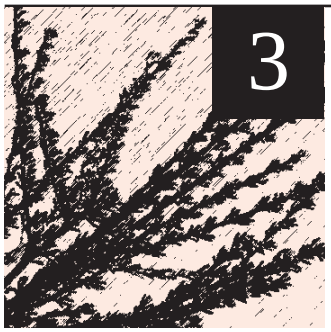
One of the special resources of these mountains is the plant life (flora). The distribution of plant life in the Park is determined by some of the following factors: presence of water, elevation, aspect, proximity to the ocean, and the presence and frequency of fire. At least seven different plant communities occur in the Santa Monica Mountains, including: Coastal Strand, Coastal Salt Marsh, Freshwater Marsh, Coastal Sage Scrub, Chaparral, Riparian Woodland, Valley Grassland, and Southern Oak Woodland. The two prominent plant communities, more typical of a Mediterranean Scrubland biome, are Coastal Sage Scrub and Chaparral.

Coastal Sage Scrub occurs in drier sites and lower elevations than chaparral, especially on south-facing slopes along the coast. Often occurring in recently eroded areas, this community plays an important role in soil stabilization. Soils underlying Coastal Sage Scrub tend to be low in nutrients and subject to rapid erosion, and they are comprised of a high percentage of sand and gravel. Coastal Sage Scrub is often referred to as "soft chaparral," characterized by soft-leaved, grayish-green, aromatic shrubs. Look for purple sage, California sagebrush, coastal buckwheat and laurel sumac as examples of this type of plant community.

The word **chaparral** *comes from the Spanish word,* ***chaparro****, referring to a dense live oak scrub plant that has similar characteristics of the plant group.* ***Al*** *means "place of" in Spanish so Chaparral means "place of chaparro."*

Chaparral, the dominant plant community in the Santa Monica Mountains, is characterized by fire-adapted evergreen shrubs growing on coarse-textured soils with limited water-holding capacity. The drought-adapted leaves of the chaparral plant species are often small, leathery, thick, fuzzy and/or waxy. Depending on the species, after a fire, chaparral plants may reproduce either by seeds, a root-crown burl, or both. Look for ceanothus, toyon, manzanita, and chamise as examples of this type of plant community.

Fire ecology has played an important role in shaping the ecosystem of Santa Monica Mountains National Recreation Area. Fire is a major factor in controlling nutrient cycles and energy pathways. It has maintained the ecosystem for over thousands of years through periodic lightning fires and possible prehistoric burning by Native Americans. The dynamic role of fire makes this Mediterranean biome thrive.



3

Student Worksheet

Closer to Home

Investigation

A. Circle the general location of your school/home on the map above.

B. Circle the location of the Santa Monica Mountains on the map above.

C. In what direction is the Santa Monica Mountains from your school/home?

_____

D. Within what latitude is the entire area? _____

E. Looking at the map, how do the location characteristics of the Santa Monica Mountains and Los Angeles compare with those of a Mediterranean biome?

_____

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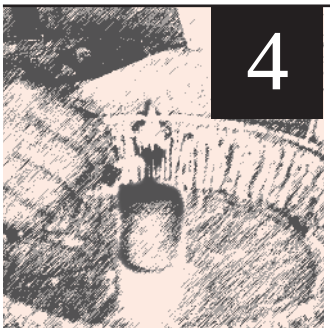


4

Ingredients of a Fire

CONCEPT
*Three ingredients: **heat**, **fuel**, and **oxygen** are necessary to create fire. These ingredients combined cause a chemical reaction known as **oxidation**.*

OBJECTIVE
Students will be able to explain the three ingredients of fire and the chemical reaction that causes rapid oxidation – combustion.

METHOD
Have students work in groups to read through their handout, conduct the lab, and answer the questions on their investigation worksheet. You may choose to conduct the lab as a demonstration, or have each group conduct it.

MATERIALS
–Student Handout
–Student Investigation Worksheet
–Candles set up in aluminum pie plates or foil
–Matches
–Glass jars (big enough to fit over the candles)

DURATION
1 – 2 class sessions

Procedure

1. Ask the students to read the *Ingredients of a Fire* handout.

2. Discuss the ingredients of a fire and the chemical reaction that takes place.

Candle Observation Lab

This lab is designed to demonstrate the ingredients of fire.

1. Divide the class into small groups and hand out materials for conducting the candle observation lab.

2. Go over safety precautions for conducting the lab.

3. Observe the burning candle flame for three to five minutes. Have students answer the questions under section A, questions 1 - 5, on the *4–Student Investigation Worksheet*.

4. Place a glass jar over the candle by slowly lowering it over the flame until it rests on the table.

5. Have students complete the remaining questions on the *4–Student Investigation Worksheet*.

6. Have students present their answers.

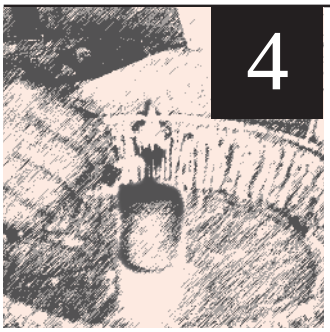
7. Discuss the answers with the students.

Video Connections

Introduction to Fire Behavior – Part I

Key Words

Carbohydrate	Combustion	Dehydrated	Foehn
Fuel	Oxidation	Volatile	



4

Ingredients of a Fire

Fire has been a cyclical part of the Santa Monica Mountains for thousands of years, particularly due to its plant life. Many of the plants not only have a low moisture content and leaves that contain volatile oils but they also grow dense and close to the ground.

How do fires begin? In the Santa Monica Mountains, human actions are the main cause of fire today. In the past, lightning from thunderstorms contributed to fires. Whatever the cause, there are three ingredients that combined will bring on fire:

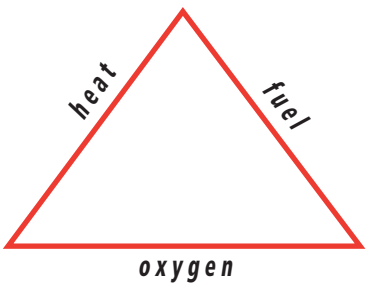
Fuel: Fuel is any combustible material. During long summer months in the Santa Monica Mountains, shrubs that become dehydrated and dead grasses provide "dry fuel" and burn more easily. When years go by without fire, dead plant material builds up, so when a fire occurs, there is ample fuel to burn.

Heat: The typical climate of the area includes long, dry summers with little rain. These conditions increase the temperatures of the ground and fuel, making it easier for the fuel to ignite and burn. Dry fuel ignites easily from sources such as lightning, a burning cigarette butt, broken glass focussing sunlight by reflection or refraction, or a match.

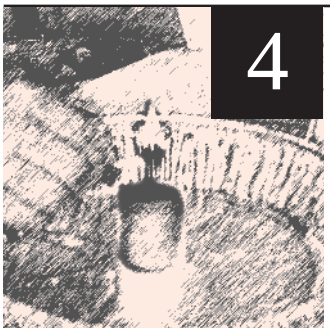
Oxygen: Another typical occurrence in the Santa Monica Mountains are *foehn* winds that blow hot and dry — the Santa Anas. This not only increases the oxygen supply and dries out the fuels, but also influences the spread of fire. Shrubs are more quickly ignited, as their small-sized leaves are surrounded by plenty of oxygen.

Fire isn't the only form of oxidation. When the carbohydrates and fats in your body combine with the oxygen you inhale, they produce carbon dioxide (CO_2) and release energy – oxidization. When metal reacts with oxygen from the air, it forms rust – another form of oxidization!

Fire is a chemical reaction. When combined, the ingredients work in this way. Start with a fuel, such as dry shrubs, which contains hydrogen and carbon atoms. When the summer sun hits the shrub, it raises the temperature of the shrub, drying it out. When an ignition source, such as lightning, contacts the shrub, it breaks the bonds between the carbon and hydrogen. This allows them to react with O_2 in the air, releasing CO_2, H_2O, and heat — oxidation. Oxidation releases heat, which triggers more bonds, becoming more oxidation, and more heat in a positive feedback cycle. This is known as ***combustion (burning)***.



This reaction, represented by the fire triangle, shows that fuel, heat and oxygen are necessary to create fire. If any one of them is missing, there can be no fire.



4

Student Worksheet

Ingredients of a Fire

Investigation

A. Observe the burning candle.

1. What is the source of fuel? _____
2. What is the source of heat? _____
3. What is the source of oxygen? _____
4. What is the evidence of oxidation? _____
5. What color represents the hottest area of the flame? _____
6. What happened when you eliminated one of the three ingredients of fire? Why? _____

_____

_____

_____

7. Explain the chemical reaction that took place: _____

_____

_____

_____

_____

B. Why are fires more likely to burn during hot weather than during cool weather?

_____

_____

_____

C. Why would plants with smaller leaf surfaces burn faster than those with larger leaf surfaces? _____

_____

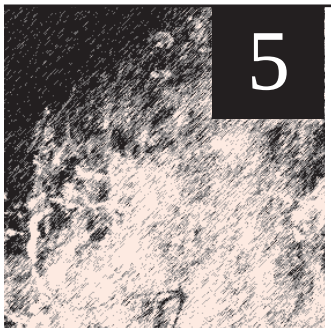
_____

D. In the Santa Monica Mountains, why would the dry, woody shrubs that have built up over the years, cause a fire to burn hotter, than in areas that burned recently? _____

_____

_____

_____



5 Conditions for a Fire

CONCEPT
Certain conditions exist in Southern California that determine "fire season" including humidity level, wind speed, air temperature, and plant fuel moisture. Specific heat plays a role in plant moisture levels.

OBJECTIVE
Students will be able to explain the relationship between specific heat and plant fuel moisture.

METHOD
Have students work in groups to read through their handout and answer the questions on each investigation worksheet. You can conduct the labs as a demonstration or have each group conduct them.

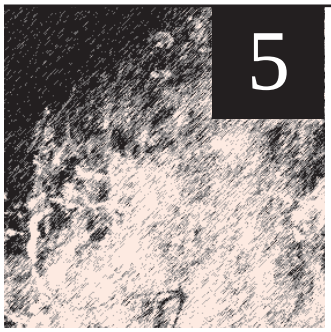
Procedure

1. Ask students to read the *Conditions for a Fire* handout.
2. Discuss specific heat and the role it plays in plant moisture and combustion.

Boiling Water Lab

This lab is designed to demonstrate the specific heat of water.

1. Set up the ring stand/tripod.
2. Go over safety precautions for conducting the lab.
3. Fill 1/3 of the paper cup with water.
4. Place the cup on the tripod so that the bottom of the cup is over the opening in the ring and above the heat source.
5. Light the lamp or Bunsen burner. The flame can touch the bottom of the cup.
6. Heat the cup until the water boils.
7. Have students record the results on *5a–Student Investigation Worksheet.*
8. Use tongs to pour the hot water out of the cup.
9. Place an empty cup in the ring or tripod, and heat until it burns.
10. Have students record the results on *5a–Student Investigation Worksheet* and complete the questions.
11. Have students present their answers.
12. Discuss answers with the student.



5 Conditions for a Fire

MATERIALS
–Student Handout
–Student Investigation Worksheets (5a and 5b)
–Paper "hot" cup (16 oz; not waxed or styrofoam)
–Ring stand/tripod w/ concentric removable flat rings
–Bunsen burner (or other flame source)
–Alcohol lamp
–Matches/butane lighter
–Tongs
–Two 3" long green and two 3" long dry plant cuttings (buds and flowers removed)
–Stopwatch
–Sling psychrometer

DURATION
1 – 2 class sessions

Fuel Combustion Lab

This lab is designed to show the specific heat of water as it relates to the amount of moisture in plants and to determine when a fuel will burn and how much heat is required to burn it.

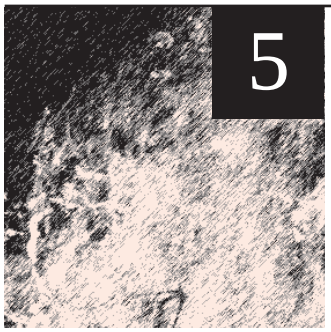
1. Set up the ring stand/tripod.
2. Go over safety precautions for conducting the lab.
3. Place the alcohol lamp under the stand.
4. Place two green twigs on the ring.
5. Light the lamp and, using the stopwatch, begin recording the time it takes for the green twig to ignite.
6. Have students record the results on *5b–Student Investigation Worksheet.*
7. Repeat the procedure using two dry twigs.
8. Have students record the results and complete the questions on the *5b–Student Investigation Worksheet.*
9. Have students present their answers.
10. Discuss answers with the students.

Video Connections

– Introduction to Fire Behavior – Part 2: Fuels
– Yellowstone Fire

Key Words

Humidity Slope Specific Heat



5

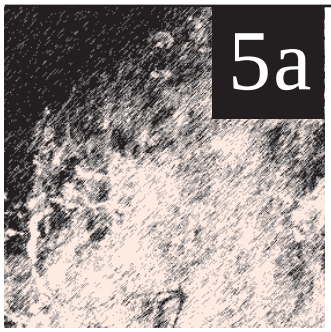
Conditions for a Fire

What do hot, gusty winds; dry weather; low humidity; and dry shrubs and grass make? — ideal conditions for fire. Here in Los Angeles we experience these conditions seasonally. This season is known as "fire season" and occurs usually between September and November. But, the time of year does not determine the season, specific conditions do. Conditions for a fire include: humidity level, wind speed, slope, air temperature, and plant fuel moisture. Plant fuel moisture is the most significant factor.

Specific heat plays a role in plant moisture levels and the speed with which plants will catch on fire. The amount of heat that must be added to 1 gram of a substance to raise its temperature 1° C is called specific heat. Water has a high specific heat, much higher than most materials, and it tends to change temperature more slowly. For example, the sun shines down on a swimming pool and the concrete around it, adding the same amount of heat to both water and concrete; but the concrete will get hotter. Because the specific heat of water is greater, it takes more heat energy to make it hotter. This is significant, because young, green plants, with high moisture levels, need more heat energy to catch fire than dry, low moisture level ones. Plants with little or no "fuel moisture" or less "specific heat" will catch fire much easier.

When dry, hot, gusty Santa Ana winds are present (usually during September through November), they replace cooler, more moist air (lowering the humidity level and lowering the fuel moisture level). When moisture levels are low, the oil content in most chaparral plants is high — promoting fire.

As the year progresses and temperatures increase, National Park Service Fire Managers pay close attention to humidity levels, wind conditions, and fuel moisture contents to gauge the conditions for fire. Failure to do this can have serious consequences.



5a

Student Worksheet

cont.

Conditions for a Fire

Investigation

Boiling Water Lab

A. Record the results of the *Boiling Water Lab* below:

Results

1. Cup with water

What happened?

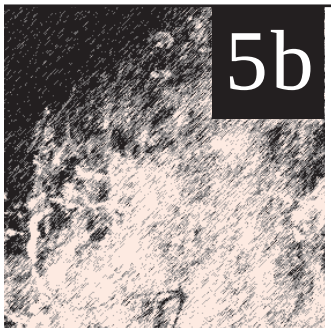
2. Cup without water

What happened?

B. Using complete sentences, answer the questions using your observations from the *Boiling Water Lab*.

1. Why is it hotter in the inland valleys of Los Angeles (San Fernando and San Gabriel), than near the ocean?

2. Based on what you know about specific heat, explain why the cup of water did not burn during the *Boiling Water Lab*.



5b

Student Worksheet

cont.

Conditions for a Fire

I n v e s t i g a t i o n

Fuel Combustion Lab

A. Record the results of the *Fuel Combustion Lab* below:

Specimen	Time it Takes to Ignite
Green Twig	_____ ***minutes*** *and* _____ ***seconds***
Dry Twig	_____ ***minutes*** *and* _____ ***seconds***

B. Using complete sentences, answer the questions using the data collected from the *Fuel Combustion Lab*.

1. How long did it take the green twig specimen to ignite? _____
Why? _____

2. How long did it take the dry twig specimen to ignite? _____
Why? _____

3. Which specimen do you think had the higher moisture content and why?

4. Which specimen do you think had the lowest moisture content and why?

5. Why is it harder to get wet wood hot enough to burn than it is to get dry wood hot enough? _____

6

Fire & Plants

CONCEPT
Plant moisture levels follow a cyclical pattern in the Santa Monica Mountains. Fire managers monitor plant moisture levels to help fire fighters gauge the amount of staffing and equipment needed in the event of fire.

OBJECTIVE
Students will be able to
–describe the plant moisture levels of the Santa Monica Mountains using a graph
–identify moisture levels in a sampling of plants
–explain the importance of monitoring moisture levels in plants

METHOD
Have students work in groups to read through their handout, conduct the lab, and answer the questions on their investigation worksheet. You can conduct the lab as a demonstration, or have each group conduct it; you can have students collect samples from different plants and compare the results.

Procedure

1. Ask the students to read the *Fire & Plants* handout.

2. Have students complete Part A on the *6–Student Investigation Worksheet*.

Fuel Moisture Study Lab

This lab is designed to determine the fuel moisture level of plants. Freshly collected samples of foliage and twigs are weighed, dried in an oven for a specific period of time, then weighed again. The moisture content of the fuel sample can then be calculated, based on the weight measurements obtained before and after oven drying.

1. Label each paint can and lid and, using the balance, weigh both to the nearest 0.1 gram. (Gently use a paint can opener to remove the lid so the lid is not distorted.)

2. Record the weight under "C" on the *6–Student Investigation Worksheet*.

3. Using the pruning clippers, cut 2" to 3" long twigs and foliage (ideally of chamise, manzanita, and/or sage).
– take your samples from all directions on the plant
– clip from only the top 1/3 of the plant
– remove any dead portions of the twig

4. Place the twigs in the container, filling it 3/4's full.

5. Place the lid back on tightly. (If collecting samples in the field, away from school, place the cans in an ice chest filled with ice to prevent deterioration, and transport the containers to the classroom. Plan to conduct the lab no more than 3 hours from the time of cutting.)

6. Before leaving the collecting area:
– take the relative humidity of the area
– describe the cloud cover
– describe the condition of the plants used

6

Fire & Plants

MATERIALS
–Student Handout
–Student Investigation Worksheet
–Laboratory drying oven
–Laboratory balance(s)
–Pruning clippers
–Sling psychrometer
–1 qt. metal paint can (per group)
–1 paint can opener
–Ice chest/ice (field gathering)
–Marker

DURATION
2 class sessions

7. Record the results on the *6–Student Investigation Worksheet*.

8. In the lab, weigh the SEALED samples to the nearest 0.1 gram.

9. Record the weight under *"A" Gross Wet Weight*, on the *6–Student Investigation Worksheet*.

10. Heat the oven for one hour at 103 - 105° C. Remove the lids CAREFULLY and place them aside. Place the OPEN containers in the oven and dry samples for 15 HOURS.

11. SEAL ALL CONTAINERS IMMEDIATELY and allow them to cool to room temperature.

12. Weigh each container to the nearest 0.1 gram.

13. Record the weight under *"B" Gross Dry Weight* on the *6–Student Investigation Worksheet*

14. Calculate the following to obtain the moisture content of the samples.
– Subtract *"C" Empty Container Weight* from *"B" Gross Dry Weight*, and record it under *"D" Dry Fuel Weight*.
– Subtract *"B" Gross Dry Weight* from *"A" Gross Wet Weight*, and record it under *"E" Weight Loss*.
– Divide *"E" Weight Loss* by its *"D" Dry Weight*, and using the quotient, multiply it by 100. Record the result under *"F" Percent Moisture*.

15. Have students complete Part C on the *6–Student Investigation Worksheet*.

16. Have students present their answers.

17. Discuss the answers with the students:

Video Connections

Introduction to Fire Behavior – Part 2: Fuels

Key Words

Convection	Density	Dormant
Dormancy	Fertility	Germinate
Predestined	Species	

Fire & Plants Title
Title

Fuel Moisture Study

In order for a plant species to survive it must adapt to the land and such natural forces as temperature extremes and fire. In the Santa Monica Mountains, the dominant natural vegetation is the chaparral, whose density, small leaves, low moisture content, deep roots, and regeneration capabilities are all clues that it has adapted well to the area.

Even with long, dry summers, and living in soils with low fertility, chaparral plants are still able to carry out their life processes on a regime of low mineral supplies and little water. Chaparral plants are equipped with leaf forms that are combinations of small, sticky, fuzzy, thick, waxy, and hard, allowing them to retain what little moisture they have during the hottest, driest months of the year. As soil moisture supplies become limited in late June, most chaparral plants enter a dormancy state which deepens as the summer heat intensifies. By August they are sustaining life at only 4 or 5 percent. It is at this time that they are at their most fire susceptible.

National Park Service Fire Managers monitor the water loss of plants in the Santa Monica Mountains bi-monthly. Water loss in plants is determined by the dry weight of the plant samples taken. This helps to determine the amount of moisture lost over time. The moisture loss of plants in these mountains follows a cyclical pattern with plant moisture levels at their highest during the months of March, April, and May, decreasing throughout the summer until they reach their critical low in August, September, and October. Once rains begin, the moisture levels slowly increase again.

6

Fire & Plants

Title
Title

Moisture levels in plants are measured by taking 3"cuttings of new growth from Chamise and Sage — typical plants of the chaparral. Berries, flowers and buds are removed, as they contain higher amounts of water. These cuttings are then weighed before being placed in a container for drying. Cuttings are dried in a convection oven for 15 hours before being removed and weighed again. The difference in the weight corresponds to a moisture level. Knowing the moisture level of plants helps firefighters gauge the amount of staffing and equipment that will be needed in the event of fire. The lower the moisture level the more resources will be needed.

Measuring the dry weight of plants can be compared to a sponge.

A moist sponge is at 100% of its weight. If it dries up, its weight drops below 100%. If it fills up with water it goes above 100% of its weight.

That is why some plant moisture levels will be above and below 100%.

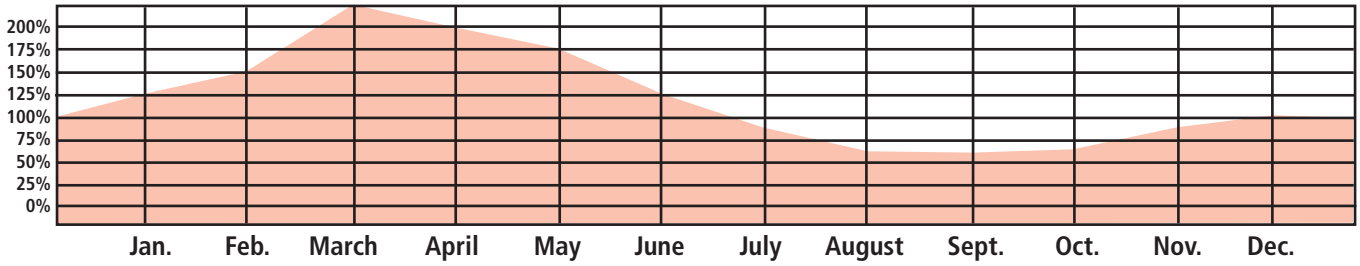
Because fire is inevitable in the Santa Monica Mountains, chaparral shrubs are uniquely equipped with a variety of fire survival strategies. About half of the species possess a root-crown burl (a large lump, just below the soil) which contains countless dormant buds. After a fire, these buds draw on water supplied in the roots and within weeks, emerge from the burl to grow. Some species produce large numbers of seeds to help ensure that some will survive the fire. Others have tough seed coats that protect them from the intense heat. And finally, some plants produce seeds that will only germinate once a fire has caused them to crack, later allowing water to seep in and help them to sprout. By whatever method, after a fire new growth of chaparral plants is guaranteed.

6

Student Worksheet

Fire & Plants
Investigation

Fuel Moisture Lab



A. Describe the cycle of plant moisture levels in the Santa Monica Mountains using the hypothetical graph above. _____

B. Record the results of the *Fuel Moisture Lab* below:

Plant Species	Can No.	A	B	C	D	E	F
		Gross Wet Wt.	*Gross Dry Wt.*	*Empty Can Wt.*	*Dry Fuel Loss* (B — C)	*Weight Loss* (A — B)	*% Moisture* (E ÷ D x 100)
Month/Season							

C. Using complete sentences, answer the questions based on the data collected in the *Fuel Moisture Lab*:

1. What was the moisture level of your sample? What do you think influenced this?

2. How did the moisture level of your sample compare to other samples collected? What do you think was the cause of any differences? _____

3. How do you think the relative humidity, cloud and plant conditions or month/season relate to the fuel moisture content of your sample? _____

4. How would the information gathered on fuel moisture levels help firefighters?

7

Fire Behavior & Weather

CONCEPT
Existing weather conditions, such as atmosphere, stability, wind, air temperature, and relative humidity, all contribute to fire behavior.

OBJECTIVE
Students will be able to:
–identify the effects of wind on fuel moisture levels
–identify current air temperature, relative humidity and cloud types
–explain the difference between stable vs. unstable air
–describe the conditions for fire risk

METHOD
Have students work in groups to read through their handout, conduct the lab, and answer the questions on their investigation worksheets.

Procedure

1. Ask students to read the *Fire Behavior & Weather* handout.

2. Discuss the weather conditions that contribute to fire behavior.

Dry Air/Transpiration Lab

This lab is designed to demonstrate how dry, Santa Ana winds and a drop in relative humidity are significant contributors to decreasing plant fuel moisture levels. Transpiration will be measured using a *potometer* (*pot*=to drink, *meter*=measure).

1. Discuss transpiration with the students, explaining that it is the evaporation of water through the stomates of a plant leaf.

You may want to have the following procedures done ahead of time and set up as a demonstration for the students.

– Place the tip of a 0.1 ml pipette into a 16" piece of clear plastic tubing.

– Submerge the tubing and pipette in a shallow tray of water. Draw water through the tubing until all air bubbles are eliminated.

– Carefully cut the plant stem UNDER WATER.

– While the plant is submerged, insert the freshly cut stem into the open end of the tubing.

– Bend the tubing upward into a "U" and use the clamp on a ring stand to hold both pipette and tubing.

– Use petroleum jelly to make an airtight seal surrounding the stem AFTER it has been inserted into the tube. Make sure the end of the stem is immersed in water.

– Let the potometer apparatus equilibrate for 10 minutes before beginning the demonstration.

2. Measure relative humidity as close to the plant as possible.

3. Record the results on *7a–Student Investigation Worksheet*.

4. Expose the plant to the wind of a fan, at least 1 meter from the plant on low speed.

5. Read and record the level of water in the pipette at the beginning (time zero).

6. Continue to record the water level in the pipette every 3 minutes for 30 minutes. (You may wish to assign this to a student, while performing the next Lab.)

7 Fire Behavior & Weather

MATERIALS
–Student Handout
–Student Investigation Worksheets
–0.1 ml pipette
–Ring stand
–Clamps
–Clear plastic tubing
–Petroleum jelly
–Electric fan
–plant cutting (as freshly cut as possible): about 1' long, diameter should fit tightly inside the tubing
–See GLOBE protocols for the Atmosphere Investigation

DURATION
2 – 3 class sessions

7. At the end of 30 minutes, retake the relative humidity.

8. Have students record the data on *7a–Student Investigation Worksheet* and complete the questions.

9. Have students present their answers.

10. Discuss the answers with the students.

GLOBE Atmosphere Investigation

1. Divide the class into small groups and hand out materials to follow GLOBE protocols under the *GLOBE Atmosphere Investigation* including cloud type, rainfall, current temperature, and relative humidity.

2. Have students complete all the questions on the *7a–Student Investigation Worksheet.*

3. Have students present their answers.

4. Discuss the answers with the students.

Video Connections

– Fire Weather, Part 1
– GLOBE – Atmosphere

Extensions

Visit www.Globe.gov/ for additional related activities under the GLOBE Teacher's Guide.

Key Words

Atmospheric	Climate	Cumulus
Dust Devil	Protocol	Relative Humidity
Stratus	Water Vapor	Weather

7

Fire Behavior & Weather

Atmosphere Study

National Park Service Fire Managers monitor weather closely, especially during fire season, as weather plays an important role in fire behavior. Fire behavior refers to the way in which fuel ignites, flames develop, and fire spreads. Existing weather conditions, such as atmospheric stability, wind, air temperature, and relative humidity, all contribute to fire behavior.

Atmospheric stability

When air is "unstable" wildfires burn hotter and more intense. Unstable air has a lot of upward motion. There are certain visual indicators that tell us whether the air is "stable" or "unstable."

— Visual indicators of unstable air: vertical growing clouds; cumulus type clouds; gusty winds; good visibility during fire; and dust devils (spiraling gusts of wind that look like little tornados).

— Visual indicators of stable air: clouds in layers; stratus-type clouds; fog layers; poor visibility during fire; and steady winds.

Temperature

The temperature of fuels (plants) and their moisture level is determined by the surrounding air temperature. Fuels ignite more readily at high temperatures.

Relative Humidity

Fuel moisture is also influenced by relative humidity – the amount of water vapor in the air. Typically, in the early morning hours when temperatures are low, the relative humidity is highest. As the sun rises, the air temperature increases, and relative humidity decreases. By late afternoon, when temperatures reach their maximum, relative humidity is at its minimum. This is the time when fuel moisture is at its lowest. As the sun goes down, temperatures go down, and the relative humidity begins to increase again.

Wind

Foehn (pronounced *fern*) winds — strong winds that occur when stable, high pressure air is forced across and down the slopes of a mountain, warming and drying the air — are typical in Southern California. These winds are called the Santa Anas. The strong, dry Santa Anas contribute to a drop in relative humidity and a decrease in fuel moisture. During a fire, winds bring a fresh supply of oxygen to fires, as well as push the fire toward a new fuel source.

7a

Student Worksheet

Fire Behavior & Weather
Investigation

Transpiration/Dry Air Lab

A. Record the results of the *Dry Air Lab* below:

Relative Humidity

	WET Bulb Reading	DRY Bulb Reading	% of Relative Humidity
BEFORE the lab	_____°F _____°C	_____°F _____°C	_____
AFTER the lab	_____°F _____°C	_____°F _____°C	_____

Transpiration Level

At Start_____ **3 min.** _____ **6 min.**_____

9 min._____ **12 min.** _____ **15 min.** _____

18 min._____ **21 min.**_____ **24 min.**_____

27 min_____ **At End** _____

B. Using complete sentences, answer the questions based on the data collected in the *Dry Air Lab*:

1. What weather conditions does the fan represent?_____

2. How did the "wind" affect the moisture level of the plant?_____

3. How do dry, Santa Ana winds contribute to fire behavior?_____

4. What do you think caused any difference in the relative humidity before and after the lab? _____

5. If the wind came off the ocean, rather than the mountains, how would this affect fuel moisture, based on your knowledge of relative humidity?

7b

Student Worksheet

Fire Behavior & Weather
Investigation

GLOBE Atmosphere Investigation

Using complete sentences, answer the questions based on the data collected in the *Globe Atmosphere Investigation*:

1. Did the air appear to be stable or unstable? Why?

2. Was the relative humidity high or low? How did this relate to the time of day?

3. Was the current temperature high or low? How is this typical, or not typical for this time of year?

4. Based solely on the atmospheric data gathered, would you consider the conditions to be "High Risk" for fire; "Moderate Risk" for fire; or "Low Risk" for fire? Why?

8

Fire & Soil

CONCEPT
Fire affects both above and below the soil. Nutrient levels, the addition of alkaline ash, and erosion due to loss of plant material, are all examples of how fire affects the soil.

OBJECTIVE
Students will be able to
–identify soil pH, fertility, temperature and moisture levels
–explain how soil temperature and moisture influence the possibility of fire
–describe the layers of a soil horizon

METHOD
Have students work in groups to read through their handout, conduct the lab, and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet
–Apple
–Knife
–See GLOBE protocols for the Soil Investigation

DURATION
1 – 2 class sessions

Procedure

1. Show the students an apple and explain that it represents the planet Earth. The skin represents the protective surface. Water covers 75% of the surface: oceans, lakes, and streams. Proceed to cut the apple in quarters and remove three of the quarters.

2. Show the remaining quarter and explain that it represents dry land but that 50% of it is made up of desert, polar, or mountainous regions too hot, cold, or high to be productive. Proceed to cut the piece in half and remove one half.

3. Show the remaining piece and explain that of this 12.5%, 40% is severely limited by terrain, fertility, or excessive rainfall. It is too rocky, steep, shallow, poor, or too wet to support food production. Proceed to cut the 40% portion away.

4. Show that what is left is approximately 10% of the apple. Proceed to peel the skin from the remaining sliver. Explain that this small fragment of land area represents the soil we depend on for the world's food supply. This fragment competes with all other needs – housing, cities, schools, etc. Explain that this tiny bit is what we will study.

5. Have students read the *Fire & Soil* handout.

6. Discuss how fire affects the soil.

Fire & Soil

GLOBE Soil Investigation

1. Divide the class into small groups and hand out materials to follow GLOBE protocols under *GLOBE Soil Investigation* including soil pH, fertility, temperature, moisture, and characterization (soil horizon).

2. Have students complete all the questions on the *8-Student Investigation Worksheet.*

3. Have students present their answers.

4. Discuss the answers with the students.

Video Connections

GLOBE – Soil

Extensions

Visit www.Globe.gov/ for additional related activities under the GLOBE Teacher's Guide.

Key Words

Acid	Alkaline	Annual	Bedrock
Clay	Germination	Horizon	Hydroxyl
Ion	Loam	Organic	Organism
Parent Rock	Percolate	pH	Sand
Silt	Terrain	Topsoil	

8

Fire & Soil

Soil Study

Soil is an essential part of the ecosystem. It is made up of organic material, water, air and billions of organisms. Soils are formed from parent rock that erodes into smaller and smaller particles, both coarse and fine. These particles, deposited by water and wind, are classified by their size from the finest (clay) to the more coarse (silt) to the coarsest (sand). Loam is a soil that is a mixture of all three. The water-holding capacity of soil determines its type, with the finest soils holding water and the coarser ones allowing water to percolate through.

Soil depth worldwide averages only six inches (fifteen centimeters). Soil and its underlying layers form horizons from the surface to the bedrock. These layers are distinct from one another chemically and physically because of their distance from the surface. For example: the top layer of soil is composed primarily of organic material, such as leaves and insects. The second layer, or topsoil, is where seeds germinate and plant roots thrive. The next layer is usually composed of sand and silt, with minerals and clay having been removed and settled into the next layer. Beyond this, the layers usually consist of rocks with little organic matter. The soils of this area tend to show a horizon with a moderately weathered topsoil layer, and subsurface layers of clay.

Soils play an important role in the plant communities of an area. Soils of the Santa Monica Mountains, range from thick, well-drained loams of oak-covered valley bottoms, to areas of chaparral where the soil is rocky, shallow, and lacking in minerals. This type of soil holds little moisture and tends to be dry. The plants of the Santa Monica Mountains have adapted to the soils of their area, which maintain a certain moisture level, nutrient level, and pH level, suitable to the needs of these plants.

8

Fire & Soil

Soil pH is an important factor in the survival of plants. The pH refers to the measure of acids and bases in a substance. Substances that produce hydrogen ions are called acids (H^+) and substances that produce hydroxyl ions (OH^-) are bases. When combined they form water (H_2O), and are neutralized. A pH scale describes the acids and bases in a substance. A pH number of 7 is neutral—neither acid or base. Below 7 are acids; above 7 are bases. Most species live in a moderately acidic environment, where soil and water pH range from 5.5 to 6.5. Most of the nutrient minerals that plants take from the soil are bases, which leaves the soil more acidic.

Fire affects both the ground above and below the surface of the soil. Soil moisture content, the amount of organic matter present, and the duration of the fire determine how soil will be affected. Severe fire can affect soil fertility causing nitrogen, phosphorus, and potassium to increase or even vaporize! After a fire, the basic minerals of the plants are converted into ash. The content of the ash causes a pH change, and the soil becomes more alkaline or basic. In some plant communities, this would cause different species of plants to grow. In the chaparral community, the ash stimulates plant germination with fire-following annuals (chaparral plants that sprout after a fire.) Because of its recovery potential through fire-germinated seeds, root-crown sprouting, and deep root systems, the plants of the chaparral return, rather than a new plant community succeeding it.

8

Student Worksheet

Fire & Soil
Investigation

GLOBE Soil Investigation

Using complete sentences, answer the questions based on the data collected in the *GLOBE Soil Investigation:*

1. What was the pH level of the soil? What do you think influenced this?

2. How do you think the pH level of the soil might be different if a fire had recently burned the area?

3. What was the soil temperature? How do you think this would influence the possibility of fire?

4. What was the soil moisture? How do you think this would influence the possibility of fire?

5. What was the soil fertility level? What do you think influenced this?

6. Looking at the soil horizon, what were the different layers composed of?

9 Fire & Water

CONCEPT
Water is continuously tested in the Santa Monica Mountains to track its condition throughout the year. Turbidity, pH, oxygen content, and temperature, are all indicators of the effects of fire.

OBJECTIVE
Students will be able to:
–identify water pH, turbidity, temperature, and oxygen and nitrate levels
–explain how water pH and temperature influence the plant and animal life of the water
–describe the effects of fire on the water

METHOD
Have students work in groups to read through their handout, conduct the lab, and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet
–see GLOBE protocols for Hydrology Study

DURATION
1 – 2 class sessions

Procedure

1. Have students read the *Fire & Water* handout.

2. Discuss the effects of fire on the plants and animals of the water environment.

GLOBE Hydrology Investigation

1. Divide the class into small groups and hand out materials to follow GLOBE protocols under the *GLOBE Hydrology Investigation* including water pH, turbidity, temperature, and nitrate and oxygen levels.

2. Have students complete all the questions on the *9–Student Investigation Worksheet.*

3. Have students present their answers.

4. Discuss the answers with the students.

Video Connections

GLOBE – Hydrology

Extensions

Visit www.Globe.gov/ for additional related activities under the GLOBE Teacher's Guide.

Key Words

Algae	Aquatic	Fauna	Flora
Groundwater	Habitat	Hydrology	Nitrate
Plankton	Sediment	Spawning	Terrain
Topography	Turbidity	Watershed	

9

Fire & Water

Hydrology Study

Groundwater, creeks, streams, and rivers flow through the watershed of the Santa Monica Mountains on their way to the ocean as part of a huge hydrologic cycle. This water source is valuable to the mountain ecosystem.

Throughout the Santa Monica Mountains, water is continually tested to track its condition throughout the year. Conducting various hydrology tests allows National Park Service Resource Managers to make comparisons of water health before and after a fire. The effect of fire on the water system is hard to predict because it is so closely linked to the topography, soil, and plant life of each individual site. What happens to a watershed after a fire often depends on what was happening in the watershed before the fire.

Fire can alter water quality, with turbidity and sediment being the most significant changes. **Turbidity** is a visual property of water and it measures the amount of suspended particles in water, such as silt, clay, plankton, microscopic organisms and organic matter. **Sediment** is the soil that gets in the water and then settles at the bottom. Sediment can degrade water quality and affect the aquatic organisms that live there. Sedimentation decreases available habitat for organisms (specifically fish) by reducing the size of spawning beds and by harming any existing eggs. Usually, where there is steep terrain and the fire has burned hot, there is a substantial increase in sediment, as erosion causes ashy soil to flow into streams with the first rain after a fire.

As nutrient-filled ash in soil flows into streams, it changes the pH and nutrient levels of the water. Most ponds and streams are acidic. Adding ashes to water raises the pH, turning it more basic. As a result, organisms that had been living successfully in the water may die off, and others, such as algae, may grow better. Increased algae production results in a more diverse population of insect larvae, changing the balance of life in the water from what it was before the fire.

Water temperature can change as a result of fire. If trees and vegetation along the stream are burned and removed, more sunlight is allowed to penetrate. More sunlight increases the water temperature directly affecting living organisms. Higher stream temperatures decrease oxygen content changing the chemistry of the stream.

As streams and rivers continue to flow, it is interesting to monitor how much time, following a fire, it takes for the water quality to return to its pre-fire levels. Water by nature, is continuously collected, purified, and distributed through the cycle. This natural recycling and purification process provides fresh water to regulate and balance out the ecosystem once again.

9

Fire & Water
Investigation

GLOBE Hydrology Investigation

Using complete sentences, answer the questions based on the data collected in the *GLOBE Hydrology Investigation*:

1. What was the turbidity level? What does this tell you about your water sample?

2. What was the water pH? What does this tell you about your water sample?

3. What was the temperature of the water sample? How would this influence the plant and animal life of the water source?

4. What was the oxygen content of the water sample? How might a decrease in oxygen affect the water?

Field Study Evaluation

CONCEPT
Data collection can be used to answer questions and formulate conclusions.

OBJECTIVE
Students will be able to:
–describe data collected in the field
–evaluate the effect of fire
–evaluate conditions for fire
–compare data collected to information about a Mediterranean biome

METHOD
Have students work in groups to read through the data sheets and past handouts, and answer the questions on the three investigation worksheets.

MATERIALS
–(9) Student handouts (for Sections 1 – 9)
–(3) Student Investigation Worksheets for Section 10

DURATION
1 – 3 class sessions

Procedure

1. Using the data collected on the field study trip, have students complete the answers on the three *Investigation Worksheets*.

Note: Provide students with copies of *Student Handouts (1 – 9)* for review

2. Have students present their answers.

3. Discuss with the students what was learned.

10

Field Study Evaluation

Investigation

Fire Influence

Use the data sheets completed on the field study trip to answer the following questions. Indicate why you think fire might or might not have influenced the results.

1. Describe the soil pH level. _____

2. Describe the soil fertility level. _____

3. Describe any evidence of fire in the soil horizon. _____

4. Describe the turbidity level. _____

5. Describe the water pH level. _____

6. Describe the water temperature. _____

7. Describe the water oxygen content. _____

8. Describe any physical evidence (burned branches, etc.) observed. _____

Field Study Evaluation

Investigation

Fire Conditions

Use the data sheets completed on the field study trip to answer the following questions.

1. Describe the temperature, humidity level and overall weather conditions during the field study trip. _____

2. Describe the moisture content of the plant samples tested. _____

3. Describe the temperature and moisture level of the soil. _____

4. Based on your descriptions above, would you consider the conditions of the field study site to be "High Risk" for fire; "Moderate Risk" for fire; or "Low Risk" for fire? Explain. _____

10

Field Study Evaluation

Investigation

Mediterranean Biome

A. Use the data sheets completed on the field study trip to answer the following questions.

1. Describe the air temperature and overall climate of the area. _____

2. Describe the vegetation of the area. _____

3. Describe the soil of the area. _____

4. Based on your descriptions of the three factors above, how do they compare to the characteristics of a typical Southern California Mediterranean biome?

B. If available, download data gathered by students in other biomes and answer the question: How do the soil, vegetation, atmosphere, and hydrology data compare? _____

Prescribed Fire

CONCEPT
Prescribed fire is a practice used to maintain fuel levels and ensure a healthy ecosystem.

OBJECTIVE
Students will be able to explain some of the guidelines for a Burn Plan when planning a prescribed fire and describe the breakdowns in the Burn Plan for an actual prescribed fire.

METHOD
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet

DURATION
1 class session

Procedure

1. Ask the students to read the *Prescribed Fire* handout.

2. Discuss the various considerations for a Burn Plan.

3. Ask students to read the information given on the *11-Student Investigation Worksheet* about the Bandelier, New Mexico fire and answer the questions.

4. Have students present their answers.

5. Discuss with the students:

– the importance of good coordination and management guidelines, and following them

– the variables including weather conditions

– emergency and contingency plans

– adequate staffing

Key Words

Backfire	Crew	Ditch	Drought
Firebreak	Forecast	Hand Line	Headfire
Prescribed Fire	Smoldering	Wind Speed	

Prescribed Fire

Management Ignited Fire

Fire in the chaparral environment of our Mediterranean biome has always been a natural force. Because of the National Park Service's mission to promote conservation, from 1916 to 1968, the national policy was to suppress all fires. Officially, all fires were considered wildfires and were "put out" as quickly as possible. This practice showed an increase in the amounts of fuel (vegetation) built up in natural areas. In the event of any fires, this increased amount of fuel ensured a more intense fire, and more severe damage. In the 1950s, Everglades National Park researched the use of prescribed fire. As a response to that report, the National Park Service dramatically changed its fire management policy in 1968. The use of prescribed fire was accepted as a way to reduce fuel build up.

Prescribed fire is the controlled use of fire to reduce excess fuel and promote the overall health of an ecosystem. It is used in a specific area of the land under predetermined conditions — it is a calculated and carefully planned event. To plan and prepare for a prescribed fire, fire managers construct a Burn Plan that considers: wind conditions; weather; season; humidity; and fuel among others. Fire managers determine how hot the fire will burn and in what direction it will travel. Part of the Burn Plan includes determining where each member of the crew will be stationed to ensure the fire is managed and the crew is safe. Also, emergency procedures are outlined to handle a fire that has gotten out of control. The following are some of the guidelines for a well-planned prescribed fire:

Coordination

Agencies and land owners within the areas of the prescribed fire must be in agreement on the area to be burned and the methods used. The overall Burn Plan must be reviewed by all appropriate management officers and receive approval.

Firebreaks

To decrease the risk of a fire escaping the planned burn area, fire breaks must be constructed. They are barriers around the planned burn area and can include roads, ditches, water, or other physical features that have no vegetation. Sometimes firebreaks are built ahead of time.

Prescribed Fire

Wind & Weather

Long-term drought conditions, and current wind and weather forecasts must be considered continually. Wind speed and wind direction will determine where the fire will be ignited and in which direction it will burn. All possibilities are considered. If the conditions are not ideal, the burn must be delayed.

Backfire and Headfire

Fire crews light a headfire at the top of a slope along a firebreak. Then, a backfire at the base of the slope is ignited downwind along another fire break. The fires slowly burn toward the center of the site where, eventually, the backfire meets the headfire and they burn each other out. Fuel types and elevation variations must be considered when deciding where fires will be ignited.

Hand Line

Hand lines are created by ground crews who work to contain the fire to the sides of the site. Breaks are created along the sides using hand tools such as chain saws, shovels, and rakes. A "hose lay" is run along the hand line with pumps full of water ready to be used to maintain the hand line. Other crew members and a fire engine are nearby if the prescribed fire should get out of control.

Finally, fire crews complete the prescribed fire by extinguishing smoldering remains. In a matter of days, the black, lifeless area will slowly come back to life as dormant seeds sprout and other fire-resistant plants begin the process of regeneration.

11

Student Worksheet

Prescribed Fire
Investigation

Prescribed Fire

Prescribed fire has been an integral part of the National Park Service (NPS) fire management programs since 1968. NPS has conducted over 3,700 prescribed fires since then, and in that time only about 1% of these have turned into wildfire. The Cerro Grande prescribed fire in Bandelier, New Mexico of May 2000 is an example of a prescribed fire that got out of control.

Review some of the findings of the Fire Investigative Team who were authorized to investigate the break-downs in the Burn Plan of the Cerro Grande fire. Based on these findings and on what you know about Burn Plans, give your recommendations of what you think could have been done to prevent the prescribed fire from becoming a wildfire.

Coordination

–There were different prescribed fire complexity rating systems being used by different agencies.

–The State of New Mexico and U.S. Forest Service did not have an agreement with Bandelier National Monument to allow prescribed fire on those properties.

–Bandelier National Monument personnel did not receive or solicit comments from all cooperating agencies in the planning process.

–The Burn Plan was not substantively reviewed before it was approved by the agency Superintendent.

Prescribed Fire

Investigation

Wind and Weather

–Moderate drought existed in northern New Mexico and surrounding regions from fall of 1999 through the spring of 2000 and was expected to continue.

–A spot weather forecast was issued at 12:20 A.M. Prescribed fire ignition was at 7:30 A.M. Weather observations were taken up to 11:00 A.M. No further weather observations were taken until 5:35 P.M.

–At times fire management personnel did not have a current spot weather forecast because the burn boss at the incident had set up no regular schedule for spot forecasts.

Backfire and Headfire

–The area for the Burn Plan had wide elevation variations, and varying slope aspects.

–There were five different types of plant fuels, each requiring differing conditions for prescribed burn.

Hand Line

–There was no hand line along the boundary of an adjacent landowner (Baca Ranch).

–In the event of a wildfire, contingency resources (extra fire personnel) were not ordered and placed on standby prior to starting the prescribed fire.

–After the fire, contingency resources that were ordered arrived late.

12 Wildland/Urban Interface

CONCEPT
Land management issues arise in areas of a wildland/urban interface. Some of these issues can begin to be addressed using conflict resolution techniques.

OBJECTIVE
Students will be able to explain a wildland/urban interface and describe the problems and stakeholders involved in issues related to areas of wildland/urban interface.

METHOD
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet

DURATION
1 – 2 class sessions

Procedure

1. Ask the students to read the *Wildland/Urban Interface* handout.

2. Discuss the issues surrounding wildland/urban interface including: prescribed burns, wildlife corridors, Native American sacred grounds and non-native plants.

3. Ask students to read the scenario on their *12–Student Investigation Worksheet*. Have them answer the questions using their own perspective of the problems and issues.

4. Have students present their answers.

5. Discuss with the students:

–The many stakeholders involved when dealing with Santa Monica Mountains environmental issues.

–The strategies for conflict resolution involving the stakeholders.

–The issues surrounding prescribed burns such as the one in Bandelier, New Mexico.

Video Connections

Oakland Firestorm

Extensions

Assign groups to choose a stakeholder to represent. Groups discuss their point of view from that of their stakeholder. Share their responses to the issue with the class.

Key Words

Issue	Landscaping	Precaution
Risk	Stakeholder	Strategy
Values	Wildfire	Wildland/Urban Interface

12

Wildland/Urban Interface

Conflict Resolution

When driving through the Santa Monica Mountains, whether across the famed Mulholland Highway or through one of the canyon passes, such as Topanga or Malibu Canyons, it is evident that open space is shared with people. When wildland areas, such as valleys and hillsides are shared with urban structures, such as residences and businesses, they are known as a **wildland/urban interface**.

When fires occur near wildland/urban interfaces, National Park Service Fire Managers must put their efforts into protecting life and property first, before wildlands. Homes in an interface threaten wildlands. One home not properly protected can endanger an entire community. Also, in areas of wildland /urban interface, property owners sometimes oppose the use of prescribed fires. Prescribed fires reduce fuel buildup, while reducing the threat of a hotter, more damaging fire. People living in, or planning to build in, wildland/urban interface areas have a responsibility to their neighbors and the environment. They must follow certain precautions to ensure safety: choose a fire-safe location, design and build fire-resistant structures, and finally, practice fire-safe landscaping and maintenance.

Managing lands in and around wildland/urban interfaces is a challenge. When management issues or environmental problems arise, such as the use of prescribed burns, many "stakeholders" can influence the decisions, especially in the Santa Monica Mountains. **Stakeholders** are those people who have a direct or indirect interest in the area. When addressing management decisions with stakeholders, some guidelines for beginning to address and resolve conflicts are listed on the next page.

12

Wildland/Urban Interface

Look at the problems.

Ask "What is at risk?" Dealing with environmental problems usually involves the interaction of humans and the environment, and the threat or risk associated with that interaction.

Example: Fuel buildup that could result in highly damaging fire puts human lives and homes at risk.

Identify the issues.

This involves the problem or its solution, for which there may be differing beliefs and values. Usually this is when two or more parties disagree. The issue is in the form of a question: "Should… or…?"

Example: Should Land Managers do prescribed burns or allow dead chaparral to build up?

Identify all the stakeholders and their positions.

These are the individuals or groups involved and the positions on which they stand. Their positions are determined by the value or relative worth they place on something: aesthetic, ecological, economical, cultural, social, recreational, scientific, religious, political, etc.

Example: Native Plant Societies have an ecological interest in the land and support prescribed fires.

Address solutions.

Using all the above, begin to look at strategies to resolve the issues.

12

Student Worksheet

Wildland/Urban Interface
Investigation

Conflict Resolution

Read the following scenario and answer the questions on the next page.

Fire has always been a natural component in the Santa Monica Mountains. Chaparral, the dominant vegetation, is the most flammable type of vegetation found in the United States. One chaparral plant, *Ceanothus*, has leaves that are coated with flammable resins and the seeds require intense heat for germination. Over time chaparral plants become less productive. Fire replaces older plants with younger ones creating a healthier ecosystem by thinning the plant life, renewing soil, cracking seed-casings, and supporting wildlife.

An increasing number of people have homes and businesses in the Santa Monica Mountains. As a result, fires that once burned as part of a natural process are now considered a threat. Because of the threat to homeowners and businesses, any fires that erupt are extinguished promptly. This causes fire-starved vegetation to grow more dense and more likely to burn at a high intensity in the event of a wildfire.

Dead and dying plants add fuel to any fire, making fires hotter and more destructive. Land management agencies want to use *prescribed fire*—the intentional igniting of a fire by trained specialists with the intent to confine it to a certain area. These fires would remove dead vegetation, and other organic debris, that decays very slowly in a dry environment, reducing the chance of high intensity wildfires.

One conflict that arises is the use of prescribed fire near homes. Many people are concerned that any fire is a threat and that controlled burns can not only destroy the aesthetic beauty of the area, but also decrease the air quality.

12

Student Worksheet

cont.

Wildland/Urban Interface

Investigation

1. What do you think is the main problem?

2. What do you think is the issue?

3. Who do you think the stakeholders are and what are their positions?

4. What do you think might be some strategies to resolve the issue?

Wildfire & the Media

CONCEPT
The media plays an important role in how a wildfire is perceived and how public opinion is formed.

OBJECTIVE
Students will be able to:
–identify words that sensationalize
–rewrite statements using facts
–explain the importance of accurate information

METHOD
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet

DURATION
1 – 2 class sessions

Procedure

1. Ask the students to read the *Wildfire & the Media* handout.

2. Discuss the issues surrounding the media and the reporting of wildfires. Discuss the difference between sensationalism and fact.

3. Ask students to read through the sample paragraphs on the *13–Student Investigation Worksheet* and complete Part A.

4. Have students present their answers.

5. Have students replace their underlined words and sentences with more fact-based words and phrases, completing Part B.

6. Have students present their rewritten statements.

7. Have students complete Part C.

8. Have students present their answers.

9. Discuss the answers with the students.

Extensions

Have students research articles about a recent fire. Have them review the information reported and compare how much of the information was sensationalized and how much was fact.

Key Words

Sensationalism

Wildfire & the Media

Sensationalism Vs. Facts

Fires Burn Out of Control! Headlines such as this cause public concern, excite emotions and make news to sell. In highly tense situations, burning wildfires provide great stories filled with emotion and drama. All this, combined with visions of flames and smoke, guarantees a highly sensational story.

The media has an important duty to inform the public about key events and the responsibility to report the events accurately. Often, stories on wildfires focus on the emotion of the moment, including interviews with weary fire-fighters or concerned people on the street, rather than on the scientific aspects of what is happening. Information about fire ecology or fire history is not usually covered until much later. As a result, visions of burning, home-covered hills, inciting public emotions, only intensify the situation.

Highly intensified events, such as wildfires, also contribute to the formation of public opinion, and may influence policy. In May 2000, a prescribed fire in Bandelier National Monument, New Mexico, got out of control and became a highly publicized event. Normally, this fire would not have drawn much media attention; however, homes burned, and the fire threatened a nuclear weapons facility within the Los Alamos National Laboratory. As a result, the practice of prescribed burns went under close scrutiny, and all scheduled prescribed burns were put on hold throughout the country.

In 1988, fires burned throughout Yellowstone National Park. These fires were also highly publicized and sensationalized. As a result, the public formed opinions about how the land managing agencies responded to the fires, and therefore, forced a review of government policy.

When all is said and done, some of the information reported by the media is often incorrect and/or sensationalized. In the formation of public opinion and policy, an accurately informed public only serves to help promote a better understanding of fire ecology. Facts on how fire works and the results of fire on the ecosystem provide valuable information.

13

Student Worksheet

Wildfire & the Media

Investigation

A. Read the following samples of wildfire reporting by the media. Underline the words or sentences that you feel help to sensationalize the story, or sway the facts.

1. "Racing against a predicted return of the blistering winds that have made kindling of Southern California's rugged terrain, thousands of bone-tired firefighters launched an all-out air and ground assault on fires that continued to rage in the canyons."

2. "Winds. Dense brush. Limited resources. These factors conspired to create blazes of unstoppable fury. The enormity of it all, the unrelenting destructive power, is what set these infernos apart. When flames ate homes in seconds, when firefighters were forced to surrender entire blocks, when mountainsides were seared to nothing, it only got worse."

B. Rewrite one of the statements above, replacing the words that sensationalize with more fact-based words.

13

Wildfire & the Media
Investigation

C. Using complete sentences, answer the following questions.

1. In what way were the media reports more exciting than your rewritten version? _____

2. Why do you think news programs and print media tend to sensationalize their reports? _____

3. In what way might the media sway public opinion of wildland fire?

4. Based on what you know about the ecosystem of the Santa Monica Mountains and fire ecology, what information might you include if you were reporting on a wildland fire? _____

Santa Monica Mountains National Recreation Area–Your Park

CONCEPT
Santa Monica Mountains National Recreation Area is a unique park that needs to be cared for and preserved for generations to come.

OBJECTIVE
Students will be able to describe the value of the Santa Monica Mountains, describe ways people impact the environment, and ways they can help to lessen that impact.

METHOD
Have students work in groups to read through their handout and answer the questions on their investigation worksheet.

MATERIALS
–Student Handout
–Student Investigation Worksheet

DURATION
1 – 2 class sessions

Procedure

1. Ask the students to read the *Santa Monica Mountains National Recreation Area – Your Park* handout.

2. Discuss with the students the purpose set out by Congress for the formation of Santa Monica Mountains National Recreation Area and how it affects them.

3. Ask students to complete the questions on the *14–Student Investigation Worksheet.*

4. Have students present their answers.

5. Discuss the answers with the students.

14

Student Handout

Santa Monica Mountains National Recreation Area–Your Park

Stewardship of the Land

The Santa Monica Mountains rise above Los Angeles and curve northward, along the coast. This beautiful land contains resources of outstanding geological, biological, archeological, historical, sociological, recreational, and scenic value. Nowhere else in the National Park System, or even within the United States, exist such significant components of a Mediterranean biome. The climate, soils, plant life, wildlife, and human culture all combine to form a unique landscape.

Congress recognized these special values in 1978 and established Santa Monica Mountains National Recreation Area to be managed in a manner which will preserve and enhance its scenic, natural, and historical setting and its public health value as an airshed for the Southern California metropolitan area while providing for the recreational and educational needs of the visiting public.

As part of a unique partnership, our mountain parks within the Recreation Area, are managed cooperatively by federal, state, county and city parks with private camps, homeowners and land planning agencies working together in an effort to preserve, protect, and wisely use the land.

The relationship between the natural world of the Santa Monica Mountains and people is not one-sided. People are a dynamic part of the cycles and changes in the mountains, whether through the building of roads and homes, the planting of non-native plants that affect the fire-dependent chaparral plant community, or garbage left behind on trails, and picnic areas. People have a profound impact.

You have had the opportunity to become informed about this unique Mediterranean landscape, to perform labs that resource managers conduct, to learn the land management issues of fire ecology and the responsibilities that surround it.

These parks are your parks. As public lands, they are owned by the people. What can you do to help them remain in their natural state and ensure that they will remain so for generations to come?

14

Student Worksheet

Santa Monica Mountains National Recreation Area–Your Park

Investigation

Using complete sentences, answer the following questions.

1. Describe some of what you have learned about the Santa Monica Mountains and fire ecology.

2. In what way do you, personally, have an impact on your environment?

3. Based on what you have learned about the Santa Monica Mountains and fire ecology, what can you and others do to ensure the preservation of the land for generations to come?

15 Glossary of Terms

1 – Biomes of the World

Adaptation adjustment to environmental conditions

Biome major ecological community

Biosphere part of the world in which life exists

Biota plants and animals of a region

Coniferous evergreen tree having cones

Deciduous refers to seasonal falling of leaves from trees

Geology study of the history of earth's surface and rocks

Latitude distance north or south of the equator

Nocturnal nighttime

Organic living or having once lived (all organic material contains carbon)

Terrestrial relating to the land surface of the earth

2 – Mediterranean Biome

Aromatic having a strong smell (for example, some plant oils)

Chaparral shrubby vegetation in Southern California adapted to hot, dry summers

Continent one of 7 great divisions of land on earth (for example, North America)

Degraded wearing down of the land by erosion

Dormant inactive

Drought prolonged period of dryness or lack of precipitation

Flammable capable of readily igniting or catching fire

Marine relating to the sea

Precipitation condensation from vapor (gas) that falls as rain or snow

Regeneration certain plants and animals re-grow parts due to loss or injury

15 Supplemental Information

3 – Closer to Home

Aspect facing a particular direction

Ecosystem group of plant and/or animal communities that functions as a unit in a specific habitat

Elevation height above sea level

Erosion wearing away by wind and/or water

Flora plants

Metropolitan referring to a large city

Nutrient food material used to promote growth and repair

Proximity nearness

Species organisms capable of interbreeding

4 – Ingredients of a Fire

Carbohydrate formed through photosynthesis by green plants, and containing the elements carbon,hydrogen, and oxygen (sugars and starches)

Combustion chemical process of oxidation, accompanied by light and heat

Dehydrate to remove water

Foehn warm, dry wind (example: Santa Ana winds in Southern California)

Fuel material consumed by burning and generating heat

Oxidation to combine with oxygen

Volatile readily able to vaporize (become a gas)

5 – Conditions for a Fire

Humidity degree of wetness

Slope ground that forms an incline

Specific heat ratio of quantity of heat required to raise the temperature of a substance one degree, to that required to raise the temperature of an equal mass of water one degree

15 Supplemental Information

6 – Fire & Plants

Convection the transfer of heat by movement of air, gas or heated liquid

Density mass per unit volume

Dormancy inactivity

Dormant period of inactivity

Fertility capable of reproducing

Germinate to begin to grow and develop

Predestined something that will happen

Species organisms capable of interbreeding

7 – Fire Behavior & Weather

Atmospheric mass of air surrounding the earth

Climate the average course of weather in a specific area over a period of years

Cumulus clouds with flat base, piled up like a mountain

Dust devil small whirlwind containing dust

Protocol a plan

Relative humidity ratio of amount of moisture in the air, compared to amount possible

Stratus cloud of great horizontal extension at low altitude

Water vapor water in a gaseous form

Weather day by day conditions of the atmosphere

8 – Fire & Soil

Acid pH less than 7, containing (OH)-

Alkaline having a pH more than 7, base or basic

Annual plant completing life cycle in one year

Bedrock solid rock underlying the surface material, such as soil

Clay earthy material composed of fine particles of minerals

Germination beginning to develop

Horizon one of distinct layers of soil in a vertical section

Supplemental Information

Hydroxyl chemical group made up of (OH)-

Ion electrically charged atom

Loam soil made up of a mix of clay, silt and sand

Organic things that once lived or are living; contains carbon

Organism any living thing

Parent rock material from which something is derived

Percolate to diffuse through

pH degree of hydrogen ion concentration

Sand loose, granular material resulting from breakdown of rocks

Silt loose sedimentary material containing small rock particles

Terrain physical features of a piece of land

Topsoil surface soil in which plants have their roots

9 – Fire & Water

Algae aquatic plants such as seaweed, with chlorophyll

Aquatic taking place in water

Fauna animal life

Flora plant life

Groundwater water within the earth that supplies wells/springs

Habitat place where life exists

Hydrology study of distribution of and quality of water

Nitrate a salt of nitric acid, source of nitrogen for plants

Plankton floating, minute animal and plant life

Sediment matter that settles to the bottom of a liquid

Spawning to lay or fertilize eggs in water

Terrain physical features of a tract of land

Topography the relative position and elevation of land forms

Turbidity clarity of water

Watershed region draining to a body of water

Supplemental Information

11 – Prescribed Fire

Backfire a fire started to clear an area in advance of a moving fire

Crew a group of people held together by a common purpose

Ditch a long, narrow excavation dug in the earth

Drought a prolonged period of dryness

Firebreak a barrier of cleared land intended to check an advancing fire

Forecast to predict based on observations

Hand line line of cleared vegetation made by crews to contain fire to sides of the site

Headfire a prescribed fire at the top of a slope along a firebreak

Prescribed fire a planned fire in a designated area

Smoldering to burn without flames, often causing much smoke

Wind speed how fast the wind is moving

12 – Wildland/Urban Interface

Issue a matter that is in dispute between two parties

Landscaping to modify plant cover

Precaution care taken in advance

Risk to expose to danger

Stakeholder person who has an interest in a procedure

Strategy a careful plan

Values principles that are valuable or desirable

Wildfire a sweeping and destructive fire

Wildland/urban interface boundary between populated area and forest/grassland

13 – Wildfire & the Media

Sensationalism process used in oral or written communication to heighten excitement about a specific subject

14 – Santa Monica Mountains National Recreation Area – Your Park

Airshed air within a given geographic area

Notes