BURNING ISSUES

Interactive Media Science Project
Florida State University
Tallahassee, Florida

United States Department of Interior
Bureau of Land Management
Washington, D.C.

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BURNING ISSUES **Development Team**

Co-Directors: George O. Dawson and David E. LaHart
Art Director: Keith Roberson
Evaluation Specialists: George Dawson, Robert Hebert, and David LaHart
Teacher and Student Guide Writer/Editors: Carrie Hamby and Julie Lambert Holmquist
Graphic Designer: Gail Rubini
FSU Students: Sherril Gross, Lee Shyu, Miles Tilman, Beth Wing
Interactive Courseware Developers: George O. Dawson, David E. LaHart, and Keith Roberson
Music and Sound Effects: Vinetree Studios, Boise, Idaho, and Scott Groeniger, Florida State University, Tallahassee, FLorida
Photo Specialists: Robert Hebert and Julie Lambert Holmquist
Post Production: Scott Groeniger, Florida State University and Seidler Productions, Tallahassee, Florida
QTVR Specialist: Philip Shepard
Programming: Eric Tamplin
Script Writers: Robyn Allers and Beth Cavano
Field Guide and Photo Glossary Writers: Robert Hebert and Julie Lambert Holmquist
Video Effects: North by Northwest Productions
Video Production: Beth Cavano, Cavano Productions, Tallahassee, Florida; Doug Copsey, Copsey Productions, Boise, Idaho; Bob Kambitsch, Bureau of Land Management, Boise, Idaho; Norman Nelson, Echo Films, Boise, Idaho.

BURNING ISSUES **Technical Advisors**

Patrick T. Durland, National BLM Office of Fire and Aviation, Project Technical Coordinator
Robert G. Clark, Bureau of Land Management, Boise, Idaho
Dan Grafton, Matanuska Susitna Borough, Wasilla, Alaska
Sharon Herman, Tall Timbers Research Station, Tallahassee, Florida
Bob Huggins, National Park Service, Washington, D.C.
Bill Leenhouts, U.S. Fish & Wildlife Service, National Interagency Fire Center, Boise, Idaho
Bob Lehman, U.S. Geological Survey, Boise, Idaho
Melanie Miller, Bureau of Land Management Boise, Idaho
Chris Olson, Alaska Division of Forestry, Fairbanks, Alaska
Cathy Rezabeck, U.S. Fish and Wildlife Service, Anchorage, Alaska
Jim Roessler, Bureau of Land Management, Fairbanks, Alaska
Dale Wade, U.S. Forest Service, Washington, D.C.
Jim Walton, Bush Pilot, Anchorage, Alaska
Larry Vanderlinden, U.S. Fish and Wildlife Service, Anchorage, Alaska

Flames **Development Team**

Flames has been modified for use with ***BURNING ISSUES***.
Flames is published by The National Interagency Fire Center, National Fire and Aviation Training Support Group, 3833 S. Development Avenue, Boise, Idaho 83705-5354
Project Leader: LaMar St. John
Training Specialist: Frank Boden
Geographic Information Systems Specialist: Ted Tower
Fire Management Specialists: Phil Range, Al Carriere

Computer Programming: Tom Grimes, President, EverGreen Wildfire Systems, Ltd., Ottawa, Ontario, Canada
Adaption of *Flames* for use on Macintosh computers by Warwick Tobin, Imager Software, Tallahassee, Florida

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This production has involved staff throughout the U.S. Department of the Interior and the U.S. Department of Agriculture. To those many folks who gave generously of their time and expertise, we give our sincere thanks and best wishes.

Actors
Nick Garcia as Leo Badger
Doug Copsey as Pat Deland
Cindy Williams as Dispatcher
Latricia Allen as Flora Good-Burns
R.K. Williams as Rollin Hill
Andrew Cappelletti as Drew Houseman
Dixie Partington as Bernie L. Moore
Dan Peterson as Smokejumper

Voices
Hannah Mahler as Ms. Dawson, homeowner
Haitao Xu as Ms. Chin, homeowner
Pedro Turina as Mr. Lopez, homeowner
Anne Biske as fire research facility receptionist
Julie Sear, Charles Carpenter, and Jason Gilley as fire facility voices
George Dawson as state department of transportation planner
David LaHart as Bureau of Land Management ecologist
Nancy Davis as fire department dispatcher
Robert Hebert as Robert's Pizza owner
Carole Whiteleather as voice of National Interagency Fire Center
Rachel Jacobus, Laura Minskoff, Paul Munson, and Andrew Oppenheimer as Kids' Voices

Field Testers:
Darryl Gerber, South Jr. High School, Boise, Idaho
Joe Brock and Robert Hebert, Rosenwald Middle School, Panama City, Florida
John Caldwell, Crescent Elk School, Crescent City, California
Valerie LaHart, Cobb Middle School, Tallahassee, Florida

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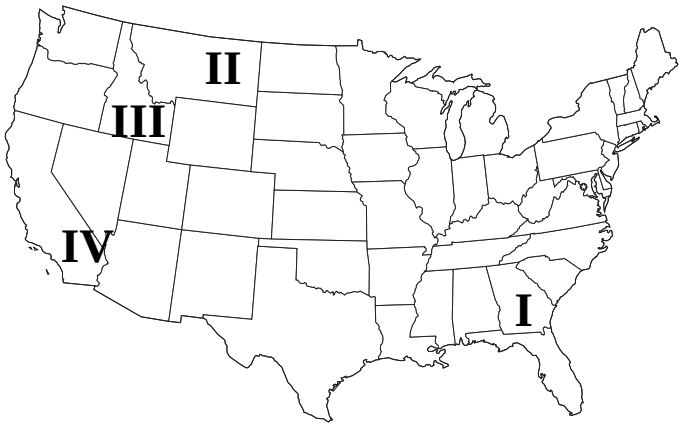


Introduction to *BURNING ISSUES*

BURNING ISSUES is an interactive multimedia program that explores fires that occur on wildlands. Fire is a ecological component of many ecosystems. People have manipulated fire for various reasons over the course of human history. Fires, deliberately set by Native Americans, created the landscapes early European settlers first encountered in North America. Settlers continued to use fire to reshape landscapes. To preserve these historic landscapes, today's land managers must restore or maintain historic fire regimes. Fire can also be a tool for managing natural resources. However, there are times and places where fire suppression is the best course of action. ***BURNING ISSUES*** provides opportunities to learn about the role of fire in ecosystems and how it can be managed.

The longleaf pine-wire grass community is an example of an ecosystem that is fire dependent. The plants and animals that live here are adapted to periodic fire. Wire grass produces few viable seeds unless it is burned in the late spring or early summer. Suppressing fires in such an ecosystem allows dead plant material and dense understory plants to build up, providing fuel that allows fires to burn hotter and longer than normal. After years of suppression, woodland fires can be devastating.

Managers use prescribed fires to restore ecosystems to a natural fire regime. Unlike wildfires, prescribed fires are conducted only when conditions such as fuel moisture, humidity and wind speed are just right. That way, the intensity and location of the fires can be controlled. These carefully planned fires are also used to remove diseased trees or to selectively maintain certain plant species, such as longleaf pine. The *Fire Power EcoVenture* focuses on prescribed burns and considerations in planning them, including their positive and negative effects.

A naturally ignited fire (as well as arson fires) presents land managers with a choice: suppress them or let them burn. The decision is based on many considerations, including conforming with environmental laws (ie. Clean Air Act), the need to protect certain habitats, human life or property, the presence of important archaeological or historic sites; and whether the historic fire regime has previously been disrupted. Fires have generally been suppressed over the past 50 to 100 years allowing natural fuels to increase. The result is that fires today are more frequent, burn more intensely and are more dangerous. Land managers need to carefully weigh their decision of suppressing fires now against the future probability of an increased fire problem due to the effects of suppression actions. The *Fire Suppression EcoVenture* provides an opportunity to explore techniques to manage and suppress fires.

A disrupted fire regime has far-reaching effects on an ecosystem. Noxious weeds can invade a burned area and displace the native plants affecting the health of entire ecosystems. These interrelationships are explored in the *Golden Eagle EcoVentur*e.

In many places, people have built homes and even whole communities in ecosystems that burn regularly, placing themselves and their property at risk. They also put natural resources at risk from human-caused fires set by burning debris or using equipment in fire-prone areas. The area where wildlands and human activities come together is called the urban-wildland interface, or the I-Zone. In the *I-Zone EcoVenture*, you will learn about building and landscaping practices that can greatly reduce the risk of fire damage to homes.

The challenge for land managers is to balance the needs of people and ecosystems. Fire is often part of the equation. Fire management is a complex issue with many factors. The *Flames EcoVenture* simulates a real fire management problem, where decisions have to be made and made quickly. Fuel type, moisture, winds, the natural fire cycle, available fire suppression resources, risks, and costs must all be considered. *Flames* provides the opportunity to apply what has been learned in previous *EcoVentures*. Many solutions are possible; there is no one right answer.

Maintaining natural ecosystems in a sustainable state is critical to all life. Fire managed appropriately, can be a positive factor in ecosystem health. Changes in lifestyles and public attitudes are also important. ***Burning Issues*** is a tool for making people aware of the problems and issues associated with wildland fires and what they can do to make a difference.

For more information about wildland fires and fire ecology, visit the National Interagency Fire Center (www.nifc.gov) and BLM's ENVIRONMENTAL EDUCATION (www.blm.gov/education/index.html) websites.

WELCOME TO **BURNING ISSUES**

Scientists often work in the field observing and collecting data. Even in this day of notebook computers, paper and pencil are commonly used to take notes—in a field notebook. We hope that you will use these pages as your Field Notebook. The ***BURNING ISSUES*** CD-ROM contains a wealth of information about fire ecology, fire management, and large, diverse ecosystems. Use your Field Notebook to help you find your way around the CD and to record your data, observations and thoughts about ***BURNING ISSUES***. Before you start an ***EcoVenture***, you should print the pages you need from the Field Notebook and use it as your guide for the on-line activity.

Each interactive activity or ***EcoVenture*** asks you to collect data or take notes on the work (and play!) you do at the site. You should record that data, perform calculations and take notes in the spaces provided in your Field Notebook. Don't forget to answer the questions about each ***EcoVenture.*** You can work on the ***EcoVentures*** in any order. Your teacher may assign your team to work on a particular ***EcoVenture*** and report your findings to the class.

The information you gather at each ***EcoVenture*** site will help you devise an action plan for responding to a wildfire when you are qualified to enter the Incident Command Center. All four ***EcoVentures*** should be completed and the secret symbol or picture properly placed before you can enter the Incident Command Center to complete the final ***EcoVenture, Flames***.

As you begin the program you will be asked to choose a site to start your investigations. The introductory movie describes the different ecosystems at each site and the issues you will investigate. Each site will have one or more consultants from the National Interagency Fire Center (NIFC) in Boise, Idaho to help you learn about the site and how wildland fire affects the ecosystem.

At each site you can:

- watch an overview movie explaining the research being conducted at that site,
- take an EcoTour and become familiar with the plants and animals found in the ecosystem,
- zoom into the site by using the shift key, back out of the site using the control key on either a Mac or a Windows machine,
- visit the Resource Area to use the visual glossary to check words that are not familiar,
- use the Field Guides to identify common organisms,
- access consultants that may help answer some of your questions.

You will start at NIFC and return to NIFC after each ***EcoVenture***. Good Luck!

I. Southern Pine
FIRE POWER

Teacher Note: *This activity teaches students about prescribed burns intentionally started by resource managers after careful planning. The setting is the longleaf pine community of the Southeastern United States. However, prescribed burns can play a role in maintaining healthy ecosystems in many places.*

FIRE POWER EcoVenture

What You Will Do

In the Southeast region of the United States periodic fires have kept the longleaf pine-wire grass ecosystem open and park-like for hundreds of years. This ecosystem supports many threatened and endangered organisms including the red cockaded woodpecker. Scientists often prescribe fire as a tool to maintain the cycle of wildland fire in this ecosystem. In this ***EcoVenture*** you will:

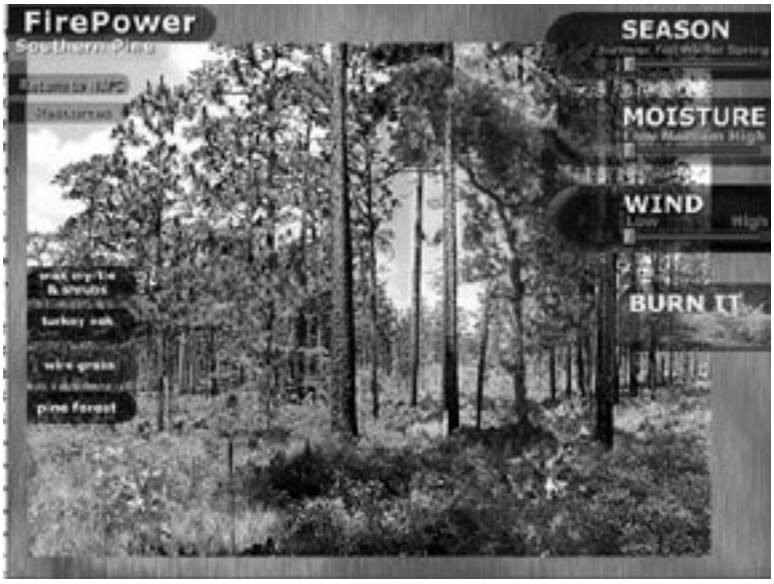
- identify the proper environmental conditions to conduct a prescribed burn,
- measure and control environmental variables in test plots,
- compare a successful burn with a burn that is not successful,
- describe some of the problems associated with prescribed burning,
- describe some of the benefits associated with prescribed burning.

Why It's Important

Many organisms have adapted to naturally occurring fires. If the natural cycle of fire is disrupted in these ecosystems by humans who suppress them, the habitat changes. Many of these organisms may not be able to live there anymore. When the natural fire regime is interrupted, scientists may recommend a prescribed fire to clear the understory, to remove fuels that may contribute to a dangerous crown fire, and to increase the fertility of the soil by releasing nutrients locked in vegetation. Prescribed fire is also used to remove vegetation that is infested with disease or insects. Some pine trees actually need fire to release the seeds stored in their cones. As people continue to build homes and businesses in areas that are maintained by the natural fire regime, prescribed fires may become a common practice to reduce the threat of dangerous wildland fires and to restore the cycle and benefits of natural fire.

Ready? Begin

If you are not familiar with the organisms that live in the Southern Pine ecosystem, take the **EcoTour** and check out the **Field Guide**. What plants seem to dominate the landscape? What adaptations have the plants made? What animals can you discover? How can these animals survive during a fire? To begin this ***EcoVenture,*** click on the fire in the panorama. Check with Flora Good-Burns to see if she can answer some of your questions.



Prescribed Burn Training

To begin your investigation of how fires shape this community, use the plant overlays to help you identify the kinds of plants growing here: longleaf pine, wax myrtle, turkey oak, and wiregrass. In this activity you are trying to identify the conditions that will get rid of turkey oak and wax myrtle but leave the pines and wiregrass.

You will need to go through training at the Tall Timbers Fire Ecology Research Station before you prescribe a burn. When you are ready to prescribe a trial burn:

- Click and drag the slider to select the variables (season, moisture, wind) you think will produce the desired fire.
- Record your choices and the reasons for them in the table below.
- Select the "Burn It" icon to start the fire and observe the burn.
- After the burn, select "Analyze Results" for information about the burn you prescribed.
- Use the plant overlays to see the results of the prescribed burn on the vegetation.
- Describe the results of your burn in Table 1 and write a short statement in the space below.

Table 1. Prescribed Burn Data

season	moisture	wind speed

Results:

Click on "**Try Again**" to prescribe different types of fires or fires under different conditions. Record your data and observations in Table 1. Continue your trial burns until you have the desired results and are ready to recommend a Prescribed Fire Plan for this site.

Trial 1

season	moisture	wind speed

Reasons:

Encourage students to look at the field guides in the resources section to learn something about the plants involved. These response areas were designed so students can write down why they think the variables they are selecting encourage the wiregrass and pine. The objective is to burn the turkey oaks and wax myrtle and leave the pines and wiregrass.

Results:

The students should copy the results statements from the computer screens. Try to get them to write summary statements of their own.

Trial 2

season	moisture	wind speed

Reasons:

Results:

Trial 3

season	moisture	wind speed

Reasons:

Results:

If you need to conduct more trials, copy this table in your notebook and record your data there.

Now that you know the conditions necessary to eliminate turkey oaks and wax myrtles yet leave pines and wiregrass, you are ready to move to a more difficult challenge. A plot of ground needs to be cleared of turkey oaks and wax myrtle. People are living nearby and State Highway 78 is located just south of the burn plot. How will these problems affect your prescribed burn?

Prescribing a Burn

After you have explored the site and learned what the tools do, describe your Prescribed Fire Management Plan. Include the best season, moisture range, and wind speed that allow you to complete a successful burn in a longleaf pine-wiregrass ecosystem.

My Fire Management Plan:

Answers will vary but should include spring or summer burning, low fuel moisture and low wind speed.

Now, you are ready to test your Prescribed Fire Management Plan to successfully complete the burn.

Note: Do not start this activity if you have less than 25 minutes remaining in the class. Burns are randomly generated and students will have to start over if they do not finish in one sitting. Students will be given one of eight weeks of data. There are usually two days each week when the environmental conditions are correct. On one of those days the fire will cause a problem for someone living nearby or by putting smoke over the highway.

Click on “Choose a Day” and record data in Table 2. To obtain data for each day of the week, click on the fuel moisture meter to determine the fuel moisture, the sling psychrometer for relative humidity (RH), and the wind sock for wind direction and speed. Watch the videos for information on how to use a moisture meter and a sling psychrometer. The Plot Map choice will let you see who lives where. Be sure to consider the houses and roads when choosing the wind direction. Use the speed dial setting on the cell phone to call people that may be affected by the prescribed burn.

You should only burn under the following conditions:

- wind speed is under 20 kilometers per hour,
- relative humidity is between 35 and 70%,
- fuel moisture is between 12 and 20%,
- check the wind direction on the compass.

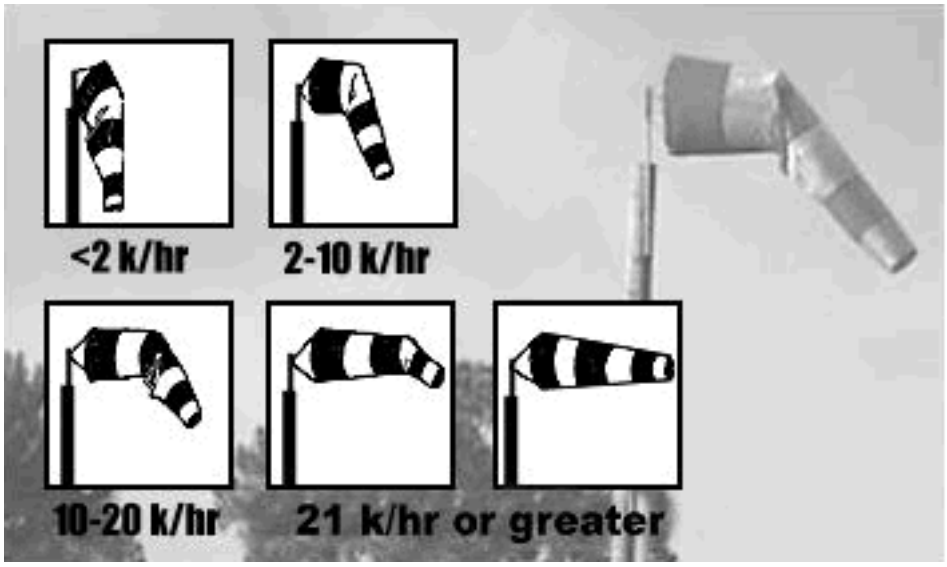


Table 2. Prescribed Burn Data
Week _____

Day	Fuel Moisture	Relative Humidity	Wind Direction
Sunday			
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			

Now that you have picked days that have good conditions for the burn, you need to complete a few tasks before beginning the burn. Check out the list of pre-burn tasks on this site. Once you have chosen the most appropriate day based on your data and responses from the people affected, record the conditions and reasons you selected the day for the prescribed burn. Light the fire! Record the results. **See if you can get it right the first time.**

Day	Fuel Moisture	Relative Humidity	Wind Speed	Wind Direction

Reasons for choosing this day:

Student answers should indicate that all the variables fall within the correct ranges.

Results :

Answers will vary based upon the variables selected but should report success or failure.

If you were not successful with your prescribed burn, keep trying until you get the results you want. Record the data from your most successful burn here.

Day	Fuel Moisture	Relative Humidity	Wind Speed	Wind Direction

Reason for choosing this day:

Answers will vary based upon the variables selected but should report success or failure.

Results :

Answers will vary based upon the variables selected but should describe the relationships among wind

speed, fuel moisture and RH.

Turn to page 33 and record your secret symbol because you will need it to enter the "Incident Command Center."

After you have completed the ***EcoVenture***, answer these questions and complete the activities.

What are some factors resource managers need to consider before conducting a prescribed burn?

Resource managers need to consider ways fire will benefit the ecosystem, whether it is safe to burn and what the costs will be compared to other treatments. Managers need to consider the wind speed and direction, fuel moisture, and relative humidity. In addition, they need to consider the people who live and work in the area. People with allergies or breathing problems should be away during the burn. The location of roads should also be considered. Smoke covered highways are very dangerous.

What happens to a longleaf pine forest when a prescribed fire is a low temperature or is too cool?

A fire that burns too coolly has little effect on the trees and shrubs as just grass and ground fuels are burned. Grasses re-grow very quickly.

What happens to a longleaf pine forest when a prescribed fire is hot?

When the hot fire stays on the ground, it burns shrubs and hardwoods (oak). If the fire reaches and spreads through the crowns of the trees, it becomes a wildfire, and can kill the pines and threaten life and property.

What are some of the benefits of prescribed burning?

It maintains the natural role of fire in the ecosystem. A prescribed burn can clear undesirable understory vegetation, reduce hazardous fuel loads, release nutrients to the soil, remove old or diseased trees, and stimulate sprouting. Prescribed fires are less expensive than many other treatments.

Describe some of the problems associated with prescribed burning.

There is a risk an escaped fire could damage natural resources and threaten people living in the area. The fire could spread to areas where it is not wanted. The fire could escape control and become a wildfire. The smoke can cause health problems and may drift across highways causing traffic accidents.

Why would managers try to prevent or exclude fire in an oak forest?

Most species of oak are not adapted to fire. If a fire started, many of the oaks would be damaged or destroyed.

What could happen to a forest where prescribed fire has not been used as a management practice?

The forest would become very prone to wildfire due to the high fuel load.

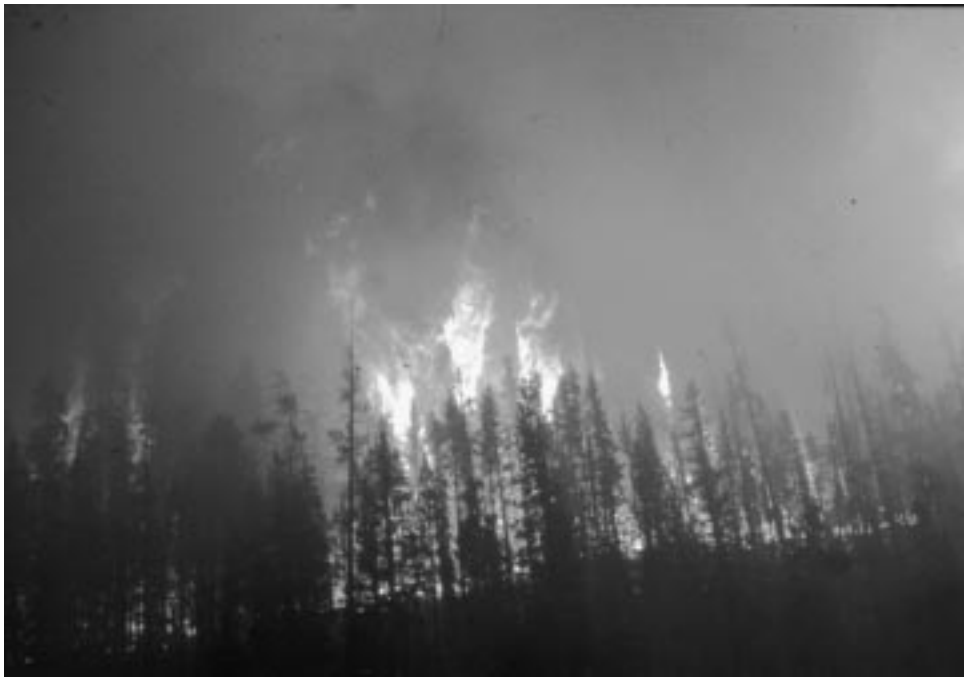
EcoChallenge

How would you design a plant that was fireproof? Build a model and share it with your team or the class. Do your classmates agree that it could survive a wildland fire?

Research a large fire that has occurred in the United States. Record information on the natural fire regime of the area, the cause of the fire, fire management practices used, and the resulting effects. Based on what you have learned from this ***EcoVenture***, how could the losses from the fire have been prevented?

Extensions

Investigate the use of fire by Native Americans in your region. In the Southeast, Native Americans burned the longleaf pine-wiregrass ecosystem to increase the diversity of game animals and to reduce hiding places for enemies near their settlements. Make a poster display showing other uses of fire by Native Americans.



II. Pondersosa Pine
FIRE SUPPRESSION

Teacher Note: *This activity gives students an opportunity to explore techniques to manage and suppress fires. The setting is in a ponderosa pine forest, but the techniques apply to fire suppression anywhere.*

FIRE SUPPRESSION EcoVenture

What You Will Do

In this ***EcoVenture***, you will learn the different ways fire management specialists can control or suppress wildland fires. As part of your investigation, you will:

- list the three components of the fire triangle,
- explain the fire triangle,
- describe how fire management and fire suppression differ,
- explain the pros and cons of using air tankers and helicopters in fire management,
- compare different methods of wildland fire suppression,
- learn about public health issues associated with wildland fires,
- identify ways a site can be rehabilitated after a wildland fire is extinguished,
- explain what happens when the natural fire regime is altered in this community, and
- describe careers associated with wildland fire management.

Why It's Important

This ***EcoVenture*** takes place in a ponderosa pine community within a national forest. For the last 50 years, the fire management policy has been to suppress and control all fires as soon as possible, allowing ground fuels to grow to dangerous levels. This situation allows a wildland fire to reach and move through the crowns of the ponderosa pines killing these trees, threatening life and property and the ecological systems of the area. Because the natural fire regime has been interrupted, this wildland fire threatens the ecosystem, human structures, and possibly human lives. It must be suppressed.

Ready? Begin

If you do not know the plants and animals in the ponderosa pine ecosystem take the **EcoTour** or check out the **Field Guide**. What plants seem to dominate the landscape? What adaptations do they have? What animals are commonly found in this ecosystem? To begin this ***EcoVenture***, click on the fire in the panorama. Check with consultant Pat Deland to see if he can answer some of your questions.

Fire Suppression - People and Equipment

To learn more about the roles of the fire suppression team members, click on the hotshot crew, smokejumper, and incident commander. Learn about the qualifications of the fire suppression team members at the help wanted sign. Click on the equipment to learn how it can be used.

There are many men and women involved in fighting wildland fires. This ***EcoVenture*** introduces you to some of them, the techniques they use to suppress fires, and the strategies used to support firefighters in the field. Complete the table by using information from **Fire Suppression.** Include information about the hazards of each job and/or the potential environmental impacts of different suppression techniques.

Table 1

who	**role/job**
Smokejumpers	*Parachute into remote areas to suppress wildland fires. Smokejumpers have little environmental impact, but it can be dangerous for the firefighter.*
Dispatchers	*Make sure all the supplies, food, and firefighters get to the fire and documents these activities in a "log". A stressful but important job.*
Hotshot Crew	*Usually used to build firelines on the "hottest" part of the fire. A hard, dangerous, exciting and rewarding job which impacts the environment by fireline construction.*
Helicopter Crew	*Drops water on fire and delivers firefighters and supplies to remote areas. Can get to remote areas easily with little environmental impact.*
Air tanker Crew	*Drops water or retardant to slow the fire's spread. Very costly method, but doesn't do much environmental damage.*
Bulldozer Operators	*Build firebreaks or firelines to prevent the fire from spreading. Scars the land and rehabilitation is often required.*

Use the information from your data chart to answer these questions.

Describe some ways fire is suppressed from the air.

Fires can be suppressed from the air by using air tankers to drop retardant, and helicopters to drop water and/or retardant. Smokejumpers and equipment can be dropped into remote areas from airplanes.

What kind of fire would require the use of smokejumpers?

A fire in a remote area without road access would require smokejumpers instead of hotshot crews.

Why does the dispatcher keep a detailed log?

A log is required to keep track of the many decisions that must be made to coordinate the firefighting effort and to be certain all the equipment that is requested makes it to the fire when needed and then makes it back home.

Why should the use of bulldozers be limited?

Bulldozers severely impact and can damage the environment.

Explain why communication is an important part of fighting wildland fires.

For safety reasons, many decisions must be made and communication must be maintained as fire and weather conditions change.

Slurry Drop!

You and your team are responsible for dropping slurry or retardant on a fire to save the Trading Post, a national historic site. As you fly toward the fire, you must check the wind direction and choose an altitude for the drop. When you think the conditions are right for dropping slurry on the fire, push the “Drop slurry” button.

Continue the drops until the fire is stopped. Record information about the drop in Table 2.

Table 2.

Slurry Drop Data	Drop 1	Drop 2	Drop 3
Altitude			
Wind Direction			
Results of Drop			

Turn to page 33 and record your secret symbol because you will need it to enter the “Incident Command Center.”

After you have completed the *Fire Suppression EcoVenture*, answer these questions and complete the activities.

Explain the fire triangle.

Oxygen, fuel, and heat are the three elements of the fire triangle. These are required for a fire to start and burn. If one element of the triangle is removed, the fire goes out.

How do firefighters break the fire triangle?

They use use water to reduce heat. They use chemical retardants to keep the fuel from burning. They throw dirt on burning vegetation to remove oxygen and smother the flames.

What are some reasons to suppress a wildland fire?

A wildland fire should be suppressed to protect ecosystems, human lives or developments, or historical landmarks.

What are reasons **not** to suppress a wildland fire?

A wildland fire could be allowed to burn when fire is part of the natural fire regime; when burning conditions are not too extreme; and when property and lives are not threatened. Many fires can be managed by watching them burn themselves out. By letting the fire burn naturally, under the proper and planned conditions, life, property, and resources are not endangered.

What are some decisions you might have to make as the Incident Commander? Which ones would be the most difficult to make? Why?

The Incident Commander makes "command" *decisions which determine how firefighting resources are deployed and used. The most difficult decisions concern human safety issues and environmental impacts including, the protection of property and natural resources from loss or damage by wildland fire.*

EcoChallenge

Which wildland fire suppression methods are the most expensive? Which ones are the most dangerous? Rank the different methods from the most expensive to least expensive; then, rank them from the most dangerous to the least dangerous. Compare your rankings with the lists developed by other individuals or teams.

Extensions

Fire suppression is just one wildland fire management technique. Use the library or the Internet to identify at least three other methods to manage wildland fires.

III. Shrub/Steppe

Golden Eagle

Teacher Note: *This activity teaches about plant and animal populations and how they interact with each other and abiotic factors, including fire, in ecosystems. It demonstrates the detrimental effects of the introduction of exotic species. The disturbance of the natural fire regime and its influence on the biotic community will be part of this* ***EcoVenture's*** *overall theme. The setting is the Snake River Birds of Prey National Conservation Area in Idaho.*

GOLDEN EAGLE EcoVenture

What You Will Do

In this ***EcoVenture*** you will investigate the relationship between predators and their prey. You will also learn how non-native plant species affect the shrub/steppe ecosystem and the critical role wildland fire plays in this habitat. During your investigation you will:

- measure population levels of prey species (small mammals),
- create and interpret graphs showing population data,
- state a hypothesis for an ecological problem,
- explain ways environmental factors such as fire affect wildlife populations,
- create and interpret graphs showing reproduction data, and
- describe the relationship between fire and the health of this ecosystem.

Why It's Important

In many regions of the world, the natural fire regime has been disturbed by the introduction and invasion of non-native plant species. The results of this disturbance are felt throughout the food web. Scientists are still discovering the far reaching effects of habitat changes started decades ago.

Ready? Begin

If you are not familiar with the plants and animals in the shrub/steppe ecosystem, take the **EcoTour** or check out the **Field Guide**. What plants seem to dominate the landscape? What adaptations do they have? What animals are commonly found in this habitat? How are they similar? How are they different? To begin this ***EcoVenture***, click on the fire in the panorama. Check with the consultants, Rollin Hills and Leo Badger, to see if they can help answer your questions.

Producers

Identify the common plants on each plateau. You may want to consult the **Field Guide** for information on these species. Discuss the following with your team:

- How do the organisms on the Cheatgrass Plateau differ from the organisms found on the Bunchgrass Plateau?
- What would be the effects of a small fire on the vegetation in this ecosystem?
- What would it look like a year from now if a small fire occurred? A large fire?

Primary Consumers

Black-tailed jackrabbits and Townsend's ground squirrels are two of the primary consumers in the Snake River Valley. To learn more about these herbivores, check out the **Field Guide** and then measure their population density.

Black-tailed Jackrabbit

Select a month then click on the flashlight icon to begin counting the number of black-tailed jackrabbits. Look for the eyes! Your count will be the density (number of rabbits per square kilometers or n / km^2) of black-tailed jackrabbits. A square kilometer has 100 hectares. Record your data in Table 1 for each month and habitat.When you click on August, you will receive a fax with data from the Bureau of Land Management (BLM) for the remaining months of the year. BLM biologists collected the data for you. Enter the data in Table 1.

Teacher note: Students should collect data twice and calculate the average population density over the two trials. Students may also share data with other teams to get an average.

Table 1. Population density of black-tailed jackrabbits in different habitats (n/km^2).

Month	Cheatgrass site 1	Cheatgrass site 2	Cheatgrass total	Bunchgrass site 1	Bunchgrass site 2	Bunchgrass total
January	1	1	2	2	*5*	*7*
February	2	*0*	*2*	*4*	*4*	*8*
March	4	*1*	*5*	*8*	*8*	*16*
April	*2*	*4*	*6*	*9*	*9*	*18*
May	*2*	*4*	*6*	*8*	*8*	*16*
June	*0*	*0*	*0*	*4*	*5*	*9*
July*			*2*			*8*
August*			*0*			*8*
September*			*0*			*6*
October*			*1*			*7*
November*			*2*			*8*
December*			*1*			*9*
TOTAL RABBITS OBSERVED			*27*			*120*

*faxed data

This is sample data. Results will vary.

Construct a line graph that represents the information in Table 1. If you did more than one trial, graph the average population density.

Townsend's Ground Squirrel

Consult the **Field Guide** to learn more about the Townsend's ground squirrel. Trap and count Townsend's ground squirrels on both plateaus. Click on the live-trap icon to begin counting squirrels. You will be able to place ten traps in each habitat. Record the number of ground squirrels you trap each month in Table 2. The density of Townsend's ground squirrels is measured in number/hectare (n/ha). You will receive data from the Bureau of Land Management for July through December. Remember to let the squirrels go when you've finished counting them!

Teacher note: Students should collect data twice and calculate the average population density over the two trials. Students may also share data with other teams to get an average.

Table 2. Population density of Townsend's ground squirrels in different habitats (n / ha).

	Trial 1		***Trial 2***	
	Cheat grass	***Bunch grass***	***Cheat grass***	***Bunch grass***
January	*0*	*0*	*0*	*0*
February	*1*	*0*	*0*	*1*
March	*1*	*2*	*1*	*1*
April	*0*	*5*	*0*	*4*
May	*4*	*7*	*4*	*8*
June	*3*	*5*	*3*	*4*
July*	*0*	*1*	*0*	*1*
August*	*0*	*0*	*0*	*0*
September*	*0*	*0*	*0*	*0*
October*	*0*	*0*	*0*	*0*
November*	*0*	*0*	*0*	*0*
December*	*0*	*0*	*0*	*0*
TOTAL SQUIRRELS OBSERVED *faxed data	*9*	*20*	*8*	*19*

Construct a line graph that represents the data for Townsend's ground squirrels. If you did two trials, graph the average population density in each habitat.

Note: *From August to January the squirrels are underground so the number is zero.*

Now that you have measured the population density of the two major prey species, you can examine the relationship between these small mammals and the raptors that depend on them.

Raptors

The golden eagle and prairie falcon are important secondary consumers in the Snake River Valley. These raptors, or birds of prey, depend on small mammals for food. To further understand how altering the natural fire regime and the invasion of non-native plants has created ecological problems, you will observe the nesting sites of these birds for a one year period.

Golden Eagle: Gathering Data

Click on the binocular icon to observe the nesting site of a golden eagle. The nest you will observe will be highlighted once the binocular icon has been chosen. By using this tool each month, you will be able to see the stages of the bird's reproduction cycle: nest-building, egg-laying, hatchlings, brood rearing, and finally dispersal, when the immature birds fly away. Consult the **Field Guide** to learn more about the life cycle of the golden eagle. Select and observe the nest for each month, and record your findings.

Table 3. Observations of a Golden Eagle Nest by Month.

January	*not nesting*
February	*nest building*
March	*egg laying*
April	*hatchlings*
May	*brood rearing*
June	*brood rearing*
July	*dispersal*
August	*not nesting*
September	*not nesting*
October	*not nesting*
November	*not nesting*
December	*not nesting*

Prairie Falcon: Gathering Data

Click on the spotting scope icon to observe a prairie falcon nest site. The nest will be highlighted once the scope has been chosen. By using this tool each month, you will be able to see the stages of the bird's reproduction cycle: site selection, egg laying, brood rearing, and dispersal, or when the immature birds fly away. Consult the **Field Guide** to learn more about the life cycle of the prairie falcon. Select and observe the nest for each month and record your findings:

Observations of Prairie Falcon Nest

January *not nesting*

February *not nesting*

March *site selection*

April egg *laying*

May *brood rearing*

June *brood rearing*

July *dispersal*

August *not nesting*

September *not nesting*

October *not nesting*

November *not nesting*

December *not nesting*

Compare the population densities of Townsend's ground squirrels in the cheatgrass area and the bunchgrass areas.

The population densities of the ground squirrels were very different for the study areas. Both populations peaked in May at a density of of 4 squirrels per hectare for the cheatgrass area and 7 squirrels per hectare for the bunchgrass area. No animals were captured between August and January. This is the time of the year when the squirrels are in estivation (hibernation).

What can you infer about the relationship between Townsend's ground squirrels and the prairie falcon?

The reproductive cycle of the prairie falcon appears to be closely tied to the population levels of Townsend's ground squirrels. The prairie falcon's young are in the nest at the time of the peak populations of ground squirrels. This means there is usually a good supply of squirrels available to feed the young falcons. In the late summer, after the falcons leave the nest, the population of Townsend's ground squirrels decreases . The squirrels began a period of estivation at this time and the prairie falcons disperse.

Study the graphs representing the population density of black-tailed jackrabbits and the golden eagle nesting data. Work with your team to answer the following questions:

Compare the population densities of black-tailed jackrabbits in the cheatgrass area and the bunchgrass area.

The population levels of rabbits in the cheatgrass area and in the bunchgrass area showed an increase in the spring, peaking in May. The populations of both areas decreased rapidly during the summer and winter months. In May there were only 7 rabbits per square kilometer in the cheatgrass area but 16 rabbits per square kilometer in the bunchgrass area.

What can you infer about the relationship between black-tailed jackrabbits and the golden eagle?

The peak population of black-tailed jackrabbits occurred when eaglets were in the nest. About the time the eagles were ready to leave the nest, the populations of rabbits started to decrease. This may have been due to predation by eagles and other predators or due to other environmental changes.

Why are eagles and falcons seldom seen hunting over the cheatgrass?

The cheatgrass provides cover for the ground squirrels and rabbits. In the bunchgrass area the prey species are easier to find and capture. The populations are also smaller in the cheatgrass.

How does fire influence the vegetation in this area?

Wildland fires seem to encourage the growth of the non-native cheatgrass instead of the native bunchgrass. Cheatgrass is a better seed producer and it becomes more and more common because it recovers from a burn more quickly than most of the native plants.

How do you think a change in vegetation due to fire will affect the relationships between the small mammals and raptors?

If the native plants continue to be crowded out by the non-natives, such as cheatgrass, the small mammals will be more difficult for the predators to find and the population will be smaller. The predators will either have to find other prey items or move to a place where the hunting is better.

Construct a food web for the sagebrush/steppe habitat. Base the web on the information you have gathered by observing the vegetation, prey, and predators in this ecosystem. (Remember that arrows point to the next higher level in the food web. Think of it as putting food into the animal's mouth). Diagram your web in your Field Notebook.

Townsend's ground squirrels eat primarily Sandberg's bluegrass, a native bunchgrass; sagebrush; winterfat; and Russian thistle. Black-tailed jackrabbits eat native grasses and shrubs and are eaten by golden eagles and several other predators. Prairie falcons prefer ground squirrels, but will eat horned larks. Townsend's ground squirrels are a food source for golden eagles, red-tailed hawks and ferruginous hawks. Snakes, lizards, and insects are also important in raptors' diets.

Turn to page 33 and record your secret symbol because you will need it to enter the "Incident Command Center."

EcoChallenge

You are a biologist hired to eliminate cheatgrass in the Snake River Valley. Prepare a chart showing the pros and cons of different management options to control cheatgrass. Write a brief memo explaining the chart and make a recommendation for a preferred choice.

Extensions

Research a non-native or invasive species in your neighborhood. Prepare a public service announcement to present your findings to your class. Describe the species and how it was introduced into the area. Inform your classmates about impacts the species has on the ecosystem and ways they can prevent the spread of the species.

IV. Chaparral
I-ZONE

***Teacher Note**: This activity challenges students to select FIREWISE home building sites and materials. Students also infer that communities working together have a greater impact on reducing fire danger than communities that do not coordinate their efforts.*

The I-ZONE EcoVenture

What You Will Do

The area where wildlands and human activities merge is often called the urban-wildland interface or **I-Zone**. In this ***EcoVenture*** you will learn about the chaparral ecosystem and how people are moving into areas that were maintained by a natural fire regime, the **I-ZONE**. The activities involve the challenges of building and sustaining homes in areas where wildland fires occur. Some of the things you will do are:

- select a FIREWISE building site,
- construct a FIREWISE home,
- design FIREWISE landscaping around the home,
- locate your home using FIREWISE criteria, and
- create a community fire safety and prevention program.

Why It's Important

When people are living in, or moving into the **I-ZONE**, the most important fire implications are (a) humans putting themselves and their property at risk from the natural fire regime, and (b) humans putting natural resources at risk from human caused fires started by things like debris burning, equipment use, and arson.

Most homeowners don't understand the natural cycle of wildfire and don't realize they are living in an area "designed" by nature to burn. Agency fire services are not able to protect homes during wildland fires. Homeowners, community planners, fire agencies, and others must work together to reduce these risks to homeowners and fighters, and to prevent the loss of homes and structures. By working together as "partners" and using FIREWISE practices for community development , communities can survive wildland fires. Before building a home and locating a site, ask yourself, "Before the fire comes have I done everything I could to protect my home and family?"

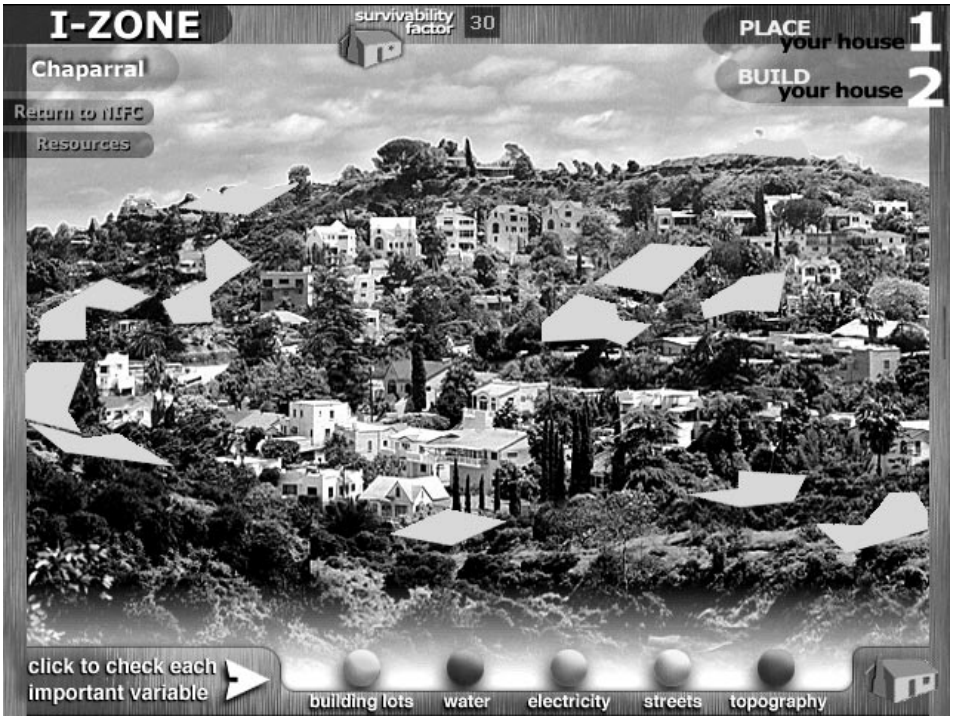
Ready? Begin

If you are not familiar with the organisms that live in the chaparral ecosystem, take the **EcoTour** and check out the **Field Guide.** What types of plants seem to dominate the landscape? What adaptations do they have? What animals can you spot? Which ones are predators and which ones are prey species? How has human habitation affected the natural landscape? What does Drew Houseman have to say about this ecosystem?

To begin this ***EcoVenture***, click on the fire in the **EcoTour**.

Explore the Neighborhood

This site is located in California's chaparral ecosystem. People have modified this area's vegetation by planting trees and other plants. Keep in mind trees are not always good indicators of the most dangerous fuels. Small diameter fuels, such as brush and grass, burn fiercely. Look at the potential building sites extending from the edge of town into the surrounding countryside. These sites extend along the street, out into the valley and up the side of the mountain. Use the overlays to see the city water supply, electrical grid, existing streets, and the topography. Spend a few minutes switching between overlays and become familiar with your new "hood."



Selecting a Building Lot

Now that you are familiar with the neighborhood, select a building lot to begin constructing your new home. The most FIREWISE sites are assigned a Survivability Factor of 30 points. Possible reasons for **not** choosing a building lot include being:

- away from the city water supply (relying on electric pumps to supply water during a fire is risky due to the possibility of the electrical supply being interrupted during this emergency),
- outside the boundaries of the local fire department and having reduced fire protection services,
- on a steep slope (fire traveling up a slope will move faster and have longer flames. A fire on a 30% slope will have flames up to twice the length and travel as much as one and a half times as fast as a fire on flat ground),
- on a road too narrow or steep for fire equipment or evacuation,
- in an area where alternate escape routes are not available,
- in a ravine or canyon which serves as a natural chimney, and
- near highly flammable landscape or wildland vegetation (flame lengths can exceed 30 meters; radiated heat can ignite combustible materials from distances 30 meters or more).

After you have picked out a possible building site, use the buttons at the bottom of the screen to look at the location of the water lines, electrical grid, streets, and the topography. It's not too late to choose another site!

Answer these questions after you have explored your neighborhood.

Why did some lots have a lower Survivability Factor than others?

Building lots located off the water line, beyond buried electrical lines, on steep slopes or at the tops of hills, on curvy roads or narrow cul-de-sacs have lower Survivability Factors. Reasons may include: water is not available if a house is not on the water line; above ground electrical lines are more susceptible to fire damage; fire travels up slopes faster; and curved roads and narrow cul-de-sacs make it difficult for the fire department to reach the house and for homeowners to evacuate to safety.

Explain why you chose "your" lot.

Answers will vary. Sites on the water line, with electric lines underground, on flat slopes, and in easily accessible areas have the highest Survivability Factors.

Once you have selected your favorite lot, record the Survivability Factor in Table 1.

Building your house

Click on "Build House" to begin construction. Select materials for the house from the options provided. A more FIREWISE house will have a higher Survivability Factor. Remember to landscape the area around the house. The type of materials you choose and how you choose to landscape your house will raise or lower the factor. Keep a careful record of your choices in Table 1. You may want to rebuild another time. List some reasons you may choose to build a house with a lower Survivability Factor. By the way, if your Survivability Factor goes down, your insurance rates go up so it costs more each month to insure your house.

Use Table 1 to record points as you make building decisions. Points will be added when you make a FIREWISE decision and subtracted when you make a risky decision. Record the total Survivability Factor of your house in Table 1. Forty-two is the highest possible Survivability Factor. This total should match up with the Survivability Factor on the monitor. You may rebuild your house and make changes.

Table 1. House Survivability

	Value
Record your Lot Survivability Factor	_____
Exterior of House	
(record the values and circle your choice)	
Stucco _____	
Treated Wood _____	
Vinyl _____	
Untreated Wood _____	
Put your choice and its value here	_____
Roof Survivability Factor	
(record the values and circle your choice)	
Treated Shakes _____	
Untreated Shakes _____	
Composite Shingles _____	
Tiles _____	
Put your choice and its value here	_____
Windows Survivability Factor	
(record the values and circle your choice)	
Small Plate Glass _____	
Tempered Glass _____	
Large Plate Glass _____	
Protective Shutters _____	
Put your choice and its value here	_____
Landscaping Survivability Factor	
(record the values and circle your choice)	
Swimming Pool _____	
Brush Against House _____	
Shrubs Cleared to 5 Meters _____	
Brush Cleared to 10 Meters _____	
Put your choice and its value here	_____
Total Survivability Factor	_____

After completing the **I-Zone EcoVenture**, answer these questions.

List some reasons you may choose to build a house with a lower Survivability Factor.

Possible answers include: having a different-looking house or lower cost in building the house or building on a particular site.

Explain why you made your selection of materials for building your house.

Answers should include a desire to protect the house from loss by wildland fires.

Describe some FIREWISE practices for building a house.

Use non-combustible materials to build the house, especially on the roof; prevent build-ups of fire prone landscape and wildland vegetation near the house; have a water source available (swimming pool); etc.

Describe some other ways to promote fire safety when building a house.

Choose fire-resistant, water-wise plants to landscape the yard. Do not build in a narrow canyon where heat can be concentrated. Design your home with reduced overhangs, which can trap heat. Concrete decks and patios may be used to create a barrier between the house and a fire. A slanted roof can accommodate convection of heat upward and away from the structure. Clean leaves and debris from roof gutters. Screen the chimney outlet to prevent sparks from igniting the roof or shrubs.

Use the I-Zone ***EcoTour*** and the **Field Guide** to identify fire prone vegetation. Which types of vegetation would be the best when landscaping a house in the Chaparral ecosystem? Explain your answer.

Chamise, sagebrush, and manzanita are "built to burn." These plants have leaves coated with oily material to preserve moisture. Unfortunately these oils are highly flammable during warm seasons and droughts. Western yarrow is a plant that is recommended for landscaping in this ecosystem. It is drought resistant and not very flammable.

Why is it important to immediately rehabilitate the chaparral vegetation after a fire?

Erosion from burned areas may be twenty times greater than from unburned areas. Vegetation helps prevent erosion. In the hilly areas, heavy rains can cause flooding leading to massive mudslides.

Turn to page 33 and record your secret symbol because you will need it to enter the "Incident Command Center."

EcoChallenge

Construct a diagram of your community. You may want to work with other students that live near you. Include street signs and street addresses. Show water lines and the location of water hydrants. Evacuation routs and electrical lines should be included. What fire hazards did you discover? What fuels are present? Did you find any houses with combustible roofs? Call your fire department to ask about special problems and fire hazards. Use the information to develop a community fire safety and prevention program. Log onto www.FIREWISE.org and review other community "Success Stories."

Extensions

With your parent or guardian, make a prediction of the Survivability Factor of the house in which you live. Consider its location for other natural events such as flood, earthquake, landslide, tornadoes, and hurricanes. The Survivability Factor is not calculated by insurance companies the same way for all areas of the country or for different disasters (flood, earthquakes, etc.). Ask your insurance agent how the risks are calculated for your house and area.

Entering the Incident Command Center

Write the name of the ecosystem next to the Secret Symbol that is shown when you complete an activity. The four activities are Fire Power, Fire Suppression, Golden Eagle, and I-Zone.

Southern Pine

Shrub/Steppe

Ponderosa Pine

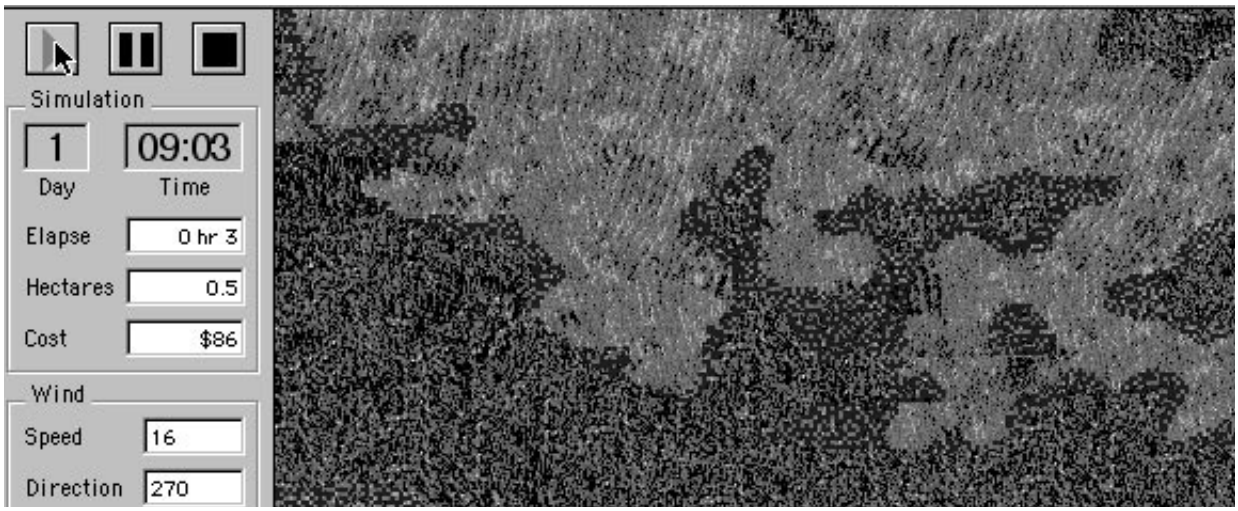
Chapparal

You must match each Secret Symbol on the keypad with the correct location to enter the Incident Command Center. Match the symbols and the doors will open. Click on the symbols until the symbol and location match.

Keypad Positions

V. EVERYWHERE **F**LAMES

Teacher Note: *This activity is based on actual simulations that are used to train firefighters. There are eight training activities.*



The FLAMES EcoVenture

What You Will Do

Congratulations! You correctly used your clues to unlock the Secret Code that allows you to enter the Incident Command Center. So far you have learned about:

- the impact of fire on the sagebrush/steppe ecosystem in the Snake River Valley,
- FIREWISE construction in fire prone locations, such as the chaparral in the I-Zone,
- techniques to manage and suppress fires in locations such as the ponderosa pine forests, and
- prescribed fires in the southern pine communities of the Southeastern United States.

In this *EcoVenture* you will practice managing wildland fires. You will be responding to:

- varying fuel types and fuel moistures,
- fires burning with low and high fire behavior conditions,
- changing wind speed and direction.

You may choose to:

- manage "less-threatening" wildland fires by reducing the impacts on the ecosystem by surrounding the fire with fire lines connected to natural barriers such as water/rock.
- reduce the costs of managing wildland fires by releasing expensive equipment when it is not needed.
- let a fire burn naturally.
- suppress "threatening" wildland fires that are burning dangerously under severe weather conditions by safely using all available air and ground fire resources.

Why It's Important

Fire management involves many decisions that must be made quickly and based on a good fire management plan. You need to consider human risks and safety, the ecological impact of wildland fire, the weather conditions, the type of fuel, fire behavior, costs, and the available fire suppression resources. You must manage and monitor rather than suppress a fire due to the location of the fire and the hazards in the area. The costs of suppressing the fire compared to letting it burn naturally is another major consideration. The best decision may be to let it burn. In this *EcoVenture*, you will practice making these important fire management decisions.

Ready? Begin

The *Flames EcoVenture* is a real challenge. This simulation is based upon the one used by the National Interagency Fire Center to train firefighters. Stick with the activities and apply what you have learned earlier. Complete the Training Exercise, then try other lessons on your own.

Training Exercise

There are eight fire lessons labeled "Fire" or "Challenge." The Challenge lessons are more difficult because they include real-life variables--things that can go wrong--including injuries to crews, disabled equipment, sudden high winds and very low humidity. These variables increase the difficulty of managing wildland fires. The "Fire 1" lesson helps you learn about the *Flames* simulation.

Double click on "Fire 1" to open it. Start a simulated wildland fire by clicking the red arrow at the top left of the *Flames* screen. You can pause or stop the simulation by using the controls at the top left. The type of fuel that is burning is shown in the "Active Fuel" window in the lower left corner of the screen. Remember that different fuels burn at different rates!

Click on the "Person" icon under "Resources" and you will learn that a 20 person hotshot crew is available. To use the crew, click on "Select." The window now displays Distance, Burn out, Accept and Cancel.

If you select "Burn out", you can start burning out the fuel. The burn out should burn toward the main fire. Before "Burn out" is selected, you need to know which direction the hotshot crew will be headed and what direction the wind is blowing. You can choose to burn out to the right or left of the hotshot crew, or not to burn out at all. The burn out must be between the fire line and the main fire. When you click on an icon for dozers, helicopters, or tanker planes, they are used and accepted in a similar way.

The "Distance" choice tells you how long a line, in meters, the crew or dozer will build. "Cancel" allows you to change the lines you have drawn, or conditions, such as "Burn out," and set the conditions again.

Use your mouse to draw a line near the fire, then click on "Accept." Until you click on "Accept," you can draw, cancel, and redraw the firebreak line that the hotshot crew will dig. When you have the line where you want it, release the mouse. When you click "Accept," you fix the position of the line to be dug by the hotshot crew. Always provide for the safety of your crews and fire resources first. Begin building a line along the back of the fire, then along the sides to pinch off the head of a fire.

Aircraft are normally used to attack the head of the fire. You may also use aircraft to knock the fire down near the resources being used to build a fire line.

If the wind changes or the fire threatens the safety of your resources, click on the "Resource" icon that is in danger, click to highlight the resource in the "Resource list" window and select the "Abort" option. You may reassign the resource to a safer location.

You may not be able to get some resources anytime you want. Go to the File menu and select "Reset." This starts the simulation over. Click on the tanker plane icon. Examine the Resource List in the window displayed. The tanker plane is listed but you must call it up by selecting "Air Tanker"

and clicking the "Callup" button. In this activity, the plane is not available until 11:34. After 11:34 you may select the tanker plane from the Resource List and draw a line on the screen where the slurry should be dropped. The line is short because the plane carries a limited amount of the slurry. When you are happy with placement of the planned drop, click on "Accept" and the line will change from white to yellow indicating that the slurry has been dropped.

If you release a resource (in the Resource List window) you cannot use it again. You have given control of this resource to Incident Commanders managing other fires. Releasing unneeded resources is a good strategy to reduce the cost of managing your fire.

The wildland fire is considered "out" when the number of hectares being burned is no longer increasing, or when the replay controls are displayed in the upper left corner of the *Flames* screen. Remember that the fire may be out but the costs may continue to increase because the crews and equipment have not been released and are still on the site.

- You can stop the simulation by pressing the pause button or stop buttons. Start over by selecting "Reset" under File at the top of the screen.
- The replay button permits you to review the burn.
- Use the forward and back arrows to review the burn scenario.

Now you are on your own. Choose another lesson and use your resources wisely. Consider the costs and hazards involved. Do you need to limit the use of heavy equipment to keep resource damage and costs down? Can you let the fire play a natural role and simply monitor it? Will you need to aggressively suppress a fire in challenging conditions?

When you are ready to end *Flames*, go to File and select Quit. This will take you back to the Incident Command Center. Click on the doorway to get back into NIFC's hallway.

Record your decisions and other data in Table 1.

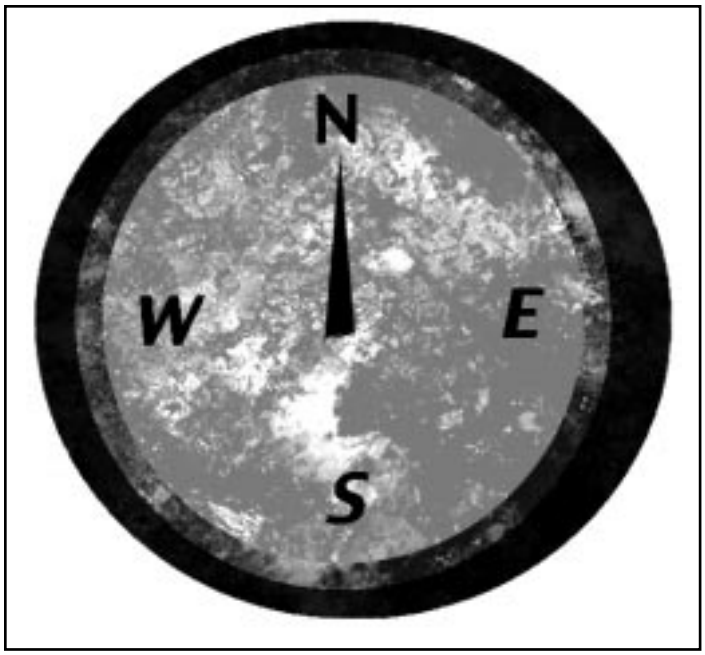


Table 1 . Fire Management Log

Team Members: _____ _____

_____ _____ _____

Fire lesson : _____

Objective Manage _____ Suppress _____

Elapsed time needed to manage the fire	Hectares burned	Cost in dollars	Wind speed	Wind direction	Fuel types	Resources used
less than 1 hour						
1 hour						
2 hours						
3 hours						
4 hours						

From the data in Table 1, construct graphs to compare the costs, hectares burned and the elapsed time for several *Flames* lessons.

Write a paragraph describing the firefighting resources used and why they were called up for each fire. What wildland fire strategy did your team use; management for the natural benefits or aggressive suppression of the fire? Support your decision to let it burn or to suppress it. Did you have injuries? How did they occur?

Answers will vary but should identify the different fire fighting resources such as hotshot crews, aircraft, dozers and justification for their use. Students should justify their decisions based on the costs, location, and safety issues.

Compare and contrast the costs and benefits of each resource.

The helicopter and air tankers are expensive firefighting resources but they can attack a fire much faster than hotshot crews, dozers or fire trucks. An air attack minimizes risk to firefighters and impacts to the environment. The dozer is cheap and builds lines fast but has a severe impact on the ecosystem. The hotshot crew is cost effective and has minimal ecosystem impacts but is slow and easily threatened by a fast moving fire.

In a *Flames* lesson of your choice, rank your choice of resources according to the fastest suppression time and lowest cost.

The dozer and hotshot crews are the best choices.

Describe a general plan to manage a wildland if your budget was limited to $5000. What equipment and human resources would you use? How would you measure success?

Release expensive resources such as aircraft; construct fire lines some distance from fire tying them to natural barriers such as water and/or rock; release crews when the fire is surrounded and let it burn within constructed fire breaks.

Your team is in charge of a "challenging" wildland fire. Use the *Flames* simulation to identify the firefighting resources you can use to suppress this fire in 2 hours (or less). Justify your choices. Were you able to provide for the safety of your people?

Strategies should include safety of dozer and hotshots; using natural fuel breaks (water/rock) when locating fire lines, use of aircraft in front of fire rather than people.

EcoChallange

Now that you have mastered the techniques for managing wildland fires, challenge other teams to manage wildland fires using the same lesson. Compare your results in terms of the amount of time the fire burned, the costs to suppress it and the safety of your crews.

Extension

Wildland fires are not unique to the North America. Use your school library, the Internet and other reference sources to learn how different countries deal with wildland fires. Compare the techniques used in other countries with the techniques you learned about in ***Burning Issues***. Prepare a poster display showing what you discovered.

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When you are ready to end *Flames*, go to File and Quit.
This will take you back to the Incident Command Center.
Click on the doorway to get back into the hallway.

Correspondence of *BURNING ISSUES* to National Science Standards Grades 5-9

Standards			
1. **Unifying Concepts & Processes** a. Systems, order, & organization b. Evidence, models, & explanation c. Change, constancy, & measurement d. Evolution & equilibrium e. Form & function	2. **Science As Inquiry** a. Abilities necessary to do scientific inquiry b. Understandings about scientific inquiry	3. **Physical Science** a. Properties of objects & materials b. Position & motion of objects c. Light, heat, electricity, & magnetism	4. **Life Science** a. Characteristics of organisms b. Life cycles of organisms c. Organisms & environments
5. **Earth & Space Science** a. Properties of earth materials b. Objects in the sky c. Changes in earth and sky	6. **Science and Technology** a. Abilities of technological design b. Understandings about science and technology c. Abilities to distinguish between natural objects and objects made by humans	7. **Science in Personal & Social Perspectives** a. Personal health b. Characteristics & changes in populations c. Types of resources d. Changes in environments e. Science & technology in local challenges	8. **History & Nature of Science**- Science as a human endeavor

BURING ISSUES EVs **National Science Education Content Standards Grades 5-9**

Activity/ Standard	1a	1b	1c	1d	1e	2a	2b	3a	3b	3c	4a	4b	4c	5a	5b	5c	6a	6b	6c	7a	7b	7c	7d	7e	8
Fire Power		√	√			√	√			√	√	√											√	√	√
I-Zone Interface		√															√	√	√		√	√	√	√	√
Golden Eagle	√	√	√	√		√	√			√	√	√					√	√					√	√	√
Fire Supression	√	√	√	√		√	√	√		√	√	√					√	√	√		√	√	√	√	√
Flames	√	√		√	√	√	√	√									√	√	√			√	√	√	√

Credits

Photo Contributions - *Individuals:*

Anderson, Loran G., Biological Sciences, Florida State University
Bailey, Demma, Martin County Schools, Environmental Studies Center
Baker, Gene, Mosquito Control, Leon County, Florida
Balls, J., Rancho Santa Ana Botanical Garden
Barrett, R. H., U.S. Fish and Wildlife Service, Bitter Lake National Wildlife Refuge
Berquist, Paul and Shirley, Arizona Sonora Desert Museum
Boden, Wayne, Bureau of Land Management, Fairbanks, Alaska
Bowers, R. and Bowers, N., Visual Resources for Ornithology, The Academy of Natural Sciences of Philadelphia
Bryan, Dana, Florida Department of Environmental Protection
Churchwell, Stacy L., Yellowstone National Park
Clarke, H., Visual Resources for Ornithology, The Academy of Natural Sciences of Philadelphia
Colo, Paul, U.S. Fish and Wildlife Service
Dawson, George, Science Education, Florida State University
desLaurlers, J., Mammal Slide Library, American Society of Mammalogists
Dodson, T., Arizona Sonora Desert Museum
Everett, P. C., Rancho Santa Ana Botanical Garden
Flood, Phillip, Florida Department of Environmental Protection
Forbes, R. B., Mammal Slide Library, American Society of Mammalogists
Fransen, Joan, Denver Botanic Gardens
Frederick, Larry W., Glacier National Park
French, Bill, U.S. Fish and Wildlife Service
Garth, Annie, U.S. Fish and Wildlife Service
Gilman, Dede, Arizona Sonora Desert Museum
Goldman, Luther C., U.S. Fish and Wildlife Service
Gorman, Jim, University of Delaware
Greer, Bill, Florida Game and Fresh Water Fish Commission
Gullickson, Dan, Bureau of Land Management, Fairbanks, Alaska
Hall, J. G., Mammal Slide Library, American Society of Mammalogists
Harris, J., Mammal Slide Library, American Society of Mammalogists
Harrison, George, U.S. Fish and Wildlife Service
Hebert, Richard, Panama City, Florida
Hebert, Robert, Science Education, Florida State University
Heitmeyer, Lawrence
Henry, C. J., U.S. Fish and Wildlife Service
Hill, Michael, Florida Game and Fresh Water Fish Commission
Hopkins, C., Rancho Santa Ana Botanical Garden
Huckaby, D. G., Mammal Slide Library, American Society of Mammalogists
Jensen, Frank, Bureau of Land Management, Salt Lake City, Utah
Johnson, Dan, Denver Botanic Gardens
Jackson, Dale, Florida Natural Areas Inventory
Johnson, Ann F., Florida Natural Areas Inventory
Jones, Thomas A., Utah State University
Koppie, Craig, U.S. Fish and Wildlife Service
LaHart, David, Energy and Environmental Alliance, Florida State University
Leffanta, Rico, Arizona Sonora Desert Museum
Leszczynski, Z., Arizona Sonora Desert Museum
Leupold, James C., U.S. Fish and Wildlife Service
Lopez, Scott, Hawaii Volcanoes National Park
Maly, Kepa, Hawaii Volcanoes National Park

Master, L. L., Mammal Slide Library, American Society of Mammalogists
McKinney, Alana, Hawaii Volcanoes National Park
Menke, Dave, U.S. Fish & Wildlife Service
Meserve, P. L., Mammal Slide Library, American Society of Mammalogists
Mickelson, Dave, Bureau of Land Management, Fairbanks, Alaska
Miller, Dwain, Bureau of Land Management, Fairbanks, Alaska
Million, P., U.S. Fish and Wildlife Service
Morgan, Al, Arizona Sonora Desert Museum
Morris, A., Visual Resources for Ornithology, The Academy of Natural Sciences of Philadelphia
Moseley, Bob, Idaho Department of Fish and Game
Munz, P. A., Rancho Santa Ana Botanical Garden
Olsen, C. M., U.S. Fish and Wildlife Service
Parmenter, Robert R., University of New Mexico
Peterson, J. D., Arizona Sonora Desert Museum
Remsen, Dr. J.V., Visual Resources for Ornithology, The Academy of Natural Sciences of Philadelphia
Rigby, Kelly, Bureau of Land Management, Salt Lake City, Utah
Resentreter, Roger, Bureau of Land Management, Boise, Idaho
Roberts, J., Denver Botanic Gardens
Robertson, William, Bureau of Land Management, Fairbanks, Alaska
Rogers, Lynn, U.S. Fish and Wildlife Service
Schwartz, Carl W., U.S. Fish and Wildlife Service
Seibert, Bob, Hawaii Volcanoes National Park
Secade, Antionette, Arizona Sonora Desert Museum
Shaw, Nancy, Mountain Research Station, USDA Forest Service, Boise, Idaho
Shiver, S., U.S. Fish and Wildlife Service
Simpson, Michael G., San Diego State University
Sintz, Jerry, Bureau of Land Management, Salt Lake City, Utah
Smart, Glen, U.S. Fish and Wildlife Service
Smith, Howard, Bureau of Land Management, Fairbanks, Alaska
Smylie, Tom, U.S. Fish and Wildlife Service
Stevenson, James, Florida Department of Environmental Protection
Stolz, Gary M., U.S. Fish and Wildlife Service
Taylor, Dan, Hawaii Volcanoes National Park
Town, R., U.S. Fish and Wildlife Service
Tschinkel, W. R., Biological Sciences, Florida State University
Van Devender, T. R., Arizona Sonora Desert Museum
Widener, Beth, Bureau of Land Management, Boise, Idaho
Will, Robyn, St. Marks National Wildlife Refuge
Wilson, Sharon, Bureau of Land Management, Fairbanks, Alaska
Zahm, G. R., U.S. Fish and Wildlife Service
Ziellemaker, C. Fred, U.S. Fish and Wildlife Service
Zimmernan, D. and Zimmernan, M., Visual Resources for Ornithology, The Academy of Natural Sciences of Philadelphia

Photo Contributions - ***Agencies***
Apalachicola National Esturine Research Reserve
Arizona Sonora Desert Museum
Denver Botanic Gardens, Helen Fowler Library
Environmental Studies Center, Martin County Schools, Florida
Florida Department of Environmental Protection
Florida Game and Fresh Water Fish Commission
Florida Marine Research Institute
Florida Natural Areas Inventory
Glacier National Park
Grand Canyon National Park
Rancho Santa Ana Botanical Garden
Sea Grant Extension Agency, Tallahassee, FL
Tall Timbers Research Station, Tallahassee, Florida
U.S. Fish and Wildlife Service, Washington, D.C.
U.S. Geological Survey
Utah Park Service
Hawaii Volcanoes National Park
Yellowstone National Park

Video Footage Contributions:
Conus Communications
Ka'Io Productions
Dan Gullickson, Bureau of Land Management, Fairbanks, Alaska
Echo Productions

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