United States Department of the Interior
NATIONAL PARK SERVICE
YELLOWSTONE NATIONAL PARK
WYOMING 82190

IN REPLY REFER TO:

K18 (YELL)

September 19, 1990

Dear Educator,

Because of your previous interest in Yellowstone and the topic of wildland fire, I'm very pleased to send you a new educational package published recently by the National Park Service.

Enclosed is a copy of a teachers unit on fire ecology entitled "Getting to Know Wildland Fire." The fire ecology package comes in two parts: a color poster developed in cooperation with the Region 1 office of the U.S. Forest Service and a 32-page activity guide developed by the interpretive staff of Yellowstone. Several of the activities in the activity guide are designed to be used in conjunction with the poster. These materials were developed for elementary school teachers in response to the intense interest generated by the 1988 Yellowstone fires.

This summer's wildfires in Yosemite have demonstrated that materials such as these will continue to be in demand as prolonged drought in the West makes the likelihood of future wildfires almost a certainty.

I hope you will share these materials with other educators and colleagues who have an interest in environmental education. Though developed specifically for the northern Rockies, the activities can be easily adapted to many parts of the country.

Comments on the materials themselves and requests for additional copies should be directed to:

Chief of Interpretation
National Park Service
P.O. Box 168
Yellowstone National Park, Wyoming 82190
ATTN: Fire Ecology Unit

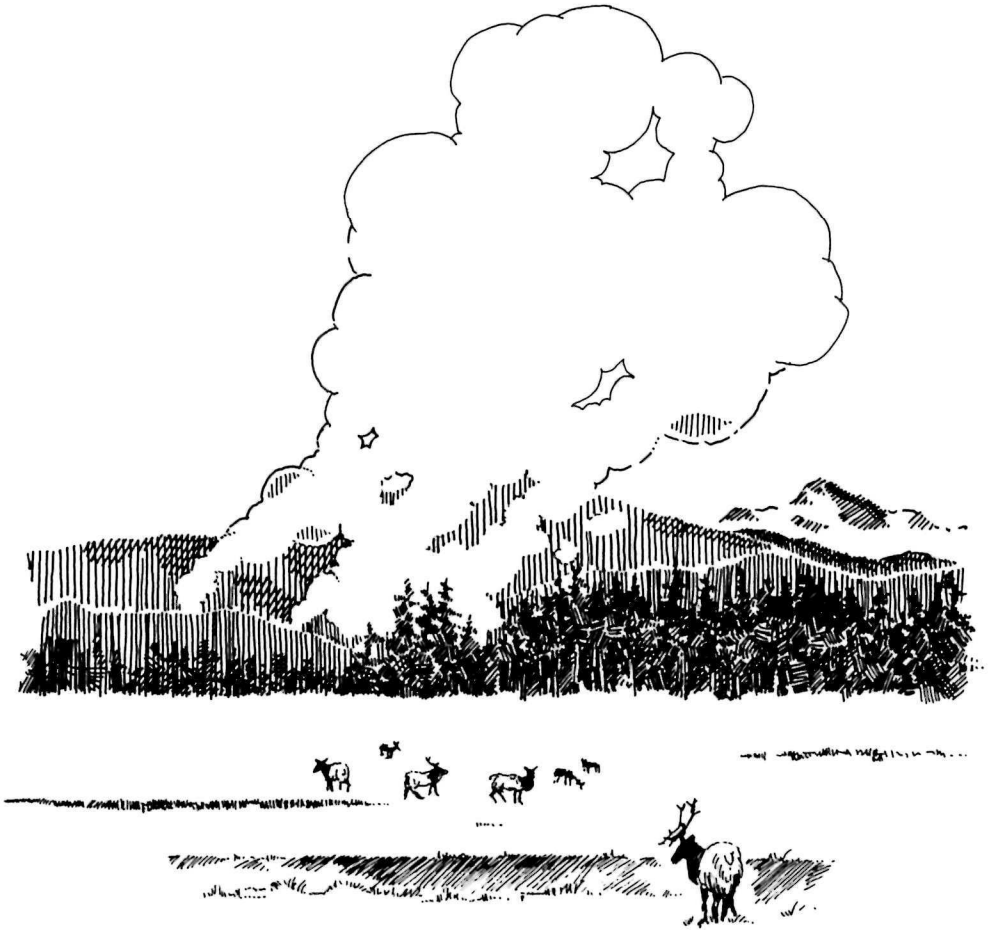
Should you have questions, please phone 307-344-7381, extension 2338 or 2255.

Sincerely,

Robert D. Barbee
Superintendent

Enclosure

Getting to Know Wildland Fire



A Teacher's Guide to Fire Ecology in the Northern Rocky Mountains

A School Outreach Project of the National Park Service and the U.S. Forest Service

Written by Ellen Petrick-Underwood
Edited by Joe Zarki
Illustrated by Ellen Meloy

INTRODUCTION

The summer of 1988 introduced all of us to a seemingly new kind of forest fire. Whether we viewed the flames from our living rooms via the evening news, or from our front porches, we watched in awe – an awe that was for many tempered with fear, sorrow, and anger. The fact that few could remember such large scale burning made it difficult for us to comprehend what was happening and what would follow. Today, most people realize that Yellowstone and other locations that burned in 1988 were not destroyed, and we are told that fires of this magnitude may burn within the region every 300-400 years. The fact that this happened in our lifetime provides us with the unique opportunity to observe and study, first hand, the effects of a powerful force which has been shaping the North American wilderness for as long as there has been vegetation to burn.

These activities were prepared as part of the *Expedition:Yellowstone!* school outreach program connected with the National Park Service's Division of Interpretation at Yellowstone National Park. They were also designed with a more general educational audience in mind and are suitable for use by almost any teacher, especially those within field-trip distance of a forested area that has burned in recent years. Hopefully, the materials will provide fuel for the natural spark of curiosity which we all harbor for things dramatic, unpredicatable, and unstoppable. May this curiosity lead to a deeper understanding of the nature of fire and may this insight be applied in the wise stewardship of publicly owned wildlands, particularly those in our national parks.

ACKNOWLEDGEMENTS

Special thanks are due to many people who supported this effort. Joe Zarki entrusted this project to me, provided just the right amount of freedom and guidance during its creative phase, and was instrumental in seeing it through to completion. Ellen Meloy contributed the artwork that has given the *Expedition:Yellowstone!* materials their distinctive look. Steve Larance was the artist for the color poster. Dave Tippets and the folks of the U.S. Forest Service Region One office in Missoula arranged for the production of the poster and approached us with the idea of a joint venture. John Gahl, Idaho Department of Fish & Game, offered support and encouragement. Many others provided inspiration, ideas, information, and help: Roger Anderson, Ginny Cowan, Jack de Golia, Don Despain, Jenny Matsumoto, Cathy Petrick, Steven Petrick-Underwood, Dave Price, George Robinson, Henry Shovic, Sherri Thompson, and Roy Wood. Many teachers and children contributed by helping test the materials. Above all, thanks to Yellowstone which, according to Bob Barbee, Yellowstone's Superintendent, "may not always be a gentle host, but never fails to be an inspirational teacher."

HOW TO USE THESE MATERIALS

Many of the activities in this package are suitable for any teacher and can be done in any educational setting. Others are more appropriate for teachers in those areas of the country with access to national forests, national parks, or other locations having forested public lands. They are especially suited for teachers using the *Expedition:Yellowstone!* environmental education curriculum by Jack de Golia and Joe Zarki. *Expedition:Yellowstone!* is a 260-page workbook of activities targeted to school children in grades 4-6. It is designed to be used as either part of a school trip to Yellowstone or for in-class study. Teachers wanting more information about *Expedition:Yellowstone!* can obtain it by writing to "*Expedition:Yellowstone!* Program Coordinator" at the address given below.

It is not necessary to use the fire supplement activities in any particular order. Teachers should select activities which they feel are most appropriate to their student's needs and skill levels. For teachers in the *Expedition:Yellowstone!* program who are planning a trip to the park, suggestions are made as to which activities are best used before, during, and after a Yellowstone visit. "Extensions" are given to challenge advanced students or provide ideas for further study. Words listed under "Key Vocabulary" are mostly technical terms used by biologists and scientists. Students should look these up as part of their research. Masters for handouts are provided immediately following the activity for which they are needed. A list of "Readings & Videos About Fire"is located at the back.

We invite your ideas for additional activities or suggestions on improving those you find here. One last word of caution: do not become overly concerned with teaching a great many facts. Anatole France advised, "Awaken people's curiosity. It is enough to open minds; do not overload them. Put there just a spark. If there is some good inflammable stuff, it will catch fire." Good luck!

Ellen Petrick-Underwood
Joe Zarki
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Wyoming 82190

Activity

Forests, Flames, and Fire Fighters

THEME: The conditions necessary for fire; techniques for fighting fire.

SUBJECTS: Physical Education, General Science

WHEN: Before or during your Expedition

OBJECTIVE: Students will learn how fires grow and how they are controlled by fire fighters.

METHOD: In a physically active simulation, students will play the role of trees and fire fighters in the face of advancing fire.

BACKGROUND: Forest fires start small and can only grow and spread if favorable fuels, heat, and oxygen are available. In windy conditions, embers blown from the main fire can start new fires or spot fires. By removing fuels from the path of an advancing fire, fire fighters can slow a fire's growth. Effective fuel removal can be achieved by cutting and hauling away the trees most likely to burn. Fire fighters can also slow a fire's growth by using water, which robs fire of its heat. Water drops on large forest fires rarely put the flames out entirely, but they may slow the fire enough to contain or surround it through the construction of fire line. Fire fighters wear special protective clothing of a flame resistant fabric called "Nomex."

MATERIALS: Enough Nomex shirts and and blue bandanas for approximately one quarter of the students. These materials will be provided by your park ranger if this activity is done during your Expedition. Otherwise strips of yellow cloth used as arm bands or yellow bandanas can be substituted for the Nomex shirts.

PROCEDURE: To start, designate one child as the spark (that starts the fire). One quarter of the group will be fire fighters, dressed in their Nomex shirts (or yellow arm bands), each equipped with a blue bandana (water) in a breast pocket. Blue "nerf" balls can be substituted for the bandanas. The remaining students will be trees (or fuel, which allow the fire to grow). At the beginning, explain to the players what each of their roles will be (see below). Have the spark go to one end of the playing area, and align the fire fighters at the other end. Now tell the trees to "take root and grow" anywhere they wish on the playing field. They should stand with their arms held up to mimic tree branches.

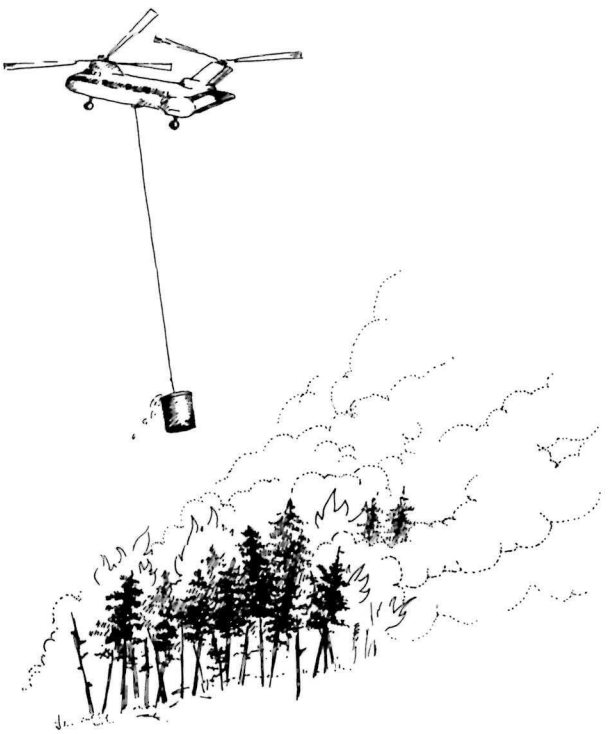
The spark, or lightning, starts the game by tagging a tree. Trees may <u>not</u> run from the fire! Tagged trees become part of the fire and must join hands with the spark. The fire must now continue its pursuit of trees as a unit, attempting to capture trees with their free hands. Captured trees must join the chain of fire. Fire can either move as a long chain, or may break into several smaller groups and travel as spot fires. They <u>may not</u> travel as individuals (pairs or more only!). This distinguishes them from trees.

Fire fighters should be held on the sidelines until the fire has had a chance to "grow" to 3-4 players. At this point, ask the fire fighters, "Do you smell smoke?" They'll be raring to go, so when they yell "Yes!", allow them to go fight the fire.

Fire fighters must avoid fire (they, too, can become fuel for the fire and must join the fire if caught) while attempting to slow the fire's growth. They can do this in three ways:

1) Removal of fuels– Fire fighters may tag trees and escort them out of the game to the sidelines. Fire fighters and trees may not be captured by fire en route!

2) Direct attack– Fire fighters may tag fire with their blue bandanas (water). Fire units that get hit with water must walk from that point on.



3) Containment– Fire fighters may work together to encircle or contain a spot fire (wet fires are the easiest to contain). Contained spot fires must go to the sidelines.

Summary of goals of players:

Trees: Stand still– you may be captured by either fire or fire fighters.

Fire: Tag trees and fire fighters and grow! Avoid water-wielding fire fighters.

Fire fighters: Remove trees to sidelines before they are captured by fire. Tag fire with water to slow its advance. Join with other fire fighters to encircle spot fires and remove them to the sidelines.

The game is over when no trees remain. Compare the number of "fire" players left at the end of the game with the number of players on the sidelines. Who won, the fire fighters or the fire? Point out the similarities and differences to real life.

EXTENSION: Play a few rounds to give everyone a chance to play different roles. See the video "Yellowstone and the Fires of 1988" to learn more about fire fighting techniques. Request a demonstration of fire fighting equipment from your local Forest Service office or fire department.

EVALUATION: Have the children draw pictures of how wildfires get started, how they grow, and how fire fighters attempt to control them.

Grades: 3-6
Duration: 30-45 minutes
Group Size: any
Setting: outdoors
Key Vocabulary: Nomex, spot fire

Activity

Burned Area Scavenger Hunt

THEME: Life exists and sometimes thrives in recently burned areas.

SUBJECT: Life Science

WHEN: During your Expedition

OBJECTIVE: Students will identify evidence of plant and animal life in a burned forest. Students will learn that fires can be selective as they burn through an area.

METHOD: Students will take part in a scavenger hunt in which they check off or draw items on a list rather than collect them.

BACKGROUND: Immediately after a fire burns through a forested area, plants and animals begin to respond to the changes. Lodgepole pines bear two different types of cones. About thirty percent of all lodgepole trees bear "serotinous" cones meaning the cones will not open until heated, usually by fire or sunlight. After a fire passes, these spread open and drop their seeds. Birds, such as pine siskins, Clark's nutcrackers, and red crossbills, then migrate into the burned area to feed on the millions of seeds thus released. Beetles and other insects lay their eggs in burned and injured trees, attracting woodpeckers that like to feed on insect larvae. Cavity nesting birds, such as mountain bluebirds, are drawn to burned areas for the abundance of food and available nest sites.

Grasses, which are capable of resprouting from underground roots, are usually the first plants to appear, pushing their way up through the ashes just weeks after the fire has passed. Flowering plants are not far behind, and eventually new seedlings, including both pine and aspen, may be noticeable. These plants grow vigorously due to the increased availability of sunlight and nutrients following a fire. They provide an ample and nutritious food source for browsing animals such as mule deer, elk, and moose. Even if you don't see animals, chewed vegetation, tracks, and scat provide evidence of their presence.

It can be surprising to see how selectively fires burn. Living trees and blackened trees may be found in close proximity. Trees that only burn partially may survive a fire. Dead and down trees are more likely to burn completely, leaving just a trace of ash and charcoal where they once lay. Old stumps may also burn out completely, leaving a gaping hole with empty tunnels extending down to where the roots once reached. Due to a buildup of dead organic material around the base of trees, they usually burn longer right at the base. This gives some burned trees an odd, decidedly precarious appearance. Sometimes called "snags" or "widowmakers," these trees can be very dangerous as they

can fall without the slightest sound or warning. It's wise to stay clear of burned forests on windy days.

MATERIALS: Burned Area Scavenger Hunt checklists (enough for one per student). Pencils.

PROCEDURE: Give each student a Burned Area Scavenger Hunt checklist. Instruct them to find and check off as many items as possible. Conclude this activity with a review of the results and a discussion of their significance.

EXTENSION:

❑ Take the students to another type of burned area, such as a sagebrush prairie or meadow, and have them make up their own checklists. Have individuals or groups of students exchange checklists and then attempt to complete them.

❑ Take your students to <u>any</u> forest and look for evidence of past burning.

EVALUATION: Take students to a recently burned area which is difficult to discern as such. Have them explore this area to determine whether or not it burned in 1988. They should list all evidence that supports their decision.

Grades: 4-8
Duration: 30-60 minutes
Group Size: any
Setting: outdoors in a natural area that has recently been burned
Key Vocabulary: browsing, cavity, nutrients, organic, scat, scavenger, serotinous

BURNED AREA SCAVENGER HUNT CHECKLIST

Burned areas can be exciting places to explore, but they can also be dangerous places! Never enter a burned area on a windy day, and always watch for falling trees.

See how many of the following things you can find in a burned forest. Check them off as you find them.

1. ——— Find a nesting cavity in a burned tree.

2. ——— Find a serotinous cone.

3. ——— Find a pine seedling.

4. ——— Find an aspen sprout.

5. ——— Find animal tracks. Draw them here.

6. ——— Find animal scat. Draw it here.

7. ——— Find evidence of browsing.

8. ——— Find the hole of an animal that lives underground.

9. ——— Find a tree that burned, but did not die.

10. ——— Find evidence of a bird looking for insects under the bark of a burned tree.

11. ——— Find a trunk that burned more at the base than higher up the trunk.

12. ——— Find evidence of a fallen tree that burned completely.

13. ——— Find evidence of a stump that burned out completely, leaving empty tunnels in place of its roots.

14. ——— Find a wildflower or the leaves of a plant you think might flower at some time. Draw the flower or leaf on the back of this page.

To Light a Fire

THEME: Fires will not burn unless specific conditions exist.

SUBJECTS: General Science, Chemistry, Physics

WHEN: Before your Expedition

OBJECTIVE: Students will learn to recognize and identify the conditions necessary for burning.

METHOD: In small groups, students will attempt to burn a variety of fuel types.

BACKGROUND: Fires need heat, fuel, and oxygen to burn. Remove any of these elements, and a fire will go out. In the northern Rockies, lightning provides a ready source of ignition. Fuels in the form of dead and down trees accumulate at a steady rate because the process of decay is slow in this region. However, conditions in Yellowstone are usually much too cold and wet to achieve large-scale, sustained burning. The drought of 1988 (conditions unprecedented in the park's 112-year written record) was the key event which turned the tide in favor of burning. Severe drought, accompanied by unusually high winds, fanned the fires to their humbling proportions. In 1988, we witnessed a convergence of conditions which may occur once every 300-400 years. Forest fires burn in a mosaic pattern which is reflective of varying fuel types. Wet meadows and stands of young trees do not burn as readily as old forests with large accumulations of litter.

MATERIALS: Matches (enough for five per group), five buckets or boxes containing varying fuel types (keep the amount of fuel in each bucket small).

Bucket #1: A good assortment of sizes of fuels, some with needles, all green.

Bucket #2: Same as #1, but fuels should be dead and dry.

Bucket #3: Same as #2, but fuels should be damp.

Bucket #4: A good assortment of fuels, all partially burned.

Bucket #5: An assortment of fuels, all of a large diameter (small surface area to volume ratio – i.e., no kindling).

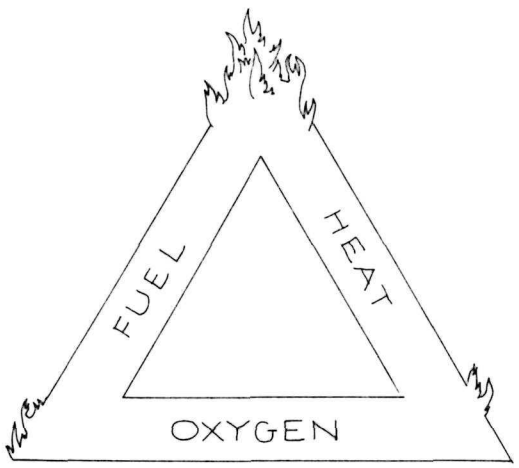
Plastic one-gallon containers filled with water, one for each fire.

PROCEDURE: Begin with a discussion of how a fire gets started and whether it is easy or difficult to start one. Instruct the students that they will be trying to start fires in small groups. It may not be easy! The groups must plan their strategies carefully. They will then try to get as much of their fuel to burn as possible in the allotted time. Read them the following rules:

1. Each group must be under the supervision of an adult.
2. All fires must be built within a designated area (an open playground or parking lot away from buildings would be best).

3. No fuels may be used other than those assigned to each group.
4. Only five matches will be given to each group.
5. A two-minute group planning session prior to action is mandatory.

After all groups have had ample time (10 minutes should be adequate), call it quits and assemble groups for discussion. Which groups were successful? Why or why not? Visit each fire site and examine differences in fuel types and success of burning. Do these differences in fuel type occur naturally? Where and under what conditions can each be found? Discuss the extreme fire conditions of 1988, and ask kids to hypothesize as to whether or not it could happen again. What other factors besides fuel type come into play? Point out strategies observed, such as blowing on fires. Introduce a fire triangle model. Demonstrate that if any part is removed, the triangle will collapse and the fire will go out.



EXTENSION: Demonstrate burning in a bell jar:
1. Seal the jar with a stopper to cut off the supply of oxygen.
2. Add oxygen to demonstrate ignition of a glowing splint.
3. Observe the fire extinguish itself when the fuel is consumed.
4. You may also remove heat to extinguish by adding water.

After having kids hypothesize how it will burn, burn a glass-encased soil profile. Measure the depth of soil charring. Have them tell you why it didn't burn deeper. Discuss the likely vegetative response. On your expedition, hike to see the vegetative response in a burned area.

Hike to observe a mosaic burn. Hypothesize as to why certain areas did not burn (differing fuel types, moisture content, age of trees, etc.) Point out the value of maintaining a vegetative mosaic.

EVALUATION: Have the kids draw and label a fire triangle.

Grades: 4-8
Duration: 30-50 minutes
Group Size: any
Setting: outdoors, preferably in an open area away from buildings or other flammable objects.
Key Vocabulary: hypothesize, litter, mosaic

Activity

If Trees Could Talk

THEME: To better understand fire, we need to broaden our perspective.

SUBJECTS: Art, Creative Writing, Drama, Mathematics, Science, Social Studies

WHEN: During your Expedition

OBJECTIVE: Students will learn the cyclic nature of fire and other environmental factors affecting the growth of a tree.

METHOD: Students will study cross-sections of trees to determine the effects of fire, drought, crowding, and beetle infestation.

BACKGROUND: The only part of a tree that is actually alive is a very thin layer directly under the bark called the cambium. If a tree's inner bark is destroyed all the way around its trunk, the tree will die. Some trees can better withstand the effects of fire than others. Douglas firs, with their thick bark, are very resistant to fire and may survive. Lodgepole pines, with their thin bark, are very susceptible to fire, but if they burn only on one side, they may survive with an easily recognizable fire scar. If a tree survives multiple fires, this can give us an idea of the fire interval for that region. A tree's age can be easily determined by counting its annual growth rings. During good growing conditions, the rings will be well spaced. In years of less favorable growing conditions, annual growth rings will be closer together.

A blue-green or gray stain on a cross-section is evidence of a fungus introduced by mountain pine beetles. As the fungi grow in the xylem, they prevent the free flow of water from roots to needles. This may eventually kill a tree. As with fire, beetle infestations come in cycles.

MATERIALS: Tree cross sections with fire scars and beetle stain. "Tree Talk" handouts. Hand lenses, rulers, pencils, yard sticks or measuring tape (one of the above for every three students).

PROCEDURE: Discuss the life of trees with students. A good introduction might be Joseph Cornell's activities "Build a Tree" and "Tree Imagery." Both of these can be found in Cornell's book, *Sharing the Joy of Nature*. Compare the lifespan of a person to the lifespan of a tree. Suggest that this might enable trees to "see" things that we cannot. Tell them that there are ways to get trees to give up their secrets. Distribute the materials and go over the "Tree Talk" handout with the students.

Once they have completed the exercises on the handout, conclude the activity with a review of everyone's results. Hold a discussion on why differences in the results were found.

EXTENSION:

- ❑ Have each group dramatize the events in the life of their tree for the rest of the class.
- ❑ Have each student write a short story describing life as if he or she were the tree.
- ❑ Go on a hike to look for trees with fire scars.
- ❑ Fit the tree time lines into the Yellowstone geologic time line.

EVALUATION: Have students draw cross-sections of hypothetical trees based on narrative descriptions of their lives. For example, given, "I am a ten year old tree, I survived a fire that partially burned me when I was 8," they would then draw a cross-section of ten annual rings with a fire scar at ring eight.

Grades: 4-8
Duration: 60-90 minutes
Group Size: any
Setting: In Yellowstone, during your Expedition
Key Vocabulary: cambium, cross-section, diameter, fungi, xylem

TREE TALK

Complete the questions below to discover the secrets of your tree.

1. By carefully counting the number of rings, you can learn the age of your tree at the time of its death. Use the hand lens to help count. How old is your tree?

_____ years

2. Is the outer bark burned on your tree? It burned during the summer of 1988. Subtract your answer #1 from the number 1988. Write the answer in the space below.

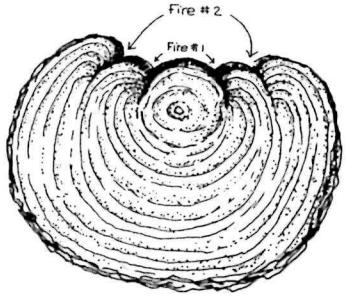
_____ This is the year your tree started growing.

3. Find the growth ring for the year you were born. Use the ruler to determine the diameter of the tree in the year of your birth.

I was born in the year _____ . In this year the diameter of this tree was:

_____ inches.

4. If a tree burns only partially, it may survive one or more fires in its lifetime. A fire scar looks like a dark line that extends part way around the trunk from both sides.



a. How many fires have burned your tree? _____ .

b. What were the years of these fires? _____ .

c. What is the average fire interval (the average number of years between two fires)?

_____ years.

5. Rings that are well spaced from one another indicate good growth years, when moisture, sunlight, and nutrients were plentiful. Periods when the rings were very close together may indicate years of drought, disease, injury, shading, or crowding by other trees.

a. Which years were the best growth years for your tree? _____ .

b. During which period of this tree's life was growth the slowest? _____ .

c. Were the years immediately following the fire(s) good or poor growth years?

_____ .

d. What might be a possible explanation for this?

6. Look at the outer margin of your cross–section. Do you notice a blue-green stain?

a. In what year was the stain first introduced? _____ .

b. This stain is caused by fungi that are introduced by mountain pine beetles. Does the introduction of the fungi appear to have affected the growth of this tree? How?

7. On butcher paper, draw a time line to show the lifespan of this tree and the dates of the major events that have occurred in its lifetime. Use the scale of one inch per year. Include major events in human history as well. Draw pictures to illustrate these events.

Activity

Cycles Behind the Scenes

THEME: Many natural changes are cyclic.

SUBJECTS: Art, Biology

WHEN: Before or after your Expedition

OBJECTIVE: Students will learn to recognize and predict changes that are cyclic in nature.

METHOD: Students will use drawings to complete a handout illustrating cycles. One stage of each cycle is represented in the poster, "Fire's Role in Nature's Cycle."

BACKGROUND: Deciduous trees, undergo a yearly cycle of growing and shedding their leaves. This helps them to conserve water during the dry months of winter when water is locked up in snow and ice.

Antlered animals, like the bull moose, grow and shed their antlers every year. When antlers are growing, they are covered by a thin layer of skin, or velvet, with a rich blood supply. The blood deposits calcium, which causes the antler to grow. When the blood supply to the antler is cut off at the end of summer, the velvet shrivels and is rubbed off. Bull moose with the largest racks are more desirable to the females. In the contest for mates, bulls may lock horns, but they rarely injure each other. Moose wear their antlers into the winter, usually shedding them between December and February.

Bluebirds lay their eggs in cavities. Once the babies hatch, the parents are kept busy bringing food to their gaping mouths. Eventually they fledge and start lives of their own.

Many flowers are pollinated by insects. After pollination, seeds develop and the flower withers away. Seeds have many different kinds of dispersal mechanisms, some relying on wind, some on water, and some on animals to take them to new sprouting grounds. Seeds that land in favorable spots begin the cycle all over again.

Water that falls to the earth in the form of rain or snow either seeps down into the earth or runs off into streams, rivers, and lakes. Water deep underground may resurface hundreds of years later as a geyser! Surface water evaporates and reenters the atmosphere as water vapor. When water vapor condenses, clouds form which may drop rain or snow.

Many animals cannot survive Yellowstone's harsh winters. So, strategies like hibernation and migration have evolved. Many of Yellowstone's birds migrate to warmer climates to spend their winters...only to return again in the spring!

MATERIALS: The poster, "Fire's Role in Nature's Cycle," supplied with these activities; "Cycles Behind the Scenes" handout (one per student); colored pencils.

PROCEDURE: Have students complete handouts individually. Post the drawings around the room.

EXTENSION: Make flip books to illustrate complete cycles.

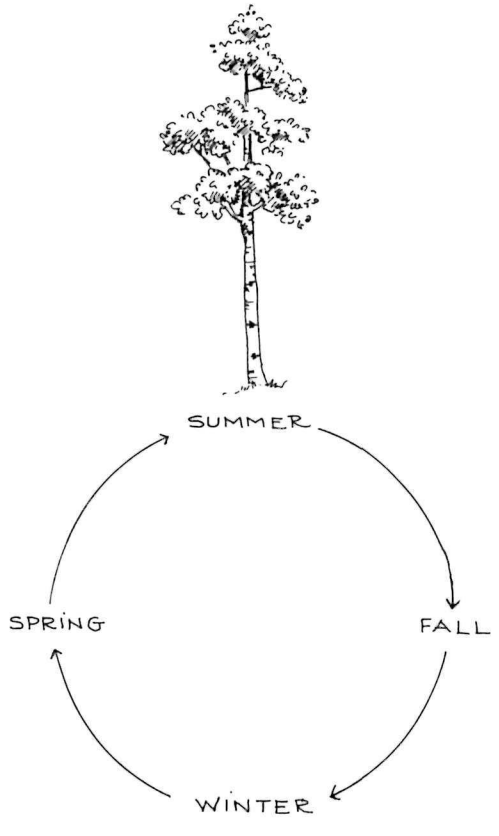
EVALUATION: Have each student define "cycle" and describe an original example.

Grades: 4-8
Duration: 1-2 class periods (allowing students time to look up needed information)
Group Size: any
Setting: classroom
Key Vocabulary: cycle

CYCLES BEHIND THE SCENES

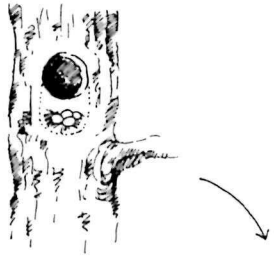
A cycle is a chain of events that bring us right back to where we started. Fire is a necessary event in the cycle of a healthy forest. This is illustrated in the poster, "Fire's Role in Nature's Cycle." Follow the changes that occur in a forest after a fire, as shown in the poster. Everything pictured in the poster plays a part in this cycle... and they are players in many other cycles as well! Draw on a separate piece of paper the pictures needed to complete the cycles below.

1. The aspen leaves in this picture are green. When will they be yellow? When won't there be any leaves at all?



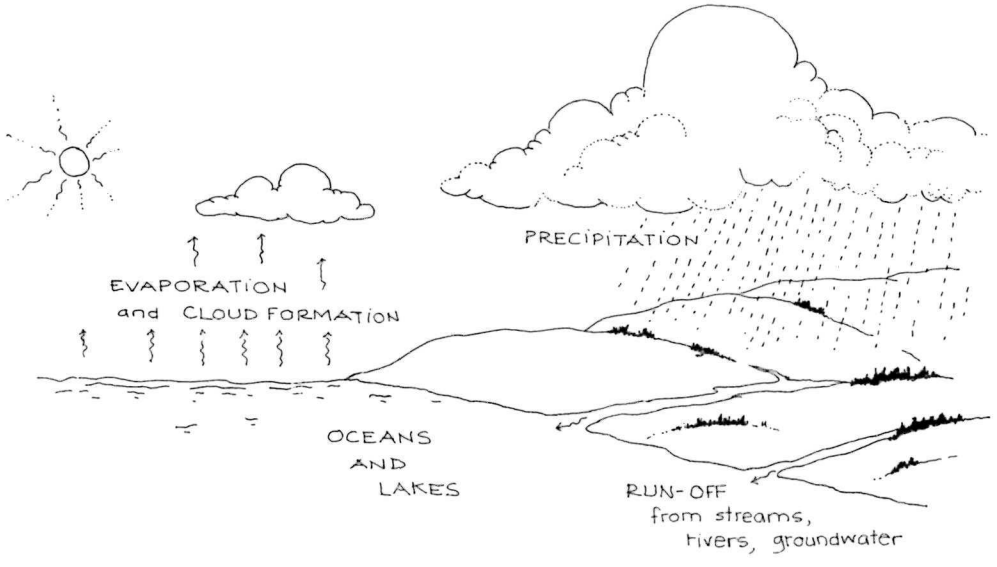
2. The bull moose pictured here has antlers in velvet. This means they are still growing. A moose grows and sheds his antlers every year! The velvet is shed between August and September, and the antlers are dropped between December and February. Draw how this moose's appearance will change as his antlers grow and are shed.

3. The bluebird at the nest represents two stages in the life cycle of a bluebird. Draw its life cycle. Start with a nest of eggs and bring the story full cycle.



4. Find the bee in the poster. Its nectar gathering ensures pollination and seed production for the flower. Draw the cycle of seed, to flower, to seed. Use as many drawings as you need.

5. The water flowing in this stream represents just one part of the water cycle. Where did this water come from? How will it get back there? Draw your own water cycle showing a rainstorm, streams and rivers, a large lake or ocean, and clouds forming.



6. Many animals also undergo a migratory cycle. The most impressive distances are covered by birds. The western bluebird, shown on the poster, will fly to the southwestern United States and northern Mexico to spend its winters. (NOTE: the western bluebird does not occur regularly in Yellowstone, but it is a common bird in many pine forests of the western United States.) The osprey will winter along the coasts of Central America and northern South America. Draw a map showing the migratory route for a bluebird that summers in Yellowstone and winters in Texas. About how many miles does it travel every year?

7. What other cycles are unfolding behind the scenes? Draw other cycles here.

Activity

Habitats Classified

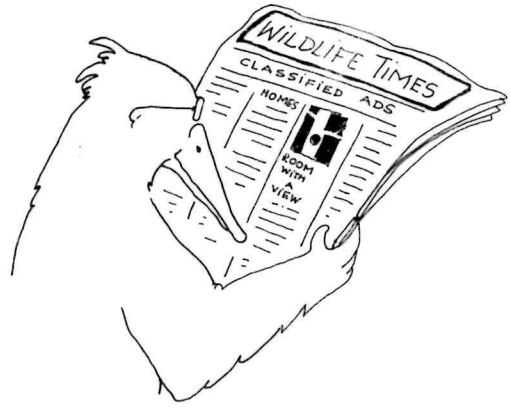
THEME: Fires both create and destroy habitat. Different animals have different habitat needs.

SUBJECTS: Biological Science, Drama, Language Arts

WHEN: Before your Expedition

OBJECTIVE: Students will be able to match animals with descriptions of their appropriate habitats.

METHOD: Using a classified section for animals, students will select appropriate ads for animals pictured in the poster, "Fire's Role in Nature's Cycle."



BACKGROUND: Animals can usually be found in areas that best meet their habitat needs. The animals pictured in the poster, "Fire's Role in Nature's Cycle" are pictured in environments that specifically meet their food, water, shelter, and space requirements. The moose would look just as out of place up in a tree as the osprey would look standing on the ground in a aspen grove.

MATERIALS: Classified sections from newspapers – one per student. Markers, pencils, poster, "Habitats Classified" handout (one per student).

PROCEDURE: Have students practice reading classified sections from newspapers. Tell them they're to circle ads for apartments or homes that they would like to live in. Call on a few students and ask them to read the ads they have circled. As they read, write a list of tastes or preferences under their names on the chalk board. For example, for a student whose ads repeatedly feature pools and large yards, you might write, "likes to swim, needs lots of space." Do this for enough students so that a variety of preferences emerge.

Next, suggest that just as people have different preferences and needs for living areas, so do animals. When environments change, animals need to "move" to new homes. Introduce the poster, "Fire's Role in Nature's Cycle." Identify the different animals pictured. Point out that they are pictured in the homes that they like best. Some prefer mature forests while others prefer recently burned ones. Suggest that these animals are constantly moving around in search of their preferred stage in the cycle. As forests change over time, animal populations follow these cycles, gradually leaving an area when it can no longer meet their needs, only to return to that very same spot when it can again support them... perhaps hundreds of years later!

If your students are not familiar with the animals pictured on the poster, you might want to spend a few moments reviewing each animal by telling its name, where it lives, what it eats, etc.

Give each student a copy of the handout "Habitats Classified" to complete.

EXTENSION:

❑ Have students write ads for other animals in different environments, such as pond, ocean, rainforest, and desert.

❑ Have the students choose a wild animal that appeals to them. They must then look up information about their animal's habitat needs and requirements for survival. They must also find a picture in a magazine of the habitat where their animal lives. They should bring this to school to post on the wall where other students can see it. It is important that each student say nothing to the other students about the identity of their animal. Choose one student to be a "real estate agent" (students can take turns at this). The "agent" then acts out a little play in front of the class by showing each prospective "animal" client the various pictures on the wall and asking their client some general question about the type of home they are looking for. Other students in the audience try to guess what kind of animal the agent is helping. They can write their answer on paper and check to see how many they got right when the different animals reveal their identities. You could also have students work in teams of two or three with one student in each group being the real estate agent.

EVALUATION: Students can be evaluated on the completeness of their work.

Grades: 4-8
Duration: 45 minutes, two class periods with a homework assignment for the Extensions
Group Size: any
Setting: classroom
Key Vocabulary: foraging, habitat

HABITATS CLASSIFIED

Read this classified section. In the space provided below each ad, write in the name of the animal you think would most like to live there. Hint: All of the animals are pictured in the poster!

Cozy high rise apartment for summer, monthly lease. Convenient location on migration route. Kids OK.

Penthouse in burned forest provides comfortable nest site with great view of your neighbors. The hunting is great when prey can run, but prey can't hide.

Undeveloped site with poor drainage on flood plain location. Sedges and willows plentiful. Must see!!

Trees! Trees! Trees! All burned! Crawling with insect larvae. Many homesites ready for immediate occupancy.

Recently burned area offers excellent foraging opportunities. Luxuriant undergrowth. Good cover nearby.

Do you like seeds? This newly burned location still has good cover but more seeds than you could ever stuff your face with! Don't delay; scurry in today!

Spacious home offers mountain views; easy access to park and forest lands. Wildlife abounds!

Looking for a secluded den? Rocky Ridge Estates offers the privacy you need with superb year-round hunting nearby.

Activity

What If You Stayed the Same?

THEME: Change is an inevitable, necessary, and often unstoppable force in Nature.

SUBJECTS: History, Social Studies

WHEN: After your Expedition

OBJECTIVE: Students will be better able to accept rapid widespread changes like those which occurred in Yellowstone in the summer of 1988. Students will be able to distinguish between changes we can control and those we cannot.

METHOD: Through guided imagery, children are introduced to the concept of change as a desirable force. A handout will then help them to predict and visualize changes in their own lives and in the "life" of Yellowstone and to distinguish between changes we can and cannot control.

BACKGROUND: In Yellowstone, during the summer of 1988, 793,880 acres (or approximately 35.7% of the park) were affected by fire some way, giving Yellowstone a new face. Intellectually, we may be able to understand that this is a perfectly natural event which may occur every 300-400 years; emotionally, change of this magnitude can be hard to accept.

Guided imagery is an information-processing technique that enhances long-term memory and comprehension of complex concepts. Using this technique, you read, or describe in your own words, a series of images for your students to visualize, with their eyes closed, in their minds. Leave time between the phrasing of your words for the students to picture the images you are suggesting.

MATERIALS: "Predicting Change" handout, pencils

PROCEDURE:

1. Read A.A. Milne's "Now I Am Six"

When I was one, I had just begun.
When I was two, I was nearly new.
When I was three, I was hardly me.
When I was four, I was not much more.
When I was five, I was just alive!
But now I am six, I'm clever as clever,
I think I'll stay six now for ever and ever!

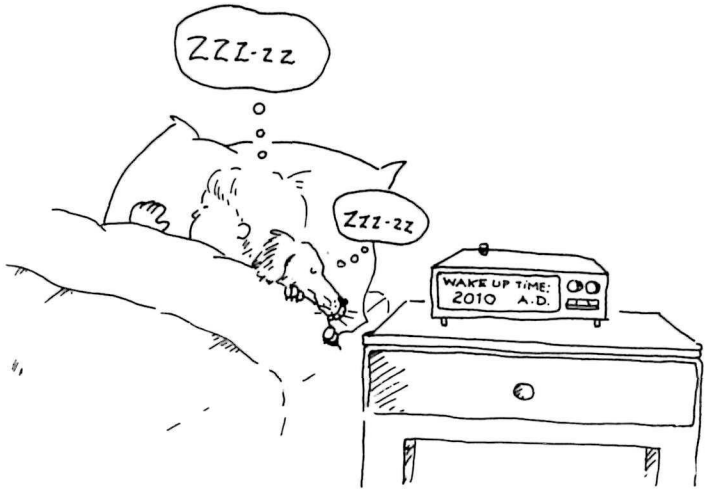
2. Discuss the advantages and disadvantages of staying six forever, then ask the children whether or not they would like to remain their present age. What would it be like if you were to stop changing, but nothing else did?

3. Tell the children that they will find out what it's like by using their imagination. Tell them to imagine that what you read to them is really happening. Since you won't be filling in all the details,

they should imagine they are actually seeing, feeling, and hearing the things you describe. Instruct them to sit comfortably with their eyes closed.

Guided Imagery

Imagine that sometime during a school field trip, you have unkowingly entered a time warp. What seemed like only a few days to you was actually twenty years to the perspective of everyone back home. From their perspective, it was as though you had all vanished off the face of this earth – only to resurface twenty years later. Your teacher called the school (as if nothing strange had happened) and said, "We're on our way home. It's been a wonderful trip! We'll be back at school this evening." They try to tell your teacher that you've been gone for decades... but he/she thinks they're joking. Back at home, the school spreads the word... and wonders... and waits. As the bus rolls homeward, you peer out the window watching for familiar landmarks... but you don't recognize anything! There are houses and stores everywhere... why don't you remember it looking like this? Did the bus driver take a wrong turn somewhere? The bus grows quieter and quieter as, one by one, you begin to realize that something very strange has happened while you were away... things that couldn't have happened in just a few days time. When the bus finally pulls up in front of the school, everyone is deathly silent. You step off the bus... nothing looks the same! You hardly recognize your school because the trees around it are so huge. Giant trees! Cars look different... the people crowding around your bus look different too. Little kids are whispering and giggling among themselves as they point and snicker at you. You overhear one of them whispering, "Look at those old-fashioned clothes!" Your family slowly walks up to you. You look right past them... you don't even recognize them! An elderly couple tap you on the shoulder and introduce themselves. Your parents look ancient! That man with them is your baby brother... that woman with the two small children, you are told, is your sister. They all treat you like a little kid. That's what you are... a little kid... just like you were twenty years ago.



4. Discuss the experience. If it was unpleasant, why? Point out that although the ways their lives will change in the next twenty years are a mystery, change will happen! Suggest that the same is true in nature, although changes usually (but not always!) happen more slowly. Point out that although their parents love them just the way they are and will always think of them as their children, they would probably be upset if their children were to suddenly stop changing. Change is an inevitable and necessary process in life. Suggest that we must love nature enough to allow it to change in the ways best suited to it.

5. Distribute and complete the handout, "Predicting Change."

EXTENSION:

❑ Research the history of how people have controlled fire. Research how your community has changed in your lifetime. How has it changed in the past twenty years? Ask your parents if they have any old photo albums going back twenty years. Interview an old timer. Look up old newspapers and magazines in your local library. Look at an old movie or television program from the early 1960's. How did people dress and talk back then? If you could choose between living then or now, which would you choose? Why?

❑ Read a science fiction novel about time travel to the children in class. Some possibilities include *A Wrinkle in Time* by Madeleine L'Engle and *Time and Again* by Jack Finney.

❑ Have the students write a descriptive paragraph about what they felt during the guided imagery experience. What would they do if they went home today and everyone in their family was twenty years older?

EVALUATION: Students can be evaluated on their participation and the completeness of their work.

Grades: 4-6
Duration: One to three class periods depending upon whether you do the Extension.
Group Size: any
Setting: classroom
Key Vocabulary: inevitable, perspective, time warp

PREDICTING CHANGE

Predict changes that will be occurring in your lifetime and in the "life" of Yellowstone during the time periods indicated.

	ME	YELLOWSTONE
Today:		
This month:		
This year:		
In 20 years (I will be ____ years old)		
In 50 years (I will be ____ years old)		
In 500 years		

Some of these changes can be controlled by us, some of them cannot. Underline the changes we can control. Circle those we cannot.

Activity

Grandfather Fire

THEME: Native Americans altered their landscape extensively, both intentionally and unintentionally, through the use of fire.

SUBJECTS: Anthropology, Art, Drama, History, Science

WHEN: During your Expedition

OBJECTIVE: Students will be able to portray and recognize Native American uses of fire.

METHOD: Around a "sacred fire," clans of students will act out skits depicting the many uses Indians had for fire.

BACKGROUND: All Indians used fire extensively. To the Indians of the eastern United States, it was known as "Our Grandfather Fire." The term implied respect, even reverence. Fire was often used ceremonially. For important religious ceremonies, sacred fires were kindled. Sacred fires were struck from flint or came mysteriously by lightning.

Indians used fire extensively for hunting purposes. They used torches to blind deer and to attract fish close enough to be speared from their canoes. Smoke was used to flush bees from hives and bears out of dens. Fire was also used to corral animals. As animals were gradually forced into the center of a large circle, they could be more easily slaughtered. Explorers Lewis and Clark observed that Indians of the upper Missouri River intentionally set fires on one side of a river in early spring when the grass was dry, and ice was still on the rivers. Bison would be attracted by the new green grass. In their attempts to reach the new grass, bison would find themselves marooned in ice floes and would float downstream where waiting Indians made easy kills.

Fire was also used as an instrument of war. Nomadic people burned off the grass and brush where they planned to put up lodges so that enemies couldn't sneak up on them or burn them out. Hunting parties venturing into another tribe's territory would often set fires. This would temporarily deprive the home tribe of forage for their game and horses, and it also meant the invaders could return next year for better hunting.

Fire was used for domestic purposes such as cooking, making ceramics, providing light, and heating lodges.

Smoke was used as a means of communication. It was also used to drive off mosquitoes and flies. The Apaches actually used smoke to attract deer tormented by the insects.

MATERIALS: Flint (optional), costumes designed from historical photographs of Indians (optional)

PROCEDURE: At school, clans of students should research Indian fire practices. Later, around a "sacred fire" (use flint or a simulated lightning strike), clans will give thanks to Grandfather Fire by acting out a skit (without words) that portrays the practice they have researched. Each clan should act out a different practice. After each skit, the rest of the class guesses what was happening and

explains how fire was used as a tool. Conclude the ceremony with a discussion of modern uses of fire.

EXTENSION:

❑ Create a list of modern uses of fire. Have the students choose a particular use of fire from the list and then have them research their topic and make a presentation to the class.

❑ Each student should think up a brand new use for fire. Creativity, imagination, and even whimsy are encouraged. Students should make a presentation about "their" new use of fire to the class.

EVALUATION: Students are evaluated on their preparation and participation.

Grades: 4-6
Duration: Two class periods for research and preparation, one evening during your Expedition.
Group Size: any
Setting: At school, or at camp in Yellowstone during your Expedition
Key Vocabulary: ceramics, ceremony, forage, nomadic

READINGS & VIDEOS ABOUT FIRE

The following references provide the latest information on fire and its role in Yellowstone and elsewhere. You can obtain books from bookstores or from your local library. The technical articles are in journals available at most college libraries. Your community library may be able to borrow the journals through an interlibrary loan request. Titles with dot (•) are available by mail order. You may order from the Yellowstone Association, Inc., P.O. Box 117, Yellowstone National Park, Wyoming 82190, or by calling (307) 344-7381, extension 2349. Wyoming orders add 3% sales tax. Schools and libraries are entitled to a 15% discount.

Videos

•"Yellowstone Fires 1988," produced by Video Visions, P.O. Box 6721, Bozeman, MT 59715. *1 hour*. $29.95.

"Yellowstone in the Summer '88," produced for Travel Montana and Wyoming Travel Commission by Sage Advertising, P.O. Box 1142, Helena, MT 59624. Phone (406) 442-9500. *17 minutes*. $9.60.

Books

•de Golia, Jack. *Fire: The Story Behind a Force of Nature*. Las Vegas: KC Publications, 1989. $4.95 plus shipping.

Despain, Don, Douglas Houston, Mary Meagher, and Paul Schullery. *Wildlife in Transition: Man and Nature on Yellowstone's Northern Range*. Boulder, Colorado: Roberts Rinehart, Inc. Publishers, 1986.

Pyne, Stephen J. *Fire in America: A Cultural History of Wildland and Rural Fire*. Princeton, New Jersey: Princeton University Press, 1982.

Pyne, Stephen J. *Introduction to Wildland Fire: Fire Management in the United States*, Princeton, New Jersey: Princeton University Press 1984.

Stewart, George R. *Fire*. University of Nebraska Press, 1984. This is a novel in which the main character is a wildfire.

•Wuerthner, George. *Yellowstone and the Fires of Change*. Salt Lake City: Haggis House Publications, Inc., 1988. $8.95 plus 90¢ shipping.

Wright, Henry A. and Arthur W. Bailey. *Fire Ecology: The United States and Southern Canada*. New York: John Wiley and Sons, Inc., 1982. This is the standard textbook on the subject.

Articles

Barbee, Robert and Paul Schullery. "Yellowstone: The Smoke Clears," *National Parks*, March/April 1989, pages 18-21.

Jeffery, David. "The Great Yellowstone Fires," *National Geographic*, Vol. 175, No. 2, February 1989, pages 255-273.

Monastersky, Richard. "Lessons from the Flames," *Science News*, November 12, 1988, pages 314-317.

Monastersky, Richard. "After the Flames: Awaiting the Regeneration of Yellowstone," *Science News*, November 19, 1988, pages 330-332.

O'Gara, Geoffrey. "Beyond the Burn," *Sierra*, January/February 1989, pages 40-51.

Williams, Ted. "Incineration of Yellowstone," *Audubon*, January 1989, pages 38-85.

Technical Publications

Effects of Fire on Fauna: A State-of-Knowledge Workshop, Denver, Colorado, April 10-14, 1978. This is actually a series of six reports on the effects of fire on soil, water, air, flora, fauna, and fuels. To obtain a set write to Forest Service, U.S. Department of Agriculture, P.O. Box 96090, Washington, DC 20090-609. Ask for GTR-WO-6.

•*The Greater Yellowstone Area, An Aggregation of National Park and National Forest Management Plans*. The entire publication has color wall maps showing a variety of resources in the area. The cost is $65 ($55.25 for schools and libraries). Call for shipping cost.

Arno, Stephen F. 1980. "Forest Fire History in the Northern Rockies," *Journal of Forestry*. 78:460.

Arno, Stephen F. 1976. "The Historical Role of Fire on the Bitterroot National Forest," Research Paper INT-187, available from the U.S. Forest Service's Intermountain Research Station, 324 25th Street, Ogden, Utah 84401.

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Christensen, Norman, et. al. "Ecological Consequences of the 1988 Fires in the Greater Yellowstone Area." Final Report, The Greater Yellowstone Postfire Ecological Assessment Workshop. 58 pp. (available from Yellowstone National Park's Research Division, P.O. Box 168, Yellowstone National Park, WY 82190).

Christensen, Norman, et. al. "Interpreting the Yellowstone Fires of 1988." *BioScience* 39:10.

Despain, D., et. al. "Burned Area Survey of Yellowstone National Park, The Fires of 1988." Dec. 1989, 14 pp. (available from Yellowstone National Park's Research Division, P.O. Box 168, Yellowstone National Park, WY 82190).

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Knight, Dennis and L. Wallace. "The Yellowstone Fires:Issues in Landscape Ecology." *BioScience* 39:10.

Minshall, G. Wayne, et. al. "Wildfires and Yellowstone's Stream Ecosystems." *BioScience* 39:10.

Myers, Peter C. and Earl E. Gjelde. "Report Concerning Fire Management Policy for National Parks and Wilderness," *Federal Register*, Vol. 53, No. 244, Tuesday, December 20, 1988, pages 51196-51205.

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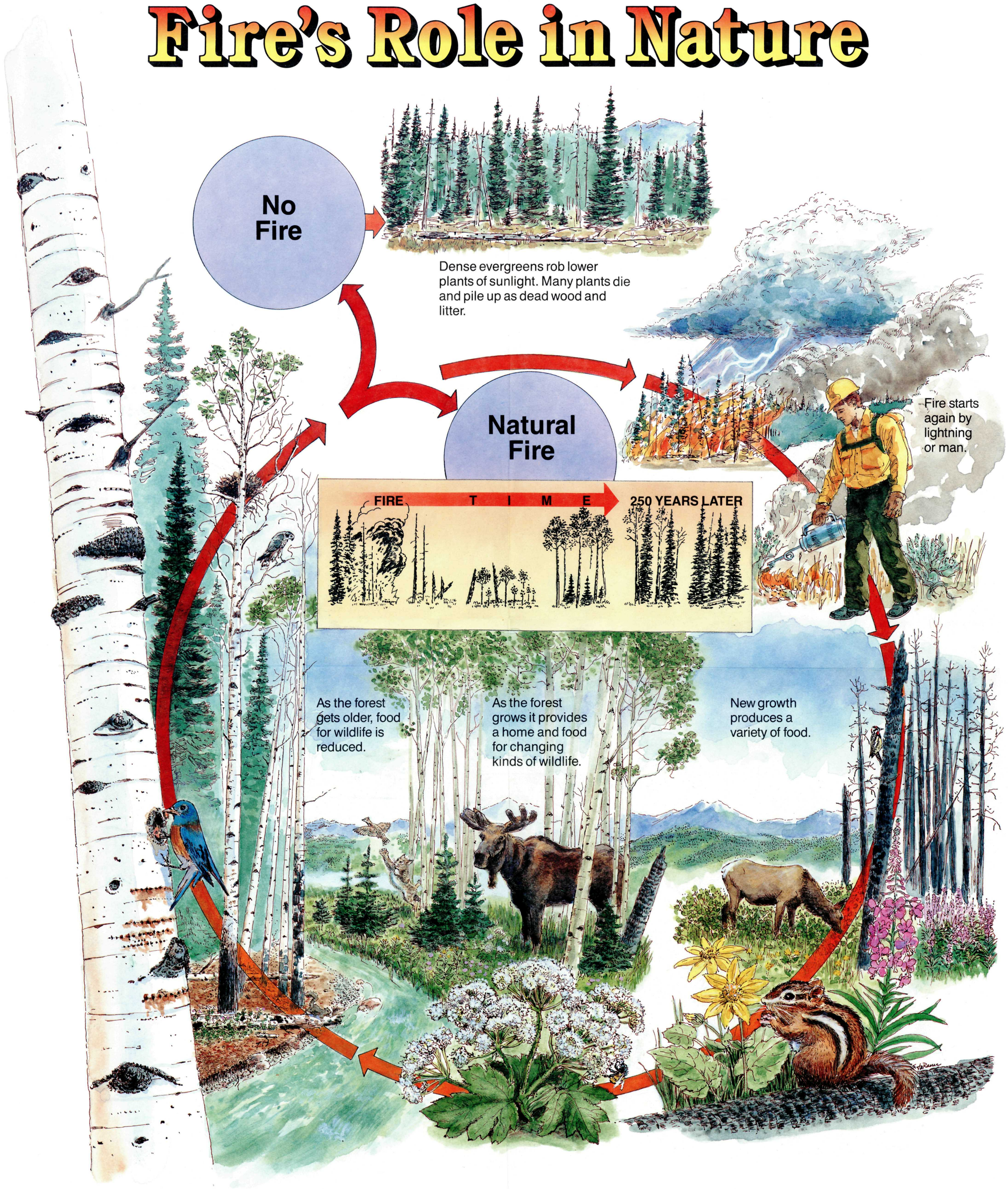
Fire's Role in Nature



"When you try to change any single thing, you find it hitched to everything else in the universe." *John Muir*

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