Forests Born of Fire

An important agent in forest succession is fire. The mosaic pattern of plant communities characteristic of Glacier National Park and the surrounding ecosystem results from a succession of fire-related events that impact most northern Rocky Mountain forests over a cycle of 100-300 years. Some fires have less impact on a plant community than others, and the natural fire cycles have been altered and interrupted by human intervention.

Until recently, all fire was viewed as having predominantly negative effects upon the environment, but plant ecologists now realize that fire is an essential agent to healthy diversified plant communities. Park and forest managers are now studying and implementing prescribed burn and controlled burn policies in order to promote more natural patterns of plant succession and diversification.

Seeds of some plants survive in the soil for many years but germinate and bloom only after a major fire prepares the environment. Some species spread seed into an area year after year without successful germination. A fire clears away the forest canopy or the carpet of leaves and needles on the forest floor, allowing plants to grow where they could not previously survive. In fact, were it not for fire, certain seral species (plants which have an intermediate role in forest community succession) might completely disappear from an area. Species such as wild geranium, wild hollyhock, dragonhead, and snowbrush appear in a given area for a short period every 100-300 years if the fire cycle follows a natural course. One of the most ubiquitous and persistent colonizers in Glacier National Park is the lodgepole pine. Lake bottom core samples indicate that lodgepole pine proliferated in the wake of receding Ice Age glaciers.

Plants on the Move

While we are aware of the ability of animals to move and adapt to changes in their environment, there is a tendency to think of plants as stationary organisms with little ability to adapt or move. In fact plants have evolved many devices and techniques for protection, proliferation, and transportation.

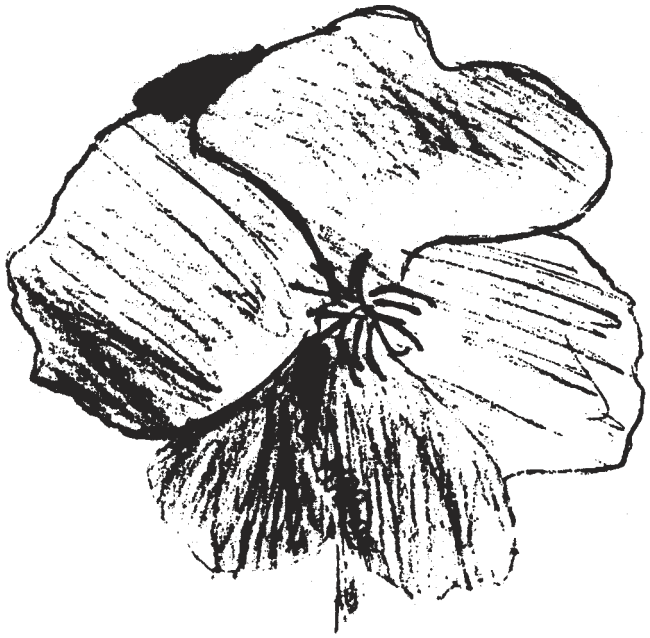
While trees do not get up and walk to a more hospitable location, looking at a record of botanical succession over time would make it clear that plants change locations based on climatic factors. A time lapse film set for a period of 2,000 years might show forests moving up and down the slopes of Logan Pass several times as climactic changes occurred. In fact evidence indicates that the dwarfed groves of trees at Logan Pass did extend higher up the mountains in the recent past. Currently they may be in the process of moving up the mountain side again.

Native American Influence

Before the European emigration to North America, Native Americans had relatively little long-lasting impact on the land. Generally migratory in their life style, they lived within the natural limits of their environment rather than altering it to suit their needs. Though they often set prairie and forest fires to clear pathways, herd game, and stimulate new growth, the impact was short-lived and of less significance than changes stimulated by todays technological society.

The Future

The ecological importance of the Glacier National Park area for the future cannot be overemphasized. The surrounding areas and most of the country in general are under intensive management for the production of food, lumber, and mineral resources. Protected areas like national parks must continue to provide a refuge for plant and animal species and communities that can no longer flourish outside the area. In a time when the last remnants of native wilderness are quickly being absorbed by civilization, it is extremely important to preserve, protect, and restore Glacier National Park and as much of the surrounding area as possible. The biological diversity of the Glacier ecosystem must be maintained for future generations.



Wild Rose
K.A.B.

Classroom Activities

Classroom Activity 1
Who Says Plants Can't Move ?

Objective:
Students will learn how plants spread their seeds and populate new areas. Students will be encouraged to think about plants as organisms that are adapted to their environment and contribute to the well being of other plant and animal species.

Background:
Modern cultures tend to think about plants as organisms that are subject to the whims and uses of humans and other animals. Traditional Native American cultures have seen plants in a very different light. According to their perception, plants have spirits and are able to communicate among themselves and occasionally with other beings. Such a view of nature may be viewed as primitive by scientists and other "modern" people. Native Americans, however, are relating very personally with their environment. The intimacy of that relationship seldom, if ever, distorts the basic soundness of their understanding of plants. Their perspective certainly adds a more personal dimension to the study of plants. In fact, plants do have a number of defense mechanisms and many techniques for pioneering new living space.

Materials:
Balloons (Green, brown, and red are preferable)
Frozen or fresh berries (huckleberries, blueberries or raspberries are most appropriate, purple or red balloons will suffice)
Grocery bags (preferably painted bright red, pink or white)
A yellow or black stocking cap
Powdered sugar
Marshmallows
velcro strips
A collection of locally gathered seeds such as dandelion, maple, poppy, cockle burrs, pine cones, and mushroom spores.

Procedure:
1. Discuss the concept that plants are rooted in the ground and spend their entire lives in one spot, but have active mechanisms with which to spread their seeds into new territory. It is through these mechanisms that plants were able to invade the barren areas of Glacier National Park as the ice age glaciers receded.
2. Choose a student to be a burr bearing plant. Explain that a burr is a seed designed to stick to animals that pass by. Mention that burrs were an inspiration for the invention of velcro (Natures Velcro). Show the students the velcro and burrs you've brought to class. Choose another student to be a large mammal that lives in Glacier National Park. Give the plant an inflated balloon. Ask the student to rub the balloon against clothing to generate static electricity. The

mammal comes walking down the trail, stops to scratch, and the plant places the balloon on the mammal's back. The balloon stays attached until the mammal has traveled some distance. Eventually the seed drops by the wayside.

3. Choose another student to be a huckleberry plant. Have the student hold some berries while standing by the trail. Another volunteer becomes a grizzly bear and eats the berries. The grizzly continues on down the trail and deposits seeds complete with fertilizer. A purple balloon is not as much fun as berries, but is more graphic in the deposit demonstration. Did you ever wonder why huckleberries seem to line so many of the trails in the Park?
4. Have another student be a mountain maple tree. Have the student inflate a green balloon, tie it, and use the wind to transport it as far away from its parent as possible.
5. Have another student be a puffball. Have the student inflate a dark balloon and release it. The balloon will rocket out into the room and settle on the floor some distance away. Some plants and mushrooms use gases to propel their seeds or spores out away from the parent plant.
6. Select students to be a pine tree and a stream. Explain that conifers use several mechanisms for seed and pollen dispersal. Give the tree a green balloon and have the stream meander by. As the stream passes by the tree, the tree drops a cone into the open arms of the stream. The stream continues down its course and deposits the cone ashore some distance below. It is important that students understand that this is only one of several ways that conifers spread their seeds.
7. Discuss the relationships that flowering plants have with pollinating insects. Explain that this is the most sophisticated arrangement for pollination of flowers.

   Before the presentation begins, sprinkle powdered sugar in the bottom of a colored grocery bag so that it sticks to the sides after shaking. Place a marshmallow in the bag with the sugar. Place another marshmallow in a second colored grocery bag (no sugar). Choose a student to represent a honey bee. Put the black or yellow stocking cap on the student's head and say there is a treat in the first bag. Explain that bees use their proboscis to obtain nectar from flowers.

   Hold the bag (blossom) and have the bee get its treat. The bee must stick its head in the bag. In the process of gathering nectar (marshmallow) the bee will pick up a coating of pollen (powdered sugar) on its head (cap). Ask the group what the bee has on its head. Tell the bee that you have another treat in the other blossom. In the process of bobbing for more nectar (marshmallow) pollen (powered sugar) will be deposited in the other bag. Show the small amount of pollen at the bottom of the second blossom to the group. Discuss the importance of bees to the process of pollination.

Follow Up:

Ask the students to explore their neighborhoods in search of various seeds and have them demonstrate and explain the mechanism for dispersal. Interesting seed variations are available during all seasons of the year. Have students choose a seed dispersal mechanism and report on plants using that method. Put the reports together in a class book on propagation methods in plants. Donate the book to the school library.

Classroom Activity 2
Native Harvest

Objective:
Students will become familiar with some of the Glacier National Park plants used by Native Americans for food, medicine, and construction.

Background:
After introducing the general background, supply as much personal information about plant uses as possible. Jeff Hart's *Native Plants and Early Peoples* is an excellent source of information, history, and stories about major plants used in this area. This book is included in the Activity Kit.

Materials:
Art Paper
Theme Paper
Colored Pencils
Native Plants and Early Peoples: Jeff Hart and Jacqueline Moore

Procedure:
1. After providing introductory information on Native American plant use, explain that the class is going to do some individual research and put together a book.
2. Emphasize the importance of respecting and preserving native plants in our environment and the respect we need to show for local tribes. We are not encouraging people to gather these plants, but rather to learn about them so that we might understand more about our environment and Native American cultures.
3. Read and discuss the background information provided by Jeff Hart for one or two interesting plants. Ask the students to each select a plant from *Native Plants and Early Peoples* or from their own experience that they would like to research. Explain that they will have to use at least two sources, oral or written, to make this research their own.
4. Ask students to keep in mind that they will be trying to locate specimens of as many of the plants as they can when they visit the Park.
5. Supply the students with the "Questions for Plant Research" listed below. Add additional questions that might be appropriate. The questions will provide students with some direction for their research.
6. When the students have finished writing, editing, and rewriting; ask them to do illustrations of their chosen plants.
7. Have the students present their research to the class and then bind the papers and illustrations into a class book. Take the book to Glacier and use it as a reference during your visit.
8. Present the book to the school library when completed.

Questions for Plant Research

1. List the common and scientific names and your local tribe's name (if available) for the plant you have chosen to research. Give a physical description of the plant.
2. How is this plant used by native peoples? What parts were used and how were they prepared for use?
3. Were there any special ceremonies or rituals observed when gathering, preparing and using this plant?
4. Are there any special legends or traditional stories involved with the use of this plant?
5. How does the plant reproduce? How does it spread into new territory?
6. In what sort of environment would you look for this plant? Does it have special requirements for soil, moisture, elevation, shelter, etc.?
7. Is this plant usually found in association with other plants?
8. Does your plant have any special relationships with other plants or animals?
9. What special contributions does your plant make to its habitat?
10. Are there any plants or animals that make life difficult for your plant? Is it a rare or threatened species?
11. What other interesting information can you supply about your plant?

Classroom Activity 3
What's in a Name ?

Objective:
Students will learn tribal names, as well as the scientific names (genus and species) for plants occurring in and near Glacier National Park.

Background:
Tribal members that have participated in the development of this program have expressed a strong desire to use bilingual teaching. Culture is difficult to understand, share, disseminate, and preserve without knowledge of native languages. Each tribe may have several words that indicate the same plant at different times of the year or when used for different purposes. There are dialect differences in pronunciations even within the same bands of each tribe. To make matters even more difficult, some sounds in native languages are not readily reproducible with phonetic symbols.

Local dialect and proper pronunciations can only be provided by elders and language enthusiasts in your area. This activity is designed to bring tribal elders into the classroom for language appreciation and study. Pronunciation and accompanying hand signs can only be communicated orally and visually. The presence of elders in a capacity to teach specific terms will stimulate language side trips and other enrichment.

Materials:
Marking pens
Note cards
Dictionary Of Word Roots And Combining Forms by Donald J. Borror

Procedure:
1. Ask a Native language speaking elder or tribal member to come to the classroom and work with the students on pronunciation and meaning of native terms for commonly used plants. A partial list is provided (contact the local tribal cultural committee for suggestions for speakers).
2. Concentrate on the common name, genus, and species and native term for your tribal area; but encourage the students to become familiar with other tribal languages as well as their own.
3. Demonstrate the use of the Greek and Latin root and suffix guide: *Dictionary Of Word Roots And Combining Forms*. Have students look up meanings of the scientific names for each plant.
4. Hand out markers and note cards, pick study pairs or teams, and have the students make their own flash cards to study as they would any other language flash cards.
5. Provide a forum to demonstrate or apply their vocabulary. For instance; labeled drawings could be displayed as part of an open house.

A List of Names for a Few Familiar Plants (add your own)

Serviceberry (sarvisberry, Saskatoonberry): ***Amelanchier alnifolia***

Blackfeet: ok-kun-okin	Kootenai: squmu	Salish: s saq

Black tree lichen: ***Alectoria fremontii***

Blackfeet: e-simatch-sis	Kootenai: a a	Salish: sawtamqan

Blue Camas: ***Camassia quamash***

Blackfeet: miss-issia	Kootenai: xapi	Salish: ltxʷe?

Biscuit-root (coos-root): ***Lomatium cous***

Blackfeet: koos	Kootenai: Naptnuquku	Salish: pcLu

Chokecherry: ***Prunus virginiana***

Blackfeet: pukkeep	Kootenai: A ki'lmak	Salish: txʷLo

Bitterroot: ***Lewisia rediviva***

Blackfeet: eks-ix-ix	Kootenai: Naqam¢u	Salish: spe> am

Lodgepole pine: ***Pinus contorta***

Blackfeet: manistami	Kootenai: I ti t'	Salish: qʷqʷLi?t

Western red cedar: ***Thuja plicata***

Blackfeet: sixinikok	Kootenai: I¢'nat'	Salish: astqʷ

Huckleberry: ***Vaccinium globulare***

Blackfeet: apa-oapspi	Kootenai: awiya	Salish: stsa

Yampa (wild carrot): ***Perideridia gairdneri***

Blackfeet: nitzi-katasi	Kootenai: Ni'¢na	Salish: s>ukʷam

Classroom Activity 4
Forest Communities

Objective:
Students will gain familiarity with local trees and learn to see them as indicators of prevailing climate, terrain, elevation, and stage of succession.

Background:
In the old days it was important for native peoples to be able to identify plant communities from a distance. Recognition of trees was a quick and usually accurate indication of the kinds of understory herbs, berries, and roots to be found in a given area. Skilled native botanists used these observations to lead their people to food sources. Today naturalists and botanists are able to tell a great deal about land, soil conditions, moisture availability, and history of natural disturbances in an area by identifying the dominant and incidental tree species.

Materials:
Easy Field Guide To Trees Of Glacier National Park by Dick and Carol Nelson
Plants Of Waterton-Glacier National Parks And The Northern Rockies by Richard J. Shaw and Danny On
(books are in Activity Kit)
Magnifying glasses
Poster board
Marking pens
Scissors
Glue

Procedure:
1. Review the background information in this track with the students. The background information for Park Visits is particularly relevant to this exercise.
2. Ask the students to gather samples of conifer branches and cones, and leaves and seeds of common deciduous trees from the areas around their homes. Discuss ways to minimize damage to trees while making collections. Emphasize that they should be looking for trees that they believe to be native to the area.
3. Have the students write descriptive notes of the physical environment from which each specimen was gathered.
4. Have the students use the tree guides to identify their specimens and to research their characteristics and habitat.
5. Have the students make leaf, cone, and needle displays.
6. Discuss where the trees they identified might occur in Glacier National Park.

Park Visit Activities

Visits to St. Mary and Apgar will involve naturalist guided investigations of plant communities studied during classroom activities. The St. Mary Valley and the Lake McDonald Valley offer fantastic visual laboratories for a wide range of activities. Visits to both sides of the park provide dramatic contrast in climate and representative plant communities.

Park Visit Activity 1
Plant Communities in the St. Mary Valley

Objective:
Students will examine plant succession stimulated by natural disturbances and examine transitional communities influenced by local climate and elevation. They will have an opportunity to locate some individual plants that they have researched, observe ways in which plants left in a natural setting interact with their environment, and see how plants pioneer and propagate in new areas. Finally, classes will be able to investigate efforts made by Park Service personnel to preserve native plant communities, restore areas impacted by human activity, and eradicate exotic plants that have been inadvertently introduced by human activity.

Background:
We know that Native Americans came to the St. Mary area for gatherings and ceremonials, to visit neighbors, to hunt, and to gather lodge poles and seasonal roots and berries. The people also tended secret tobacco gardens in cool moist areas near the mountains where the Great Spirits made their home. Many came to the mountains to make contact with the Spirits in vision quests.

St. Mary Lake is situated at the terminal point of a vast prairie that continues onto the open grasslands of Alberta. Rough fescue *(Festuca scabrella)* is the dominate native grass in the St. Mary Valley. Though the valley has been invaded by some exotics like spotted knapweed *(Centaurea maculosa)*, it remains one of a few refuges for native grassland communities.

The small lateral moraines on both sides of the valley display a gradual progression of plant communities as elevation increases. Moving up the St. Mary Valley, the grasslands quickly narrow to borders of shrub communities. As the valley edges climb, there is a gradual transition from grassland-shrub communities to aspen groves with understories composed of grasses and shrubs.

Near the valley floor, intermittent groves of conifers occur on stream banks. For the most part, however, individual conifers are interspersed within aspen groves. The quaking aspen *(Populus tremuloides)* and black cottonwood *(Populus trichocarpa)* that make up the groves are an extension of the southwestern Alberta aspen grove communities. Isolated conifers along the St. Mary Valley floor tend to be predominantly Douglas fir *(Pseudotsuga menziesii)*, lodgepole pine *(Pinus contorta)*, Engelmann spruce *(Picea engelmanni)*, and limber pine *(Pinus flexilis)*.

Further up the moraines and on the mountain slopes, aspen groves gradually give way to stands of fire-influenced lodgepole pine. Further into the St. Mary Valley where fire has not been severe, seral communities of Douglas fir and Engelmann spruce are more common.

Throughout the continuum of plant communities, moisture and elevation are the most important determinants of species composition: however, other minor climatic and terrain variables can be responsible for unexpected plant communities.

Higher up the mountain slopes (between 4-6000 ft.), lodgepole and Douglas fir gradually make a transition into stands of Engelmann spruce and subalpine fir *(Abies lasiocarpa)*. The higher the elevation, the more dominant the subalpine fir becomes. Above 6000 feet, especially at the head of the valley near Logan Pass, Engelmann spruce becomes less common, subalpine fir becomes more common, and white bark pine *(Pinus albicaulis)* makes a strong showing. At these elevations most species begin to take on krummholz or dwarfed characteristics because of the severity of the climate and the extremely short growing season. Above the alpine meadows, isolated flowers and grasses appear on moist barren ledges. Lichens can be found on the highest peaks in the park and algae occur on the surface of glaciers and snowfields.

Plant succession is influenced by natural disturbances such as flood, snowslides, drought, fire, and erosion. Fire is the greatest influence upon plant succession and accounts for the predominance of lodgepole pine at the lower elevations where it occurs most often.

Fire control during much of Glacier's history has altered the patterns of plant succession; however, it is difficult to assess the impact of Park fire control policies on plant communities. A major fire swept through the west side of the St. Mary Valley from Rising Sun to Babb in 1885. Before the 1885 fire, a more mature forest existed. Pioneer communities of lodgepole and aspen have dominated the valley since and have been aided in their dominance as late as the mid-1980's by the Napi Point fire.

Lodgepole are adapted to a natural fire regimen and produce two kinds of cones. One kind opens to spread seeds on a regular basis, while serotinous cones can lie dormant for years and only open in extreme heat. Thousands of lodgepole seeds released after a fire thrive in burned over-soil. Aspen have a similar pioneering advantage. They can reproduce by vegetative means spreading suckers in an ever-increasing island. While established aspen groves normally spread slowly through both vegetative and sexual means of reproduction, explosive vegetative sprouting occurs following fires severe enough to destroy the parent plants.

Elk, moose, deer, beavers, rabbits, ground squirrels, and mice feed on young pioneer saplings along the edges of groves during the coldest part of winter. In earlier times, large populations of buffalo provided a natural pruning service in the mountain valleys, resulting in more and larger open grassy areas than we see today. The spread of lodgepole and aspen communities into surrounding meadows is slowed by the feeding activity. Plants and animals, along with the occasional intercession of fire, have created a healthy mosaic of plant communities over time.

Park Visit Activity 2
Plant Communities in The Lake McDonald Valley

Objective:
Students will examine an area where prevailing climatic conditions support very localized and distinctive plant communities. Students will have an opportunity to locate some of the plants they have researched, observe ways in which plants left in a natural setting interact with their environment, and see how plants pioneer and propagate in new areas. Finally, classes will be able to observe efforts made by Park Service personnel to preserve native plant communities, restore areas impacted by human activity and eradicate exotic plants that have been introduced by human activity.

Background:
Lake McDonald was an important gathering place for the Kootenai and Salish. In spite of the impact of modern civilization, archaeologists have found evidence of seasonal paleo-Indian occupation near many streams and lakes on the west side of Glacier National Park.

The Lake McDonald Valley is a unique place in terms of its plant communities. The largest number of plant species in Glacier National Park occurs in the Lake McDonald valley. The western red cedar *(Thuja plicata)* and western hemlock *(Tsuga heterophylla)* forest is the eastern most extension of the Pacific Coast floristic peninsula. This forest is similar to the Pacific Coast temperate rain forest community.

As a result of fire and early settlement in the Lake McDonald area, the forest reveals a complex mosaic of plant communities. Today, cedar and hemlock are not abundant in the West Glacier and Apgar areas. However, historical records and existing isolated pockets of trees indicate that the cedar-hemlock dominance evident in the Avalanche Campground area extended to West Glacier near the beginning of this century. Due to fire and other disturbances, lodgepole pine *(Pinus contorta)* and western larch *(Larix occidentalis)* are currently more prevalent along the lower reaches of the Lake.

While lodgepole pine is generally the most common pioneer species after fire, western larch is also a very successful invader of newly burned areas. Lodgepole have amazing adaptive mechanisms that favor their propagation in newly burned territory. While they have some cones that release seeds on a continuous seasonal basis, they also have serotinous cones that remain closed and dormant until exposed to temperature extremes produced by fire.

Lodgepole and their accompanying understory plants do not thrive once a significant forest canopy has evolved. In fact, barring a second fire, the very success of lodgepole inhibits the success of their offspring, allowing opportunities for shade tolerant species to thrive. Lodgepole pine have a maximum life expectancy of about

150 years, while western larch, because of thick fire resistant bark, can often survive relatively cool fires and live as long as 800 years. As a result of this resilience, larch are often significant components of pioneer, seral, and climax forests.

In the absence of natural and human-caused disturbances, the McDonald Lake area would likely support a climax cedar-hemlock forest today. In fact, the Trail of The Cedars, near Avalanche Campground, approximates an ideal climax forest and all of its dynamics. The forest exists at an ideal elevation between 3200 and 3500 feet and many of its trees have survived for over 400 years. A short distance up the trail to Avalanche Lake, (elevation 3500 to 4000 feet), cedar and hemlock share dominance with subalpine fir *(Abies lasiocarpa)* and Engelmann spruce *(Picea engelmanni)*. As the elevation increases and average temperature decreases above 4000 feet, the spruce-fir community becomes more dominant and the cedar-hemlock community all but disappears.

Above the 4000 foot level Along the Going to the Sun Road north of upper McDonald Creek, the fire of 1967 has created a pioneer community dominated by mixed larch and lodgepole. Between the Loop and the alpine meadows of Granite Park, the terrain is populated by alternating stretches of subalpine fir, dense stands of alder *(Alnus sp.)*, and open meadows dominated by herbaceous plants ideal for grazing animals. Below the highway and near the head of Logan Creek, there are patchy stands of subalpine fir and various shrubs in subalpine meadows.

Western red cedar is a seral dominant within fire established lodgepole-larch communities along the lakeshore between Avalanche Campground and Apgar. While ample light is available in a newly established lodgepole canopy, cedar will readily spread seedings. Cedars once established also utilize asexual or vegetative reproduction. Low hanging branches make contact with soil and establish adventitious roots to produce new trees. Broken branches can fall to the ground and establish roots. It is not at all uncommon to see young trees maintaining their original connection with the parent tree.

While cedars are in the process of replacing lodgepole and larch, the environment becomes more receptive to their successional partner, western hemlock. Hemlock seedlings thrive in the moist organic debris of dying pioneer species. These seedlings can remain in a slow growth pattern for many years until an opening appears in the canopy. Hemlock go into a surge of growth to fill the space in the canopy. Eventually hemlock and cedar are able to assert dominance with only a smattering of other tree species interspersed among them.

Once a cedar-hemlock canopy is established, the understory tends to remain organically rich and moist, but too dark for the establishment of other tree species. Cedar saplings and shade tolerant hemlock seedlings can thrive in the environment prepared by parent plants. The moist understory provides some protection against fire. This climax community can maintain stability for hundreds of years under ideal conditions.

Back In The Classroom

Take the time to reinforce the Park Visit experience. Discuss the field trip with your students and decide what worked and what didn't. Be sure to fill out the trip evaluation form and return it to the park.

Some follow up activities for this Track include:

1. Have students write a letter to the naturalist who conducted your visit. Ask the students to tell the naturalist what they learned and what they enjoyed.
2. Invite someone who had extensive experience with the great westside fire of 1967, the Napi Point Fire, or the Red Bench Fire to come into your classroom and discuss conditions before the fire, management of the fire, and conditions in the area after the fire.
3. Invite elders into the classroom to tell students about traditional tribal use of the Glacier National Park area. Encourage a sense of pride in the historical associations and wise stewardship of the area by tribal ancestors.
4. Invite tribal elders to speak to the students about tobacco use and abuse. In the process of researching this track, many of the advisers expressed concern about difficulties involved in communicating the differences between traditional ceremonial use of tobacco and habitual tobacco abuse.