Table Rocks Curriculum

Some Plants Love Fire

Objective: By creating a fictitious ***pyrophyte*** (fire-loving plant), students will demonstrate knowledge of the ***adaptations*** Table Rocks plants have developed to survive fire. Students will explore positive and negative impacts of fire in each of the four plant communities on the Table Rocks.

Benchmarks Targeted: 2 and 3 (Grades 5-8)
Oregon Standards:

Subject Area: Life Science

Common Curriculum Goals: Diversity/Interdependence: Understand the relationships among living things and between living things and their environments.

Benchmark 2: Describe the relationship between characteristics of specific habitats and the organisms that live there. Describe how adaptations help a species survive.

Benchmark 3: Identify and describe the factors that influence or change the balance of populations in their environment.

Common Curriculum Goals: Organisms: Understand the characteristics, structure, and functions of organisms.

Benchmark 2: Group or classify organisms based on a variety of characteristics.

Benchmark 3: Describe and explain the relationship and interaction of organ systems.

Subject Area: Social Sciences

Common Curriculum Goals: Geography: Understand how people and the environment are interrelated.

Benchmark 2: Understand how physical environments are affected by human activities.

Benchmark 3: Understand how human modification of the physical environment in a place affects both that place and other places.

Subject Area: The Arts

Common Curriculum Goals: Create, Present, and Perform: Apply ideas, techniques, and processes in the arts.

Benchmark 2: Use experiences, imagination, observation, essential elements, and organizational principles to achieve a desired effect when creating, presenting or performing works of art.

Benchmark 3: Select and combine essential elements and organizational principles to achieve a desired effect when creating, presenting, or performing works of art.

Length of Lesson: 45 - 60 minutes

Materials:

- ✓ Various art materials; e.g., pencils, colored pencils, markers, drawing paper, construction paper
- ✓ Photographs or drawings of various fire loving plants

Key Vocabulary: ***adaptation, ecosystem, fire-dependent, fuels, germination, habitat, pyrophyte, scarification***

Background:

The response of a plant species or plant community to forest fire depends greatly on the fire's level of intensity. See Fire Ecology Chapter Introduction for more information on fire intensity.

Benefits of fire:

- Removal of invasive species
- Control of insects and disease
- Return of nutrients to the soil
- Promotion of seed ***germination*** by clearing leaf litter and underbrush
- Triggering seed ***germination*** or resprouting in many fire-adapted species
- Control of parasites
- Increased habitat (i.e., snags and fallen logs)
- Promotion of greater biodiversity by creating landscape "patchiness" (i.e., a mosaic of different ***habitat*** types, some recently burned and others at more mature successional stages)

Negative impacts of low to moderate intensity fire are generally short-term:

- Possible invasion of noxious weeds into open areas
- Temporary loss of food for herbivores and omnivores
- Temporary ***habitat*** loss for wildlife

Negative impacts of high intensity fires:

- Loss of late successional tree species that take longer to reestablish
- Scorching of soil which depletes the humus layer of nutrients and organisms
- Potential damage and loss of structures in the Wildland Urban Interface (WUI)
- Alteration of plant communities
- Loss of economically and ecologically valuable resources

The following information describes how each plant community on the Table Rocks responds to fire and explains fire adaptations of selected plant species within each community. **Please Note:** While hiking the Table Rocks, you will notice a fair amount of overlap between the plant communities and the species that are found in each.

Oak Savannah

Potential positive impacts of fire: inhibits growth of plants such as poison oak and buckbrush from invading the grassland; may inhibit growth of mistletoe, an oak parasite; returns nutrients to the soil; prevents the establishment of Douglas-fir saplings which can take over this plant community; promotes greater biological diversity; provides greater age variation within species; may help control invasion of nonnative grasses and other invasive weeds.

Potential negative impacts of fire: temporary loss of ***habitat*** for grassland and oak savannah species; may provide opportunity for nonnative species to establish; temporary loss of food resources (seeds, grass, acorns) for wildlife.

- **Oregon White Oak** and **California Black Oak**: The trunks of these two oak species can be destroyed by moderate to high intensity fires, especially when the trees are young. However, both species vigorously resprout from the roots or remaining trunk within a few weeks after burning. Low intensity forest fires actually help oak trees by burning excess leaf litter which can accumulate mold and destroy acorns and block sunlight from reaching seedlings. Low intensity fires improve conditions for acorns to ***germinate*** by recycling nutrients back into the soil. It is hypothesized that smoke from fires can kill mistletoe, a common parasite of oaks. Fire also prevents the intrusion of other trees, like Douglas fir, that do well in shady areas.

Chaparral
Potential positive impacts of fire: promotes growth of new sprouts from shrubs such as buckbrush, providing good forage for deer and other herbivores; low to moderate intensity fires prevent brush from becoming too thick and eases migration path for wildlife; helps control the spread of invasive species; promotes seed ***germination*** (many chaparral species require fire for ***germination***); promotes greater biological diversity.

Potential negative impacts of fire: temporary loss of wildlife ***habitat***; increased erosion (especially on slopes) due to loss of plant cover and brush on ground; may provide the opportunity for nonnative species to become established.

- **Buckbrush**: During late summer, mature buckbrush are highly flammable due to low moisture content and a waxy coating on their leaves. This coating helps them survive in dry climates and increases the chances of burning in a fire. High flammability is an ***adaptation*** that assists with ***germination*** and establishment of buckbrush. It is so flammable that it can actually increase the intensity of a fire! High fire temperatures cause ***scarification*** or weakening of the hard outer coating of a seed to speed ***germination***. Seedlings that sprout following a fire benefit from an influx of nutrients in the soil, greater space and access to sunlight, and less competition with other plants. Though a few seeds may sprout in the absence of fire, these young plants are less likely to survive.

- **White-leaf Manzanita**: A high intensity severe fire will destroy the aboveground parts of this shrub, but manzanita can resprout from its underground root mass. Manzanita has several ***adaptations*** that increase the fuel load and the chances of burning: it drops its branches during drought and continuously sheds its bark; leaves contain flammable oils which serve to promote the spread of fire and facilitate seed ***germination***; seeds are activated by fire which causes ***scarification*** of the seed and helps the plant ***germinate***; seeds remain dormant in the soil for decades, awaiting the next fire.

Mixed Woodland
Potential positive impacts of fire: promotes biological diversity; thins underbrush, lessening fuel load and decreasing the likelihood of catastrophic fire; promotes ***germination*** in serotinous cones (cones that require fire to open and disperse seeds) and seeds require ***scarification***; may help control insects, diseases, and parasites; recycles

nutrients into the soil; promotes growth of new shoots in root sprouters such as silk tassel and madrone.

Potential negative impacts of fire: loss of ***habitat*** for mixed woodland wildlife species; destroying thin-shelled seeds; drying out and loss of soil through increased erosion; decrease in shade-tolerant or late-successional species that take longer to regenerate; may provide opportunity for nonnative species to establish.

- **Pacific Madrone**: Mature madrone trunks can survive moderate intensity fire, but a high intensity fire will usually destroy the aboveground parts of this tree. Similar to its relative the manzanita, madrone has a fire-resistant underground root mass from which it resprouts aggressively during the first two years following a burn. Each new shoot can grow more than five feet in the first year! When a madrone tree grows in a cluster, ring or circle, it is evident a fire has been through the area. These trunks are not separate trees - they all sprouted from the same underground root mass after the last fire.

- **Ponderosa Pine**: When this tree is mature, it has very thick bark, which protects the living tissues beneath. It "self-prunes" by dropping lower branches as it grows so fire cannot climb the tree. Ponderosa needles have high water content, making them less flammable. The elongated needles insulate the growing bud tip of young ponderosa pines, giving the saplings a good chance of surviving a light fire. The shedding of needles provides fire with a fuel bed that burns slow and cool. Low intensity fire clears ***fuel*** and assists with the ***germination*** of seedlings.

- **Douglas-fir**: Like ponderosa pine, mature Douglas-fir has thick bark for protection from moderate intensity fires. Lower branches are continuously shed and this prevents fire from climbing into the canopy. Douglas-fir seeds ***germinate*** and grow well following a fire, but young trees are not fire-resistant. Therefore, Douglas-fir establishes in areas with infrequent fire. It is a shade-tolerant species that tends to be found in the later successional stages of a forest.

- **Silk tassel**: Similar to mountain mahogany, a high intensity severe fire will kill the top of silk tassel and will kill its thinly coated seeds if they are not more than 1" below the soil. After a fire, the shrub resprouts from the root crown and from any unburned branches. Growth of new shoots is very rapid; silk tassel can regain or exceed its previous height within a few years after burning. New branches can produce flowers and fruits in just two years. Fire is not required for seed ***germination***.

Mounded Prairie/Vernal Pools
Potential positive impacts of fire: returns nutrients to the soil; causes ***scarification*** of seeds; may help prevent invasion of nonnative grasses and other noxious weeds.

Potential negative impacts of fire: temporary loss of ***habitat*** for mounded prairie species; depending on severity, may disturb thin-shelled seeds, eggs, and cysts in the soil of the vernal pools; may provide opportunity for nonnative species to establish.

- **Dwarf Woolly Meadowfoam**: The seed contains oil that can withstand very high heat such as a moderate to low intensity fire. Fire usually occurs in this community during the hottest and driest part of the year which tends to happen after the seeds have dropped, when they are more resistant to high temperatures. The nutrients added to the soil after a fire allows seeds to establish themselves and thrive in the spring. A high intensity, severe fire, however, would scorch the soil, destroy the seed bank, and make it difficult for the plants to establish.

- **Miniature lupine**: After a fire, lupine typically thrives: it increases flower and seed production and sprouts from rhizomes following a fire. Lupine is a nitrogen-fixer which means it has the ability to pull nitrogen from the atmosphere and convert it into a form other plants can use.

Procedure:

Preparation:
Using information given in the Background and Fire Ecology Chapter Introduction, discuss plants and their relationship with fire.

Ask students if they think fire would help or harm plants. Have them think about an individual plant and how fire might affect it. Then ask how fire might affect an entire plant species. What ***adaptations*** do some plants have to survive fire? Have students hypothesize the positive and negative aspects of fire. Explain that prior to western settlement low intensity fires in southwestern Oregon occurred regularly and high intensity, severe fires occurred less frequently. Natural fires occurred from lightning strikes and the Native Americans used low intensity, cool burns to manage their landscape. It was not until after fire suppression that high intensity fires began to occur more often. With the lack of regular fire intervals in a forest, ***fuel*** loads have increased and trees have grown closer together making the forest more likely to burn.

After students have offered some ideas, introduce some Table Rocks plants and discuss their fire ***adaptations***. Pictures of some of these plants may be found on the BLM Table Rocks website at: <http://www.blm.gov/or/resources/recreation/tablerock/table-rock-plants.php>.

Activity:
1) Instruct each student to design a fictitious plant that has ***adaptations*** for surviving in a ***fire-dependent ecosystem***. Students may incorporate some of the ***adaptations*** discussed above, or invent their own. Encourage them to be creative and draw or craft a model of their fire-loving plant, or ***pyrophyte***.

2) Review the plant communities of the Table Rocks and discuss positive and negative impacts of fire in each community. Ask them to consider which community their plant is best ***adapted*** to survive in.

3) Have each student write an article about the plant they "discovered." The article should name the plant, explain how it is adapted for living with fire, tell which plant community it grows in, describe its growth requirements (soil type, amount of sun and water, etc.),

describe identifying characteristics, and explain which animals depend on it for food or shelter. Compile the completed articles into a scientific journal or ***pyrophyte*** plant catalog. Students could hold a mock scientific convention, giving presentations about their new plants for other classes, or stage a marketing campaign to persuade other classes to "buy" the ***pyrophyte*s** from their catalog for use in home gardens.

Extensions:

- Divide the class into small groups and have each group research one to three species of plants that require or benefit from fire and that grow in another part of the country or world. Have each group give a presentation to the class in which they describe the ***ecosystems*** where their plants live and how each plant is adapted to fire. Encourage creativity in presentation of the material. Have students discuss similarities or differences in the plant ***adaptations*** of our region to those of the plants found elsewhere. For different types of ***fire-dependent ecosystems*** in the United States, refer to <http://www.smokeybear.com/natural_ecosystem.asp>.

- Have students research a recent local forest fire (within the last five years). Have them collect media articles on the fire and present this "current event" to the class in a creative format. Ask students to analyze the media's treatment of the event. For example, is the fire portrayed positively or negatively? Why? Does this fire seem to be more beneficial or detrimental to the ***ecosystem***? Do the media provide information on any of the ecological impacts of fire? If so, are positive or negative ecological impacts emphasized? Do the media address the natural role of fire in the ***ecosystems*** of our region?

- Individually or in groups, have students research different types of plants on the Table Rocks. Have them answer the following questions:
  1) How can a fire harm the plant?
  2) How can the plant survive fire?
  3) How can fire help the plant?
  4) Is the plant a seeder, sprouter, resister, invader, or avoider? How do you know?

- Divide students into small groups and have each group gather pictures of ***pyrophytes*** to make a collage.

- Take a field trip to a recently burned area. Contact the BLM Medford District Office at 541-618-2200 for information on a safe site nearby.

- Explore additional resources at <http://www.blm.gov/education/LearningLandscapes/teachers.html>.

- Investigate <http://www.fs.fed.us/database/feis/about.html>, the USDA Forest Service database on the effects of fire on plants and animals. There is a great glossary of fire terms included.

Discussion Questions:

Give some examples of positive effects that a fire can have on an *ecosystem*.
*Fires maintain the health of many **habitats** such as prairies, savannahs, and chaparral. Fires can enrich the soil by releasing and recycling nutrients in litter and undergrowth, can activate heat-dependent seed varieties (i.e., lodgepole pine). Fire can generate new growth and can clear out underbrush, allowing a greater diversity of plant **species** to thrive. In the months and years after a fire, an increased amount of food and shelter sources will be available for many animals.*

Why do you think certain plants are more adapted to fire than others?
Plants that are highly adapted to fire occur in places where fire was historically present at regular intervals. For example, ponderosa pines developed thick bark for protection during a forest fire. Other conifers have cones that require fire to open and allow seeds to germinate. Plants growing along streams or near the ocean are less adapted to fire due to the infrequency or lack of fire in those particular ecosystems. Some plant communities produce more fuels than others, making them over time, more adapted to fire.

Do wildfires benefit humans as well as the forest?
*Low to moderate intensity fires can benefit humans in many ways. By clearing **fuels**, they can prevent high severity fire from occurring and spreading. Resources obtained from the forest are more likely to flourish in forests with regular fire intervals. These small-scale fires can keep insects and pests out of trees that we use for wood and paper, and can generate the growth of young plants we use for medicine, food, and materials. High intensity, severe fires, however, can destroy our homes and the aesthetic appeal of where we live.*

References:

"Fire." BLM Learning Landscapes. Michael Smith. 2002. Bureau of Land Management. 3 December 2007 <http://www.blm.gov/education/LearningLandscapes/teachers.html>.

Fire Effects Information System. Jane Smith. 2006. USDA Forest Service. 11 February 2008 <http://www.fs.fed.us/database/feis/about.html>.

McGlauflin, Kathy. Project Learning Tree: Environmental Education Guide. Pre K-8. Washington, D.C.: American Forest Foundation, 1993.

"Only You". Smokey Bear. USDA Forest Service. 11 February 2008 <http://www.smokeybear.com/wildfires.asp>.

PLANTS Database. 29 October 2007. United States Department of Agriculture, Natural Resources Conservation Service.13 February 2008 <http://plants.usda.gov>.

Table Rocks Environmental Education. 2007. USDI BLM. 7 December 2007 <http://www.blm.gov/or/resources/recreation/tablerock/index.php>.