ELSEE
Environmental Laboratory for
Sustainability and Ecological Education

Lesson 14: Fire Ecology

California Education Standards

Kindergarten, Earth Science

1. Different types of plants and animals inhabit the earth. As a basis for understanding this concept:

a. *Students know* how to observe and describe similarities and differences in the appearance and behavior of plants and animals (e.g., seed-bearing plants, birds, fish, insects).

b. *Students know* stories sometimes give plants and animals attributes they do not really have.

c. *Students know* how to identify major structures of common plants and animals (e.g., stems, leaves, roots, arms, wings, legs).

3. Earth is composed of land, air, and water. As a basis for understanding this concept:

b. *Students know* changes in weather occur from day to day and across seasons, affecting Earth and its inhabitants.

Grade One, Earth Science

2. Plants and animals meet their needs in different ways. As a basis for understanding this concept:

c. *Students know* animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting.

3. Weather can be observed, measured, and described. As a basis for understanding this concept:

a. *Students know* how to use simple tools (e.g., thermometer, wind vane) to measure weather conditions and record changes from day to day and across the seasons.

b. *Students know* that the weather changes from day to day, but that trends in temperature or in rain (or snow) tend to be predictable during a season.

c. *Students know* the sun warms the land, air, and water.

Grade Two, Earth Science

2. Plants and animals have predictable life cycles. As a basis for understanding this concept:

b. *Students know* the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice, and plants, such as lichen, woods, and fungi.

Grade Three, Earth Science

1. Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:

a. Students *know* energy comes from the Sun to Earth in the form of light.

3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:

a. Students *know* plants and animals have structures that serve different functions in growth, survival, and reproduction.

b. *Students know* examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.

Grade Four, Earth Science

2. All organisms need energy and matter to live and grow. As a basis for understanding this concept:

c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

b. *Students know* that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

c. *Students know* many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.

d. *Students know* that most microorganisms do not cause disease and that many are beneficial.

5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:

a. *Students know* some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Grade Five, Earth Science

4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:

a. *Students know* uneven heating of Earth causes air movements (convection currents).

Grade Six, Earth Science

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, students should develop their own questions and perform investigations. Students will:

c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.

Grade Seven, Earth Science

3. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

a. *Students know* both genetic variation and environmental factors are causes of evolution and diversity of organisms.
e. *Students know* that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

Grade Eight, Earth Science

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept:
d. *Students know* the velocity of an object must be described by specifying both the direction and the speed of the object.

Objective: Students should understand and determine the levels of fire by observing the landscape environment, and have a good knowledge of the three major environment factors that trigger wildfire.

Vocabulary

Fire Ecology – the process that links the wildlife fire to some associative ecological effects triggered by the fire
Firescaping – a form of landscaping design and maintenance
Climate – a measure of temperature, humidity, precipitation, pressure, and wind over a long period of time
Pests – animals or plants harmful to humans, causing a nuisance to human activities
Weeds – unwanted plants or plants that may disrupt the growth of native plants
Fire Suppression – techniques used to prevent wildfire from occurring
Fire Prescription – also known as controlled burn, a technique used to manage a forest by igniting fire for the stimulation of plant growth.

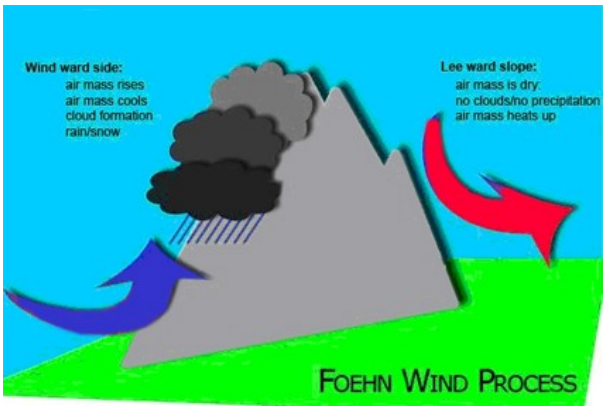
Lesson

Fire ecology is the process linking the wildlife fire to some associative ecological effects triggered by the fire. Natural fire can occur in many ecosystems, such as savanna, prairie, chaparral, etc. Natural fire is closely associated with ecology because it allows both animals and plants to germinate, to establish, and to reproduce.

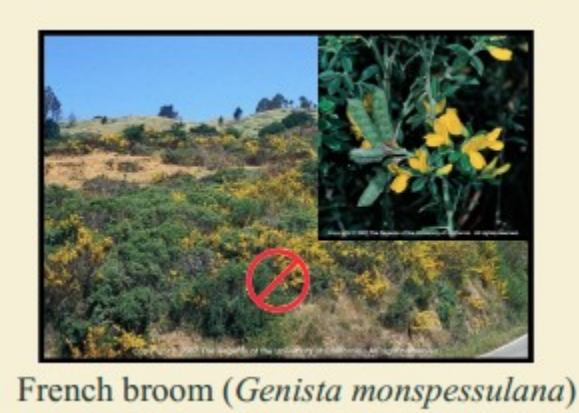
In determining the risk of fire, there are five factors students need to understand and apply to any living properties, because they determine the ignition of fire in a property. They are:

Defensible Space: area within 30 feet of a property
Outlying Areas: within 30 feet to 100 feet from a property (most influential if the property is old)
Degree of Slope: the steeper the slope, the greater chance of igniting fire
Exposure: directional exposure to sunlight, wind, and evaporation dries the soil
Emergency Access: important for human and pet survival during a wildfire

Three major forces that act on the control of a wildfire are climate, pests, and people. Climate is one of the main driving forces for igniting fire especially in extreme climates, such as
- Heavy rains: heavy rainfalls, acting as **flash fuels**, can lead to fast growing of grasses, which are more likely to spread fire.
- Seasonal or prolonged drought: can cause excessive amount of dead leaves and deadwood, increasing the chance of wildfire
- Freezes and prolonged frosts: extremely cold weather induces wildfire
- Uncommonly hot weather: heat can dry out the plants
- Ferocious winter storms: storms can cause severe damage to a landscape
- Foehn winds: a type of dry leeward slope wind that creates warm, dry conditions on a slope and may induce wildfire.



Weeds and pests can have a detrimental impact on triggering a fire on a landscape.
Weeds or nonnative plants such as Himalayan Blackberry, Giant reed, and French Broom are mostly likely to induce fire; they are considered flammable weeds.


French broom (*Genista monspessulana*)

Some pests, such as bark beetles, can potentially harm the health of conifer trees, which tend to be nonflammable, by increasing the proportional ratio of flammable plants versus nonflammable plants.


Bark Beetles

Human Impact
Human-induced impacts are air pollution, runoff, level of groundwater, and fire suppression.

- Air pollution can lower the rate of photosynthesis and make plants less resistant to fire.
- Runoff is the most dangerous factor for the risk of fire on a natural landscape.
- Over-extraction of groundwater leads to dry landscape and the risk of fire.
- Fire suppression is sometimes not preferable because regular fires can prevent a natural landscape from getting infested and old.

The relationship between water and fire in a garden tends to be opposite. The more moisture we add into the garden stored within the plants, the harder it is for a fire to ignite. However, adding too much water into the garden is not good either. The goal is maintain the water budget and balance the water we use and the water plants essentially take in.

Materials
Paper
Pencils
Magnifiers

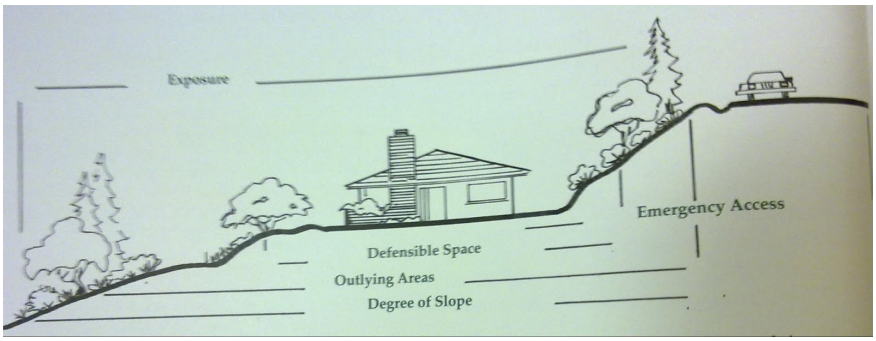
Activity 1: Ranking fire likelihood
Divide students into three groups of five students each. Each student will be assigned specific factors that describe the risk of fire in a garden. These factors are defensible space, outlying areas, degree of slope, emergency access, and exposure. There are total of 34 points. The higher the points, the more risk the garden will potentially burn. The group that gets the most accurate points for the risk of fire in the garden truly understands how to determine the level of fire risk.

Factors	Options	Points Awarded
Outlying areas	Landscape that is cleared of dead material. Trees and	1 point

	shrubs are isolated by a distance of two times per height.	
Outlying areas	Wild grasses intermixed with poorly maintained shrubs. The shrubs comprise no more than one third of the grassy landscape.	2 points
Outlying areas	Maintained shrubs under regularly maintained trees	3 points
Outlying areas	Poorly maintained shrubs and trees with dead vegetation	5 points
Degree of Slope	10% slope, flat surface	1 point
Degree of Slope	11%-30% sloped surface	3 points
Degree of Slope	Slopes greater than 30%	5 points
Exposure	Landscape facing northeast	1 point
Exposure	Landscape facing northwest	2 points
Exposure	Landscape facing southeast	3 points
Exposure	Landscape facing southwest	4 points
Emergency Access	Two lanes	1 point
Emergency Access	Single lane	3 points
Emergency Access	Single lane that is narrow, curvy, and has dense vegetation	5 points
Emergency Access	Large enough lane for a fire engine. Trees and shrubs are 6 feet away from the pavement.	1 point
Emergency Access	A house with unprotected areas, such as a deck that overhangs a slope	3 points

Emergency Access	No access to house	5 points
Additional factors	A roof covered with branches and withered leaves	1 point
Additional factors	A tree overhanging a chimney by 10 or fewer feet	2 points
Additional factors	A house more than 1,000 feet from a fire hydrant, or 5 miles or more from a fire station	2 points
Additional factors	A house 20 or more years old	2 points
Additional factors	A house with unprotected areas, such as a deck that overhangs a slope	3 points
Additional factors	A house that has a wood-shingle roof	5 points

Scoring System
6-15 points = low risk of fire
16-23 points = medium risk of fire
24-35 points = moderately high risk of fire
36-44 points = dangerously high risk of fire



Activity 2: Observing the growth of plants after fire
This is an observational activity. In the ELSEE garden is the Butterfly Garden, which is composed of two rows of plots. We may burn one of the garden plots and leave the other intact to see their differences in terms of growing. After a couple weeks, students may come back and see which plot is flourishing the most. Thus, we understand the importance of wildfire as part of the ecological process in a natural ecosystem.

Activity 3: Learning how to water in a firescaped garden
Recap from the previous lesson; drought tolerant plants are more likely to burn. They are characterized by small, brittle, waxy, and hairy leaves. They need a careful irrigation system in

order to survive and flourish. If a garden gets too little water, the likelihood of fire increases. To keep plants growing well, we need to know the amount of water each plant needs. The first step is to determine the soil type. Students can split into groups of four and dig up two samples of soil at two depths: the soil at the top and soil that is 8 inches deep. Then moisten one of the samples. Finally, squeeze the two samples to identify what they are.

Coarse/Sand: loose soil; easily fall apart.
Medium/Silt: moist, keeps its own shape; dry, it crumbles.
Fine/Clay: dry, easily breaks into slump (a mass of loosely consolidated materials); wet, easily holds shape.

Watering Times

Plant Group pmwd	Coarse/Sand	Medium/Silt	Fine/Clay
As shown below, deep watering is time consuming. Fortunately, soils that are slow to take water are also slow to lose it. Even in the middle of summer, it may take three to four weeks for clay soils to dry. (Note: gpm is gallons per minute. Also, 1 inch of water equals 62 gallons of water, the equivalent of filling 100 square feet with 1 inch of water.)			
Low, shallow-rooted ground covers 3 inches	Water: 0.25"/15 gal. Time: 1–2 min./10 gpm max. pressure	Water: 0.375"/23 gal. Time: 4–5 min./6 gpm. max. pressure	Water: 0.5"/31 gal. Time: 8 min./4 gpm max. pressure
Medium-sized ground covers 6 inches	Water: 0.5"/31 gal. Time: 4–5 min./7.75 gpm max. pressure	Water: 0.75"/46 gal. Time: 13 min./3.5 gpm max. pressure	Water: 1"/62 gal. Time: 1 hr./1 gpm max. pressure
Large ground covers 9 inches	Water: 0.75"/46 gal. Time: 12 min./4 gpm max. pressure	Water: 1.25"/77 gal. Time: 25 min./3 gpm max. pressure	Water: 1.5"/93 gal. Time: 1.5 hrs./1 gpm max. pressure
Small shrubs 1.5 feet	Water: 1.5"/93 gal. Time: 26 min./3.5 gpm max. pressure	Water: 2.25"/140 gal. Time: 48 min./3 gpm max. pressure	Water: 3"/186 gal. Time: 3 hrs./1 gpm max. pressure
Large shrubs 2.25 feet	Water: 2.25"/140 gal. Time: 42 min./3 gpm max. pressure	Water: 3.375"/232 gal. Time: 1.25 hrs./3 gpm max. pressure	Water: 4.5"/279 gal. Time: 4 hrs. 50 min./0.9 gpm max. pressure
Small trees 3 feet	Water: 3"/186 gal. Time: 1 hr. 6 min./2.8 gpm max. pressure	Water: 4.5"/209 gal. Time: 1 hr. 45 min./2.8 gpm max. pressure	Water: 6.5"/403 gal. Time: 7 hrs. 10 min./0.8 gpm max. pressure
Large trees 3.75 feet	Water: 3.75"/232 gal. Time: 1 hr. 36 min./2.4 gpm max. pressure	Water: 5.625"/349 gal. Time: 2 hrs. 26 min./2.4 gpm max. pressure	Water: 7.5"/465 gal. Time: 8 hrs. 33 min./0.8 gpm max. pressure

Source: Adapted from Estimating Water Requirements of Landscape Plantings: The Landscape Coefficient Method, *Cooperative Extension University of California, Division of Agriculture and Natural Resources, Leaflet 21493; and* Low Volume Landscape Irrigation Design Manual, *Rain Bird Sales Inc. Contractor Division, 1994.*

Videos:

Ecological Restoration Animation:

http://www.youtube.com/watch?v=CR-vsAwCR0Q

Sources and Links:

Kent, Douglas, *Firescaping*, Wilderness Press, Berkeley, California, 2005.
http://en.wikipedia.org/wiki/Fire_ecology