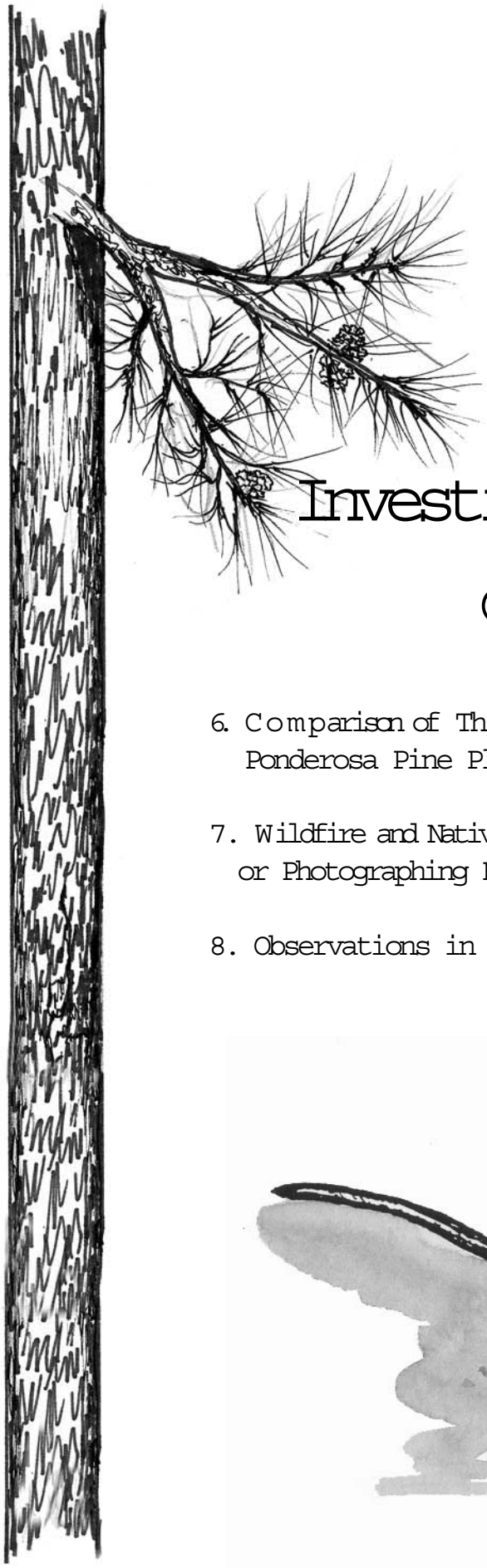

Investigating Fire Ecology

On-Site Activities

6. Comparison of Thinned and Unthinned Forests: Ponderosa Pine Plot Study 127-132

7. Wildfire and Native Plants: Sketching or Photographing Plants 133-137

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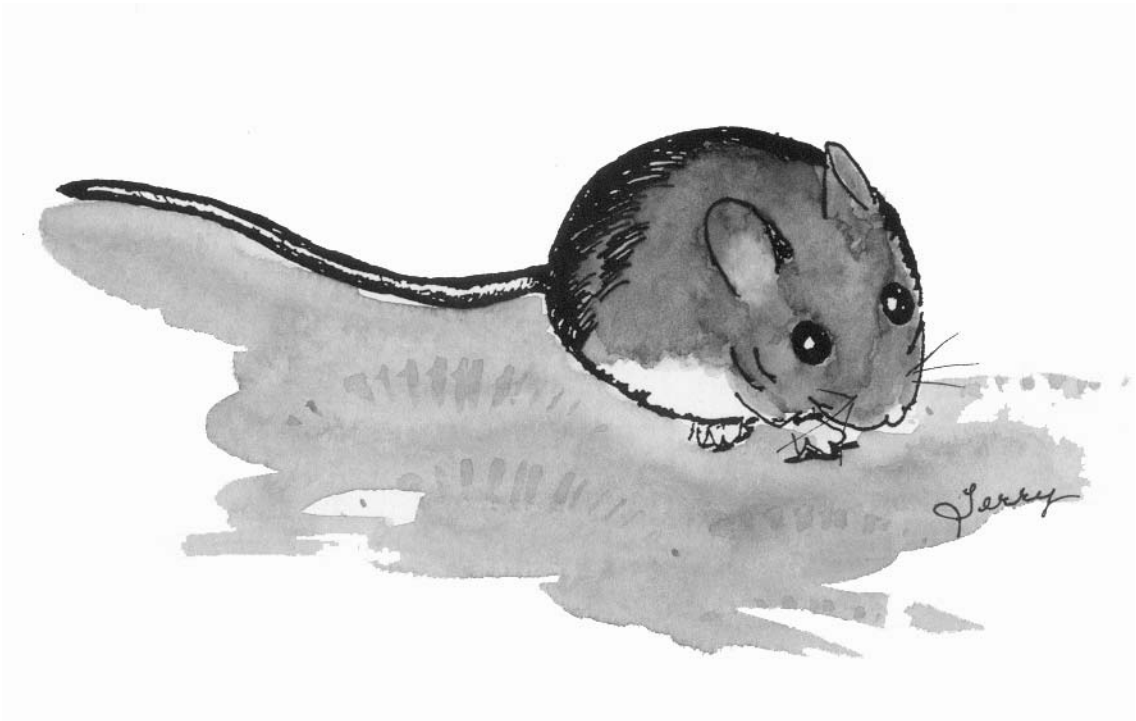


COMPARISION OF THINNED AND UNTHINNED FORESTS: PONDEROSA PINE FOREST STUDY PLOTS

FOCUS QUESTIONS:
What makes a healthy forest?

When wildfire strikes, why do some trees live while others die?

OVERVIEW OF LESSON PLAN:
This interdisciplinary field unit lesson combines mathematics, science, and language arts skills to discover and describe conditions and characteristics in thinned and unthinned sample plots in a ponderosa pine forest. These plots are an analog of pre- and post settlement forest conditions. In the classroom students will be introduced to basic fire ecology with an emphasis on local fire history.After classroom preparation lessons on fire, fire ecology, and measuring, in the field students will collect field data in a 20 x 50 meter ponderosa pine tree plot. They will divide this plot into 4 smaller rectangular sections 20 x 12.5 yards meters each. Working in teams, they will be counting, measuring diameter, and recording the number of pine trees they find in both the thinned and unthinned sections of forest. They also will be counting the number of different species in the understory of each plot. Students will enter their data in a database and submit a report summarizing their findings.

TEACHER BACKGROUND INFORMATION
On the field trip, students will collect the raw data necessary to evaluate forest health. In a post-trip classroom session, student will use the data to evaluate five indicators of forest health: number of trees per acre, average size of trees,the total tree basal area, and diversity of the understory.

Ponderosa Basics
Ponderosa pine (Pinus Ponderosa) is the most common and widespread pine in North America. A ponderosa pine can live 400-500 years. They grow to be 60 130 feet tall and up to 2 to 4 feet in diameter, depending on local conditions. The variety of ponderosa pine we have here usually has needles in bundles of three. The needles are 4 8 inches long the longest of any conifer (cone-bearing tree) in the Jemez Mountains. Sometimes the bark smells like vanilla! Ponderosa forests developed in this part of the southwest about 8,000 9,000 years ago,as the climate warmed at the end of the last ice age. These forests were open with individual trees or small clumps of trees, spaced widely apart (about 50 150 trees per acre). Locally, ponderosa pine forests grow from about 7,000 8,500 feet in elevation.

Humans in Ponderosa Pine Forests
Humans have lived in these forests for thousands of years. There are cavates in the diffs on the north side of Rendija Canyon that are between 400 and 900 years old and a homestead on the mesa above them that dates back to the 1800s.

PONDEROSA FIRE ECOLOGY

Fire is a keystone ecological process in ponderosa pine forests of the southwest. It helped to shape and maintain these forests. Ponderosa pine is a fire-adapted species. These trees have thick bark to protect the tender growing tissue beneath. They lose their lower branches, so surface fires don t have a ladder to climb into the crowns. They have long needles to help protect the growing branch tips.

Prior to 1890, ponderosa pine forests had the highest fire frequency of all forest types found in the Jemez Mountains. Frequent, low-intensity surface fires burned through the grassy understory of these forests about every 7 10 years. These fires, mostly caused by lightning, kept the forest open, with trees widely spaced. These fires also recycled important nutrients. Then, around 1890, the fires just stopped throughout the southwest. This was due to the combined effects of overgrazing by livestock, high-grade logging, fire suppression, and climate. Grazing animals, especially sheep, ate all the grass that used to carry the fires. Without them, the forests became much denser and full of fuels for bigger, more destructive crown fires. Some of our ponderosa pine forests now have several thousand trees per acre!

Wildlife Habitat in Ponderosa Pine Forests Who Lives Here?
Deer, elk, mountain lions, squirrels, porcupines, hawks, songbirds, woodpeckers, bees, wasps, lizards can you name 3 others?

SUGGESTED TIME ALLOWANCE:
Class Time: 45 minutes, Field Time: 1.5 to 2 hours

LOCATION:
Rendija Canyon, Ponderosa Campground or other field site

SUBJECT AREAS: Language Arts, Social Studies, Science, Math, Technology

STUDENT OBJECTIVES
Students will:

- Demonstrate mathematical skills by laying out a plot and measuring the diameter of the trees in two plots
- Gain an overall understanding of how forest density affects wildfire behavior
- Study the effects of wildfire on thinned and unthinned ponderosa pine forest stands and make quantitative measurements by comparing tree density and understory species of two comparable plots
- Demonstrate mathematical skills by measuring the diameter of the trees and stumps in both plots
- Collect and record scientific data in each identified plot
- Describe qualitatively the characteristics of a healthy forest and an unhealthy forest
- Gain an overall understanding of how forest density affects wildfire behavior

VOCABULARY

Thinned	Keystone process
Unthinned	Biodiversity
Competition	Fire suppression
Crown	Ladder Fuels
DBH	

MATERIALS AND RESOURCES

- Field journals
- Clipboards
- Pencils
- 8 aluminum corner stakes
- 4 300-foot rag tapes
- 6 100-foot rag tapes
- 8 rolls of surveyor tape
- 8 marking pens
- 8 diameter tapes
- 2 increment borers
- 8 pin flags, labeled T1-T4, U1-U4
- 8 three-foot ropes or plastic circles
- Forest Plot Datasheets
- GPS receivers
- Plot Sketch Data Sheets
- Computers
- Internet Connection (optional)
- Database/Spreadsheet software

PRETRIP PROCEDURES

1. In the classroom, students will learn about how grazing and fire suppression over the last 100 years have changed our forests. In the field, they will gather data from a healthy and unhealthy forest plot and compare tree density, ground cover, and species diversity to evaluate forest health.

2. As a class, students will brainstorm a list of what makes a healthy forest and what makes an unhealthy forest.

3. Divide students in groups of three or four, assigning each group the following questions:
    a. When wildfire strikes, why do some trees live and others die?
    b. What happened in the late 1800 s that contributed to crowded forest conditions?
    c. How has the ponderosa pine forest ecosystem changed over the past century?
    d. What differences do you think you will observe in the thinned plot and the unthinned plot?

4. Resume whole class discussion.

FIELD ACTIVITY PROCEDURES

Lay Out Plot

Instructors may want to line out the plots ahead of time.

1. Use the method practiced in lesson 4 to lay out two rectangular plots, one in a treated stand and the other in an untreated stand. The plots will bear 20 x 50 meters (approximately 1/4 acre). Mark plot corners with rebar or stakes.
2. Divide this plot into 4 smaller rectangular sections 22 meters by 12.5 meters each and mark the dividing lines with pin flags.
3. Label the flags for each subplot with a two-symbol code: U or T for thinned or unthinned, and a number from 1 to 4.
4. Use pin flags to identify the subplot section.
5. With a GPS receiver, find and record the coordinates for the corners of the plot.

Unthinned Plot Data Collection

Preliminary Observations

Write down three things you notice about the plot. These can be things about the trees (height, density, color), the amount of bare soil under the trees, whether or not the tree crowns overlap, etc. Are there any signs of animals, birds, or insects living on or using the plot?

Mark and Number Trees

1. Record the plot number code on the data sheet.
2. Record relative locations and dimensions of all the trees in the subplot by making a sketch on the data sheet provided.
3. Tie colored flagging around each tree in the plot section. Include the stumps, if you are working on the thinned plot.
4. Use a marking pen to write a unique number on the flagging tied around the tree.
5. Measure the diameter of each tree at chest height (about 4.5 ft. above the ground). Record this number on the data sheet in the column marked DBH (diameter breast height).
6. Use the tape to measure the diameter of all trees in the subplot. Record each diameter on the flagging tied around each tree.

Map Trees

Use a pencil with an eraser for this part! Using the sheet with the outline of the plots, write the plot (thinned or unthinned) and section (1, 2, 3, and 4) on this map. Make sure to fill in the correct section. Work in teams. Move to one corner of the plot. Students can estimate the position within the plot rectangle of each tree in the plot. Use the tapes along the edges of the plot and the stakes at the corners as guides. Students then draw a circle on their the map for each tree. Write the tree s number next to the circle. Be careful to leave enough room on the map for all the trees.

Measure Trees
Measure the diameter of each tree at chest height (about 4.5 ft. above the ground). Record this number on the data sheet in the column marked DBH (diameter breast height).

Measure Stumps (Thinned Plot Only)
1. On the thinned plot, measure the diameter of all the stumps. Record this number on the data sheet.
2. Count the number of annual growth rings on the stumps. Record this number on the data sheet.

Biodiversity Indicators
1. Select a random patch of ground and spread out a loop of rope in a rough circle, or toss a plastic ring. Within the circle, estimate which of the following best represents the percent of ground surface covered by vegetation (as opposed to bare dirt): is it 0%, 25%, 50%, 75% or 100%. and record the estimate on the data sheet. Look at the plants within the circle and determine the number of different species present. (grasses, shrubs, wildflowers, etc.). Repeat 8 times at different locations around the plot.

2. Repeat the study for the thinned plot.

POST TRIP ACTIVITIES DISCUSSION AND ESSAY

1. Compare the number of trees per acre for subplot data and the entire plot. Are the numbers close? Which is more accurate and why?
2. Pre-settlement tree density in ponderosa stands averaged 70 to 100 stems per acre. Which of the two plots is more representative of historic forest conditions?
3. Ground cover and species diversity are measures of forest health. What does your understory data tell you about the forest health in unthinned and thinned pine forests?
4. Compare the distribution of size classes in the two plots. What conclusions about forest health can you draw from your observations?
5. Compare the volume of timber in each of the plots. What can you conclude about the thinning on tree and forest health?

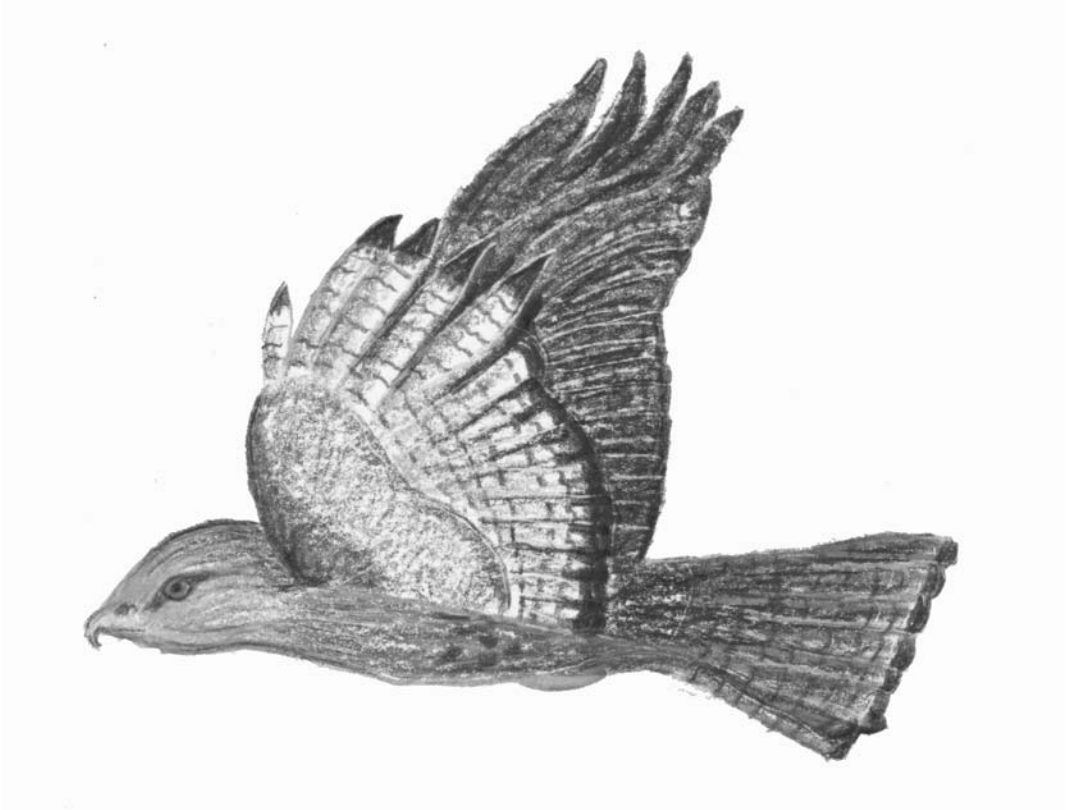
EVALUATION:
Students will use forest density data collected on their field trip to analyze forest structure and compare pre and post settlement forests. Using their analysis and background, they will write a prescription for creating a healthier forest.
Student data should be complete with tree diameters, understory vegetation, and general observations recorded on their data sheets.

POTENTIAL RESOURCES:

http://www.greenforests.com/newsrel.html

http://www.wa.gov/dnr/htdocs/rp/stewardship/bfs/WESTERN/thinning

http://fire.nifc.nps.gov/fire/ecology/docs/construct.html



WILDFIRE AND NATIVE PLANTS:
SKETCHING or PHOTOGRAPHING PLANTS

ON-SITE ACTIVITY

FOCUS QUESTIONS

What effect does wildfire have on plants?

What are the common types of plant species that inhabit an area after a forest fire?

OVERVIEW OF THE LESSON PLAN

This field lesson will introduce students to common plant species found in the region following a forest fire. On the field trip they will participate in a plant scavenger hunt and sketch or photograph selected common native plants. Back in the classroom, they will compile their research into a plant field guide. In order to ensure that this lesson is successful, the students will need to identify common plants via available resources in the classroom before going out in the field. It is advisable for the teacher to survey the area where plant observations are to take place before the students go out in order to find the most suitable location for collecting plants. The plants listed in this guide are most common in late summer and early fall in the Los Alamos area. (NOTE: Be sure NOT to collect or disturb any species which may be endangered or at risk).

SUGGESTED TIME ALLOWANCE: 1 hour

LOCATION: Rendija Canyon or other field site (not Ponderosa Campground)

SUBJECTS: Science, Language Arts , Math, Art, Technology

STUDENT OBJECTIVES

Students will:

- Use keys and plant cards for plant identification
- Develop plant observation, identification and classification skills.
- Use the handout, Plant Scavenger Hunt Check List and look for as many identified plants as time allows.
- Use the Plant Scavenger Hunt Observation sheet to draw and label two native plants of their choice. (See also photographing & collecting)
- Become more sensitized to and appreciative of the flora around them.

VOCABULARY

- Forest succession
- Adaptation
- Serotinous
- Phyrophytes
- Endangered species
- Native plants

FIELD MATERIALS

- Science journals
- Field guides of regional plant life
- Colored pencils
- Cameras
- Plant scavenger hunt check list
- Plant scavenger hunt observation sheet
- Plant identification cards
- Plant data sheets

PROCEDURES

1. PLANT SCAVENGER HUNT

a. Review safety rules.
b. Pair students in teams of 2-4.
c. Using the plant scavenger hunt check list and plant identification cards find as many plants as time allows.

2. FIELD SKETCHING

Introduce field sketching as part of both science and art. Many students will be apprehensive about drawing, and claim that they can t draw. This is just not true. The importance of field sketching is in conveying information, and allowing the sketcher an in-depth understanding of the object sketched. Sketching can improve observation, patience, and hand-eye coordination, as well as increase knowledge of how things are put together, how they function, and where they live.

1. Have students work in teams of 2 4.
2. Give students a choice of plants they may sketch.
3. Spend at least 2 minutes just observing their plant before they begin drawing.
4. Drawing by memory: Have students observe the plant, then try and draw it from memory. This is a skill that all sketchers would like to perfect because they could then be formulating drawings in their heads all the time. Have students try a few of these before they look at their plant again.
5. Contour drawing: This time, have students look only at their subject, and NOT at the paper. Have students place their pencils on the paper and NOT lift them up until they feel they are finished. Draw all the ins and outs, not just the outline. These drawings may be really funny looking but for new students of sketching, they will often show some of the best observing and line use.
6. Quick gesture sketch: Have students look at both the plant and the paper simultaneously. No erasing allowed!! This type of sketching was common for artists like Michelangelo, Picasso and Van Gogh. Gesture sketches should loosen up hands and fingers. Keep these sketches under 10 seconds.
7. Diagrammatic sketches: Basically a line drawing like those seen in field guides. Have students write details next to the drawing, like hair stem, pinkish petals, found near a burned tree in Los Alamos, NM and the date. Spend about 5 minutes on this drawing.

8. Draw only part of the plant.
9. Study drawing: A complete drawing. Spend about 15 minutes to 45 minutes. Include shading

(Reference: Leslie, C.W. (1995). The Art of Field Sketching)

3. PHOTOGRAPHY

Handling a camera with skill and ease may make the difference between getting a sharp picture or getting one that s fuzzy. It s important that the photographer doesn t fumble with the camera, doesn t focus improperly, or jiggle the camera as the shutter release is pressed. It is recommended to practice without film first to develop good camera handling habits.

1. Have students work in teams of 2-4.
2. Give students a choice of what plants they may photograph.
3. Make sure the camera lens is clean.
4. Hold the camera steady in order to obtain sharp pictures.
5. Explore different camera angles to determine the best composition and the most creative approach. Shoot down to create attractive pinwheel patterns of daisies; kneel to the level of other flowers.
6. Use a simple background. Find a position that provides a plain, non-competing background. Or place a black or pleasingly-colored cardboard behind the flower.
7. Move close to your subject (plant) for dynamic photos with impact. With a digital camera, use the display screen to compose the picture.
8. Use creative lighting. Observe the lighting on your plants. Backlighting shining through some flowers gives them an appealing glow. Cloudy-day lighting reveals subtle hues.

(Resource: Adapted from the Kodak website http://www.kodak.com)

4. PLANT COLLECTING

(not an option at Ponderosa Campground in Bandelier National Monument - items may not be collected anywhere in the park)

Discuss the ethics of plant collecting.

When collecting plants you may find yourself hesitating because you don t want to alter or disturb the particular habitat in which you find them. You always have to weigh the educational value of the collection against the impact of removing the parts of the plant. Make sure there is enough of the desired plant in your area. If you only see two, the plant should be left alone. If you see 10 that s a reasonable number to work around. You should be familiar with any sensitive, threatened, or endangered species you might encounter. Only take enough of the plant to serve the needs of your lesson. Never pick more than a third of a plant. If it is a solitary bush or tree, remove just a few twigs and leaves from the outer edge. Small pruning shears work well for a cutting tool. Wildflowers have a slower reproduction rate and grow much more slowly than other types of plants. Collecting or disturbing could affect their survival. Use your best judgment. If they are in their seeding mode, collect the seeds from only a couple of plants and leave the rest. Collect plants when the dew has dried and the flowers are fully opened. Be sure to collect enough length of the plant to show several leaves, flowers, and fruits.

Before going on to private land, get permission. Collecting is illegal in city, county, state, and national parks. Collecting is allowed in most national forests and grasslands and state-owned wildlife and waterfowl production areas. You should always seek permission from the state agencies first.

Introduce common plants students may find in the field by showing them pictures or making overheads from sketches. Ask students if they can identify these or know of any other species they may find.

1. Direct teams to specific collection areas with the following materials: pruners or scissors, coffee filters for collecting plants, pencils, data sheets, guide books, or copies of plant identification handouts.
2. Have students collect up to 10 samples, each of different plants they find.
3. It is very important to keep careful records when collecting plants. Plant names do not have to be known at the time of collection they can be looked up later. Data should contain common name of plant, scientific name of plant, location collected, growing site, habitat, surrounding vegetation, name of collector, date, general description. (See plant collecting data form).
4. To get successful results from pressing, it is important to pick and then store the plants properly while you are still in the field. Ideally it is best to press them on location. Good botanical specimens deteriorate quickly. If practical, press plants in an old phone book or plant press on site. Paper coffee filters work temporarily, so students can carefully store their plants until they return to the classroom. Small plants can be placed singly, or two or three together if necessary. Plastic bags are not recommended because the risk of damaging the specimen is very great. A small sticky note with the plant name placed with the plant will help students with identification later.
5. If they haven't already done so in the field, students should press their plants as soon as they return to the classroom.

PRE-TRIP

Students should complete lesson 3 in the classroom, and review the special safety rules below.

SAFETY IN THE FIELD FOR PLANT COLLECTION

1. Survey the study site for potential hazards before taking your class out.
2. Define boundaries of the study site. Make sure students know these boundaries. Consider using brightly colored engineer stape to mark boundaries.
3. Check for the presence of large amounts of bees or wasps around the plants you want to sketch or photograph.
4. Warn the students never to eat any plant or plant part.
5. Check for allergies and asthma with your students and on their school medical cards.
6. Always have a backpack with a first aid kit and preferably a cell phone or other communication device with you in the field.
7. Refer to attached safety sheet for general safety tips.

PROCEDURE ON HOW TO PRESS PLANTS

(If using collected plants for the field guide follow this procedure)

Layered Paper Method

1. Make sure the plant is clean and dry.
2. Arrange the specimens on two layered sheets of absorbent paper. Make sure all plant parts are spread out to show them off. Make sure your plant pressing area is on a flat, dry, hard surface in a warm, dry room.
3. Put two or three sheets of paper on the plant(s). Add more plants to top sheet, layer three more sheets on top and so on up to ten layers (otherwise it becomes too unwieldy).
4. On the top three layers of paper, add books or bricks to cover paper. Make sure there is sufficient weight to exert enough pressure on plants. Pile should yield to weight.
5. Change sheets every two or three days. It will take the plants one to two weeks to dry completely.
6. They will be very brittle so handle with care.

Phone Book Method

1. Place plant specimens randomly in phone book so they are evenly distributed.
2. Place tissue paper on both sides of the specimen.
3. Use post-it notes to bookmark and record common name.
4. Place weight on top of phone book and leave until thoroughly dry.

OBSERVATIONS OF BURNED AND UNBURNED FORESTS

ON-SITE ACTIVITY

FOCUS QUESTIONS

How can I use my senses to help me understand burned and unburned forests?

How can I look at a burned forest and take photographs of what the burned forest means to me?

OVERVIEW OF LESSON PLAN

This field trip lesson challenges students to make observations in burned and unburned forests, to express their observations and feelings in writing and in a photo collage in the style of David Hockney. From notes taken on the field trip, they will compose an essay or a poem. Using basic photography skills, they will take a series of photos in the field to use in creating a photo collage.

SUGGESTED TIME ALLOWANCE: Class Time: 1 hour

LOCATION: Rendija Canyon or other field trip location

SUBJECT AREAS: Language Arts, Fine Arts, Technology

STUDENT OBJECTIVES

Students will:

- Use more than just sight to make observations about burned and unburned forests
- Organize their observations with a Venn diagram
- Locate visual images that express their feelings of burned forests and organize photos of those images into a collage
- Learn basic photography techniques
- Find an interesting forest landscape and experiment with composition and transformation

MATERIALS

Writing exercise

- Pencils
- Field journals
- Clipboards
- Disposable cameras or digital

Photo collages

- Disposable cameras (color 26 exposure)

PROCEDURES

Writing exercise

Find a location in an unburned section of forest. Have the students sit down, get comfortable, and get out their clipboard with the Forest Observation Sheet. Working alone (at least at first), have the students start making and recording observations. They should record their observations in the Unburned Area circle in the Venn diagram on the observation sheet, and add any more details they wish to record in the space below. Have them record at least 10 observations, with at least one for hearing, smelling, and touching.

Some observations that might be made are the amount of vegetation, kinds of vegetation, height of vegetation, the number of different plants that are growing, the feel of the soil, the sound of the wind, odors, and the colors in the forest.

After about 10 minutes, walk down a road or trail to find an area of severely burned forest. Sit again and have the students repeat the observation process. Have them record what is unique about the burned area in the Burned Area circle on the Venn diagram. If they find observations that are common to both burned and unburned forest, they should record it in the intersection of the two circles.

PHOTO COLLAGES

Before you start, it's a good idea to practice taking pictures with a cardboard viewfinder, or shaping your fingers into a "box".

With a partner, students will take a series of 24 pictures (12 each) that can be assembled into a collage in the classroom.

1. One student needs to take a picture of the other so they can identify their pictures after they are developed.

2. In a section of burned forest students should look for areas that have been severely burned, moderately burned, or areas of regrowth.

3. Emphasize to students the need to spend time designing a plan before they actually start taking the photographs. Have them look for interesting features, such as unusual shapes of trees, color contrast, shadow patterns and landscape details. People are not to be in the pictures.

4. With their partner, students need to find a suitable area and then select a specific spot on the ground. They will stand on this spot and begin shooting a series of pictures so that when developed, they will overlap slightly. Remind them to avoid horizontal and vertical gaps between photos.

5. Holding the camera level, and very still, one student will carefully take 13 pictures. He/she will then hand the camera to their partner in the exact same position and continue with the remaining 13 pictures. The area covered is comparable to a semi-circle.

6. If they wish to design their collage vertically instead of horizontally, they can use the same procedure, just aim the camera differently. When finished instruct students to put the camera inside their backpack.

EVALUATION

Students will produce a writing sample and a photo collage in the classroom. Students will be evaluated on photo composition, participation in class discussions, cooperation with their partner, and completed photo collages.