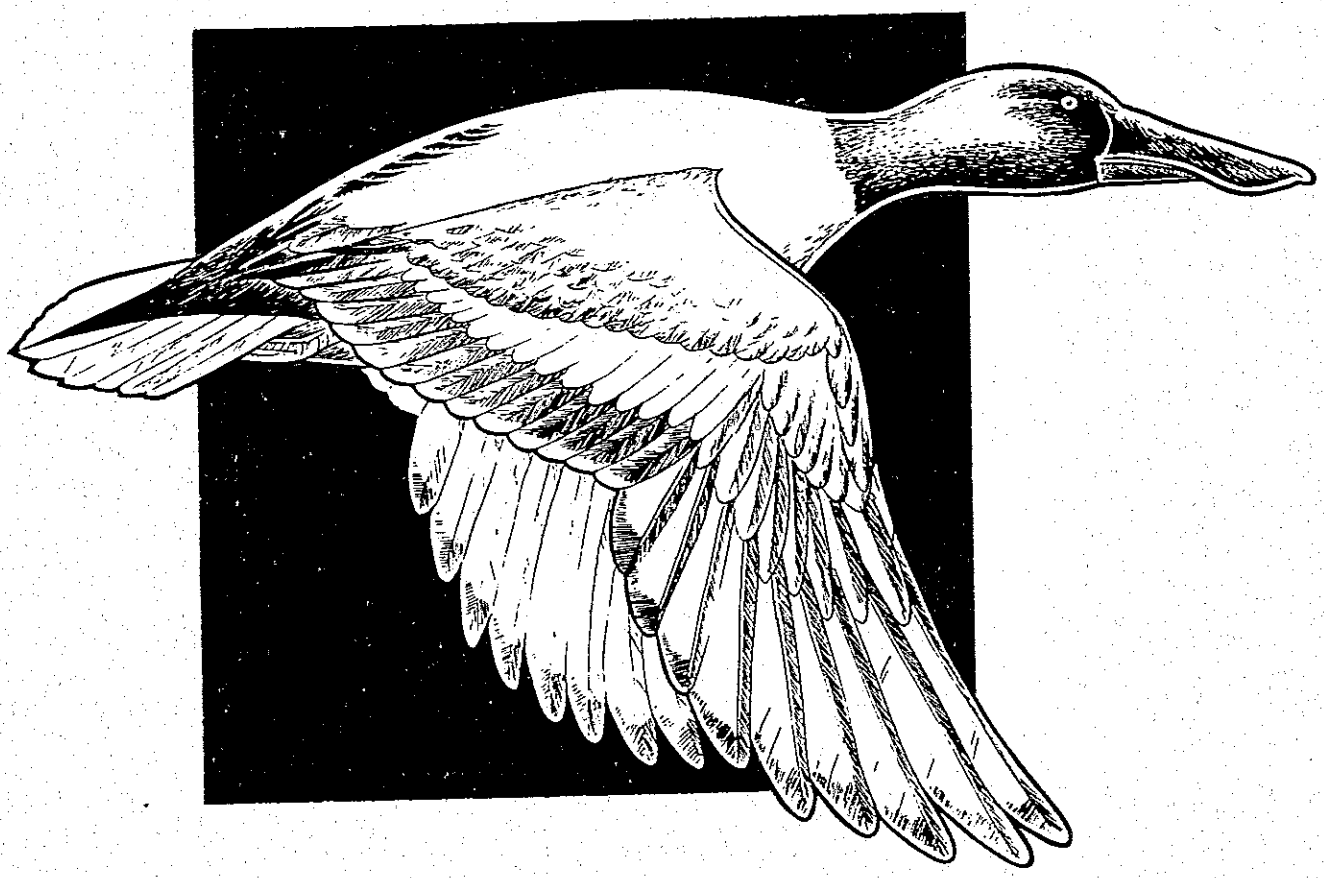
Cosumnes River Preserve

curriculum—grades 7-12



Cosumnes River Preserve
13501 Franklin Blvd.
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Please Note:
Cosumnes River Preserve Staff welcomes any comments/suggestions on this first edition curriculum. With your input, the next edition promises to be even better.

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introduction

Do not try to satisfy your vanity by teaching a great many things. Awaken people's curiosity. It is enough to open minds; do not overload them. Put there just a spark. If there is some good inflammable stuff, it will catch fire.

Anatole France

Welcome to the Cosumnes River Preserve, a cooperative project of The Nature Conservancy, Ducks Unlimited, the U.S. Bureau of Land Management, California Department of Fish and Game, The Wildlife Conservation Board, Sacramento County Department of Parks and Recreation, and the American Farmland Trust. These organizations work together on this Preserve to conserve agricultural lands, restore freshwater wetlands, and to protect and expand the best remaining example of valley oak riparian (streamside) forest left in the world. This 5,400-acre Preserve is located on the eastern edge of the 1,153-square-mile Sacramento-San Joaquin Delta, which is a rich network of waterways, wetlands, and (in this century) agricultural land.

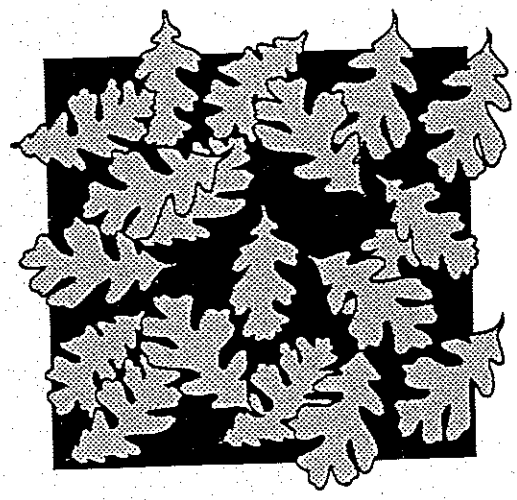
We are pleased that you have requested these materials and look forward to your field-trip to the Preserve. As you prepare for the trip and review the following pages, you will notice some reoccurring themes. These are the fundamental concepts we hope students will grasp as they venture out onto the Preserve—we also hope that they bring them back to the classroom and their personal lives. Please take the time to discuss the following concepts with your students:

1. The Cosumnes River is the last undammed river flowing from the Sierra Nevada through California's Central Valley and ultimately to the Pacific Ocean. The river is partially channelized and levied (especially near agricultural lands) to control flooding. Because the river is not dammed, it floods naturally in some areas, and this flooding creates some important environmental conditions.

2. Natural flooding still occurs in winter and spring. This flooding is the key ecological process underlying the natural regeneration of the rare valley oak riparian forest. Flood waters are beneficial to valley oak forests in several ways: (1) they deposit rich silty soils which nourish existing valley oaks; (2) they drown small herbivores, such as mice, which normally eat acorns (oak tree "seeds"), leaving larger numbers of acorns to sprout; and (3) they scour weeds from the landscape, cutting down on competition for soil nutrients and moisture and clearing the way for oak seedlings.

3. Restored and created freshwater marshes are managed to provide habitat for migratory waterfowl spending the winter at the Preserve. Central Valley wetlands have gradually been lost over the years. The Preserve is committed to protecting many species of birds that are dependent upon seasonal and permanent wetlands. This includes increasing the acreage available as habitat for these animals. A bird's basic mission when it comes to the Central Valley in the winter is to rest-up and get fat. They are preparing for the spring return to their nesting grounds and the rigors of raising young. The Delta marshes at the Preserve provide precisely what these birds need before flying north in early spring.

The natural flooding that occurs at the Cosumnes River Preserve in the winter also explains why we encourage your visits in the spring and fall. The following activities are actually designated for those two seasons, though you will see that many can be used interchangeably. Enjoy your visit, and please do not hesitate to call Preserve Outreach Coordinator (916-683-1700) if you have any questions.



fall





Six Communities on the Cosumnes River Preserve

Background

The Cosumnes River Preserve protects thousands of acres of diverse habitat and is recognized as one of the Central Valley's most significant natural areas. It is a wonderful setting that evokes curiosity and excitement about the environment, and it presents several features that make it unique. Among these features are its six distinct natural communities: the Cosumnes River, tidal wetlands, seasonal wetlands, valley oak riparian forest, valley grasslands, and agricultural lands. Before visiting the Preserve spend some time investigating the plants and animals that rely on these habitats.

Cosumnes River.

The Cosumnes River is the last remaining undammed river flowing from the Sierra Nevada through California's Great Central Valley and ultimately to the Pacific Ocean. The river provides a unique aquatic habitat and supplies the lifeblood of the Preserve's various habitats—water! Here you will see alders, sandbar willows, buttonbush and box elders among the trees and shrubs, and sedges and rushes among the understory plants. You may also be able to observe various fish, turtles, salamanders, frogs, and lizards. The river is home to legions of insects—look for dragonflies, mosquitoes, and water beetles.

Valley Oak Riparian Forest.

The Cosumnes River Preserve protects one of the last remaining valley oak riparian (streamside) communities. Valley oak forests were historically cleared for farming and development. Natural regeneration still occurs here, but dedicated volunteers are helping to speed the process by planting native species. In the underlayers of the forest, you can find wild grape, poison oak, berry vines, wild rose, and nettles. Cottonwoods and willows dominate the river's edge, and

valley oak and Oregon ash are found on the more stable higher terraces. You are likely to spot signs of wildlife in this area: holes along the trails made by burrowing mice and other rodents; nibbled shoots of young trees (evidence of deer); and various mammal tracks (raccoon, beaver, river otter). Birds you might see in the forest include wood ducks, great horned owls, cedar waxwings, rufus-sided towhees, and scrub jays to name a few.

Tidal Wetlands.

Although the Cosumnes River Preserve is nearly 100 miles from the Pacific Ocean, the river and its sloughs are subject to tidal influence. Tide waters entering San Francisco Bay push fresh water inland and up the Cosumnes River to create freshwater tidal wetland habitat. You will see tules and cattails growing together in the tidal marsh, as well as buttonbush, sedges and marsh primrose. Again, though wildlife are present, you may only see signs left by raccoons, bull frogs, turtles, garter snakes, and blackbirds. However, you are sure to hear many varied sounds of resident birds, especially grebes, blackbirds and marsh wrens.

Valley Grasslands.

Beyond the river's floodplain, the upland topsoil is underlain by a hardpan layer of compacted clayey soil. This compacted, impenetrable barrier restricts tree growth and encourages grassland habitats. Refreshingly green during the wet season and parched brown by summer, this habitat supports various native grasses, wildflowers, and occasional oak trees along with insects, birds, and mammals. Some of the insect species you may find during your visit include beetles, aphids, flies, bees, wasps, butterflies, crickets, and grasshoppers.

Seasonal Wetlands

Wetland grasses, sedges, rushes, and wetland wildflowers dominate this environment and create habitat for amphibians, reptiles, mammals, thousands of insects and many other invertebrates. The Preserve's seasonal wetlands also attract thousands of migratory waterfowl and shorebirds, as well as providing habitat for many resident birds. More than 200 bird species frequent the Preserve. The better known migrants include sandhill cranes, tundra swans, Canada geese, and ducks such as the northern pintail, cinnamon teal and American wigeon. Important residents include the great blue heron, great egrets, American avocets, and raptors like the Northern harrier.

Agricultural Lands.

Centuries of uncontrolled flooding along the Cosumnes River have produced some of the moist fertile soil in California's Great Central Valley. This rich soil combined with a Mediterranean-like climate have proved irresistible to farmers, who have adapted to, and to some extent depend upon the shallow, short-duration, seasonal floods. Today, agriculture dominates approximately 85% of the lower Cosumnes floodplain, and most of the land surrounding the Cosumnes Preserve is farmland. Most of these lands are managed as pasture, or planted with cereal crops such as rice and corn. These pursuits are compatible with, and benefit, resident and migratory wildlife. Adjacent farms and agricultural lands within the Preserve provide important habitat for wintering waterfowl, shorebirds, and sandhill cranes.

Objectives

Students will perform the research needed to identify and compare six natural communities occurring at the Cosumnes River Preserve. They will make predictions about the wildlife and plants they will find at the site, and they will understand the importance of natural areas like the Cosumnes River Preserve.

Materials

- Reference books and field guides
- Other materials for the presentation, as determined by each group

Procedure

Divide the class into six small groups and assign, or have them choose, one of the natural communities listed above as a research project. Each group will present their findings to the class and they will determine the format of their presentations. These might include a straightforward lecture to the class, a photo-lecture using field guides and photographs from wildlife magazines, the presentation of a mural or detailed drawing, a mock news report about the area, a poem or creative story describing the area, a short play addressing key features, a built miniature version of the area, etc.

Each presentation should include some information about the following:

- Plant life in the area

- Wildlife dependent on the area for habitat
- Information about special features impacting the area, i.e. flooding (a critical feature which impacts all of the six communities), migration and the Pacific flyway (seasonal wetland community), diversity of wildlife species (especially prevalent in the valley oak riparian community), and the impact of humans (on all communities)
- History of human use of the area
- Importance of preservation of the area, to people, and to wildlife

Remind the students that most of the wildlife they learn about will probably remain under cover during the time the class is on site (any group of enthusiastic visitors generally creates too much noise for wildlife, even though conscientious visitors try to stay quiet). Rather, the clues of what those animals have been eating, where they have been walking, defecating, running, resting, or rearing their young will be all around them.

Some animals, particularly frogs, insects and birds may be heard, but not seen. Once they know what to look for, students will surely see some of the following:

- Tracks, most easily found in mud or sand near puddles, ponds or waterways where the ground is soft
- Claw marks on smooth bark where squirrels, opossums, or raccoons have been climbing
- Narrow trails marking the regular routes of deer, rabbits, or raccoons
- Worn places on the river's bank where beavers or otters come ashore
- Snipped-off tips of twigs and branches where deer have browsed
- Scattered feathers or tufts of fur where a predator captured a bird or mammal
- Scat, the droppings of various animals (scat of herbivores is usually small and uniform in size; scat of carnivores and omnivores is usually larger and may contain hair, bones, and seeds)
- Compressed vegetation where animals have been sleeping or resting
- Nests

At the end of each presentation, have the group direct the class in making a checklist or drawings of the types of animals that live in the area, the clues those animals might leave behind, and the plant life they expect to see. Use these after the field trip to review what you saw at the Preserve.

Extensions

- Invite other classrooms or parents to enjoy the students' presentations.

- Examine and pick apart owl pellets to retrieve the rodent and bird bones inside. Carolina Biological Supply (1-800-334-5551) is a source for obtaining pellets and diagrams of skeletons that students can use to identify bones and skulls. Or, discuss with Preserve Outreach Coordinator (916-683-1700) the possibility of collecting barn owl pellets from the Preserve's barn.

- Research common animal tracks and scat.

- Write letters to government officials expressing your concern about the preservation of natural areas.

Letter Format

*Be sure to state the reason you are writing, and what specific action, if any, you would like this person to take.

Governor of California:

The Honorable (first and last name)
Governor of California
State Capitol
Sacramento, CA 95814

Date

Dear Governor (last name),

the introduction, body, and closing of your letter

Sincerely,

your name

State Representatives:

The Honorable (first and last name)
State Assembly of California
(you must check the California Roster for the mailing address)
Sacramento, CA 95814

Date

Dear Mr./Mrs./Ms./Miss (last name),

the introduction, body, and closing of your letter

Sincerely,

your name

State Senators:

Senator (first and last name)
The Senate of California
(you must check the California Roster for the mailing address)
Sacramento, CA 95814

Date

Dear Senator (last name),

the introduction, body, and closing of your letter

Sincerely Yours,

your name

Traveling Along a Transect Line

Background

A transect is a method that scientists use to sample points along a line. When vegetation changes over a distance, you can use a transect to identify and describe the different natural communities in that study area. This observation and charting tool will be very useful at the Cosumnes River Preserve, where you and your students can explore several distinct communities: the Cosumnes River, tidal wetlands, valley oak riparian forest, and valley grasslands. Agricultural lands and seasonal wetlands also occur on the Preserve, but access into these areas for such a study is limited.

While the transect study provides important opportunities for observation, recording data, and analysis, it may not on its own, awaken the students' appreciation and interest in nature that we hope to encourage. Outdoor education will be more meaningful and interesting to students when their first-hand experience is open-ended and hands-on. Use this activity as but one piece in a larger context, with the Cosumnes River Preserve as a backdrop for developing an attitude of curiosity and enjoyment of the environment.

Objectives

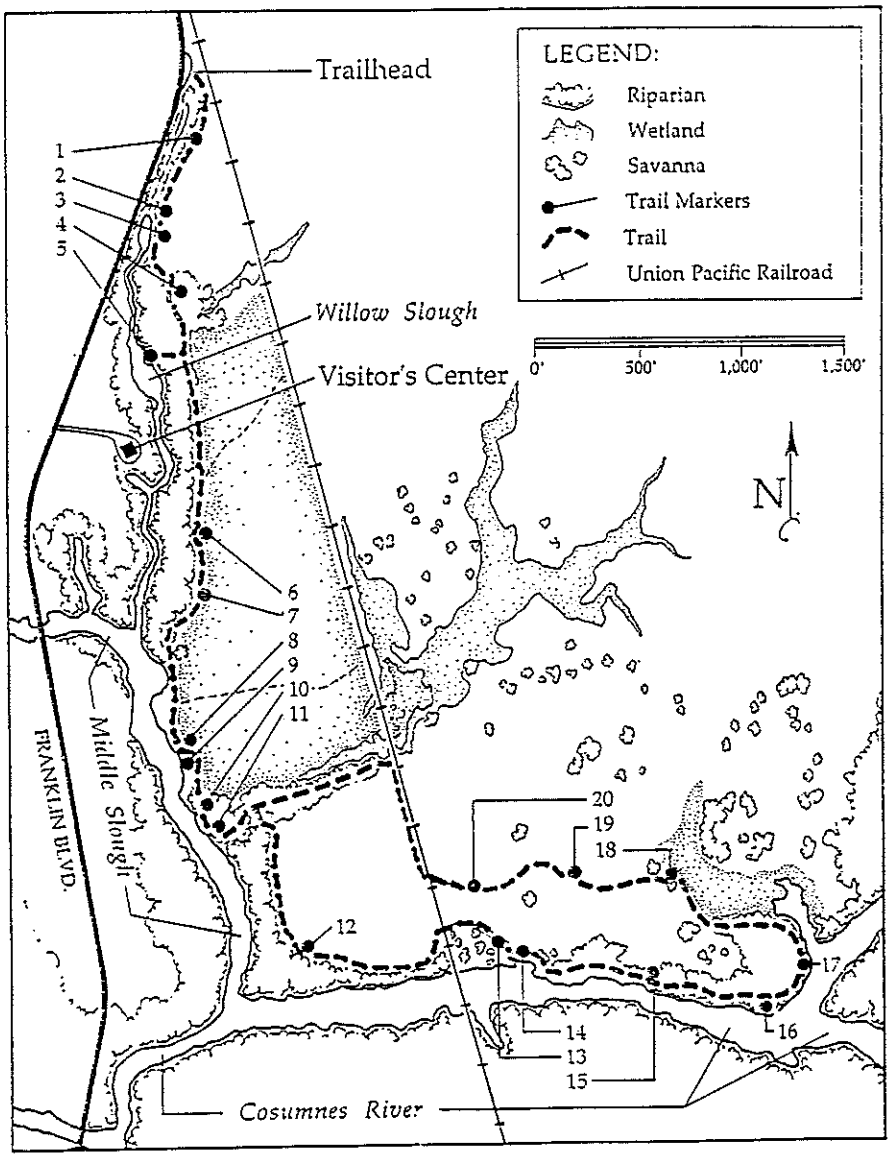
Students will recognize four different natural communities, they will practice using a transect line to chart plant and animal life in the areas, and they will record data reflecting their observations.

Materials

- Clipboards with paper held on with rubber bands—one or two per group
- Pencils
- 12" rulers—one per group

- Five 12 meter-long strings marked at every meter with colored tape or tags (provided by Cosumnes River Preserve)
- Plant and animal identification/field guides (for example, The Outdoor World of the Sacramento Region, A Local Field Guide) - available for purchase at Effie Yeaw Nature Center in Carmichael, Nature Company stores, or to borrow from Cosumnes River Preserve Visitor Center
- Copies of attached data sheets—one each per group
- Magnifying glasses, one for each group if possible

Suggested Location



Map by Betsy Clark

Procedure

Much of the study area for this transect observation will include trees. You may want to teach the class how to measure the height of a tree before your trip to the Preserve. If so, practice the following exercise in the school yard first:

1. Choose a stick the same length as your arm held out in front of you.

2. Now hold stick upright to form a right angle with your arm.

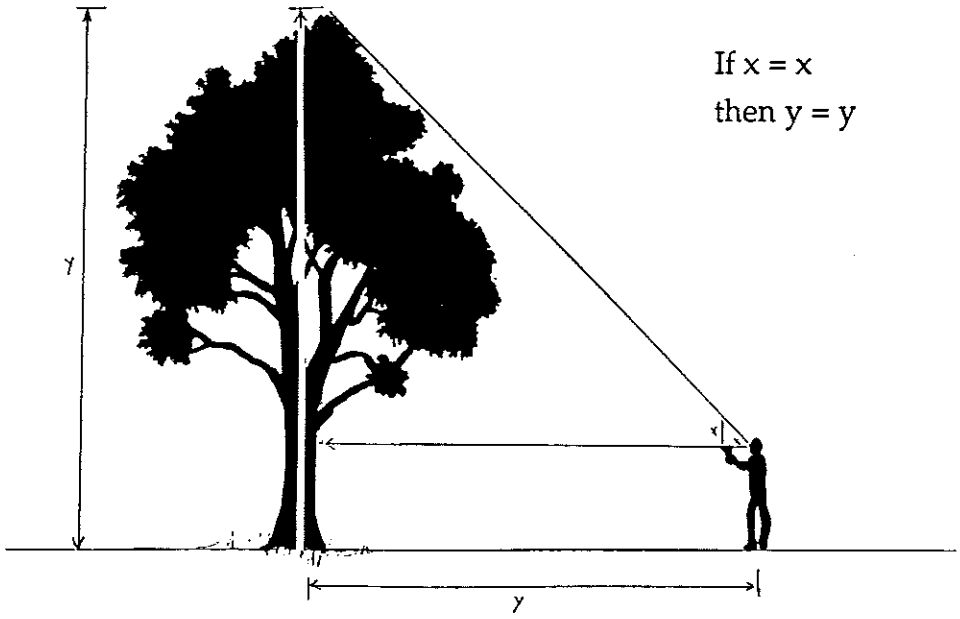
3. Walk backward away from the tree on level ground, sighting across the upper end of the stick you are holding upright and the bottom of the stick above your fist. Count the number of steps.

4. Continue to walk backward until you can see the top of the tree at the top of the stick and the bottom of the tree at the top of your fist.

5. You are now the same distance from the tree as the tree's approximate height.

6. Measure the distance between yourself and the tree and you will have its approximate height.

7. Number of steps _____ x length of step _____ = height of tree



Just before your trip to the Preserve, review the natural communities (pg. 4-6) found there and discuss the presentations they made for the pre-visit activity. Remind students that they will almost certainly see many signs of wildlife, and may have the opportunity to see animals as well (especially if they are quiet visitors!). Review the kinds of clues they may see.

Divide students into groups and assign the roles of Expedition Leader, Recorder, Botanist, Zoologist, and Reporter (see definitions on page 20). Practice a line transect in the school yard. Remind students that nature is best observed while remaining still and quiet. Disturb the site as little as possible. Avoid trampling and uprooting plants. Return rocks and sticks to their original position if you move them. Never disturb nesting animals or animals with young. **Remember, in natural areas you are the visitor. Act with respect and you will be rewarded with knowledge!**

Once at the Preserve, have students examine the study area and make some general observations. Using these observations, ask students to form a prediction or an hypothesis about any changes they will find among the communities. The group's Recorders should write down these general observations on the General Observation sheet.

Decide whether or not groups will study the communities about which they made their pre-visit presentations. Irrespective of this decision, divide the class so that at least one group is working in the valley oak riparian area (marker #12), one is in the tidal wetland area (marker #4), one is in the valley oak grassland (or savanna - markers # 19 and #20) and one is as close as possible to the river. (See trail map provided on page 16) Some areas will have more than one study group. Remind students about the importance of flooding for the Preserve communities (see introduction) and ask each group to be on the lookout for signs that flooding has occurred (they may notice tree trunks with a dark stain up to the same place on all or most of the trees; leaves, twigs, and other debris caught in shrubs or tree branches above the ground; leaf litter that is black and flattened or matted together, from lying under water, etc.).

Each group will observe along a different 12 meter line. They should remain with their group throughout the entire observation period (approximately 30

minutes). Stretch the lines, pulling them taut and carefully setting the full lengths down on the ground. Each group should begin observing the plants that touch it or fall within one foot (above and to either side) of the line. They should wait to record observations about the animals until after they have completed the plant study.

Botany Data Sheet

Count and record the number of different plants along the transect. Determine the plant types (grass, vine, shrub, tree) and, if using measuring tape, record where they occur (meter number). Draw a picture of the dominant plants—at least three (those you see the most of along the line). Identify one or two species if possible. Measure the height of the three tallest plants.

Zoology Data Sheet

Animals are generally harder to find, but if you look closely, you will probably find at least a few. If so, record the number of different animals along your portion of the transect. Determine the type (mammal, reptile, bird, amphibian, insect, spider) and identify any that you can. Draw a picture of at least two animals, if you see them! Record any evidence of animals (tracks, scat, feathers, etc.). Be sure to record where the animals (or evidence of them) occur (meter number) along the line.

General Observation Sheet

Make more general observations about your team's portion of the transect after you have completed the data sheets. Weather conditions, any special features of your area, or places where animals have gnawed the vegetation will all help you remember the site once you have returned to school. If you notice any human impacts like trails or litter, be sure to note them—please remove all litter. Your personal impressions, including things you like and things you did not like count as well!

Note: Poison oak is common on the Cosumnes Preserve. It may appear as low ground cover in shaded areas, or as a robust shrub on sunny open areas—poison oak also climbs up into valley oak trees. Get to know this plant—but only from a distance! Many people are severely allergic to the potent oils released from the

leaves and stems of this cantankerous member of the sumac family. The best protection is avoidance!

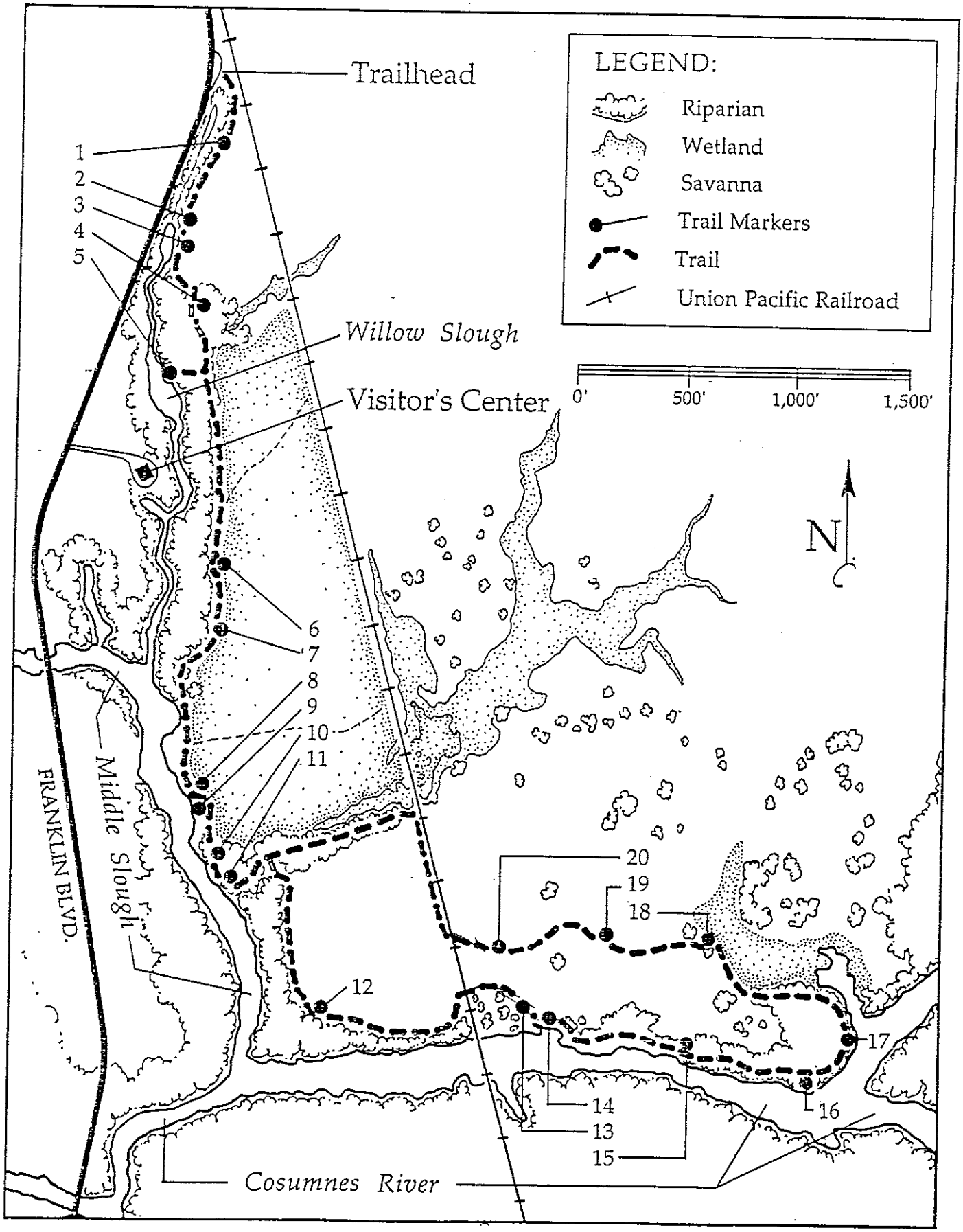


Illustration by Jan Meninga

Note: Before leaving the Preserve, be sure to point out the seasonal wetland areas which were not included in the study area. Students will also notice agricultural areas once back in the bus, all around the Preserve.

After the transect observation is complete, gather all of the field equipment and reassemble the group in a circle, seated on the ground. As a conclusion, tell the group that everyone will do a listening observation. Students should remain quiet for several minutes and wait to hear both natural (bird songs, wind rushing through leaves and grasses, crickets, etc.) and unnatural sounds (planes, cars, trains, horns, etc.). You may decide to discuss what was heard, or simply leave the area with those sounds in mind.

Back at school or later at the Preserve, compare the data sheets for each section of the transect line. Ask each Reporter to give a summary of the findings. Discuss ideas about why the plant zones change as you move from the tidal areas to the grasslands. Name the different zones and the dominant plants in each one. Determine which parts of the transect have the greatest diversity (number of species). Why are these areas so diverse? Compare your findings with the checklists or drawings made during the pre-visit presentations. Were your observations consistent with what you predicted you would find? If no, why not? (seasonality, time of day, cryptic coloration, behavior patterns, etc.). Discuss students' impressions of the areas they surveyed. What interested or appealed to them most? What didn't they like?


LEGEND:
Riparian
Wetland
Savanna
Trail Markers
Trail
Union Pacific Railroad
0'
500'
1,000'
1,500'
N
Trailhead
Willow Slough
Visitor's Center
Middle Slough
FRANKLIN BLVD.
Cosumnes River
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

General Observation Data Sheet

Names:

Date:

Time:

Location (Trail Marker #):

Write or draw your observations about the study area:

1. Weather conditions:

Clouds:

- ☐ covering entire sky
- ☐ covering partial sky
- ☐ no clouds

Wind:

- ☐ none
- ☐ light breeze
- ☐ gusty

Humidity:

- ☐ dry
- ☐ humid
- ☐ rain

Draw predominant clouds:

Temperature:

_____ °F

_____ °C

2. General description of the area:

3. Describe the ground cover. Approximately what percentage of the ground is covered?

4. Describe the canopy? Approximately what percentage of the sky is covered?

Signs of Wildlife Data Sheet

Names:

Date:

Time:

Location (Trail Marker #):

Look for signs of wildlife in the study area. Check the ones you find and try to determine the animals that left them. In the boxes below draw or write about what you discover.

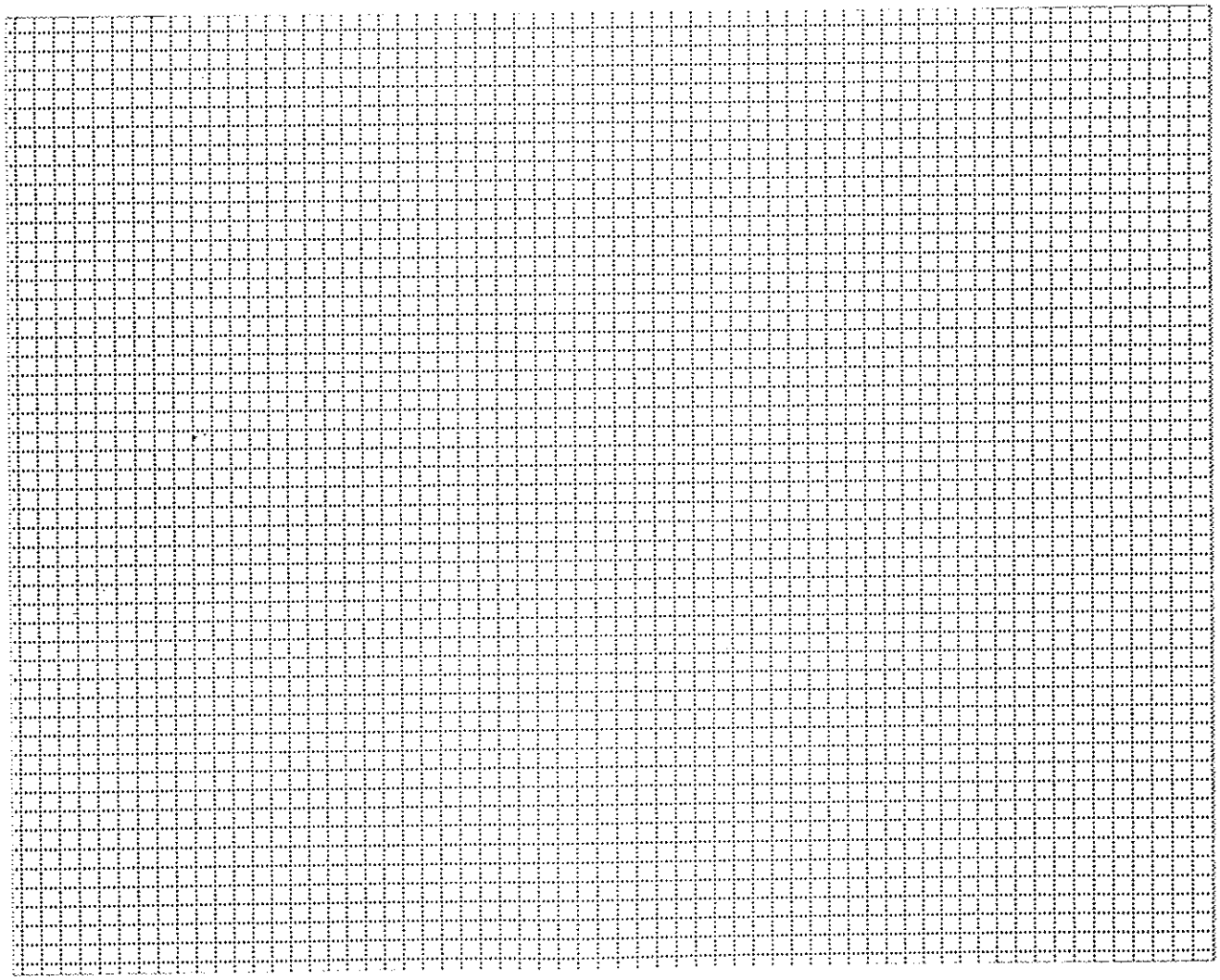
mammal track	bird track
broken or matted grass	chewed tree or sticks
pile of branches near water	hole in the ground

4. Measure and record the height of the tallest tree, shrub and succulents in the study area:

	grass	shrub	tree
height			
common name or description:			

5. Evidence of flooding?

6. Draw a map of the study area.



Botany Data Sheet

Names:

Date:

Time:

Location (Trail Marker #):

Write or draw your observations about the study area:

1. Number of different plants in study area:

2. Which plants are found in the study area?

Grasses:	Forbs:	Shrubs:	Vines:	Trees:
☐ absent	☐ absent	☐ absent	☐ absent	☐ absent
☐ present	☐ present	☐ present	☐ present	☐ present
☐ flowers	☐ flowers	☐ flowers	☐ flowers	☐ flowers
☐ seeds	☐ seeds	☐ seeds	☐ seeds	☐ seeds

3. Trace or draw and label a leaf from the two most common plants in the study area.

5. List the predominant colors in the area:

6. Describe the smells:

7. Describe the sounds:

8. Predict the wildlife that inhabits this area, list them under each category:

mammals	birds	amphibians
reptiles	insects	fish

9. Describe visible and audible evidence of people:

10. Personal impressions - what do you like/dislike about this area?

holes in trees	scat
broken seeds or acorns	path through grass
oak gall	nest
path through earth	leaves with holes
other signs	other signs

Extensions

- Discuss the roles of the Zoologist, Botanist, Recorder and Expedition Leader with your students (definitions follow). Divide the class again, this time into all the zoologists, all the botanists, all the recorders and all the expedition leaders. In these groups, discuss and compare findings. Students should assist each other if any have questions about their observations. Re-group into the original teams and share newfound knowledge with the group.

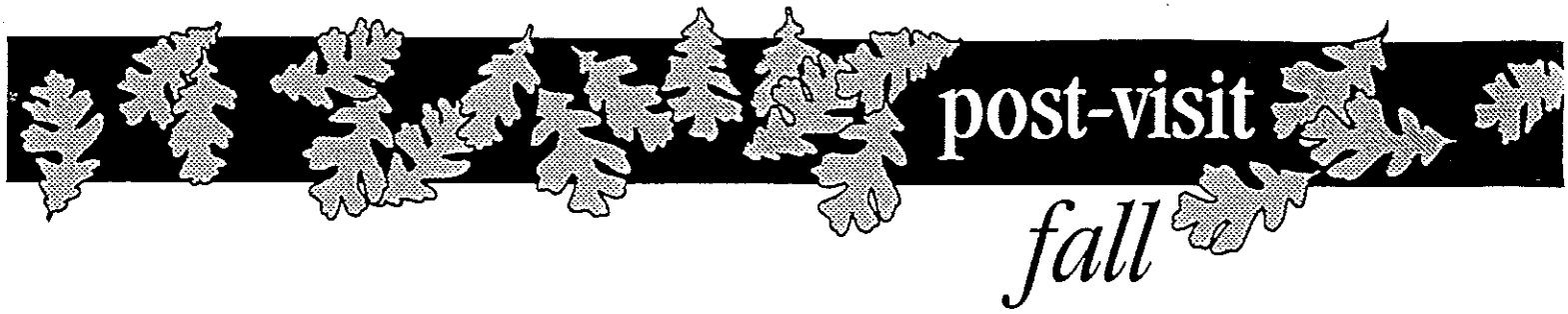
    - Zoologist—A scientist who studies animals
    - Botanist—A scientist who studies plants
    - Expedition Leader—A scientist who finds, and describes the study area. [This person might ask questions like where do plants and animals here find food, water, and shelter? Describe the soil. Is it course, medium, or fine? Is the soil moist or dry? Warm or cold? What can live in this soil? How sunny, or shaded, is the community?]
    - Recorder—A scientist who writes down the observations and makes measurements for the team.

- Make a transect mural of the Preserve for the classroom. Invite another class (especially a class that is planning a trip to the Preserve!) to see the mural. Have students give a "mini-expedition tour" through their mural.

- Write a "mini-expedition tour guide" for someone who lives far away and probably will not have the opportunity to visit the Preserve.

- Attract native species to the school yard by planting native plants for native wildlife. Survey the wildlife population before planting and survey at intervals thereafter to determine whether the action has increased the use of the habitat.

- Return to the Preserve with your students for a Volunteer Planting Day on a weekend. Contact the Volunteer Coordinator at 916-683-1701 to request a schedule.



Planning with a Purpose

Background

Now that you have spent time at the Preserve, discuss some of the reasons why it is so important to learn about and appreciate natural areas. Ultimately, when we understand and enjoy something, we are more likely to care and take interest in it. Ethical questions arise all the time as people make decisions about how to live in the modern world and care for nature at the same time. Any development of an area has an impact on the plants and animals who do and can live there, as well as on any people who might live there. This activity is designed to help students consider the importance of land-use planning and to see themselves as key players in how they shape their lives and the places people live.

Cities have developed as people have clustered together for purposes of meeting their needs—from food and shelter to a sense of community. Cities have typically developed as a hub of transportation and commerce, again serving as a means by which people meet their day-to-day survival needs. The development of cities, however, has been a mixed blessing. The large concentration of people in a given area has displaced plants and animals that lived there previously, and this has given rise to problems unique to such crowded conditions. For example, varying forms of pollution accumulate in such centers, frequently with inadequate means for handling them—from products of industry to human waste.

Most cities are not the result of careful planning. Many have developed haphazardly, with attention to problems taking place only when crises emerge. Crime, unemployment, poor housing, smog, contamination of water supplies by industrial and sewage waste disposal, energy consumption, transportation costs, and urban sprawl are all among the serious problems facing contemporary cities.

* This activity is adapted from Project Wild Aquatic (Boulder Colorado: Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council, 1983) p 205; *Laypersons Guide to California Water* (Sacramento, California: Water Education Foundation, 1993); and *Layperson's Guide to the Delta* (Sacramento California: Water Education Foundation, 1994)

People today are faced with many important choices concerning how and where they will live. Many people in the United States are leaving the cities for suburban and rural life, bringing some of the same problems with them that encouraged them to leave the cities in the first place. New communities—large and small—are being developed. Some are the result of individual families moving into previously undeveloped areas; some are the result of business interests organizing to develop resources in an area, and creating entirely new cities in the process. This is happening throughout the planet. Whole areas of some large and old cities are decaying as they are abandoned; in some cities, re-development projects are taking place to try to improve the habitability of the old and dying neighborhoods.

Development can be of benefit, and sometimes of long-term harm. When such decisions are made, it seems prudent to plan for the impact of our actions as carefully and thoughtfully as possible.

Objectives

Students will be able to describe considerations that are important in land-use planning for cities and other communities of people; identify means by which negative impact on wildlife and other elements of the natural environment can be reduced in developing cities; and describe actions that can be taken in some contemporary cities to enhance them as places in which both people and some wildlife can live.

Materials

- Heavy cardboard or masonite
- Salt, flour and water to make salt clay for model-building
- Glue
- Toothpicks
- Natural materials (like dried grass) and construction paper for making buildings, roads, people, wildlife, and other components of community
- Tempera paint, brushes
- Any other materials available and useful in model-building

Procedure

Ask students to close their eyes and visualize the community in which they live. Next ask them to visualize what that area might have looked like before the city or community was built in that spot. What plants were common to the area? What animals? Was there water in the area? What was the topography of the land?

Ask for a committee of volunteers to find out more precisely what the land, vegetation, wildlife, etc., was like in their area before their community was built. Ask the committee to report back to the class with this information in a week or two. Sources could include local historical societies, libraries, etc. City, county, and state land-use planning offices may also have such information.

Have the committee report back to the rest of the students. This report should list the descriptive characteristics of the vegetation, identify the kinds of wildlife, and note the water and food sources upon which this wildlife once depended. The report should also leave a written or visual record of the major information they found for the class to use as a reference during the rest of the activity.

Next, divide all of the students into working groups of three to four students. Each group will create and develop a community in this natural area, given the background information the committee has provided. In designing their community, they should aim to develop a community in which people live and work with the least possible negative impact on the existing vegetation, air quality, soil, and wildlife, at the same time that the needs of the people are met as well. In order to do this, the students should consider the following:

- Water sources, transportation, and treatment
- Economic base (industry, small business)
- Kinds of housing, school, shopping areas, job sites
- Ecological and recreational features (open space, green belts, parks)
- Sewage, waste disposal, and treatment
- Utilities
- Food sources, transportation, and treatment
- Aesthetics
- Environmental safeguards

- Means by which the community can grow if necessary, retaining minimum impact on the quality of the environment

Once each group has come up with a plan, review and discuss the plans. Once the plan is approved, provide students with the necessary materials to build a model of their community.

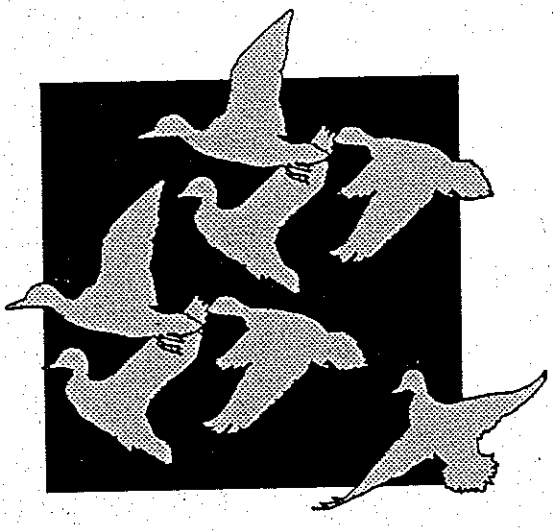
Have each group explain the design features of their community once the projects are complete. Discuss the advantages and disadvantages of each design in detail. Include questions like: "What if a new school had to be built?" ; "What if there is a drought or severe winter, would it be necessary to take special measure to assist wildlife?"

Finally, return to the models after two or three weeks and ask the students to reflect upon whether or not they would make changes in their designs.

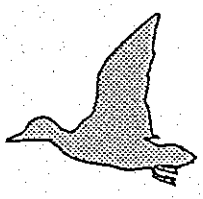
Extension

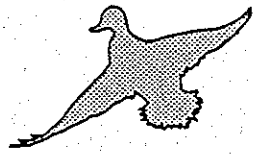
- Look at photographs of actual cities, both small and large. Look for advantages and disadvantages of city life, under a variety of circumstances.

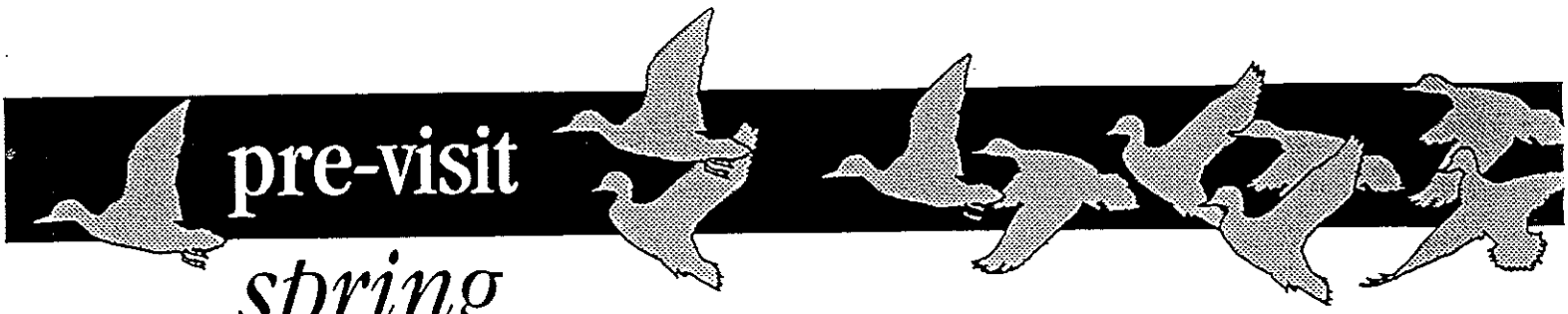
- This exercise is easily coupled with the Spring, post-visit activity, "If You Build It, They will Come and Others will Go."



spring







Back to Watershed Basics*

Background

A watershed is all the land area that contributes runoff (water) to a particular body of water. It is a "catch basin" that guides all the precipitation and runoff into a specific river system. A watershed affects all living and non-living things within its boundaries. Water is a necessary human commodity, and yet it is more than that. All plant and animal life is dependent upon the water within each watershed. Prior to human intervention and use, watersheds tended to be in a natural balance with the ecological components of the environment.

Self-destruction is part of the natural process of a watershed. The rivers and drainages that give determine the character of a watershed are engaged in the gradual erosion and wearing down of the highlands that contain it. The key here is "gradual," part of the natural dynamic balance. Human settlement began to affect the gradual rate at which watersheds erode and other conditions within watersheds through actions such as land clearing, dam building, farming, and industrial development. Demands on water shifted from domestic use to agricultural use and then expanded to industrial use. Today, according to the U.S. Geological Survey, about 8 percent of the water consumed in the United States is for domestic use, 33 percent for agriculture, and 59 percent for industrial use.

A watershed filters, absorbs, and stores water. As water percolates through soil and into the groundwater, the soil filters some of its impurities. A well-functioning watershed allows water to soak into the ground. Forest soils have a great capacity for holding water and, therefore, serve as natural regulators of water flow. They keep an area from flooding during the rainy seasons by

* This activity is adapted from *A Childs Place in the Environment* (Sacramento, California: California Department of Education, 1994), pp. 89-97.

absorbing large quantities of rain water. This stored water is then available to tree roots during the dry season. In addition, the groundwater in a watershed often feeds streams, rivers, and lakes, keeping them from drying out in the hot summer months.

The interrelationships among water, soil, plants, animals, within a watershed, and the human-built environment are evident. The types of soil and plants present determine how much water will be absorbed by the ground and how much will flow down the waterways. If the majority of the land in a watershed has been cleared, paved, or built upon, the soil cannot absorb excess rainfall, and the water will run off rapidly, resulting in floods. In addition, land without vegetation limits groundwater replenishment, decreasing the available groundwater supply during the dry months of the year.

Finally, as the human population grows, so does the need for water. To acquire water for their communities, people often divert it for their use. Dams are built to ensure a constant supply of water for homes, business, industries, and agriculture. Dams also generate hydro-electric power—electricity. Each diversion affects the watershed as well as the organisms that live there. Societies often find that it is necessary to weigh carefully both the benefits of providing water to far-away population centers and the effects of altering the fragile ecosystem of a watershed.

The Cosumnes River originates from snowmelt, springs, and seepage in the cool heights of the Sierra Nevada. It receives additional water from many smaller tributaries and meanders slowly through the Central Valley. Although it has been partially channelized and levied, especially near agricultural lands (to protect livestock and crops during small floods), the Cosumnes is the largest remaining undammed river flowing through the Central Valley. The river supports an extensive network of marshes and other wetlands year-round. Flooding during the wet winter months creates hundreds of additional acres of seasonal wetlands, provides a feeding and resting ground for thousands of migrating birds, and is vital to the health of the Preserve's habitats, especially the California valley oak riparian community.

Objectives

Students will be able to describe the characteristics of a watershed and they will understand the special role played by the Cosumnes River's watershed in providing wildlife habitat.

Materials

- "California Rivers, Dams and Reservoirs" (included in this packet)
- Waterproof container, approximately 18" x 28" and 6" deep
- Butcher paper, approximately twice as big as the waterproof container
- Crumpled paper, crushed cans and twisted cardboard— place under butcher paper to simulate mountains and valleys
- Tape
- Four small empty milk cartons, two of which have small holes poked in the bottom
- Diluted blue tempera paint, enough to fill at least two milk cartons

Procedure

Place the container in which you plan to simulate a watershed on a table in the classroom. Ask students to crumple pieces of newspaper or cardboard to make an uneven surface over which the butcher paper will be placed. Students should make high mountain ranges, foothills, and valleys inside the container. Crumple the butcher paper; then smooth it out. This will make it easier to shape. Place the butcher paper over the crumpled newspaper and arrange mountains, valleys, and foothills. Tape the edges of the butcher paper to the container.

Have one student hold a milk carton, with holes poked in the bottom, over the watershed while another pours the blue paint into the carton with the holes. Students should observe how the paint flows in the watershed. Pour another carton of paint on the watershed if necessary. (Paint can be poured back into a glass or plastic container for later reuse.)

Encourage students to share their observations (i.e. water flowed into the valleys and collected in plateaus). What factors contributed to the movement of water (the amount of water, the steepness of the land, the lack of vegetation on the land). Explain that the model they just created represents a watershed—the

entire area of land from which water drains into a stream, river, lake, or ocean. The land "sheds" the water into waterways.

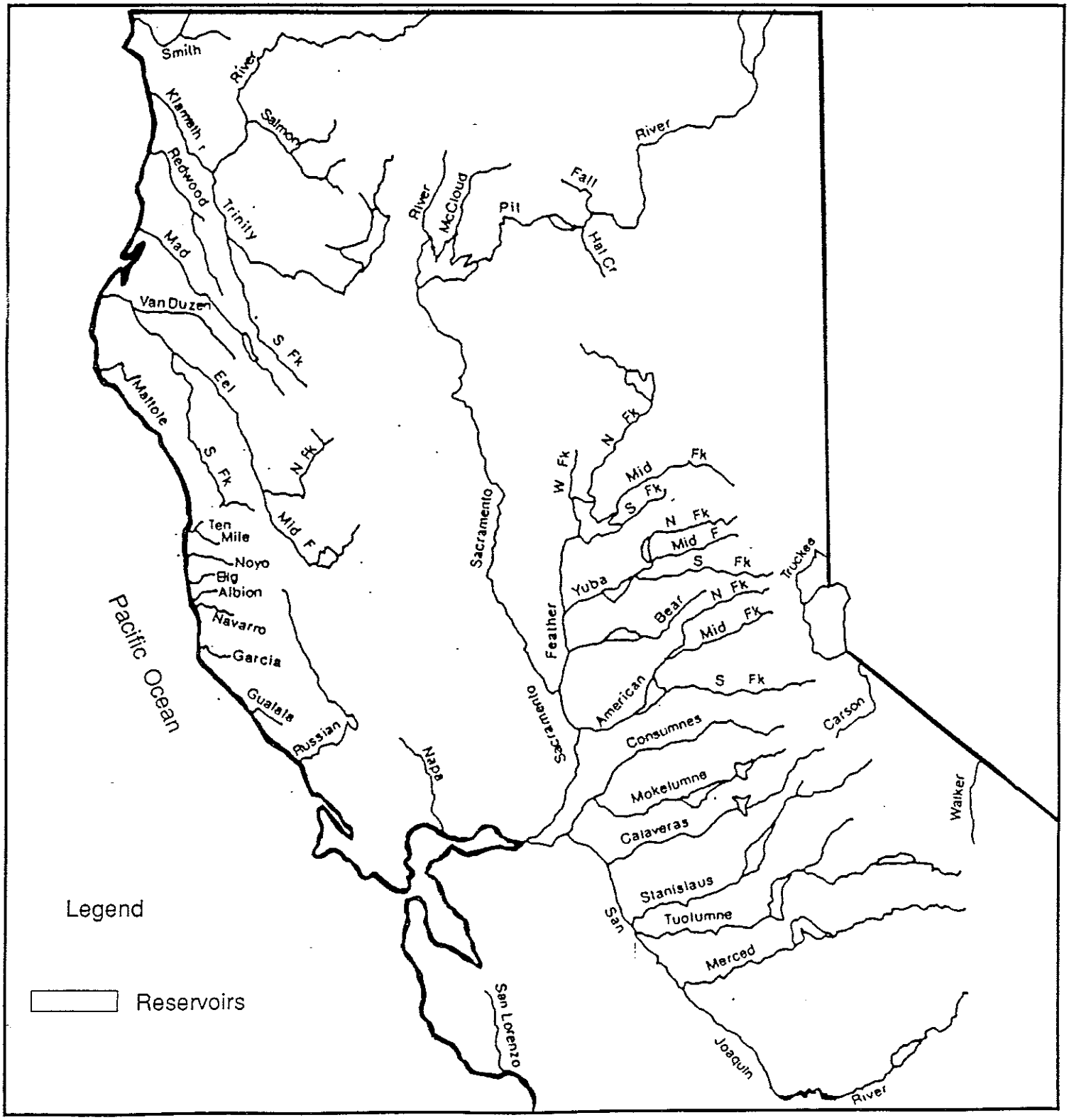
Discuss the upcoming field trip to the Cosumnes River Preserve. Have the students look at the map of California and determine the number of large Sierran rivers. Have them observe the Cosumnes River carefully and discover what makes it different from all the other large rivers. (It is the largest undammed river flowing through the Central Valley—it has no reservoir.) Ask them why this is important. Answers will vary, but should include the critical observation that the absence of a dam allows the river to flood in the flat bottomlands of the lower river. This area, which floods extensively in a wet year, is called the floodplain.

Finally, ask students to make a list of ways flooding can impact, and especially be beneficial to wildlife. Flooding during the wet winter months creates seasonal wetlands. These wetlands support important habitats for amphibians, reptiles, mammals, insects, and other invertebrates. Floodwaters deposit rich nutrients around the floodplain providing perfect conditions for grasses, sedges, rushes and cattails. These wetland areas are crucial in providing wintering habitat—both for food and protective cover—for thousands of migratory birds, shorebirds, and resident birds. Flooding also deposits rich loamy soils, enriches the soil, drowns herbivores that eat acorns and seedlings, scours weeds from the ground so the young seedlings will not have to compete for moisture, and ultimately encourages the rare valley oak to flourish. In time, the valley oak provides important habitat for many animals including the wood duck which builds its nest in tree cavities like those of older valley oaks.

California Rivers, Dams and Reservoirs

Name:

Date:



Extensions

- Challenge students to design a demonstration that will show the role of plants in a watershed.

- Discuss how people affect or change watersheds (by constructing dams, roads, housing, and other developments: logging, overgrazing livestock, taking water for irrigation or drinking, rerouting waterways, accidentally starting fires, polluting water, eroding the land by riding off-road motorized vehicles or mountain bikes off designated trails, etc.) Have a simulated "talk-show" to discuss alternatives to these damaging activities. Have students report on the effects of levees and water control structures. Include documentation in the form of photographs, drawings, and newspaper articles about the effects they discover.

- Participate in "Water Awareness Month" during May. Contact your local water district for information. Poster contests and other activities are often planned.



Walking the Willow Slough Trail

Background

Watersheds, the floodplain, natural regeneration, active restoration, creating habitat for migratory birds, caring for the environment—finally, all of these important concepts and phenomena come together, in front of your eyes during your visit to the Cosumnes River Preserve. First-hand experience and active exploration ensures discovery and a sense of wonder. Invite your students to take you and their classmates on a tour of the Willow Slough Trail at the Preserve, and see for yourself. Careful observation and collecting, and organizing information will lead to problem-solving and action planning. As students become more and more aware of their place in the environment, they will be motivated to protect it in a sensible and thoughtful way.

Objectives

1. Students will use the transect and plot method to survey and compare the plant and animal life found at various locations in the Preserve.

2. Students will recognize natural communities and hypothesize which changes in the environment might be the reason for observed changes in vegetation,

Materials

- Trail notes (xeroxed from this packet) cut into numbered cards and given out one to every two students
- Clipboards, paper and pencil for each student

Procedure

Before your visit to the Preserve, review the key concepts described in the introduction to this packet with your students. Then, copy and distribute the trail notes to the class, one per two students. There are 20 notes in all, so you may

elect to distribute any remaining notes to chaperones. Each group of two students will be trail guides, responsible for pointing out and describing the topic of note to the class at their designated trail marker. Allow plenty of time before the visit for students to look-up any words they may not know in their trail note. Plan time as well for each pair of students to meet with you to discuss the contents of their notes.

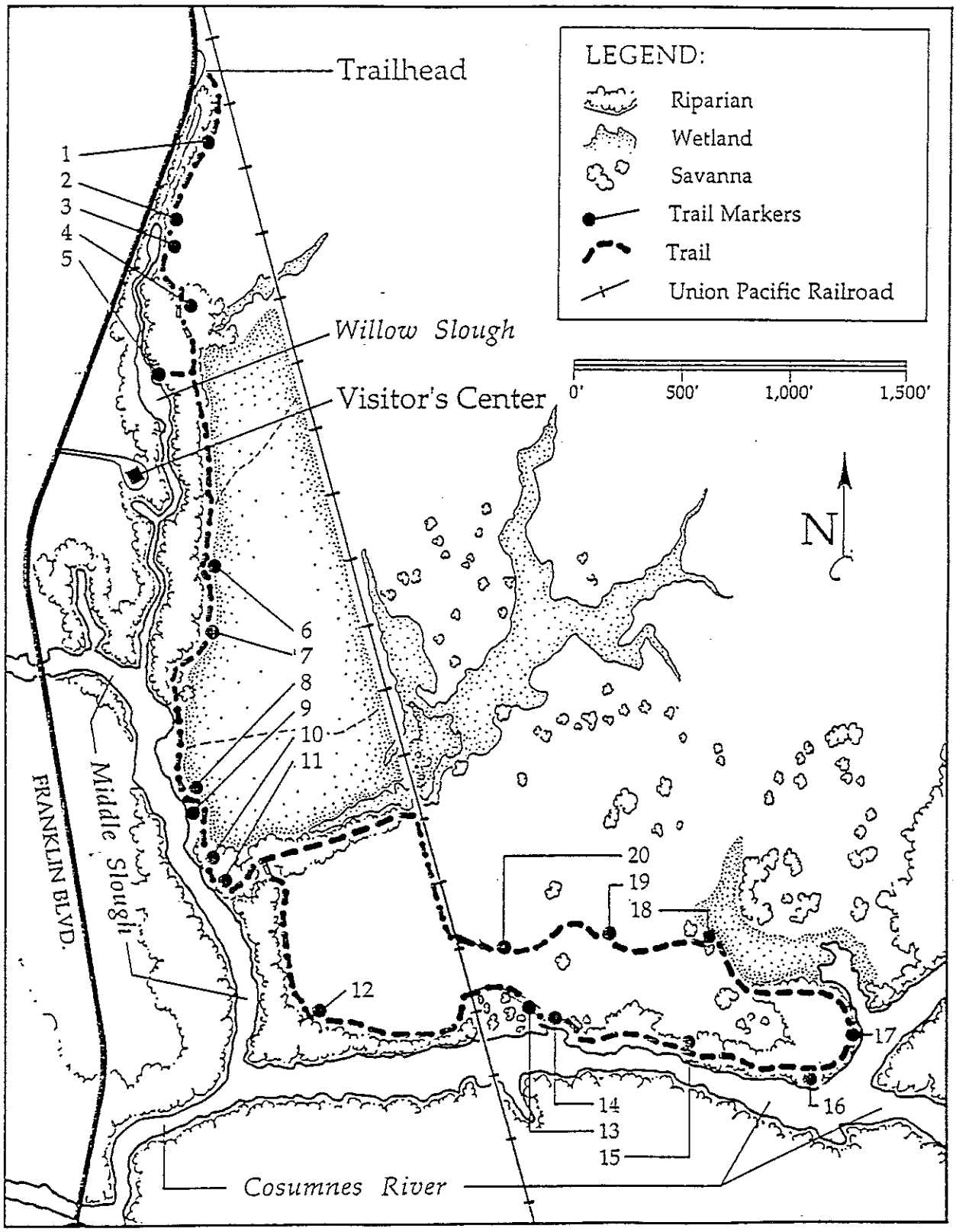
Because students will not have visited the location prior to your "teaching" the class about it, reassure them that they will have a few moments at the location to observe and discuss with you the topic they will be teaching. Then, ask all classmates to give the trail guides their undivided attention as they briefly point out the notable features. Students should be permitted to ask questions, but remind them that you and the trail guides may not know all of the answers. When you do not know an answer, this is a great opportunity for further research back at school.

Note, walking the entire trail will require a minimum of 2 hours. If you determine that some stops along the trail must be omitted in the interest of time, be certain to include numbers 1, 3, 4, 8, 11, 12, 13, 14, 16, 17, and 19. These stops illustrate many of the most important themes of the Cosumnes River Preserve. Keep in mind that the trail notes with the highest numbers are for the most part the farthest from the trail head.

As students walk the trail, they should write down notes about things that especially interest them. Encourage a supportive and respectful atmosphere as you go. Students should feel comfortable making their own discoveries and need to know that every contribution they make to the activity is valuable. These trail notes can be used to organize a discussion after the walk back at school.

After the hike is complete, gather all of the field equipment and reassemble the group. As a conclusion, tell the group that everyone will observe with their ears next. Students should remain quiet for several minutes and wait to hear both natural (bird songs, wind rushing through leaves and grasses, crickets, etc.) and unnatural sounds (planes, cars, trains, horns, etc.). You may decide to discuss what was heard, or simply leave the area with those sounds in mind. (This also makes a good post-visit activity for use in the school yard.)

Trail Map


LEGEND:
Riparian
Wetland
Savanna
Trail Markers
Trail
Union Pacific Railroad
0'
500'
1,000'
1,500'
N
Trailhead
Willow Slough
Visitor's Center
Middle Slough
FRANKLIN BLVD.
Cosumnes River
1
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1 Trailhead Restoration Site

These young valley oak (planted as acorns in January, 1988) are among the first trees planted on the Cosumnes River Preserve in an effort to restore the riparian (streamside) zone. This land comprising the Cosumnes River Preserve was selected for restoration efforts because periodic flooding of the Cosumnes River still occurs. Seasonal flooding is essential for a healthy riparian forest. Floods deposit rich loamy soils over the floodplain, they drown herbivores (like mice) that eat acorns and seedlings, they scour weeds from the ground (so the young seedlings will not have to compete for moisture), and ultimately they encourage the rare valley oak to flourish. In time, the valley oak provides important habitat for many plants and animals.

2 Creeping Wild Rye

Look out across the ground before you. The grass growing in a uniform stand or patch among the oak trees is creeping wild rye. This native grass thrives in low-lying areas which are likely to be flooded from time to time. Creeping wild rye spreads by rhizomes, or underground stems, rather than by seed. It is easy to recognize this grass in the spring because it quickly grows higher than other grasses.

3 Willow Slough.

You are standing at the head of Willow Slough. A slough is a water channel that does not have headwaters—sloughs receive their water from seepage, floods, or tides. Although seepage and floods contribute water to this slough, Pacific Ocean tides are the greatest influence. Twice a day, the water in the Cosumnes River and Willow Slough rises and falls as the tide flows and ebbs through the Delta from the Pacific Ocean. Willow Slough is home to many aquatic creatures, including Pacific tree frogs, western pond turtles, crayfish, and many aquatic invertebrates. All of these animals play an important part in the food-chain.

4 Freshwater Tidal Swamp

You are now standing in the midst of a freshwater tidal swamp. Swamps are wetlands dominated by woody plants. This swamp is dominated by buttonbush, Oregon ash, and several species of willows. As you pass by, look at the depth of water under the bridge and the water lines around the tree trunks. Is it high tide, or low tide?

5 Freshwater Marsh.

Peek through the screen of sandbar willows into the freshwater marsh. A marsh is a wetland dominated by herbaceous (soft-stemmed) plants. This site shows how different plants grow in different zones of the tidal area, adapting to the amount of water they receive with the tides. Yellow marsh primrose, cattails, and arrowhead are all found here.

6 Buttonbush Swamp.

To the west of the trail is a dense buttonbush swamp. This type of vegetation was once widespread throughout the Delta. Buttonbush are named for their round seed pods. The white blossoms are very fragrant in June, and honey made from buttonbush flowers is prized by beekeepers!

7 Willows of the Cosumnes

To the west of the trail stand 3 of the 4 species of willow that grow on the Cosumnes River Preserve. You can see black willow, shining willow and arroyo willow (sandbar, the 4th species, is located at stop #10). Black willow is the only willow at the Preserve that forms a tree. Its leaves are narrow, sharply pointed and green on both sides. The shining willow is a large shrub, and its leaves are pointed, green on top and blue on the underside. The Arroyo willow is also a shrub; its leaves are rounded and dark green on the top, silvery blue-green on the underside.

8 Restored Seasonal Marsh

To the east of the trail are 30 acres of freshwater seasonal marsh. Marshes like this have sharply declined in California's Great Central Valley during the last 100 years. The few remaining acres of seasonal wetlands provide critical habitat for thousands of migratory birds, including sandhill cranes, tundra swans, Canada geese, pintail ducks, and many other waterfowl and shorebirds. These 30 acres are carefully managed and periodically flooded by the Preserve to ensure a healthy seasonal wetland habitat.

9 Rare Plant

Just west of the trail, growing among the tules, are small shrubs that produce large white blossoms in late summer—California hibiscus. During the winter the only evidence of this rare plant that you may see are its dead stems sprouting from a single base. Before you move on, look closely at the mudflats (especially at low tide). You may spot a Virginia rail or a sora rail lurking among the tules.

10 Pioneer Species

Most of the willows growing along the eastern edge of the levee trail are sandbar willows—a tenacious, hardy "pioneer species" that often grows where the currents were strongest during floods, or where flowing water has stripped the ground bare and open to the sun. Sandbar willows, like all pioneers, are among the first plants to grow naturally on "disturbed" ground.

11 Historic Delta

If you can see over the blackberries, this site presents a view back in time. Tidal sloughs characterized much of the Delta's landscape 100 years ago. Tules, buttonbush, and sandbar willows lined the channels, while snags sticking out of the water presented stark reminders of the previous winter's floods. (The blackberries you see provide food for birds, fox , other animals and occasional hikers throughout the late summer.)

12 Valley Oak Riparian Forest

This small grove of streamside valley oaks is only a vestige of the dense riparian oak forests that once extended from the waterways of California's Great Central Valley. The water you see through the trees is the Cosumnes River. Just in front of you is a stand of Barbara's sedge—it grows in bunches with flat dark green blades. For thousands of years, the local Miwok peoples used the roots of this sedge to weave baskets—descendants of these peoples still collect these roots along the Cosumnes River today.

13 The Cosumnes River

Here, the Cosumnes River flows from east to west. But sometimes, especially during the summer, when the Pacific Ocean tides are coming in,, this flow reverses dramatically—the water flows from west to east! Shrubs of wild California rose grow here; they produce a delicate pink blossom in summer.

14 Cosumnes Mammals

Have you noticed those well-worn paths cutting across the Willow Slough Trail? These are "runs" etched into the ground by beavers, river otters, and other animals. You may have already noticed twigs, branches, or even the neatly chewed-off trunks of small cottonwoods and willows along the trail—beaver snacks! Beavers do not build dams on this part of the Cosumnes River, they den in the banks of the river. River otters live here too and eat crawfish, fish, and shellfish. Other mammals of the Preserve include the coyote, black-tailed deer, mink, muskrat, raccoon, grey fox, weasel, skunk, cottontail, and jackrabbit.

15 Live Oak

The tree just over your head is the only *live oak* on the Cosumnes River Preserve! (A *live oak* is evergreen.) This oak species is rare here, even though they grow plentifully along the Mokelumne River. During spring, the bright yellow California buttercup is abundant here; in summer, watch for the many spotted buckeye butterflies.

16 Flooding

Here, at the place we call "The Point" you can see the river in its many stages. The Cosumnes River is the last undammed river flowing from the Sierra Mountains into California's Great Central Valley. This means that flooding still occurs here throughout the winter and early spring. Look around carefully: debris piled-up at the base of trees is evidence of last year's flooding. The pale, dried mud coating around the base of most tree trunks indicates the height of the previous season's floodwaters— 4 or 5 feet high at this spot! The riparian plant communities you have experienced along this trail are very dependent upon seasonal flooding. Yes, flooding can be good! It brings nutrients into the forest; it knocks over trees, creating gaps that let light reach the forest floor. This light allows the germination of many other species whose seeds have been lying dormant in the shade. Floods also drown rodents (like mice) that eat acorns and seedlings.

17 Wood Duck Nest Boxes.

Those boxes that you see attached to the oak trees along the slough and river are wood duck boxes. The brilliantly colored wood duck naturally nests near water in trees which are large and old enough to have developed holes and cavities. Because mature (old) riparian forests are rapidly declining, so too are suitable wood duck nesting sites. Local residents and neighbors initiated the Preserve's nest box program several years ago and today, over 200 boxes provide for the local wood duck population.

18 Tule Marsh

Before you, stretching to the east, is a natural tule marsh. This marsh is surrounded by the willows typical of the Preserve: yellow willow and arroyo willow (both grow as many-stemmed shrubs) and black willow (grows to tree size). Tules are common in marsh areas that are wet year-round. This particular marsh serves is a breeding place for pied-billed grebes and as a roost for hundreds of blackbirds and warblers in late summer.

19 Natural Regeneration

To the north lies a valley oak savanna (grassland with trees), and to the south a dense stand of willows. The plants in both of these areas have been regenerating naturally since 1987. When new plants appear on their own, without human assistance, we call this natural regeneration. Natural regeneration is a sign of a healthy plant community. When new vegetation is planted purposefully to help a plant community which is struggling, we call this restoration. Remember the first stop along this trail? There you saw young valley oaks planted by volunteers in 1988—an example of restoration.

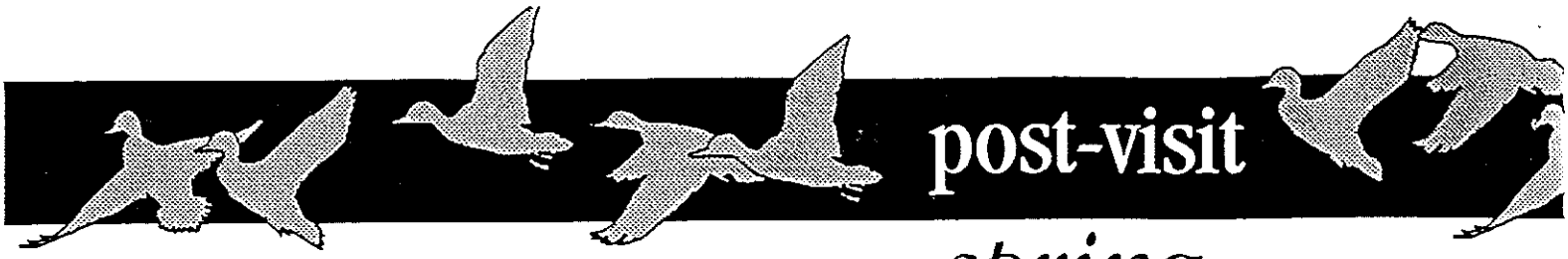
20 Union Pacific

The railroad tracks you see are part of the transcontinental railway system that carries freight from as far away as Chicago. The Union Pacific Railroad cooperates with the Cosumnes River Preserve staff to manage its lands that run through this natural area.

Extensions

- For homework, ask students to make a written log of their field experience, relating what they saw and experienced in their own words.

- If the students return to the Willow Slough trail at a later date or in a different season, note seasonal changes.



spring

If you Build It...

If You Build It, They Will Come ...
and Others Will Go

Background

The Cosumnes River provides the lifeblood of the Cosumnes River Preserve, a natural area with important attributes: valley oak riparian forest, freshwater seasonal and tidal wetlands, oak savanna, grasslands and agricultural lands in a rich habitat mosaic. This mosaic is part of what makes the area so important for wildfire, and why they are so abundant here. Much, though not all, of the Preserve, is within the 100-year floodplain. This is the area of land around the river that would be likely to flood at least once every 100 years. The upland areas adjacent to the floodplain consist of either additional riparian habitat along the river, grasslands and sloughs, or farmland (primarily grain crops) and pasture. These farmlands are good buffers from modern disturbances that come with urban development, namely traffic, noise, pets, people, invasive exotic plants and pollution.

The floodplain has a number of important attributes. Within it, hundreds of acres of freshwater seasonal marsh form as a result of flooding in most years. The natural and restored wetlands provide important wintering habitat for migratory waterfowl in the Pacific flyway and act as "rest stops" for shorebirds during spring and fall migration. Sustained by periodic flooding are the finest remaining examples of a California valley oak riparian (streamside) ecosystem. Within and surrounding the floodplain are lands where a growing population's needs (especially farming and recreation) are integrated with the complex and sometimes contradictory needs of a healthy and balanced environment. Unfortunately, places where all of these needs are met at once are rare. All of these needs are in competition for the same two critical components: water and land.

Over the past one hundred years, settlers coming to the bountiful Central Valley learned to key in on the valley oak forests as indicators of prime soils for agriculture

because the valley oak prefers to grow in deep, rich alluvial (deposited by flooding) soils. Finding vast forests that spread sometimes for miles from the edges of the rivers, the forests were plentiful and seemed limitless. But time has taken its toll, and now less than 4% of riparian forest habitat is left in California's Central Valley. Increasingly, as the Central Valley becomes more urban, development in the form of more houses is consuming not only rare natural lands but also the best agricultural lands, which have long been a mainstay of the California economy.

Consider the following hypothetical situation in the Central Valley:

The community of Arroyo, with a population of 600 people is located approximately 35 mites from the large city of Viento, population 300,000. Arroyo is located near the San Pablo River, which runs through Viento County. The city of Viento is governed by the city council but Arroyo is unincorporated, and thus is governed by the Viento County Board of Supervisors.

Intercontinental Business Machines (ICBM) was recently well received by the community of Arroyo when they decided to build their new assembly plant on the outskirts of town. The people of Arroyo are anticipating that the new plant will bring more jobs and increased prosperity to their community. Because of the new plant, there is a large unmet demand for housing in the vicinity of Arroyo -- approximately 500 employees currently must commute from the city of Viento.

To meet this demand, the Board of Supervisors for Viento County is considering an 1,800-acre development, 1,200 acres for 3,200 home near the San Pablo River, with an adjoining 600-acre golf course. The entire development would be situated within a 3,000 acre site along the river that currently supports 1000 acres of riparian forest and freshwater marshes, 1000 acres of oak woodland (scattered oaks among the grasslands), and 500 acres of grasslands and 500 acres of farmland used to grow high value crops, such as asparagus.

In the Environmental Impact Statement commissioned by the County planners, the following information was identified:

- The 3,200 houses being proposed would be built at a density of 4 units per acre (.25 acres per house) with the remaining 400 acres taken up in roads and facilities. The houses will be in the mid-level price range of around $150,000.

- The housing project would increase the County's tax base significantly, bringing in about 1% of property value per year, an estimated $4.8 million per year.

- The housing project would provide a temporary boost to the economy through increased construction. It would exceed the unmet demand for housing from the 500 ICBM employees by 2700 homes.

- The increased population could provide an infusion to the local economy, by increasing demand for local private services and providing the consumer base to attract more businesses to the area.

- The housing project would create a cost to the County, in that the demand for services such as sewage treatment, police, fire protection, schools, etc., would increase.

- Swainson's hawks are a threatened species in California. Two Swainson's hawk nests are located in the riparian forest along the river, shown on the map. Swainson's hawks generally need between 6800 and 10,000 acres of foraging habitat per pair. Swainson's hawks forage in agricultural and grassland areas nearby their nests.

- The project would approximately double the diversion of water from the San Pablo River that is currently being used for agriculture. The demand would be for increased drinking water and sewage treatment needs.

- Stormwater runoff from the new development, plus pesticide and herbicide runoff from the golf course would contribute to non-point source pollution the San Pablo River system, creating a potential need for additional water treatment facilities.

- Songbirds, such as robins and orioles, nesting near areas of intense pesticide application are known to experience a significant decrease in nesting success.

- Loss of the oak woodland will result in a 20% reduction in the area songbird population, and pretty much eliminate all habitat favorable for bluebirds, Western kingbirds, and magpies (yellow-billed magpies are nowhere else in the world except California's Central Valley).

- One egret/heron rookery (colonial nesting trees) would be lost.

- The agricultural land around Arroyo is blessed with extremely rich, alluvial soil that has been laid down over the centuries by repeated flooding of the meandering San Pablo river. It is prime agricultural land highly sought after to grow high value crops, such as asparagus. Only 20,000 acres of prime agricultural land currently exist in Viento County, with the County having lost 15% of over the past 15 years to development and infrastructure projects. Loss of the 500 acres of agricultural land will constitute a net reduction by 5% of prime agricultural land in the County.

- Golf courses function very well as open space and can be designed to provide a buffer to natural areas. However, golf course turfs provide no cover for wildlife, so that populations of small mammals are reduced by 90% and insects are reduced by 80%. This eliminates the prey base for many songbirds, raptors, reptiles and coyotes.

- There is a significant herd of deer (averaging 30 - 80 deer) that lives in the lowland riparian areas during the summer, but moves to the higher ground of the oak woodlands in winter.

Objectives

1. To provide students with a real-life sense of the complexity of modern development and environmental protection;
2. To clarify the benefits of natural areas to people, the needs of wildlife and the effects of human activities on natural systems;
3. To démonstrate that there is usually room for creativity and compromise in the decision making process.

Materials

- Role cards (xeroxed from this packet)
- Props (optional)

Procedure

Provide students with background information about the history of California's Great Central Valley. Use Cosumnes River Preserve as an example, and review the fact sheet available at the preserve as supplementary background information.) Generate an initial

discussion with the students about some of the possible costs and benefits of a large housing development in a significant and relatively pristine natural area, considering it from a variety of perspectives.

Ask each student to choose and act out the role of an individual for the purpose of this activity, or assign roles randomly. It is best to cut out each role description and pass them out to the students individually once they have been assigned. This way, information presented by each student will seem fresher and more authentic to everyone else. Establish a balanced variety of roles with people having conflicting values and concerns relating to the potential impacts of the development. Copy the role descriptions and give one to each student. Each role description comes with a description of that character's "room for compromise". This should allow interesting dynamics to evolve in the form of negotiating an outcome. [NOTE: There is no "right" outcome.] You may also have students create additional roles to illustrate a variety of perspectives and interests. They should recall the special characteristics of the Preserve as they go about this task.

Ask students to prepare for their role, by developing a short position paper for use as background for the dramatization of their role. Students should be encouraged to interview real people in preparing for their role. Students may want to bring appropriate props, such as lab coats, binoculars, hats or business jackets to increase the authenticity of their identities.

Arrange the classroom to represent a meeting forum for the Viento County Board of Supervisors. Students will role-play their position and make a presentation to the five-member County Board. This Board will ultimately take a vote to decide the outcome of the development. **It should be stressed that the County Board has the flexibility to form subcommittees to work on issues, to approve an amended proposal or to delay their final decision. They do not have to simply decide yes or no on the proposal as is.** Their vote could result in approval, disapproval or recommended alternatives to the proposed development plan.

During the course of the exercise, it is likely that many unanswered questions may arise. The teacher should take the role of providing additional "facts" as necessary or feasible to address issues that students may raise.

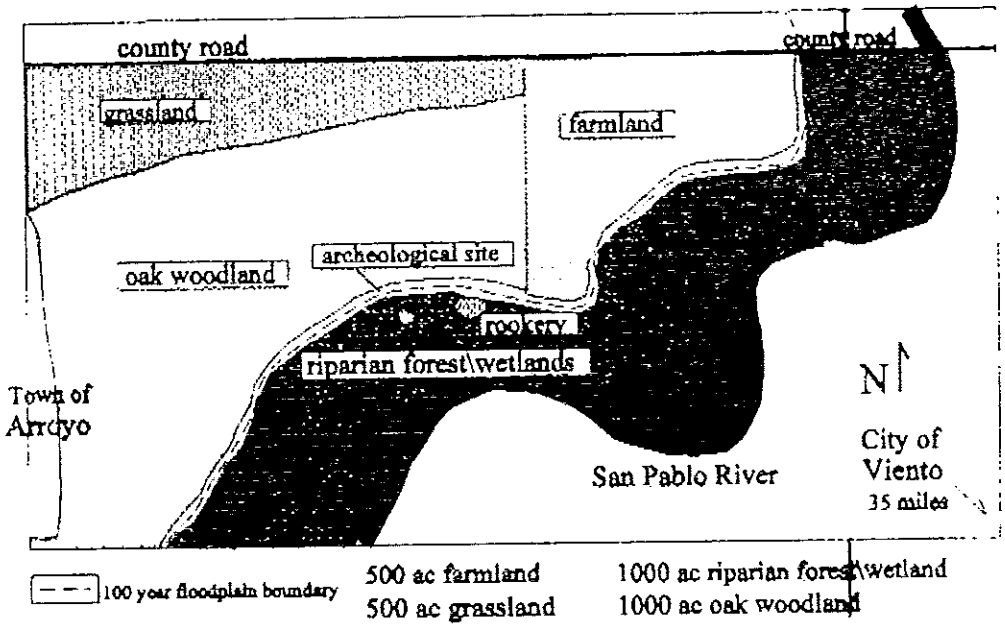
Decide and announce the order of presentation at the meeting. Groups or people presenting factual information should be heard before those voicing opinions. Enforce a two minute limit. You may want to prepare time cards with "one minute." "30 seconds" and "time is up" written on them. (Speakers should be allowed to finish their thought after the time is up - but not allowed to introduce any additional information) After all the students have made their presentations, ask the County Board of Supervisors to render a decision.

Following the decision, have a class discussion to summarize the "pros" and "cons" that emerged from the presentations. Identify and list the benefits, if any, and costs or liabilities, if any, as a result of the new development. Include effects on people, plants and animals.

After the role play and class discussion, ask each student to write a brief personal recommendation about whether and how the development should be built. They might expand the position papers developed for their role play or "start from scratch" to give personal opinions in writing their essays.

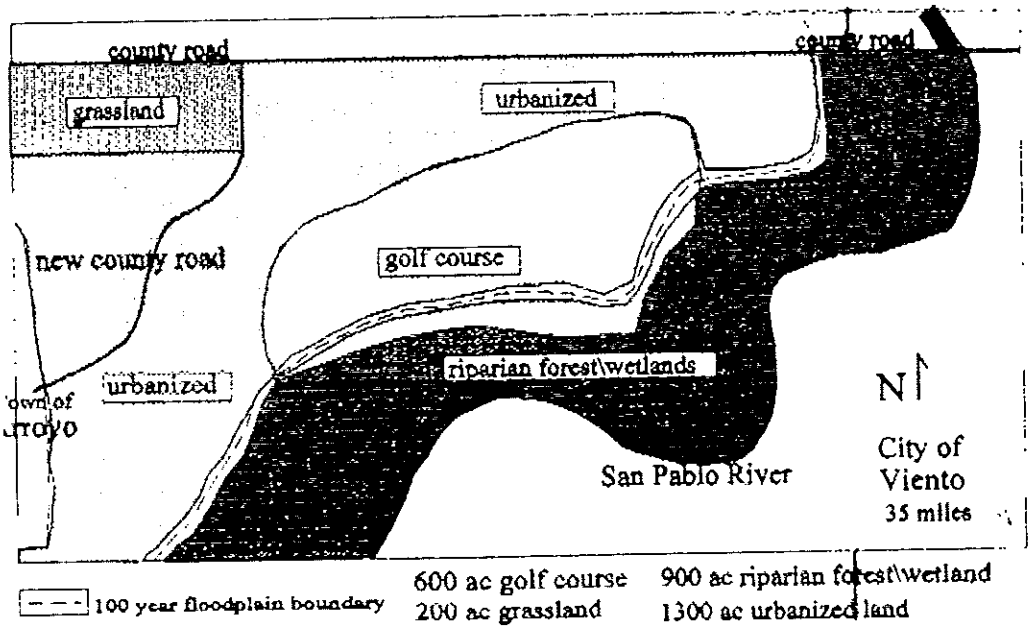
3000 Acre Site—Existing Features

All 1000 acres of riparian forest/wetland habitat lie within the 100-year floodplain, (houses cannot be built on the floodplain); a total of 2,000 acres of upland (land out of the 100-year floodplain) is available for development. The upland consists of agricultural land, oak woodland and grassland.



3000 Acre Site—After Development

Morehouse Construction is proposing an 1,800 acre development be situated in the area, leaving 900 acres within the floodplain, plus 300 acres of grassland outside the floodplain as open space. A portion of the golf course extends into the 100-year floodplain. Under the proposed scenario, all 500 acres of agricultural land, all 1000 acres of valley oak woodland, 100 acres of riparian forest and wetlands, and 200 acres of grassland would be developed as either homes or golf course.



Role Descriptions/Name Cards

(Note: Roles can be modified to accommodate the class and students' interests, For example, Jim McDuffer can become Jill McDuffer. Three people could constitute the County Board of Supervisors instead of five, etc.)

Loren Builder, financier of the proposed development. Loren has a vision for 3,200 homes. However, Loren also knows that the development could be pared down to 1,600 homes and still make a tidy profit.

Jim McDuffer, an avid golfer and proponent of the proposed course. Jim's dream is to have a PGA-approved (PGA is Professional Golf Association) golf course that could support world-class golfing events practically in his own backyard. Such golf courses must usually be of significant size, often 600 acres. However, Jim also knows that a good golf course could be developed using 300 acres, but it would probably not be PGA quality.

Fran F. Armer: the farmer whose property would be sold for the development. Although Fran would like to see the land continue to be farmed, Fran's children do not want to take over operation of the farm. Fran is also attracted by the prospect of turning a remarkable profit that could be set aside for retirement by selling the land. The developer has offered $I 0,000 per acre; the property would only sell for about $5,000 per acre as farmland.

Sandy Fisher: a local sporting goods store owner and avid fisher is concerned about the potential impacts on water volume and quality in the river. Sandy knows that the salmon spawning in the upper reaches of the river each year need water to get upriver—in dry years there is already too little water. Sandy is worried about the effects of increased diversions. Sandy is also aware of ways in which non-point source pollution can be minimized, including neighborhood storm drain awareness programs; "state-of-the-art" treatment facilities, and the fact that marshes—whether natural or restored—can act as natural filters for runoff water; decreasing the total paved area of a development.

Matt Turner: president of local "Campaign to Stop Growth". Matt has a personal affinity for the area proposed for developed, as well as an ideological opposition to large-scale development. He is opposed to "leap frog" development, and argues that such a development should not even be located in the unincorporated area of the County, but should instead be planned as "fill-in" development in undeveloped areas within Viento's city boundaries.

Bill E. Conomy: a local businessperson who is concerned about the long range business potential of the area. Bill believes that more people will boost sales at local stores, and could attract new businesses to the area. On the other hand, many local businesses benefit from recreational tourists, attracted to the area's bucolic landscape and abundant wildlife. Increased development could mean a decrease in tourism to the area.

MCDUFFER

BUILDER

FISHER

FARMER

CONOMY

TURNER

Role Descriptions/Name Cards

Bobbie Aviary, PhD: a respected biologist is prepared to testify about the potential effects of the proposed development on wildlife. As a scientist Bobbie must present the facts: The floodplain, about 1000 acres of riparian forest and woodland, must remain undeveloped to provide critical habitat. Bobbie knows that in a floodplain, wildlife need refugia (i.e., refuges or places to escape floods.) Thus, the habitat requires at least a 300 meter upland buffer to act as refugia for animals, such as jackrabbits, fox and deer, living in the floodplain. In addition, an ecosystem suffers if one type of habitat is eliminated. Bobbie will argue to preserve some oak woodlands and agricultural land.

Taylor T. Lobata: a landscape architect brought in as an expert witness by the undecided members of the County Board of Supervisors to discuss alternatives to the proposed housing design. Taylor has a reputation for designing facilities in harmony with the natural surroundings. Taylor will propose: (1) Decrease the size needed for the development by building houses in clusters. Cluster development allows each house a small private yard, but the development shares large areas of open space. (2) Decrease the proposed golf course, and (3) include native plantings in the fairways, plan wetland "traps" and landscaping that will double as filters for herbicide/pesticide runoff.

Arnold Shepherd: a neighboring farmer/rancher who is opposed to the development. Farmers often have trouble operating in rapidly urbanizing areas because homeowners complain about the noises and smells that go along with the farming business.

Pat Potts, Ph.D.: an archeology professor from the local university who has done extensive research on the archeological sites of the Miwok Indian fishing camps along the river. Pat knows that one important archeological site would be disturbed under the development proposal. Pat thinks that the development could be modified to avoid that site.

Lynn Dripper: the director of the municipal sewage treatment plant, responsible for ensuring that all sewage is treated to federal standards before returning effluent to the river. Lynn is concerned that the capacity of the current sewage treatment plant is almost at maximum and could not serve an additional 3,200 families.

Sherlock Homes a representative of homeowners from nearby Viento neighborhoods who are afraid that the development could impact their quality of life. Most Viento homeowners moved there for the rural small-town character of the place. Viento is a relatively compact hamlet with housing and small businesses clustered around the town square. They say the proposed development seems like a big sprawling development in comparison.

LOBATA

AVIARY

POTTS

SHEPHERDS

HOMES

DRIPPER

Conrad Constable: local policeman concerned about maintaining police protection, peace, health, and safety with limited staff. Constable is not sure that the additional property taxes from the development would be allocated to help increase police protection.

Bonnie B. Bird: president of the local bird watching club who has organized bird-watching trips to the area every spring for past 15 years. In spring, many migratory songbirds can be seen in the oak trees and the herons and egrets begin nesting in the rookery. The first Swainson's hawks arrive in March from their long migration back from Argentina. Bonnie believes that destruction of the heron rookery could easily be avoided and that the proposed development is too large. A much smaller development that allows a portion of each type of habitat to remain undisturbed is what Bonnie is pushing for.

Corey Planter: the owner of a local nursery, Corey sees opportunity for some big business with the planned golf course. Corey specializes in exotic ornamental shrubbery, but has the capacity to raise many different types of plants at the nursery, including native species.

CONSTABLE

BIRDS

PLANTER

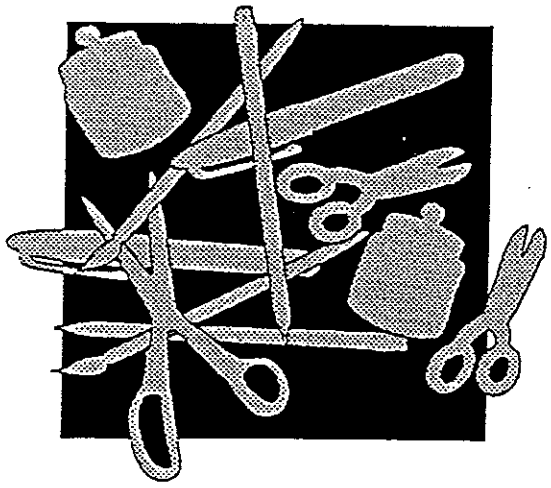
Extensions

- Assume that the County Board of Supervisors could not make a final decision and asked for the developers, ecologist, landscape designer, water treatment expert and local citizens to develop an alternative development proposal that would better balance the needs of people and wildlife. Have the students design an alternative development proposal, using the habitat site map provided.

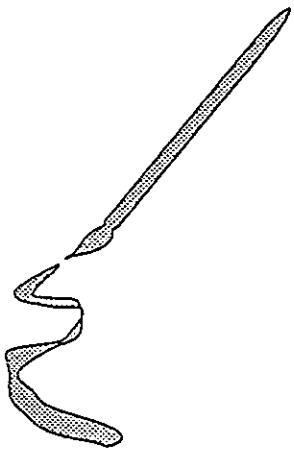
- Change roles and conduct the Board meeting again. Note any differences as your perceptions of the process and experience.

- Consider a proposed development that you may know of from local or national news or that students may know of from their own experience. Ask students to research a development project and make recommendations about whether or not the development should take place, or what changes they might suggest for the proposed development. Have the students provide reasons and rationale behind their recommendations.

NOTE: Preserve staff would appreciate receiving any comments, questions or issues that seem to consistently arise during this exercise. We welcome feedback and will seek to improve the curriculum with teacher and student input.



indoor exhibits





Design a Guide

Objectives

Students will understand that:

1. The preserve is made up of different natural communities
2. Different plants and animals comprise (favor) each habitat
3. The free-flowing river has a distinct role in each habitat
4. People relate today and historically with each habitat
5. Adaptions/Relationships between the plants and animals may be habitat specific

Materials

- Writing paper
- Drawing paper
- Colored pens, pencils, etc.
- Identification (field guides for birds, mammals, butterflies)

Procedure

Students number off from 1 to 6 repetitively until each student has a number. Form groups and have students designate within their group, a recorder, an illustrator, a naturalist and an explorer. Assign exhibit area a number: Cosumnes River (1), Oak Riparian Forest (2), Valley Grasslands (3), Seasonal Wetlands (4), Tidal Wetlands (5), Agricultural Lands (6). Each group is responsible for creating a "field guide" to the natural communities. The guide should be very descriptive. Address the following items for each habitat:

1) Describe in detail what you see in the mural strip.
2) Explain the role that the river plays within the habitat
3) Explain the role that people play within the habitat
4) Identify as many plants, animals and insects as you can within that habitat
5) Describe several ways in which animals are adapted to the habitat (Coloration, foot shape, bill shape, etc.)

Tasks for group members:

Recorder: record all observations for the group.

Illustrator: illustrate the guide. Illustrations can include a key to the mural, illustrations of animals, plants or a cover for the guide.

Naturalist: develop a species list for the habitat. Identify the animals within the exhibit areas and mural strip, some are labeled, some are mentioned within the text and some must be looked up in the field guides.

Explorer: Describe to the recorder what you would want to tell another person about this habitat. What do you see, first, second, third? What are the predominant colors, Are you likely to get your shoes wet? Could you go for a swim? Are the surrounding plants tall or short?

Work together to define the role the river plays in the habitat and the role people play.

Near the end of the activity, gather students together and have them present their field guides to the habitats to the group.

Extensions

- The students could develop these guides into books and expand them to include more detailed information about the plants and animals.

- Ask students to diagram each habitat into primary, secondary and tertiary themes. Ask them to design and produce their own "interpretive" or educational exhibit for a bulletin board at school.

For High School Students

The following *Exhibits Quiz* is provided as a means of encouraging students to thoroughly read the exhibit text for comprehension. It can be used as a handout that students complete during a their visit to the preserve.

Exhibits Quiz

Cosumnes River

1. Describe the origin and destination of the Cosumnes River.

2. What allows this river to flood? What effect does flooding have on wildlife? What effect does flooding have on forest regeneration?

3. How are the upper and lower rivers different?

Valley Oak Riparian Forest

1. Name two birds commonly found in the Valley Oak Riparian Forest.

2. Describe the soil characteristics that support the Valley Oak Riparian Forest.

3. How has the range of the Valley Oak Riparian Forest changed over the years? What role have humans played in the past and currently? How are volunteers involved in the Valley Oak Forest?

Valley Grasslands

1. What are the greatest threats to native grasses?

2. Name three butterflies and two dragonflies found at the Cosumnes River Preserve.

Butterflies	Dragonflies
1._____	1._____
2._____	2._____
3._____	

3. Construct a segment of a food chain using animals identified next to and found in the painted mural.

Bonus question: How have birds and insects adapted to non-native plants? (Answers found in the painted mural.)

Seasonal Wetlands

1. What factors have contributed to the loss of wetlands?

2. Match bird and habitat:

Sandhill crane	seasonal ponds for migratory waterfowl
American avocet	nesting habitat for resident waterfowl
Mallard	shallow flooded agricultural fields
Northern pintail	mudflats for nesting shorebirds

3. What is a "flyway"? What countries make up the Pacific Flyway?

4. Name five migratory waterfowl species.

1._____ 4._____

2._____ 5._____

3._____

Tidal Wetlands

1. Describe the vegetation found along the slough channels.

2. Discuss the influence of the Pacific Ocean tide on the Cosumnes River and its associated sloughs. Is the Cosumnes River made up of (circle one) saltwater, brackish water or freshwater.

3. Match the following plants and their uses by the Miwok American Indians:

Willow shoots	ceremonial headdresses
Black walnut	clapper rattle
Feathers	dye for baskets
Elderberry stem	basket weaving

Agricultural Lands

1. To learn about the typical year of sandhill cranes, complete the following table:

Season	Activity	Location
Fall		
Winter		
Spring		
Summer		

2. What are the differences between the greater and lesser sandhill cranes?

3. What can farmers do to attract wildlife? What benefits do wildlife provide to farmers?

4. What is a bird's "range"? What is the range of the Swainson's hawk?

5. What is a raptor?

6. What two threatened birds exist at the Cosumnes River Preserve?

Bonus question: Complete the following table for the Swainson's hawk:

Season	Activity	Location
Fall		
Winter		
Spring		
Summer		

ANSWERS

COSUMNES RIVER

1. Origin: Sierra Nevada mountains, Destination: Pacific ocean.
2. The river floods from snowmelt, springs and seepage in the heights of the Sierra Nevada mountains, which, due to the lack of a dam may cause flooding in wet years.

Effects of flooding on wildlife and forest regeneration:

- Flooding creates acres of seasonal wetlands, which are used as home and breeding ground the migrating waterfowl.
- Flood waters carry sediments rich in minerals and topsoil which are vital as food sources especially for the California valley oak.
- Floods kill rodents that feed on acorns and oak seedlings.
- Flooding speeds up forest regeneration since the flood waters carry rich nutrients which are readily available to the organisms that survive the flood.

3. The upper river is narrow and shallow, with the water flowing swiftly over granite bedrock. The water is also cold in upper areas. The lower river is deeper, slower and warm. It also carries more sediments than the upper river.

VALLEY OAK RIPARIAN FOREST

1. Cantankerous scrub jay, acorn woodpecker, great horned owl, wood duck and cedar waxwing.

2. Rich in nutrients and minerals; loose in texture; and loamy.

3. A). The total acreage of valley oak riparian forest has shrunk to less than two per cent of what it was in the mid - 1800's. B). Human settlers took advantage of the rich soils of the valley oak forest. They cleared the land for agriculture and urban growth, they dammed the rivers to generate power and control flooding. C). Hundreds of volunteers plant valley oaks and other native species, that have been destroyed by human encroachment.

GRASSLANDS.

1. Overgrazing by cattle and sheep, clearing for agriculture, introduction of aggressive non-native plant species, and reduction of native herbivores.

2. Butterflies: western parsley swallowtails, mourning cloak, Lorquin's admiral. Dragonflies: common green darner, jagged-edged saddlebag.

3. flies— spiders — small birds — garter snakes
   leaves — jack rabbits — coyotes.

4. Birds and insects have adapted by eating nectar from flowers of non-native plains.

SEASONAL WETLANDS.

1. Construction of dams and levees, the channelization of rivers, and the requirements of agriculture, and urban development.

2. sandhill crane — shallow flooded agricultural fields.
   American avocet — mudflats for nesting shore birds
   mallard — nesting habitat for resident waterfowl.
   northern pintail — seasonal ponds for migratory waterfowl.

3. A "flyway" is a "bird highway" in the sky. United States, Canada, and Mexico.

4. ducks (northern pintail, northern shoveler, green-winged teal, American wigeon)
   swans, geese, sandhill cranes.

TIDAL WETLANDS

1. expansive stands of tules, cattails and buttonbush shrubs.

2. The Cosumnes River and its sloughs feel the influence of the Pacific ocean tides. Twice each day the water level on the Preserve rises and falls as the tides flow and ebb through San Francisco Bay. The high tides from the Pacific ocean push freshwater up the Sacramento -San Joaquin delta raising the water level of the lower river by as much as 4 feet.

3. willow shoots— basket weaving
   black walnut — dye for baskets
   feathers — ceremonial headdresses
   elderberry stem — clapper rattle.

AGRICULTURE LANDS

1. fall — foraging — Central Valley
   winter — mating, migrating north to breed —Central Valley, North America
   spring — raising young — N. California, Oregon, Alaska, Canada
   summer — foraging preparing to fly south— N. California, Oregon, Alaska, Canada

2. GREATER sandhill
   larger, migrate to North Eastern California, Oregon, British Columbia. Endangered.

LESSER sandhill
small, migrate to North Canada, Alaska and North East Siberia.

3. Flood their land to attract wildlife. Birds fertilize the soil and help work the years crop stubble into the soil.

4. The distance a bird migrates, from breeding ground to wintering ground. North America to South and Central America (16,000 miles).

5. A bird of prey.

6. greater sandhill and the Swanson's hawk.

7. fall — migrating — Central Valley.
   winter — foraging, raising young — South and Central America.
   spring — nesting and foraging — Central Valley.
   summer — nesting — North .America.

glossary

Adaptation: A behavior, physical feature, or other characteristic that helps an animal or plant live more successfully.

Amphibian: A cold-blooded vertebrate that usually hatches as aquatic larva and grows into an adult with air-breathing lungs.

Aquatic: Living in water.

Biodiversity: The diversity or variety of life forms on earth, at the genetic, species and community levels.

Bird: A warm-blooded, egg-laying feathered vertebrate with fore-limbs modified to form wings.

Botanist: A scientist who studies plants.

Broad leaf: A term describing a plant with wide-bladed leaves, such as an oak or maple; generally refers to flowering trees in contrast to conifers.

Carnivore: A meat eater.

Community: A collection of all species living within a given area that interact with one another.

Data: Recorded information based on observations.

Development: The act of converting land for a specific purpose, i.e. industry or housing.

Dominant species: Plant or animal species which exert major controlling influence on the community

Ecological: Having to do with the study of the relation of organisms or groups of organisms to their environment.

Ecosystem: A natural unit that includes living and non-living parts interacting to produce a stable system in which the exchange of materials between the living and non-living parts follows closed paths; all living things and their environment in an area of any size, with all linked together by energy and nutrient flow.

Erosion: The process by which the surface of the earth is worn away by the action of water, glaciers, winds, and waves; the process by which water, wind, and temperature break down rock and soil into small, loose particles; which may then be swept away by wind and water. Movement of soil by water and wind.

Exotic: Introduced; non-native; not adapted to local site conditions.

Floodplain: The area along a stream or river that is subject to flooding. It may be wide or very narrow depending on topography.

100-year floodplain: the area of land around a river or body of water that would be likely to flood at least once every 100 years. Most homes or buildings cannot be legally built within the 100-year floodplain in California.

Forage: (verb) the act of searching or hunting for food; (noun) the food found by such means.

Forb:	Any broad-leaved herbaceous plant other than grass.
Grass:	Plants that usually have narrow leaves, hollow, jointed stems, and spikes or clusters of flowers borne in smaller "spikelets."
Groundwater:	The water beneath the earth's surface that supplies wells and springs.
Habitat:	An area that provides an organism (plant or animal) with the particular things it needs to survive: space, shelter, food and water.
Habitat mosaic:	an interconnected mixture of different habitat types, usually with a variety of wildlife that utilize several habitats within the mosaic.
Habitability:	The quality of being suitable to live in.
Herbaceous:	A soft-stemmed plant.
Herbivore:	A plant eater.
Hypothesis:	A proposed explanation about the answer to a question (problem) which can be tested in an experiment.
Insect:	A small invertebrate, the adults of which have three pairs of legs, a segmented body with three parts, and usually two pairs of wings.
Interrelationship:	The reliance of two or more living things on one another for survival.

Mammal:	A warm-blooded animal with a backbone, the female mammal produces milk.
Marsh:	A wetland dominated by herbaceous plants.
Migration:	Seasonal movement from one region to another. For example, a hawk might migrate from southern Canada to Central America for the winter.
Migratory:	Birds or other animals that make annual migrations.
Natural regeneration:	Healthy regrowth of vegetation, such as trees, subsequent to its elimination.
Niche:	An animal's job (role) in a community; particularly how it finds food and shelter.
Omnivore:	An animal which eats both plant and animal materials.
Percolate:	To pass or ooze through.
Pioneer species:	An animal or plant species that establishes itself in a previously barren environment.
Population:	A group of individuals of a certain species, in a given area at a given time.
Reptile:	A cold-blooded, egg-laying animal with a backbone.
Reservoir:	A human-built lake usually constructed to hold water for future use or to keep back floodwaters.
Rhizome:	Underground stem.
Riparian:	Occurring along the bank of a creek, stream, or river.

Scat:	The excrement or droppings of an animal.
Sediment:	Fine particles of soil (silt, sand, and clay) moved by wind or water from one place to another, often deposited in a body of water like a stream, river, or lake. (Some of these fine particles sink to the bottom while others are suspended in the water.)
Shrub:	A woody plant with several stems and of relatively low height.
Slough:	A water channel that has no headwaters, but gets its water from floods or tides instead.
Snag:	A standing dead tree from which the leaves and most of the branches have fallen; typically important as wildlife habitat.
Species:	A particular kind of animal or plant that can interbreed and produce offspring of the same kind.
Spider:	An animal in the arachnid family that has eight legs and two body parts.
Swamp:	A wetland dominated by woody plants.
Topography:	The graphic representation of the exact physical features of a region on a map.
Transect:	An observation and charting method used by scientists to sample points along a line.
Tree:	A woody plant 12 or more feet tall with a single main stem (trunk) and a more or less distinct crown of leaves.

Understory:	The layer of plants growing under another higher layer of plants, e.g., grass, weeds, and brush under forest trees.
Vine:	A plant that has a flexible stem and supports itself by climbing or creeping along a surface.
Watershed:	The whole region from which a river, stream, or lake receives its supply of water from rain and melted snow; all the land that carries rainfall to the same stream or river. In the largest sense, all the land on earth is the watershed for the oceans.
Wetlands:	Areas that, at least periodically, have waterlogged soils or are covered with a layer of water. Wetlands include ponds, bogs, swamps, freshwater and saltwater marshes, mudflats, channels, and seasonally ponded areas.
Wildlife:	Any animal that is not tamed or domesticated.
Zoologist:	A scientist who studies animals.

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The Water Education Foundation
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The Water Education Foundation
717 K Street, Suite 517
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