Taking Action

In the 1970's, with approximately half of the wetland acreage in the United States lost to development, agriculture, and other land uses, the government finally began to take action to protect what remained—through federal and state legislation.

One federal law—the Clean Water Act—contains provisions (Section 404) to improve the water quality of wetlands and protect wetlands from development. Section 404 does not prohibit development in wetlands. But if properly enforced, it does provide a way to control wetland destruction and encourage more ecologically sound alternatives. In California, the California Coastal Act provides additional protection for wetlands and other sensitive habitats. Both of these laws provide opportunities for public review and comment on proposed developments.

Though these laws do provide some protection for wetlands, many people believe that more needs to be done to prevent additional wetland losses and to restore wetlands that have been dredged, drained, or polluted.

Restoration

Many of our remaining wetlands have been degraded so that they no longer support the diversity of wildlife that once existed there. These wetlands may benefit from restoration.

Can We Restore Nature?

As it applies to nature, the term "restoration" means different things to different people. To some, restoration means recreating what existed in the past. To others, it is re-establishing a portion of the values and functions of a damaged ecosystem. In many cases, complete re-creation of a pre-existing ecosystem is not feasible. Factors that restrict our ability to completely restore a degraded ecosystem include:

- human-built constraints, such as bridges, roads, upstream dams, and other developments
- our limited scientific knowledge of what it takes to successfully restore an area
- limited funds—restoration can be very expensive.

Restoration usually focuses on the whole ecosystem, not on a single species. In spite of difficulties and constraints, restoration projects strive to replicate as many of the values and functions of the original ecosystem as possible, to support multiple native species and create a healthy, self-sustaining system.

Restoring wetlands—replicating the complex physical, chemical, and biological interactions—is not quick or easy. It is a process that takes place over a long time. Restoration often requires:

- Re-establishing water flow to support wetland plant communities. This may mean redirecting a river back into the wetlands, removing dams, or dredging certain areas.

- Controlling pollution. Determining and decreasing sources of contaminants that enter the wetland can be accomplished through educating the public and developing and enforcing laws.

- Re-establishing functional habitat. This may involve removing invasive species, growing and installing native plants, and maintaining the restored habitat by weeding and watering.

- Creating habitat links so that species can breed and maintain genetic diversity. This may require bridging roads or establishing "green-ways" in order to connect existing habitats so that wildlife can travel between isolated patches.

- Long-term monitoring and adaptive management. Measuring plant survival, wildlife usage, and other wetland functions provides information on what is working and what can be improved to achieve goals. Using an adaptive management strategy enables ecologists to respond to changing conditions and needs.

Some of the goals of restoration are for the wetlands to become:

- sustainable, with vegetation maintaining and replacing itself over time, independent of human help
- resistant to invasion by non-native species
- diverse, with a range of habitats and species.

Restoring UNB

Years of rapid urban growth have seriously degraded the wetlands of Upper Newport Bay (UNB). Some existing problems include:

- water containing pesticides and heavy metals from urban runoff at levels toxic to aquatic life
- trespassers and dogs disturbing the nesting areas of the endangered Least Tern, Belding's Savannah Sparrow, and Light-footed Clapper Rail
- invasive species, which represent almost half of the plant life at UNB, displacing native communities; many plants and animals that exist nowhere else depend on UNB, but with the continued disappearance of native habitat, these species are threatened with extinction.

Recognizing that southern California's coastal wetlands are of vital ecological, hydrological, and economic significance, the California Coastal Commission selected Upper Newport Bay, the region's largest wetland, to pilot a Community-Based Restoration and Education Program. CBREP recruits volunteers from the general public and schools to restore habitat at UNB.
Program volunteers have:

- removed thousands of pounds of invasive plants
- created a native plant nursery
- planted natives that support indigenous wildlife
- monitored restoration sites for vegetation coverage and wildlife usage.

Volunteers also remove more than 15 tons of trash each year that washes into the Bay and endangers its wildlife and blemishes its beauty. Other groups working in conjunction with CBREP to restore and protect the Bay include the California Department of Fish and Game, Orange County Harbors Beaches and Parks, the City of Newport Beach, and the Newport Bay Naturalists and Friends.

Stewardship

Without help, the sensitive habitats of Upper Newport Bay—as well as other wetland areas—will continue to be threatened. Although we have halted the high rate of wetland destruction, much work remains to be done to protect and restore remaining wetlands. Everyone can help.

Environmental stewardship is an understanding that we are both caretakers of and dependent on the natural environment. Human health and well-being depend on clean water and air and on functioning ecosystems. As humans, we have the power to decide how we want to live in the world—whether we are going to exploit the environment for short-term gains or live in harmony with it. By recognizing our interdependence with the natural world, we begin to take responsibility for its future and our own.

Ultimately what is good for our natural environment is good for us as well.
We benefit in many ways from maintaining and restoring natural places like Upper Newport Bay. Besides providing flood protection and a system for filtering water, wetlands provide habitat and nurseries for plants, fish, birds, and other wildlife, and also offer important open space for people to bike, jog, kayak, or simply walk or sit and observe nature's beauty.

Each of us, as individuals and as groups, can help improve and restore our wetlands and other sensitive habitats by getting involved.

First, learn about the importance of wetlands and other sensitive habitats, and the issues that affect these natural environments. Share your knowledge with others.

Second, be active. Participate in clean-up days or restoration events. Plant natives in your backyard and enjoy the wildlife they attract. And get others involved. When people help pick up the trash that has collected downstream or keep track of the quality of the water in the Bay, they become aware of such harmful habits as littering or washing the car in their driveway.

Third, participate in the decision-making process. Government officials who make decisions concerning wetlands and other sensitive habitats need to hear your views. Write letters and attend public hearings. And whenever possible, let your voice be heard by voting.

Protection and restoration of our natural environment is possible if government and the residents in the watershed work together. The value of restoration is not just its ability to transform the landscape but also its ability to educate and transform the human beings who inhabit and shape it.

Activity: Seed Experiments

Summary: Students germinate seeds, compare plant growth and health, introduce variations in soil, and gather and analyze data on optimal conditions for plant growth.

California State Content Standards

SCIENCE

Chemistry

- **Acids and Bases 5a.** Students know the observable properties of acids, bases, and salt solutions.
- **Acids and Bases 5d.** Students know how to use the pH scale to characterize acid and base solutions.

Biology/Life Sciences

- **Ecology 6b.** Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- **Ecology 6e.** Students know a vital part of an ecosystem is the stability of its producers and decomposers.

Investigation and Experimentation

- **1a.** Students will select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
- **1b.** Students will identify and communicate sources of unavoidable experimental error.
- **1c.** Students will identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
- **1d.** Students will formulate explanations by using logic and evidence.

MATHEMATICS

- **Probability and Statistics 6.0.** Students know the definitions of the *mean, median,* and *mode* of a distribution of data and can compute each in particular situations.

Objectives:

Students will be able to:

- Germinate seeds
- Analyze data on plant growth

Materials:

- Seeds with high germination rates; if growing plants for a restoration project, use California native plants:
  - Goldenbush – *Haplopappus venetus*
  - Bush Sunflower – *Encelia californica*
  - Sagebrush – *Artemisia californica*
- Newspaper
- Plastic wrap
- Water spray bottle
- Water
- Seeding flats
- Liners (small plant pots)
- Potting soil
- (*optional)* Seed-starter mix (may produce better germination)
- Substances to change soil conditions (not too toxic!), such as baking soda, vinegar, fertilizer, sand, salt, etc.
- Handouts
  - *Observation Worksheet* (Parts 1, 2, 3, and 4)
  - *Planting Techniques*

Preparations:

- Make a copy of the 4 parts of the *Observation Worksheet* for each student or group

Time Required:

- Three 50-minute class periods
- 5 minutes each day for 2 weeks for observing and recording

Note: The Community-based Restoration and Education Program at Upper Newport Bay may provide seeds, flats, and pots; call 949-640-0286.

Procedures:

Part I – One 50-minute class period plus 5 minutes for observation/recording each day for the next week.

1. Distribute to each student or group:
   - seeding flat
   - seed-starter mix or potting soil
   - three different kinds of seeds
   - Part 1 of the *Observation Worksheet*
2. Ask students to complete questions 1 through 3 on their worksheets:
   - the common and scientific names of the seeds
   - a description of the seeds
   - a prediction of the number of days for the seeds to germinate (to sprout)
3. Have students sow their seeds following these directions:
   - Fill a container with drainage holes to the top with seed-starter mix or potting soil; pat down lightly and uniformly.
   - Water thoroughly. After watering, the surface of the soil should still be level.
   - Broadcast the seeds evenly on the surface.
   - Sprinkle seed-starter mix or potting soil to cover the seeds to a depth equal to one or two times its smallest diameter. Seeds sown too deeply will not produce seedlings.
   - Spray the soil with water and place the container in a sheltered location out of direct sunlight.
   - Use masking tape and a marker to label the species, date, and student or group name on the container.
   - For protection and moisture retention, enclose the container in a plastic bag or piece of plastic wrap, with a sheet of newspaper on top to prevent heat build-up.
   - During the germination period (1-2 weeks), keep the surface of the soil moist. As seeds start to germinate, remove the newspaper and plastic.
4. Have students record daily observations on Part I of the *Observation Worksheet*.

Part II – One 50-minute class period plus 5 minutes for observation/recording each day for the next week.

1. Distribute to each student or group Part 2 of the *Observation Worksheet*.
2. Use the questions on the worksheet to have students compare and compile data on the germination of their seeds.
3. Explain that to demonstrate the importance of soil composition and the effects of contaminants in soils, they are going to plant their seeds in different soil mediums. Ask students what pollutants might be absorbed into soils, how long these contaminants might last, and how they might be cleaned from the soil? Have students choose the variations they will introduce.

Possibilities include:
- adding acidic or basic substances such as vinegar and baking soda to change the pH
- adding sand or salt to alter the soil composition
- using various fertilizers
- using soil from the yard
- over-watering

4. Have students transplant their seedlings following these directions:
   - When the seedlings are large enough to handle, prepare the contaminated soils and fill liners 2/3 full. Water the liners. Fill at least one liner with unaltered potting soil to act as a control. Transplant extra seedlings into potting soil to grow for restoration.
   - Lift each seedling out with a fork or knife to protect the tender roots.
   - Gently hold the seedling with roots dangling above the liner soil and sprinkle more soil around the roots until they are buried.
   - Lightly press the soil around the root crown and add more soil until the seedling is planted to the same depth as it was in the flat.
5. Distribute to each student or group Part 3 of the *Observation Worksheet*. Ask students to fill in questions 1 through 3 on their worksheets.
6. For the next week, have students monitor plant growth and health and record their observations on their worksheets.

Part III – One 50-minute class period.

1. Distribute to each student or group Part 4 of the *Observation Worksheet*.
2. Use the questions on the worksheet to have students compare and compile data on the growth of their plants.

Follow-up:

Follow the *Planting Techniques* to plant the native seedlings on the schoolgrounds or at Upper Newport Bay after the first rain of the season. (Contact UNB Restoration Project to arrange for planting.)

Extension:

Have students calculate the variance and the standard deviation of the time that it took for all the seeds in the classroom to germinate. Explain that variance and standard deviation are indices that statisticians use to characterize differences in a population.

x = the number of days to germination

mean = average

$$\text{Variance} = \frac{(x \text{ for Seed 1} - \text{mean germination of all seeds})^2 + (x \text{ for Seed 2} - \text{mean germination of all seeds})^2 + \ldots \text{etc.}}{\text{Total number of seeds}}$$

Standard Deviation = the square root of the variance

Adapted from "Seed Experiments" from *National Park Labs Curriculum*, National Park Service at the Golden Gate National Recreation Area.

Observation Worksheet

Part 1
(Answer before sowing seeds.)

1. What are the common and scientific names of your seed species?

	Seed A	**Seed B**	**Seed C**
Common Name	_____	_____	_____
Scientific Name	_____	_____	_____

2. Describe the condition of your seeds. What do the seeds look like? Is there any visible damage? Are the seeds robust or withered? What color are they? Can you tell by looking at them what the seed dispersal mechanism is?

Seed A _____
_____

Seed B _____
_____

Seed C _____
_____

3. Predict the number of days it will take for your seeds to germinate.

Seed A _____ **Seed B** _____ **Seed C** _____

4. Monitor daily changes below. Note the day of seed germination.

	Date	**Time**	**Observation**
Seed A			
Seed B			
Seed C			

Observation Worksheet

Part 2
(Complete one week after sowing seeds.)

1. How long did it take for your seeds to germinate?

Seed A _____ days **Seed B** _____ days **Seed C** _____ days

2. Did your seeds take a longer or shorter time to germinate compared to other seeds in your classroom? (circle one)

Seed A	**Seed B**	**Seed C**
Longer or **Shorter**	**Longer** or **Shorter**	**Longer** or **Shorter**

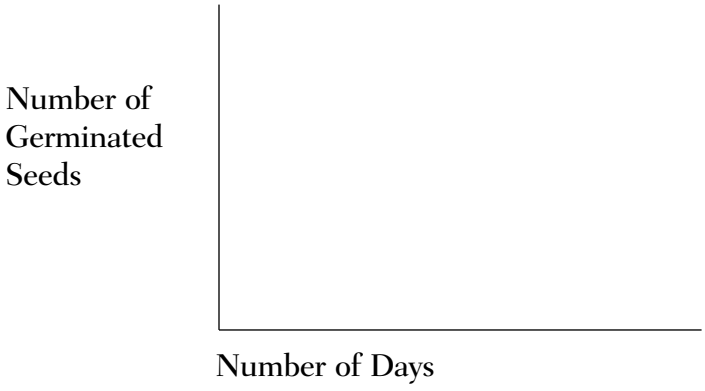
3. For all the seeds in your classroom, determine the mean (average), mode (most common), and median (middle) time it took them to germinate.

Mean = **Mode =** **Median =**

4. What was the germination rate (percentage of seeds sown that germinated) in your classroom?

(number of germinated seeds ÷ total number of seeds x 100 = % germination rate)

5. Graph the time it took for the seeds to germinate.



6. What are some of the reasons that the seeds germinated on different days?

Observation Worksheet

Part 3
(Complete immediately after treating soil.)

1. How was your soil treated?

Treatment 1 (T1): _____

T2: _____

T3: _____

2. Measure the pH, nitrogen, phosphorous, and potassium levels of the soil and record below.

Seed A pH _____ nitrogen _____ phosphorous _____ potassium _____

Seed B pH _____ nitrogen _____ phosphorous _____ potassium _____

Seed C pH _____ nitrogen _____ phosphorous _____ potassium _____

3. Predict the growth of the plants in altered soil (experimental plants) compared to the control plants.

_____
_____
_____
_____

4. Monitor daily changes below.

	Date	Time	Observation
Seed A			
Seed B			
Seed C			

Observation Worksheet

Part 4
(Complete one week after treating soil.)

1. How have your experimental plants grown in comparison with your control plants?

_____
_____
_____

2. How have your plants grown in comparison with other plants in your classroom?

_____
_____
_____

3. How does your actual plant growth compare to your predictions (Part 3)?

_____
_____
_____

4. What are the most favorable soil conditions for plant growth?

_____
_____
_____

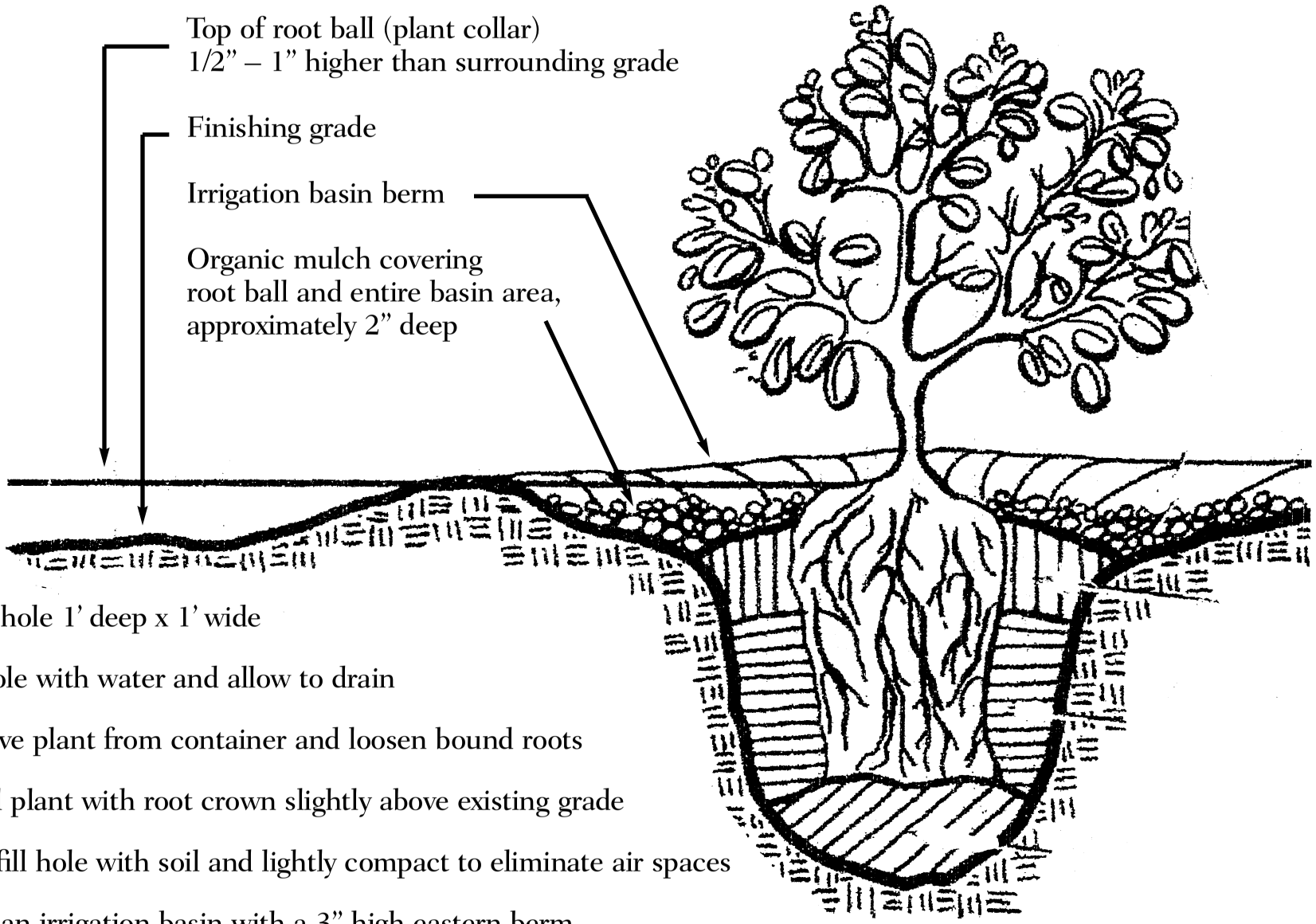
5. What are the least favorable soil conditions for plant growth?

_____
_____
_____

6. For each treatment, create a graph that compares plant growth and survival among species. Include all details that you feel are important. Label both axes.

7. How do contaminants in soil affect plant health?

_____
_____
_____



1. Dig a hole 1' deep x 1' wide
2. Fill hole with water and allow to drain
3. Remove plant from container and loosen bound roots
4. Install plant with root crown slightly above existing grade
5. Back fill hole with soil and lightly compact to eliminate air spaces
6. Build an irrigation basin with a 3" high eastern berm
7. Cover basin bottom and berm with a 2" layer of mulch
8. Irrigate basin with 4 gallons of water

Activity: Plant Monitoring

(Field Study)

Summary: Students learn to compare the ecological roles of native and non-native plant species in an ecosystem and to assess the impact of removing invasive plants based on interdependencies within the system. At Upper Newport Bay, or other site, students monitor vegetation growth.

California State Content Standards

SCIENCE

Biology/Life Sciences

- **Ecology 6a.** Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
- **Ecology 6b.** Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- **Ecology 6c.** Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.
- **Ecology 6d.** Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.
- **Ecology 6e.** Students know a vital part of an ecosystem is the stability of its producers and decomposers.
- **Evolution 8b.** Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.

Investigation and Experimentation

- **1a.** Students will select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
- **1g.** Students will recognize the usefulness and limitations of models and theories as scientific representations of reality.
- **1j.** Students will recognize the issues of statistical variability and the need for controlled tests.
- **1k.** Students will recognize the cumulative nature of scientific evidence.

ENGLISH-LANGUAGE ARTS

Grades 9-10

Speaking Applications

- **Deliver Expository Presentations 2.2**

b. Convey information and ideas from primary and secondary sources accurately and coherently.
c. Make distinctions between the relative value and significance of specific data, facts, and ideas.
f. Use technical terms and notations accurately.

- **Deliver Descriptive Presentations 2.6c.** Use effective, factual descriptions of appearance, concrete images, shifting perspectives and vantage points, and sensory details.

Grades 11-12

Listening and Speaking Strategies

- **Organization and Delivery of Oral Communication**

1.8. Use effective and interesting language, including:
a. Informal expressions for effect
b. Standard American English for clarity
c. Technical language for specificity.

MATHEMATICS

- **Probability and Statistics 8.0.** Students organize and describe distributions of data by using a number of different methods, including frequency tables, histograms, standard line and bar graphs, stem-and-leaf displays, scatterplots, and box-and-whisker plots.

Objectives:

Students will be able to:

- Identify wetland plants
- Use quadrats to inventory plants
- Monitor a site to determine ecosystem health

Materials:

- Cones or flags to mark off field study area (if needed)
- Field Guide for plants (see www.newportbay.org/plants)
- *(optional)* Camera and compass for photo-monitoring log
- Handouts
  Plant Monitoring Log
  Percent Coverage Data

For each group:

- Hula Hoop® or meter-square quadrat (can be made from PVC piping and elbows or meter sticks and string)
- Clip board and pen

Preparations:

- Contact field study site to arrange a visit. (See Apendix D. For UNB call 949-640-0286.)
- Find out what materials will be available on site.
- Make a copy of the *Plant Monitoring Log* and *Percent Coverage Data* handouts for each group.

Time Required:

- 50 minute class session
- Approximately 1-1/2 hours in the field to inventory plants and discuss findings

Note: Plants are easiest to identify during the growing season, March-June.

Procedures:

Part I – In class, prior to field study.

A. Demonstrate the concept of interdependence *(optional)*

1. Have students stand in a circle. Ask each student to name a specific part of the wetland ecosystem, either biotic (living) or abiotic (non-living)—for example: cordgrass, water, plankton, sun, killifish, clam, Brown Pelican, Light-footed Clapper Rail, cattail, soil, etc. Be sure all major areas of the ecosystem are represented, including the primary energy source—the sun.

2. Ask every other student in the circle to turn and face the outside. (Remove one student if there is an odd number.) Ask students to either hold hands or link elbows and then to lean back with their arms in front of them until they all find balance. Explain that they are demonstrating the delicate balance in any ecosystem.
   (Note: If students are reluctant to perform this activity, simply have various students state how their part of the wetland ecosystem is related to other parts.)

3. Explain you are going to act as an invasive plant that disrupts the interdependencies of the ecosystem. Attempt to break the balance of the ecosystem by pulling some students' hands or arms apart. Point out that though some sections stick together, the overall balance of the structure is broken. Ask students which links they think would break first in the ecosystem?

B. Identify invasive species

1. Divide the class into groups and assign one (or more, depending on number of groups) of the following plants to each group:

   Non-native
   - Mustard, *Brassica nigra*
   - Star Thistle, *Centaurea melitensis*
   - Ice Plant, *Gasoul crystallinum*
   - Lollypop Tree, *Myoporum laetum*
   - Giant Reed, *Arundo donax*
   - Brazilian Pepper Tree, *Schinus molle*

   Native
   - Coastal Buckwheat, *Eriogonum fasciculatum*
   - California Sagebrush, *Artemisia californica*
   - Pickleweed, *Salicornia virginica*
   - Saltgrass, *Distichlis spicata*
   - Cordgrass, *Spartina foliosa*
   - Mulefat, *Baccharis glutinosa*

2. Have each group do some research and prepare a brief report and presentation on their plant species. In their presentations, be sure students address:
   - Is the plant native or non-native?
   - If non-native, where did it come from?
   - If non-native, how does it affect the ecosystem?
   - What might be the effects if it disappears?
   - Should the plant be removed?
   - If native, what role does it play within its habitat?
   - What characteristics does the plant have that allow it to survive within its specific habitat?

Part II – Field study, at Upper Newport Bay or other natural site

A. Inventory species

1. Remind students that plants provide the basis of health in a wetland. Explain that a variety or high diversity of plant species, especially native species, usually indicates a balanced ecosystem.

2. Ask students how they would study plant populations in a site. Tell students that scientists often study small sample plots—quadrats—within a site and then use this information to make generalizations about the larger study area. Explain that a quadrat is normally a one square meter area randomly selected in the site and analyzed to quantify the density and percent cover of species within the site. Tell students that they are going to use a hoop as their quadrat.

3. Along with site staff, determine the area to be inventoried and, if necessary, mark the area with flags or cones. Choose an area with easy access that will not be harmed by foot traffic. Point out the area to students and tell them that each group will sample a different part of the site. Caution students to tread lightly as they work.

4. Divide students into groups and distribute a clipboard, pen, and *Plant Monitoring Log* to each group. Before they begin, have students quietly observe their surroundings and note their observations on their *Plant Monitoring Log*.

5. Have each group randomly toss their hoop, and then count and identify plants that are within the hoop. Have students fill in their *Plant Monitoring Logs* as they work. Tell students that if they cannot identify a species, just to give it a descriptive name.

B. Discuss plant inventory

After groups have inventoried their quadrats, bring the groups together to discuss what they found. Use the following questions to generate a discussion:

1. How many total species were found?

2. What percentage of plants is native and what percentage non-native?

3. What are the five most common plants? Are they native or non-native?

4. Were there any monocultures (only one species within a quadrat) sampled?

5. What is the average percent of plant coverage?

6. What insects and other animals were identified?

7. Is there a relation between the plant coverage and the number of animals observed?

8. Do you think the area the class sampled is a good representation of the entire site? If not, by how much would you increase the sample size to achieve a good representation? How frequently would you collect data?

Follow-up:

1. Work with staff at the site to have students remove invasive plants. Use the following questions to discuss the process:

a. What are the interactions between the non-native plants and the native plants?
(The non-native plants often out-compete the native plants, limit their growth, and sometimes kill them by altering soil chemistry and sequestering water, space, light, or nutrients.)

b. What do you predict would happen to this ecosystem if we ignored the non-native plants?

c. Will this ecosystem have increased ecological function if the non-native plants are removed? How long do you think ecosystem recovery might take?
(*Removing plants disturbs the soil, and there is likely a large non-native seed bank waiting to germinate.*)

d. Besides non-native species introductions, what other disturbances could affect ecosystem balance?
(*Disturbances may be natural or anthropogenic: fire, flood, drought, grazing, dredging, etc.*)

2. Back in class, analyze and display the data collected. Tell students that the data they collect could be a valuable addition to a long-term study of the site.

a. Have students create a visual representation of the species data collected within the different quadrats, showing the number and type of species. Have students select an appropriate method for displaying the data, such as a frequency table, histogram, etc.

b. Have students complete the *Percent Coverage Data* sheet and use the information to create a visual representation of the percentage of native, non-native, and bare ground at the site. Have students select an appropriate method for displaying the data, such as a pie chart or graph.

Extensions

1. Have students photo-monitor the site. Establish specific points from which to photograph the site. Use a compass to determine the direction of the photograph. Record information on the direction, the date, the time of day, and the weather. Compile the photographs, records, *Plant Monitoring Log,* and *Percent Coverage Data* in a binder. Have students keep up the photo-monitoring book from season to season, year to year, noting changes in the site and positive and negative trends.

2. On a world map, have students indicate where the non-native plants in Upper Newport Bay originated. What is the climate in these areas? How did the plants get to California?

Adapted from "Invasive Plant Removal & Monitoring" from *National Park Labs Curriculum*, by National Park Service at the Golden Gate National Recreation Area

Plant Monitoring Log

Date:_____ Data Collectors: _____

_____

Site Location: _____

Site Size: _____

Weather: _____

1. Observations before analyzing quadrat:

2. Species identification (list all species within the quadrat):
Note: When estimating percentages, first visualize the quadrat divided into quarters (25%), then record the average percentage estimated by two or more group members.

	native	or	invasive	% of quadrat
_____	[ ]		[ ]	_____
_____	[ ]		[ ]	_____
_____	[ ]		[ ]	_____
_____	[ ]		[ ]	_____
_____	[ ]		[ ]	_____
_____	[ ]		[ ]	_____

3. Number of species within quadrat:
Native _____
Non-native _____
Total _____

4. Percent coverage of quadrat:
Native _____
Non-native _____
Bare ground _____

5. Evidence of insects and animals identified in quadrat:

	number
_____	_____
_____	_____
_____	_____

Percent Coverage Data

Date: _____

Site Location: _____

1. Total number of quadrat samples: _____

2. Total number of species found: _____

3. Average number of species found in each quadrat: _____
   Average = total number of species found / number of quadrats

4. Total number of native species: _____

5. Percent coverage of native species: _____
   Percent coverage = average % covered by native species / total number of samples

6. Total number of non-native species: _____

7. Percent coverage of non-native species: _____

8. Percent coverage of bare ground: _____

Activity: Wetland Tradeoffs

Summary: This activity highlights the tradeoffs in wetlands management decisions. Students review the benefits of wetlands, then debate the tradeoffs in a local wetland issue.

California State Content Standards

SCIENCE

Biology/Life Sciences

- **Ecology 6b.** Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

ENGLISH-LANGUAGE ARTS

Grades 9-10

Reading Comprehension

- **Comprehension and Analysis of Grade-Level-Appropriate Text 2.3.** Generate relevant questions about readings on issues that can be researched.
- **Comprehension and Analysis of Grade-Level-Appropriate Text 2.5.** Extend ideas presented in primary or secondary sources through original analysis, evaluation, and elaboration.
- **Expository Critique 2.8.** Evaluate the credibility of an author's argument or defense of a claim by critiquing the relationship between generalizations and evidence, the comprehensiveness of evidence, and the way in which the author's intent affects the structure and tone of the text (e.g., in professional journals, editorials, political speeches, primary source material).

Writing Strategies

- **Research and Technology 1.3.** Use clear research questions and suitable research methods (e.g., library, electronic media, personal interview) to elicit and present evidence from primary and secondary sources.
- **Research and Technology 1.5.** Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).

Listening and Speaking Strategies

- **Organization and Delivery of Oral Communication 1.3.** Choose logical patterns of organization (e.g., chronological, topical, cause and effect) to inform and to persuade, by soliciting agreement or action, or to unite audiences behind a common belief or cause.
- **Organization and Delivery of Oral Communication 1.6.** Present and advance a clear thesis statement and choose appropriate types of proof (e.g., statistics, testimony, specific instances) that meet standard tests for evidence, including credibility, validity, and relevance.
- **Organization and Delivery of Oral Communication 1.8.** Produce concise notes for extemporaneous delivery.

Speaking Applications

- **Deliver Persuasive Arguments 2.5**

a. Structure ideas and arguments in a coherent, logical fashion.
b. Use rhetorical devices to support assertions (e.g., by appeal to logic through reasoning, by appeal to emotion or ethical belief; by use of personal anecdote, case study, or analogy).
c. Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations, expressions of commonly accepted beliefs, and logical reasoning.
d. Anticipate and address the listener's concerns and counterarguments.

Adapted from "Wetland Tradeoffs" from *WOW! The Wonders of Wetlands*, co-published by International Project WET and Environmental Concern

Grades 11-12

Reading Comprehension

- **Comprehension and Analysis of Grade-Level-Appropriate Text 2.3.** Verify and clarify facts presented in other types of expository texts by using a variety of consumer, workplace, and public documents.
- **Comprehension and Analysis of Grade-Level-Appropriate Text 2.4.** Make warranted and reasonable assertions about the author's arguments by using elements of the text to defend and clarify interpretations.
- **Comprehension and Analysis of Grade-Level-Appropriate Text 2.5.** Analyze an author's implicit and explicit philosophical assumptions and beliefs about a subject.
- **Expository Critique 2.6.** Critique the power, validity, and the truthfulness of arguments set forth in public documents; their appeal to both friendly and hostile audiences; and the extent to which the arguments anticipate and address reader concerns and counterclaims (e.g., appeal to reason, to authority, to pathos and emotion).

Listening and Speaking Strategies

- **Comprehension 1.2.** Analyze the impact of the media on the democratic process (e.g., exerting influence on elections, creating images of leaders, shaping attitudes) at the local, state, and national levels.
- **Comprehension 1.3.** Interpret and evaluate the various ways in which events are presented and information is communicated by visual image makers (e.g., graphic artists, documentary filmmakers, illustrators, new photographers).
- **Organization and Delivery of Oral Communication 1.6.** Use logical, ethical, and emotional appeals that enhance a specific tone and purpose.
- **Organization and Delivery of Oral Communication 1.8.** Use effective and interesting language, including:
  a. Informal expressions for effect
  b. Standard American English for clarity
  c. Technical language for specificity.

HISTORY/SOCIAL SCIENCE

- **Principles of American Democracy 12.7.5.** Explain how public policy is formed, including the setting of the public agenda and implementation of it through regulations and executive orders.
- **Principles of Economics 12.1.1.** Examine the causal relationship between scarcity and the need for choices.
- **Principles of Economics 12.1.3.** Identify the difference between monetary and nonmonetary incentives and how changes in incentives cause changes in behavior.
- **Principles of Economics 12.1.4.** Evaluate the role of private property as an incentive in conserving and improving scarce resources, including renewable and nonrenewable natural resources.

Objectives:

Students will be able to:

- Identify the benefits of wetlands
- Compare economic, social, and environmental tradeoffs in various wetland conservation and development decisions

Materials:

- Current reference materials that identify various viewpoints about wetland issues
- Handouts
  - *Tradeoffs Analyzer* (sample)
  - *Tradeoffs Analyzer* (blank)

Preparations:

- Bring in articles from local newspapers or magazines (or from the Internet) concerning wetlands (*e.g., dredging, invasive plant removal, herbicide-use, soft bottom channels, natural treatment systems*)
- Research current laws that affect development in wetlands (e.g., Clean Water Act, Coastal Act)
- Make a transparency of the sample *Tradeoffs Analyzer*
- Make a copy for each group of the blank *Tradeoffs Analyzer*

Time Required:

- Approximately 1 hour
  (more if students do research)

Procedures:

1. To review the importance of wetlands and to introduce varying viewpoints, ask students the following questions:

   a. Why are wetlands valuable? (**Note:** List benefits on the chalkboard.)
   - Wetlands filter runoff, thus improving water quality.
   - Wetlands provide habitat and rest-stops for migratory birds.
   - Wetlands sustain biodiversity by supporting threatened and endangered species.
   - Wetlands are feeding, breeding, and nursery grounds for many animals.
   - Wetlands provide recreation—hiking, biking, kayaking, bird watching.
   - In some areas, wetlands recharge groundwater.
   - Wetlands protect against flood damage by storing and slowing peak flows of water.)

   b. Why would people want to build houses or other buildings on or near wetlands?
   (People often like waterfront homes and offices. If people don't value the benefits that wetlands provide, they may want the land used in a way that is more financially beneficial to them in the short term. For example, the flat, undeveloped land with low-growing vegetation is advantageous for airports; the productive soil is beneficial for agriculture.)

   c. Why would people want to protect wetlands?
   (People may value wetlands for aesthetic beauty, for recreation, for wildlife habitat, for clean water at the beach, for the economic benefits of tourism or commercial fisheries. Some people may have only one reason; other people may value all the benefits of wetlands.)

   d. What might Upper Newport Bay look like today if citizens had not fought for its protection in the 1960s?
   (The Robinsons and other concerned citizens formed the Friends of Newport Bay in 1967, leading tours around the Bay in order to educate others about the Bay's ecological significance as well as opposing development plans, such as the Irvine Company's proposal to build hotels and marinas along the shoreline in 1969.)

2. Have students review the wetlands reference materials. Ask students what controversies they identify in the materials. Discuss and record them on the board.

3. Ask students to think of any controversies as "problems" rather than "issues." Use as an example a newspaper headline that states: "Developer Seeks Permit to Fill Wetlands for Subdivision." Explain that the "issue"— to develop or not to develop — divides people, but that a problem-solving approach will ask, "Are there alternative plans for protecting the wetland?" or "Are there alternate sites to build the subdivision?" or "Can we assure jobs and housing and still protect the environment in this case?" Ask students to identify some of the problems associated with the controversies listed on the board.

4. Have students choose a particular controversy. Ask them to:

   - describe the cause of the problem, determining if it was a natural occurrence, human-made, or a combination of the two.
   - identify the major players in the controversy and determine if others will be affected by the outcome.
   - compare the values and needs each of the players brings to the negotiating process.

5. Write a brief description of the problem in the center of the board and draw a box around it.

6. Brainstorm potential solutions to the problem. Write the proposed solutions on the board surrounding the problem description. Circle each solution.

7. Explain to students that in order to evaluate each solution, they need to determine the pros and cons. Project the overhead of the sample *Tradeoffs Analyzer*. Briefly discuss with students the problem (community flooding), the potential solutions, and the pros and cons of each solution. Ask students what solution they think is the best and why.

8. Distribute a blank *Tradeoffs Analyzer* to each student group. Ask each group to analyze the problem on the board by listing the pros and cons of the potential solutions. (If many solutions are listed, have the class choose the top four.) Encourage students to consider economic and environmental factors, including:
   - costs
   - time
   - resources
   - ecological balance
   - jobs
   - wildlife habitat
   - historic perspectives
   - people affected
   - long-term consequences
   - public policy

   (Note: If the reference materials do not provide enough information, give students time to do additional research.)

9. Have groups share their analyses, discussing any questions and debating any disagreements that arise. Create a master *Tradeoff Analyzer* on the board.

10. Ask students to rank the solutions and explain their reasons for the preferred order. Discuss the results:
    - Does the ranking reflect personal values?
    - Did they arrive at a viable solution?
    - Did the solution involve any negotiation or compromise?

Follow-Up

Have students research the consequences of their proposed solution. If students still believe that they have a viable solution and if the problem is currently being addressed in your area, have students write advocacy statements and send them to the players involved.

Extensions

1. Organize class debates on a variety of wetland issues and problems. Scenarios might include:

    - filling in and developing a wetland site
    - creating a wetland nature preserve in an area pressured by an expanding population
    - dredging a wetland to remove the sediment
    - removing an invasive plant that is aesthetically pleasing

2. Have students read newspaper accounts of a wetland controversy and analyze which arguments are based on opinions versus facts.

3. Have interested students attend and participate in public discussions of wetland issues. Ask them to report back to class.

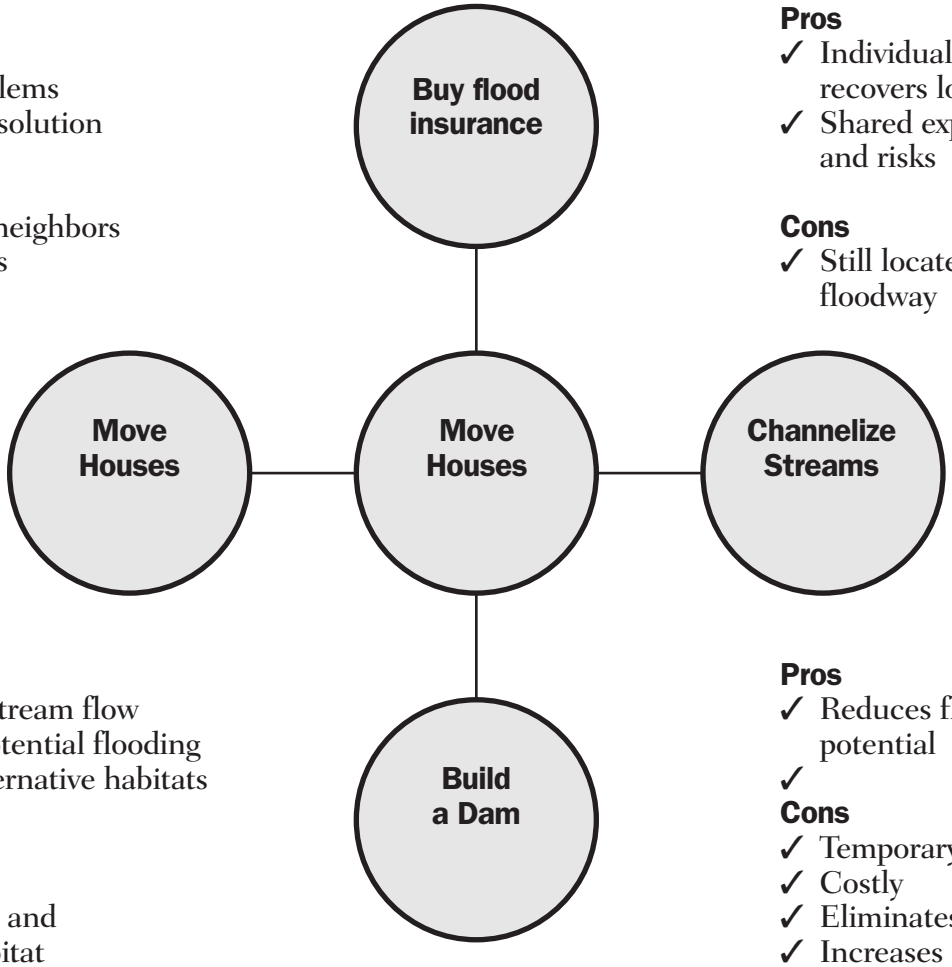
4. Tell students that sending Letters to the Editor is a great way to keep editors aware that many readers are concerned about wetlands, and it means newspapers are more likely to publish stories on the topics. Point out that published letters keep decision-makers aware of citizens' concerns and help to shape their opinions on the issue. Have students write letters to the editor. Tell them that it is best to limit yourself to 150 words or less, and remind them to include their name, home address, and daytime phone for verification.

    LA Times: letters@latimes.com, fax to 213-237-7679
    Orange County Register: letters@ocregister.com, fax to 714-796-3657

Adapted from "Wetland Tradeoffs" from *WOW! The Wonders of Wetlands*, co-published by International Project WET and Environmental Concern

Tradeoffs Analyzer

(sample)



Pros
- ✓ Eliminate future problems
- ✓ Long-term solution

Cons
- ✓ Impact on neighbors and families

Pros
- ✓ Individual or Business recovers losers
- ✓ Shared expenses and risks

Cons
- ✓ Still located on floodway

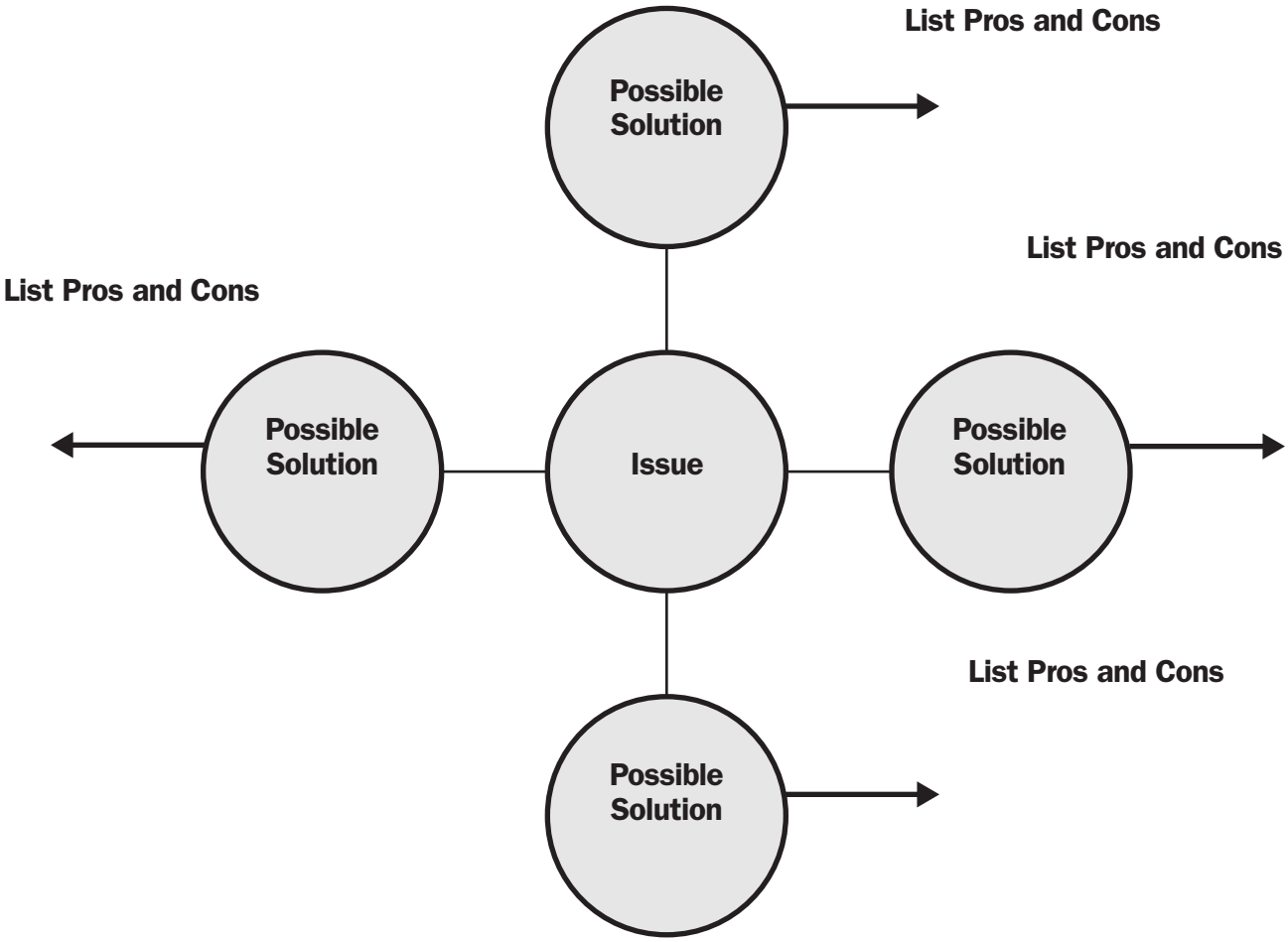
Pros
- ✓ Regulates stream flow
- ✓ Reduces potential flooding
- ✓ Creates alternative habitats for wildlife

Cons
- ✓ Loss of fish and wildlife habitat
- ✓ Alters drainage patterns
- ✓ Costly

Pros
- ✓ Reduces flood potential
- ✓

Cons
- ✓ Temporary solution
- ✓ Costly
- ✓ Eliminates habitat
- ✓ Increases sediment
- ✓ Alters drainage patterns

Tradeoffs Analyzer



Activity: Stewardship

Summary: Students learn how they can contribute to wetland preservation and restoration through stewardship.

California State Content Standards

SCIENCE

Biology/Life Sciences

- **Ecology 6a.** Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
- **Ecology 6b.** Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

ENGLISH-LANGUAGE ARTS

Grades 9-10

Writing Strategies

- **Organization and Focus 1.1.** Prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.

Writing Applications

- **Expository Compositions 2.3**

b. Convey information and ideas from primary and secondary sources accurately and coherently.
c. Make distinctions between the relative value and significance of specific data, facts, and ideas.
d. Include visual aids by employing appropriate technology to organize and record information on charts, maps, and graphs.
e. Anticipate and address readers' potential misunderstandings, biases, and expectations.
f. Use technical terms and notations accurately.

Grades 11-12

Reading Comprehension

- **Structural Features of Informational Materials 2.1.** Analyze both the features and the rhetorical devices of different types of public documents (e.g., policy statements, speeches, debates, platforms) and the way in which authors use those features and devices.

Writing Strategies

- **Organization and Focus 1.3.** Structure ideas and arguments in a sustained, persuasive, and sophisticated way and support them with precise and relevant examples.
- **Organization and Focus 1.4.** Enhance meaning by employing rhetorical devices, including the extended use of parallelism, repetition, and analogy; the incorporation of visual aids (e.g., graphs, tables, pictures); and the issuance of a call for action.

HISTORY/SOCIAL SCIENCE

- **Principles of American Democracy 12.7.5.** Explain how public policy is formed, including the setting of the public agenda and implementation of it through regulations and executive orders.
- **Principles of Economics 12.1.3.** Identify the difference between monetary and nonmonetary incentives and how changes in incentives cause changes in behavior.

Objectives:

Students will be able to:

- Participate in projects to improve wetlands
- Become aware of citizens' roles as stewards

Materials:

- Depends upon activities selected

Preparations:

- Depends upon activities selected

Time Required:

- Depends upon activities selected

Procedures:

1. Ask students what kinds of decisions they make as a group *(e.g., where to go for lunch or what movie to see)*. Then ask how the group reaches a decision.

2. Tell students that every group decision is, in some way, a demonstration of small-scale politics. Explain that the debate, discussion, lobbying, and informal voting that they use in everyday decisions can also be useful in community and national political action.

3. Ask students how certain school policies were established (e.g., dress code, lunch rules, role of student council). Ask how they would go about having a policy reviewed or changed.

4. Tell students that wetland stewardship is often in the spotlight of the political process and that students can participate more significantly than they may suspect. Explain that through becoming aware, participating in local government, being involved in the community, teaching others, and setting good examples, they can have an impact on issues important to them. For example, the Smoke-Free Beaches campaign started by high school students in Solana Beach has spread across the state, including several beaches in Orange County that have accepted a ban on smoking.

5. Review the following activities with students and have them get involved.
   Visit www.coastforyou.org for more suggestions and to take the "Coastal Stewardship Pledge."

Follow-up

Have students keep progress reports of their projects and eventually write final summary reports addressing what they did, how well it worked, what they would do differently next time, and what recommendations they would make to someone taking on a similar project.

Extensions

1. Set up committees of students to follow several local issues and make periodic reports to the class.

2. If students participated in restoration projects, have them monitor the site for maintenance needs and for future projects.

3. Have students write letters to newspapers and policy makers expressing their views on local wetlands issues.

Projects and Activities

Restore Habitat

Volunteer to help restore your local wetland or school grounds by removing invasive plants and planting natives. Become part of the ROOTS (***R****estoration* ***O****utreach* ***O****pportunity* ***T****eamwork* ***S****tewardship*) team that meets on the fourth Saturday of every month. Call (949) 640-0286 for details.

Volunteer with a Local Environmental Group

Most wetlands have one or more environmental groups dedicated to preservation and restoration. Contact these groups and volunteer to help. (See Appendix C for ideas.)

Get the Facts

If you want something done about the condition of wetlands in your community, you'll have to be well-informed. Before you begin, do your homework. Here's what you need to know:

- Why are these wetlands important or valuable to people? To wildlife?
- What (or who) is threatening the wetlands?
- Are wetlands protected? Know the law.
- Who's in charge of protecting wetlands in your state and community?
- What are local politicians' views on the environment?

Participate in Local Government

Keep informed of the environmental issues in your area. Are wetlands getting the attention they deserve? What does the planning and zoning office have in store for the wetlands in your area? If you disagree with the actions of these offices, say so! Watch the news for public hearings on development projects that may affect your community. Inform your neighbors of the problem. Write a petition stating your views, get as many signatures as you can, then take the petition to the hearing and present your case.

Start a Club

Start a campaign in your school or neighborhood to let people know about wetlands and why they are valuable. Think of a catchy slogan or a phrase that's easy to remember. Make colorful posters; create brochures or buttons; put an ad in your school or community newspaper or newsletter. Let people know how they can help conserve and protect wetlands.

Be a Role Model for Younger Kids

Help younger kids learn about wetlands and responsibility. Take kids fishing, bird-watching, or hiking and use the time to teach them about the importance of wetlands and respect for nature. Make a presentation about wetlands, such as a puppet show or play, or create songs. Volunteer to help with local schools' outdoor lessons or field trips for younger students.

Participate in Coastal Clean-up Events

Find out when coastal clean-ups are scheduled in your area (*www.coastforyou.org* or 800-Coast-4U) and get a group together to participate, or just go on your own to meet new people and help clean up the beach. (Remember not to pick-up organic debris like driftwood or kelp as these items are important players in beach ecology.)

Organize a Clean-up Day

Hold a clean-up day in your community. Organize a committee to help you plan the day. Advertise the clean-up well in advance and let people know what to bring (e.g., gloves, trash bags, wheelbarrows). Ask local stores for donations of snacks or other supplies. Combine the clean-up with something fun and educational, such as a picnic, canoeing, hiking, or a nature presentation. Circulate press releases about the entire event to broaden public awareness.

Start a Neighborhood Recycling Program

Recycling programs help keep litter down and reduce the need for landfill space. Call your city's department of public works or search online for ideas to set up neighborhood recycling. If a program already exists, encourage more people to recycle, or offer to take their materials to the collection center for them. Green waste can also be recycled; find out what composting programs your community offers.

Plant a School Garden

Work with other students and your school's administration to establish a garden on your school grounds. Types of native plant gardens suitable for schools include: container gardens, raised beds, borders along sidewalks, specialty gardens designed to attract butterflies or birds, or to be edible, or to represent plants used by California Indian tribes. Get permission for the location of the garden and the use of the school's water; request tools and plants from local stores or residents; and create a maintenance schedule. Make your garden pesticide-free and "water-wise"! Native plants may be purchased at Tree of Life Nursery—(949) 728-0685. Visit the School Gardens webpage of the California Integrated Waste Management Board at *www.ciwmb.ca.gov/Schools/WasteReduce/Food/SchoolGarden.htm*. The California Native Plant Society has published a guide titled *Southern California Native Plants for School Gardens* by Betsey Landis—(310) 472-0624.

Perform an Environmental Audit of Your School

Make a detailed study of your school's environmental impact, looking at the water and energy consumed and the waste and pollution created. Create a report for your school administration and suggest ways that the school could improve. The Natural Resources Defense Council has an interactive website that can help you learn about environmental problems and solutions at your school, *www.nrdc.org/greensquad*. Check out the Center for Environmental Education's School Sustainability Guidelines for sample audit forms, *greenschools.schoolsgogreen.org/green/GREEN_Sustain*. Read Youth for Environmental Sanity's "Green Schools Energy Project" manual, *www.yesworld.org/info/GreenSchoolsManual.pdf*, for an example of how some students helped their school become more energy efficient and save money in the process.