The National Park Service wishes to thank Toyota USA Foundation for donating one million dollars to make National Park Labs possible at Golden Gate National Recreation Area and four other parks across the country.

We also wish to acknowledge the important role played by the National Park Foundation in working with Toyota USA Foundation to establish and guide this generous grant.

National Park Labs is a program of the National Park Service, National Park Foundation, and Toyota USA Foundation. This multi-year program is the first of its kind to provide high school students with experiences that will enhance the quality of science and mathematics and foster stewardship of national park resources. Five national park sites were competitively selected to participate in this exciting endeavor. The other NPL sites are Carlsbad Caverns National Park (NM) and Guadalupe Mountains National Park (TX), Lowell National Historical Park (MA), National Capital Region Parks (DC), and Santa Monica Mountains National Recreation Area (CA).

Overview

National Park Labs at the Presidio is a hands-on education program that engages high school students in a project-based science curriculum. This Educator's Handbook has been prepared for classroom teachers and National Park Service (NPS) and Golden Gate National Parks Association (GGNPA) staff who together make up the National Park Labs education team. It contains the background information, lesson plans, and handouts for the modules that comprise the program.

National Park Labs is a semester-length program consisting of a classroom-based introductory module, three field-based modules, and a culminating activity. The three field-based modules are scheduled to coincide with the seasonal work of the park's restoration team and are not necessarily scheduled in the sequence given below.

Perspectives provides the students with an opportunity to get acquainted with the National Park Labs web site, the restoration cycle, and the process of formulating study questions. A word puzzle helps students become familiar with vocabulary that will be used throughout the program. A classroom lesson facilitated by NPS staff gives students a brief history of the Presidio, engages them in a discussion about the mission of the National Park Service, and creates a context for learning about issues in Environmental Justice. After the NPS visit, students create a list of Top Ten Environmental Rights and share a vision of what is and what should be in a national park.

Plant Propagation revolves around genetic diversity and plant reproduction. After playing a board game that introduces the concept of genetic diversity, students visit the Presidio's native plant nursery to help with propagation and other nursery functions. In a classroom experiment, students sprout seeds, introduce variable soil conditions, and then monitor the effects of these conditions on the seedlings.

Invasive Plant Removal and Monitoring focuses on interdependence in nature. This module begins with a classroom lesson that features *The Private Life of Plants*, a video illustrating the complex interactions between plants, animals, and the abiotic elements of the environment. Students then use the National Park Labs web site to practice using a dichotomous key. During a field visit to the park, students remove invasive plants from a restoration site and perform quantitative and qualitative monitoring studies of the area. The module concludes with a lesson in Environmental Justice and community planning. An optional post-visit lesson can be used to help students understand the global nature of restoration work.

Planting begins with a lesson that helps students understand plant structure and adaptation. During the Planting field visit, students study structure and function as they transplant indigenous plants into a restoration site. The field lesson concludes with a look at the importance of volunteers in achieving restoration goals. Back in the classroom, students use the National Park Labs on-line Plant Guide and other resources to create a multicultural quilt of plant uses. An optional post-visit lesson guides students through the process and issues involved in planning a community garden.

A **Culminating Project** is chosen by the teacher and students to fit the needs of the class and allow students to apply what they learned during the program. Classes may choose to create exhibits describing some aspect of their restoration work and present these exhibits at a local restoration fair, or perform a restoration project in a local city park.

CURRICULUM ORGANIZATION

The modules in this curriculum are divided into pre-visit, on-site, and post-visit lessons. The first page of each module provides an overview of these lessons and summarizes the activities. The second page details the educational standards addressed in the module. The next pages contain background information on topics covered in the module. The lesson plans that follow include a summary, expected duration, materials list, facilitation procedures, and handouts when applicable. The last page of the module is an assessment rubric.

Icon Key: Icons used in the lesson plans and summaries designate where the lessons take place and whether the lessons are facilitated by the teacher or NPS staff.

Location Icons:

Classroom

Park

Web-based

Facilitator Icons:

Teacher

NPS Staff

Glossary: At the end of the handbook we have included a Glossary of terms for all words that may be new to students or teachers.

AUTHENTIC ASSESSMENT

Students will keep a journal documenting their thoughts and questions during the program. These journals can be used to assess the students' understanding of important concepts and the evolution of their knowledge and attitudes. Each module includes performance standards, integrated assessment activities, and an achievement rubric to further facilitate evaluation. The rubrics will give teacher and students a clear idea of the learning objectives.

EDUCATIONAL STANDARDS

The National Park Labs curriculum focuses on science principles learned through authentic restoration activities in a national park. Students also practice applied math skills and examine issues in Environmental Justice that relate to the restoration work. The program is an excellent vehicle for helping students obtain important life skills necessary to find and keep employment, and effectively contribute to society. The standards met in each module are detailed within that module.

The following sources were used to compile the educational standards for the program:

- **Science:** The science standards correlate directly to San Francisco Unified School District's (SFUSD) life science standards for grades 9 through 12.

- **Math:** The math contained in the program supports one of SFUSD's key guiding principles for science in grades 9 through 12. This principle states that students will "use technology and mathematics to improve investigations and communications." The specific math standards for each module are based on SFUSD's math standards for grades 9 and 10. These standards serve as a review for the 11th and 12th grade participants. All grade levels benefit from using the applied math within the context of science.

- **Environmental Justice/Social Studies:** The Environmental Justice/Social Studies aspects of the program meet national behavioral studies standards for grades 9 through 12. These standards are based on information from *Content Knowledge, A Compendium of Standards and Benchmarks for K-12 Education*. The Environmental Justice components are partially derived from *Principles of Environmental Justice* issued by the First National People of Color Environmental Leadership Summit, October 1991, Washington, D. C.

- **Life Skills:** The program incorporates standards for grades 9 through 12 from the National Life Skills section of *Content Knowledge, A Compendium of Standards and Benchmarks for K-12 Education*.

PROGRAM LOGISTICS

So that all students may participate in and enjoy their program days at the Presidio, please take careful note of the following:

- **We must have one completed "Agreement for Sponsored Voluntary Services" form for each class** that participates in the program. We must also have a signed **"Parental Approval" form for each student.** We have provided master copies of these forms on the following pages of this handbook. Please note that park policy requires each individual/group in the program to complete these forms. **Those who do not complete the required forms will not be allowed to participate.** Groups complete and return these forms at the beginning of the school year, or before the first field session in which they will participate.

- Clothing appropriate to the nature of the activities and weather conditions at the Presidio is required. The following is a list of program-day considerations that need to be conveyed to students so they are prepared and can have a positive learning experience.

  Dress in layers to accommodate the variable temperatures characteristic of the Presidio (clothing and footwear may get dirty).

  On sunny days, a cap and sunscreen are needed.

  If there is a chance of rain, bring personal rain gear if possible.

- Arrangements can be made to accommodate most students with special needs. Please call the NPS staff to discuss any specific circumstances.

Form No. 10-86
Rev. (9/99)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
VOLUNTEERS-IN-PARKS PROGRAM

Golden Gate National Recreation Area

Agreement for Sponsored Voluntary Services

NAME OF SPONSOR, ORGANIZATION, OR EVENT

ADDRESS (Street, city, state, zip code)

CONTACT PERSON (Liaison for day-to-day operations)

WORK TELEPHONE (Including area code) HOME TELEPHONE (Including area code)

Brief description of work to be performed, including minimum time commitment required.

Do work to support native habitat restoration in outdoor restoration areas and the native plant nursery, including (but not limited to) transplanting seedlings, removing invasive species, sowing seeds, collecting seeds, filling flats and pots with soil, disposing of plant material and soil, cleaning up at the nursery and work sites, and moving plants, pots, flats, equipment and tables. Use tools including (but not limited to) picks, shovels, trowels, and shears.

We agree to obtain parental or guardian consent for each individual under 18 years of age and to comply with applicable child labor laws. We understand that the individuals volunteering under this agreement will not receive any compensation for the above work and that they will NOT be considered to be Federal employees for any purpose other than tort claims and injury compensation, and we understand that volunteer service is not creditable for leave accrual or any other employee benefits. We also understand that either the National Park Service, or we, may cancel this agreement at any time by notifying the other party. We agree to provide the National Park Service with a listing of active participants, and the number of hours each contributed, when and as requested.

Signature Date

The National Park Service agrees, while this arrangement is in effect, to provide such materials, equipment and facilities that are available and needed to perform the work described above, and to consider you as a Federal employee only for the purpose of tort claims and compensation for work related injuries.

Signature of Park VIP Coordinator *Date*

TERMINATION OF AGREEMENT

Agreement Terminated on

Month, Day, Year *Signature of Park VIP Coordinator*

Formulario No. 10-86 (Revisado 9/99)
ESTADOS UNIDOS - DEPARTAMENTO DEL INTERIOR
SERVICIO NACIONAL DE PARQUES, PROGRAMA de VOLUNTARIOS DE PARQUES

Área Nacional Recreativa (Golden Gate Golden Gate National Recreation Area)
Acuerdo de Servicios Voluntarios Auspiciados

Nombre del Auspiciador, Organización ó Evento

Dirección (Calle, Cuidad, Estado, Zona Postal)

Persona Contacto (Enlace para operaciones diarias)

Teléfono del Trabajo **Teléfono del Hogar (Incluya Código de Área)**

Descripción Breve del Trabajo que va a Realizar, incluyendo compromiso mínimo de tiempo requerido (Incluya descripción completa de trabajo con este formulario)
Realizar trabajo para la restauración de hábitats originales en áreas exteriores de restauración y en viveros de plantas autóctonas, incluyendo (pero no limitado) a transplantar plantas jóvenes, remover especies invasoras, sembrar y recoger semillas, rellenar terreno raso y llenar macetas con tierra, disponer de residuos de plantas y tierra, limpiar viveros y áreas de trabajo, mover plantas, macetas, tierra, equipo y mesas. uso de herramientas incluyendo (pero no limitado a) picos, palas, palustres y tijeras.
Nos comprometemos a obtener consentimiento del padre o encargado de todo individuo menor de 18 años de edad, y a cumplir con las leyes aplicables al trabajo de niños. Entendemos que los individuos que se ofrecen como voluntarios bajo este acuerdo no recibirán compensación alguna por el trabajo mencionado arriba y que NO serán considerados empleados Federales para propósito alguno excepto reclamos por daños y compensación por lesiones, y entendemos que el servicio voluntario no acredita licencia acumulada ni otros beneficios de empleado. Entendemos además que tanto el Servicio Nacional de Parques, como nosotros, podemos cancelar este acuerdo en cualquier momento mediante aviso a la otra parte. Acordamos proveerle al Servicio Nacional de Parques una lista de participantes activos y el número de horas cuando sea así requerido.

Firma **Fecha**

El Servicio Nacional de Parques se compromete, mientras esté en efecto este arreglo, a proveer materiales tales como equipo y recursos que estén disponibles y sean necesarios para realizar el trabajo arriba descrito, y a considerarlo a usted como un empleado Federal solamente en cuanto a reclamos por daños y compensación por lesiones.

Firma Coordinador de Parques **Fecha**

TERMINACIÓN DEL ACUERDO
Acuerdo Terminado en

Mes, Dia, Año **Firma Coordinador de Parques**

Form No. 10-89
(1/83)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
VOLUNTEERS-IN-PARKS PROGRAM

Golden Gate National Recreation Area

Parent Approval Form

_____

NAME OF VOLUNTEER

_____

PARENT OR GAURDIAN'S NAME

_____

ADDRESS

_____

PHONE: (Residence) (Business)

I affirm that I am the parent/guardian of the above named volunteer. I understand that the National Park Service's Volunteers-In-Parks program does not provide compensation, except as otherwise provided by law, and that the service will not confer on the volunteer the status of a Federal employee. I have read the attached description of the work that the volunteer will perform.

I give my permission for _____ to participate in this program

sponsored by _____
(Name of sponsoring organization, if applicable)

at _____ from _____ to _____
(Name of park or office) *(Date)* *(Date)*

_____
(Signature)

_____
(Date)

Formulario No. 10-89 (Rev. 1/83)
ESTADOS UNIDOS, DEPARTAMENTO DEL INTERIOR
SERVICIO NACIONAL DE PARQUES
PROGRAMA de VOLUNTARIOS DE PARQUES

Área Nacional Recreativa (Golden Gate Golden Gate National Recreation Area)
Formulario para Consentimiento de los Padres

_____

Nombre del Voluntario

_____

Nombre del Parde o Encargado

_____

Dirección (Calle, Cuidad, Estado, Zona Postal)

_____

Teléfono del Trabajo **Teléfono del Hogar (Incluya Código de Área)**

Declaro que soy el padre/madre o encargado(a) del voluntario referido arriba. Entiendo que el Programa de Voluntarios de Parques, del Servicio Nacional de Parques, no provee compensación, excepto cuando así lo dispone la ley, y que el servicio no ofrece al voluntario la condición de empleado Federal. He leído la descripción de trabajo adjunta, que ha de realizar el voluntario.

Doy mi permiso para que _____

participe en esta programa.

Auspiciado por

_____

Nombre de Oganización Auspiciadora (si es aplica)

en _____ **de** _____ **a** _____
(**nombre del Parque u oficina)** **(Fecha)** **(Fecha)**

_____

Firma **Fecha**

Perspectives

SUMMARY OF INSTRUCTIONAL ACTIVITIES

Restoration Cycle & Question Formulation* - page 16

*Please note that students should formulate their questions even if they cannot complete the web-based portion of the lesson.

- Students review the restoration cycle by exploring the National Park Labs web site: www.nps.gov/goga/parklabs.
- Students work together to formulate questions about the restoration cycle, Golden Gate National Recreation Area, the history of the Presidio, or other elements of the program.

Vocabulary Word Puzzle - page 17

- Students use a word puzzle and the National Park Labs web site Glossary to study vocabulary.

Perspectives - page 20

- Students are briefly introduced to the restoration cycle.
- Students learn about the cultural and natural history of the Presidio.
- Students consider the role of the National Park Service by studying its mission statement.
- Students examine their pre-conceived ideas about environmentalists and what it means to be an environmentalist.

Top Ten Environmental Rights - page 22

- Students create their list of Top Ten Environmental Rights.
- Students compare their ideas about environmental rights with the ideas of others and with the NPS Mission.
- Students think about what they might find in a national park that shows how the NPS fulfills its mission and supports Environmental Justice.

The Presidio of San Francisco

EVOLUTION OF THE PRESIDIO'S PEOPLE AND LANDSCAPE

Ohlone

The area now known as the Presidio was once the territory of the Ohlone people. The Ohlone were not a single group, but rather, dozens of distinct tribes who spoke related languages and had similar cultures. For centuries, as hunter-gatherers, they looked to the land to provide food as well as the material needed to build shelters and to make tools and baskets. They used fire to promote the growth of seed-bearing annual plants, to prevent shrub encroachment on grasslands, and to keep the landscape open for deer and other animals. The arrival of Spanish troops—who built and occupied the Presidio—brought the traditional Ohlone way of life to an end. The Ohlone people survived, however. Today, they comprise several distinct tribal groups, many of which are reviving aspects of their traditional culture and seeking formal government acknowledgment as Indian tribes.

Spanish and Mexican

In 1769 the Spanish became aware of what would later become known as San Francisco Bay. Shortly after, the Viceroy of New Spain ordered a presidio (a military garrison) and a mission built near the bay. Spanish troops established El Presidio de San Francisco in 1776.

The Spanish impacted the area's ecosystems in many ways. In the early years, they cleared most of the scrubby trees and thickets, using the wood for buildings and fires. They introduced herds of animals such as sheep, goats, cattle, and horses that overgrazed the grasslands. The Spanish also brought exotic plants to the area. They introduced some plants as livestock feed, and others as crops. Some plants came to the area in ships' ballasts. Many of these exotic plants, lacking natural controls, thrived in their new environment. They invaded the landscape by covering extensive areas, displaced the original flora, and altered food sources for the fauna.

When Mexico gained its independence from Spain in 1821, it also gained control of Alta (Upper) California. This change had little significance for the Presidio until 1835, when Mexican troops relocated to Sonoma, leaving the buildings of the Presidio to fall into disrepair.

United States Military

By the 1840s, significant numbers of Americans were arriving in California. In March of 1848, following U.S. victory in the Mexican-American War, California became a United States territory. By the time the U.S. Army occupied the Presidio,

trees were few and confined primarily to wind-protected drainages. Many of the soldiers considered the area barren and bleak.

In the 1880s W. A. Jones developed a plan to plant a forest at the Presidio. He wanted to "crown the ridges . . . cover the areas of sand and marsh waste with a forest that will generally seem continuous, and thus appear immensely larger than it really is. . . ." Jones introduced many exotic trees, including eucalyptus, acacia, and Monterey cypress and pine. Once planted, these trees quickly dominated the landscape and blocked the prevailing winds from sweeping across the dune habitat that had provided an ever-changing sandy environment for local plant species. The forest extended into established native plant communities and created microclimates, trapping moisture from the fog and providing increased shade. These new microclimates further encouraged the growth of exotic plant species.

National Park Service

In 1972, Congress established Golden Gate National Recreation Area (GGNRA) as part of the National Park System. The Presidio became part of GGNRA in 1994, when it was transferred from the U.S. Army to the National Park Service. Today, GGNRA encompasses a large number of the Bay Area's open spaces and historic sites, including Alcatraz, Muir Woods, Ocean Beach, Fort Funston, Fort Point, the Marin Headlands, and the Presidio of San Francisco.

The National Park Service partners with the Golden Gate National Parks Association, the Presidio Trust, and a large network of community volunteers to restore indigenous plant communities in a portion of the Presidio's open spaces. Seed collection, propagation, planting, monitoring, and maintenance of natural areas are now commonplace park activities.

El Presidio de San Francisco

EVOLUCIÓN DE LA GENTE Y EL PAISAJE DEL PRESIDIO

Ohlone

El área que ahora se conoce como el Presidio fue una vez el territorio del pueblo Ohlone. Los Ohlone no eran un solo grupo, sino más bien docenas de tribus distintas que hablaban lenguas relacionadas y tenían culturas similares. Durante siglos, como cazadores y colectores acudían a la tierra para proveerse alimentos así como los materiales que necesitaban para construir viviendas y para fabricar herramientas y canastas. Usaban el fuego para promover el crecimiento de plantas que daban semillas todos los años, para prevenir la invasión de arbustos en los pastizales y para mantener la campiña despejada para venados y otros animales. La llegada de las tropas Españolas – las cuales construyeron y ocuparon el Presidio – le pusieron fin al modo de vida de los Ohlone. Sin embargo, el pueblo Ohlone sobrevivió. Hoy día ellos componen varias tribus, muchas de ellas han revivido aspectos de su cultura tradicional y tratan de lograr reconocimiento del gobierno como tribus indias.

Españoles y Mexicanos

Para 1769 los Españoles se dieron cuenta de la importancia de lo que luego habría de llamarse la Bahía de San Francisco. Poco después, el Virrey de Nueva España ordenó la construcción de un presidio (una fortificación militar) y de una misión cerca de la bahía. En 1776 las tropas Españolas establecieron El Presidio de San Francisco.

Los Españoles alteraron los ecosistemas del área en muchas maneras. En los años iniciales removieron la mayoría de los arbustos y la maleza y usaron la madera para edificios y para fuego. Introdujeron manadas de animales como ovejas, cabras, ganado y caballos que consumieron los pastizales. Los Españoles también trajeron plantas exóticas al área. Introdujeron algunas plantas para alimentar el ganado y otras para cosechar. Algunas plantas llegaron al área como lastre de barcos. Muchas de estas plantas exóticas, a falta de controles, florecieron en su nuevo ambiente, invadieron la campiña cubriendo extensas áreas desplazando la flora nativa original y alterando las fuentes de alimentos de la vida animal.

Cuando México logró su independencia de España en 1821 también logró el control de la Alta California. Este cambio no tuvo gran significado para el Presidio hasta 1835, cuando las tropas Mexicanas se movieron a Sonoma dejando atrás los edificios del Presidio en estado de abandono.

Estados Unidos

Para 1840, un gran número de americanos llegaba a California. En marzo de 1848, luego de la victoria de los Estados Unidos en la guerra Mexicano-Americana, California se convirtió en territorio estadounidense. Cuando el ejército de los Estados unidos ocupó el Presidio habían pocos árboles principalmente en drenajes protegidos contra el viento. Muchos de los soldados consideraban el área como desolada y sombría.

Para los 1880 W.A. Jones desarrolló un plan para plantar un bosque en el Presidio. Él quería "coronar las cumbres ... cubrir las áreas arenosas y las ciénagas con un bosque que pareciera continuo y de este modo lucir como inmensamente más grande de lo que era realmente..." Jones introdujo muchos árboles exóticos, incluyendo eucalipto, acacia y pinos y cipreses de Monterrey. Una vez plantados, estos árboles dominaron el paisaje y bloquearon los vientos que soplaban por todo el hábitat de dunas, el cual había provisto un ambiente arenoso y siempre cambiante, para las especies locales de plantas. El bosque se extendió hasta comunidades establecidas de plantas nativas y creó micro-climas, atrapando la humedad de la niebla y proveyendo más sombra. Estos micro-climas le dieron más estímulo al crecimiento de las plantas introducidas.

En 1972 el Congreso estableció el Área Nacional Recreativa Golden Gate (GGNRA) como parte del Sistema Nacional de Parques. El Presidio se convirtió en parte del GGNRA en 1994, cuando fue transferido del ejército de los E.U. al Servicio Nacional de Parques. Hoy día, GGNRA consiste de gran cantidad de espacios abiertos y lugares históricos del Área de la Bahía, incluyendo Alcatraz, el Bosque Muir, la playa Ocean Beach, el Fuerte Funston, el Fuerte Point los Cabos de Marín y el Presidio de San Francisco.

El Servicio Nacional de Parques trabaja con la Asociación Nacional de Parques Golden Gate, el Fideicomiso del Presidio y una vasta red de voluntarios de la comunidad para restaurar las comunidades de plantas originales en un área de espacios abiertos del Presidio. El recogido de semillas, la propagación, sembrado, supervisión y mantenimiento de las áreas naturales son ahora actividades regulares del parque.

The Restoration Cycle

Restoring native plant habitats takes place on a yearly cycle. Timing is determined by factors such as weather, when plants bloom, and when they go to seed.

Plan

Planning plays a significant role throughout the habitat restoration cycle. Many factors must be considered before a plan can be developed and implemented.

Planners must address issues such as environmental impact, cultural and historical significance, recreational uses, long-term management costs, and volunteer and educational opportunities. Once a long-term plan has been drawn up, restorationists create short-term plans addressing the nuts and bolts of growing, caring for, and planting indigenous plants into a restoration site.

Remove

Before a restoration site can receive indigenous plants, invasive exotic plant species must be removed. Exotic plants are those occurring as a result of deliberate or accidental actions by humans. These plants can originate from many different countries; those from Mediterranean climates are particularly successful at establishing themselves in San Francisco.

Exotic plants were brought to the Bay Area for agriculture, livestock grazing, forestry, ornamental landscaping, and soil stabilization. Many exotic plants outcompete indigenous plants. This can result in a dramatic reduction of bio-diversity.

When and how exotic plants are removed varies depending on the characteristics and life cycle of each species. Some plants, such as mustard, are annuals and grow only during a brief period. It is important to remove mustard before it can go to seed. Perennial plants, such as ice plant, can be removed all year.

Plants are safely removed by using the best tool for the job. A weed wrench can leverage some pulling power to remove the deeply rooted scotch broom. A small hand pick helps to dig up pampas grass seedlings. But a polaski is used to remove the larger bushes. Sometimes the best tool for the job is a pair of strong hands. The relatively shallow roots of the iceplant allow it to easily separate from the soil.

Propagate

Plants indigenous to Golden Gate National Recreation Area (GGNRA) are not sold in local nurseries or seed catalogs. Therefore, the park staff propagate the plants needed for habitat restoration projects in the park's own native plant nurseries. These plants are used to revegetate a variety of plant communities within the park including sand dunes, riparian, coastal scrub, and many more.

Plant propagation is the multiplication of plants by either sexual or asexual methods. Sexual multiplication is carried out using seeds, while asexual multiplication is done with cutting, layering, division, or grafting. Propagules (seeds and cuttings) for revegetation are collected from the restoration site itself or from the surrounding areas, the closer to the site the better. It has been discovered that the genotype (genetic makeup) of plants can change within very short distances.

The time of year when seeds and cuttings are collected depends on the life cycle of each plant species. Generally, collection takes place between spring and fall. No more than 10 percent of the native seed base is collected. This allows the habitat to continue to build its own seed base.

Getting seeds to germinate in a nursery can sometimes be challenging. For example, in nature, small rodents eat lupine seeds. When the seed passes through the rodent's digestive system, the outer seed coat is scarified and redeposited on the ground with the animal's feces. This acts as a natural fertilizer. Natural processes such as this need to be mimicked in the nursery. To do so, nursery staff put seeds in a contraption that uses sandpaper to scarify the seed and then the seeds are planted in compost.

Plant

Revegetation means to provide an area with new plant cover. Once invasive exotic plants have been removed, appropriate indigenous species are planted to help the habitat recover.

Revegetating a vulnerable site both helps prevent a reinvasion of exotic species and rebuilds the native seed bank. Thus, the plant community reaches a state of resiliency more quickly and is able to provide habitat for other members of its ecosystem. Outplanting and direct seeding are the two methods of revegetation that are used at GGNRA.

Outplanting is the process of taking plants that have been raised in the nursery (which sometimes includes immature specimens) and planting them in the landscape. Direct seeding is the process of sowing seeds in the restoration site and letting

them germinate and develop naturally. Once in their natural habitats, native plants are essentially on their own. A strong root system, which allows a plant to access water and nutrients, is key to the plant's survival.

Revegetation takes place during the rainy season. Working in wet and/or muddy conditions may not be comfortable, but it significantly reduces the mortality rate of the seedlings and makes all the hard work in the nursery worthwhile.

Monitor

Monitoring is the collection and analysis of data at regular intervals over time. It is used to predict or detect natural and human-induced changes and to provide the basis for the appropriate management response.

The collection of baseline data on natural resources and the initiation of long-term monitoring programs are essential parts of the natural resource program. The GGNRA monitors approximately 2 percent of a restoration site. This low percentage is due to constraints in time and the number of people available to do the work. Monitoring methods are employed to generate qualitative and quantitative data. Qualitative data is gathered using photomonitoring, and quantitative data is gathered by conducting vegetative transects. Monitoring data is used to revise both long-term and short-term plans, completing the restoration cycle.

El Ciclo de Restauración

El restablecimiento de plantas nativas ocurre en un ciclo anual. El tiempo apropiado es determinado por factores tales como el clima, cuándo florecen las plantas, y cuándo producen semillas.

Plan
La planificación juega un papel importante en todo el ciclo de restauración. Muchos factores deben ser considerados antes de desarrollar y poner en práctica un plan.

Los planificadores deben atender asuntos como el impacto ambiental, la importancia cultural e histórica, los usos recreativos, el costo de administración a largo plazo y las oportunidades educativas y para voluntarios. Una vez un plan a largo plazo ha sido establecido, los restauradores crean planes a corto plazo dirigidos a atender los detalles de sembrar, cuidar y sembrar plantas indígenas en el lugar que va a restaurarse.

Remover
Antes de que un lugar que va a ser restaurado pueda recibir plantas indígenas, las plantas exóticas invasoras deben ser removidas. Plantas exóticas son aquellas que resultan de la acción deliberada o accidental de los seres humanos. Estas plantas pueden ser originales de muchos países diferentes; las de climas como el mar Mediterráneo en particular se establecen con éxito en San Francisco.

Las plantas exóticas fueron traídas al Área de la Bahía para la agricultura, para pasto del ganado, para bosques, como plantas ornamentales y para estabilizar terrenos. Muchas plantas exóticas desplazan a las plantas indígenas; esto puede ocasionar una reducción dramática en la variedad de formas vivientes (biodiversidad).

Cuándo y cómo han de removerse las plantas exóticas depende de las características y el ciclo de vida de cada especie. Algunas plantas, como la mostaza, tienen ciclos anuales y crecen sólo durante un corto tiempo. Es importante remover la mostaza antes de que eche semillas. Las plantas perennes (que se reproducen todo el tiempo) cono la planta de hielo (ice plant) pueden ser removidas durante todo el año. Las plantas son removidas de modos seguros utilizando las mejores herramientas para esta tarea. Un "tuerce hierbas" (weed wrench) ofrecen poder para remover las raíces de la retama escocesa (scotch broom). Un pico de mano pequeño ayuda a desenterrar semilleros de hierba de la pampa. Pero se usa una herramienta llamada "polaski" para remover arbustos grandes. Algunas veces la mejor herramienta para la tarea es

un par de manos fuertes. Las raíces no profundas de la planta de hielo permiten separarla fácilmente del terreno.

Propagar

Las plantas que son nativas del Área Nacional Recreativa Golden Gate no se venden en viveros locales o en catálogos de semillas. Por lo tanto, el parque cultiva las plantas que necesita para proyectos de restablecimiento de hábitat en su propio vivero de plantas indígenas. Estas plantas son utilizadas para restaurar la vegetación en una variedad de comunidades de plantas dentro del parque, incluyendo dunas, riberas, maleza costera y muchas otras.

Propagación de plantas es la multiplicación de plantas por métodos sexuales y asexuales. La multiplicación sexual se efectúa usando semillas mientras que la asexual se hace cortando, transplantando a otros terrenos, con trozos de tallos y mediante injertos. Las semillas y esquejes o trozos de tallo (propagules) usados para restauración se obtienen en el mismo lugar de la restauración o de los alrededores, preferiblemente lo más cerca del lugar. Se ha descubierto que el genotipo (la estructura genética) de las plantas puede cambiar aun en distancias cortas.

La temporada del año en que se recogen las semillas y esquejes depende del ciclo de vida de cada especie de planta. Por lo general el recogido se realiza entre la primavera y el otoño. No se recoge más de un 10% de las semillas nativas existentes. Esto permite que el hábitat continúe creando su propia reserva de semillas.

En ocasiones, el obtener semillas para hacerlas germinar en un vivero puede ser un gran reto. Por ejemplo, en la naturaleza pequeños roedores se comen las semillas del lupino. Cuando la semilla pasa por el sistema digestivo del roedor, la cáscara de la semilla se agrieta y se redeposita en la tierra con el excremento del animal el cual actúa como un fertilizante natural. Estos procesos naturales deben ser reproducidos en el vivero. Para lograr esto los trabajadores del vivero colocan las semillas en un artefacto que usa papel de lija para raspar la semilla que son entonces sembradas en estiércol.

Sembrar o Plantar

Restaurar la vegetación, o reforestación, quiere decir proveerle al área una nueva cubierta de plantas. Una vez las plantas exóticas invasoras han sido removidas, se siembran especies nativas para ayudar el hábitat a recuperarse.

Restaurar la vegetación de un lugar vulnerable ayuda a prevenir la re-invasión de especies exóticas y reconstruye el banco de semillas nativas. De este modo, la comunidad de plantas alcanza un estado de resistencia más rápido y es capaz de proveer hábitat a otros miembros de su ecosistema. El replante (outplanting) en el campo, y

la siembra directa de semillas son los dos métodos de reforestación utilizados en el Área Nacional Recreativa Golden Gate.

Replantar es el proceso de tomar las plantas que han sido cultivadas en el vivero (que en ocasiones incluyen plantas inmaduras) y sembrarlas en el campo. Sembrado directo es el proceso de sembrar semillas en el lugar de restauración y dejarlas que germinen y crezcan de manera natural. Una vez están en su hábitat natural, las plantas nativas esencialmente crecen por sí solas. Un sistema de raíces que sea fuerte y que permita a la planta acceso a nutrientes y agua es lo más importante para que ésta sobreviva.

La reforestación tiene lugar durante la época de lluvia. Trabajar bajo condiciones húmedas o con lodo puede no ser cómodo, pero reduce significativamente la tasa de mortalidad de las semillas y hace del duro trabajo en el vivero una satisfacción.

Monitorear (supervisar)

Monitoreo quiere decir obtener y analizar regularmente los datos a intervalos regulares a través del tiempo. Esto se hace para predecir o detectar cambios naturales u ocasionados por seres humanos y tener una base que permita un manejo apropiado.

Obtener datos sobre los recursos naturales que sirvan de base y poner en práctica programas de monitoreo a largo plazo, son parte esencial del programa de recursos naturales. El Área Nacional Recreativa Golden Gate supervisa aproximadamente un dos por ciento (2%) del lugar donde se realiza la restauración. Esta pequeña proporción se debe a limitaciones de tiempo y de las personas que hay disponibles para realizar el trabajo. Los métodos de monitoreo son utilizados para generar datos sobre calidad y cantidad. Los datos sobre calidad (cualitativos) se recogen usando fotografías y los datos sobre cantidad (cuantitativos) se obtienen recogiendo muestras del área. Los datos así obtenidos son utilizados para revisar los planes a largo y corto plazo necesarios para completar el ciclo de restauración.

The Restoration Cycle & Formulating Questions

SUMMARY
Students review the restoration cycle using the National Park Labs web site. After sketching their own version of the restoration cycle, students formulate questions that will help motivate their learning for the remainder of the program.

TIME
50 minutes

MATERIALS
- Computers with internet access or copies of The Restoration Cycle

Lesson

Introduction - 5 minutes
Teacher explains that the restoration cycle is the heart of the project that students will be working on at the Golden Gate National Recreation Area.

Restoration Cycle/Journal - 25 minutes
Students access the National Park Labs web site (www.nps.gov/goga/parklabs) and review the restoration cycle (or read The Restoration Cycle handout). Students sketch their own version of the restoration cycle in their journals.

Formulating Questions - 15 minutes
As a group, the class brainstorms questions they have regarding the restoration cycle or other aspects of the National Park Labs program (the National Park Service, the history of the Presidio, the students' role in the restoration project, etc.).

Journal - 5 minutes
As a group, students choose the five most interesting questions from the brainstorming session, and then enter these questions in their journals. This is the first step in a questioning process that will continue throughout the program. The purpose of the questioning is not necessarily to find answers but rather to allow the questioning to evolve with deeper sophistication and understanding of the issues.

Vocabulary Word Puzzle

SUMMARY
Students become acquainted with vocabulary as they use the National Park Labs web site (or the Glossary from this handbook) to complete a word puzzle.

TIME
50 minutes
10 minutes for preparation

MATERIALS
- Computers with Internet access or copies of the Glossary
- Vocabulary Word Puzzle

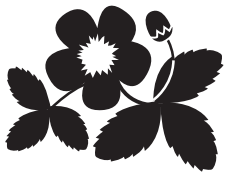
Lesson

Introduction - 5 minutes
Teacher explains to the class that the restoration project they will perform at Golden Gate National Recreation Area is a hands-on science project. Students need to know the vocabulary of restoration so that they can fully understand the issues involved in the project.

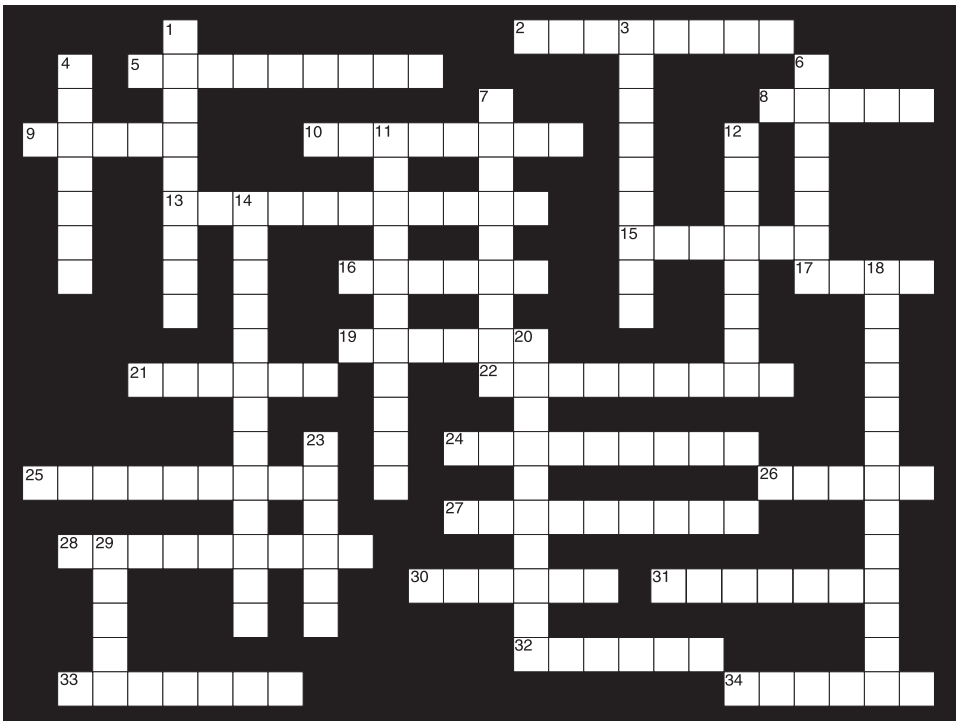
Vocabulary Word Puzzle - 35 minutes
Teacher distributes the Vocabulary Word Puzzle. To solve the puzzle, students must access the National Park Labs web site, go to the Glossary, and look for the words that match the definitions.

Conclusion - 10 minutes
The class discusses and clarifies any definitions that were difficult to understand.

Vocabulary Word Puzzle



Directions: Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs/. Find the Glossary. Find the words that match the definitions.



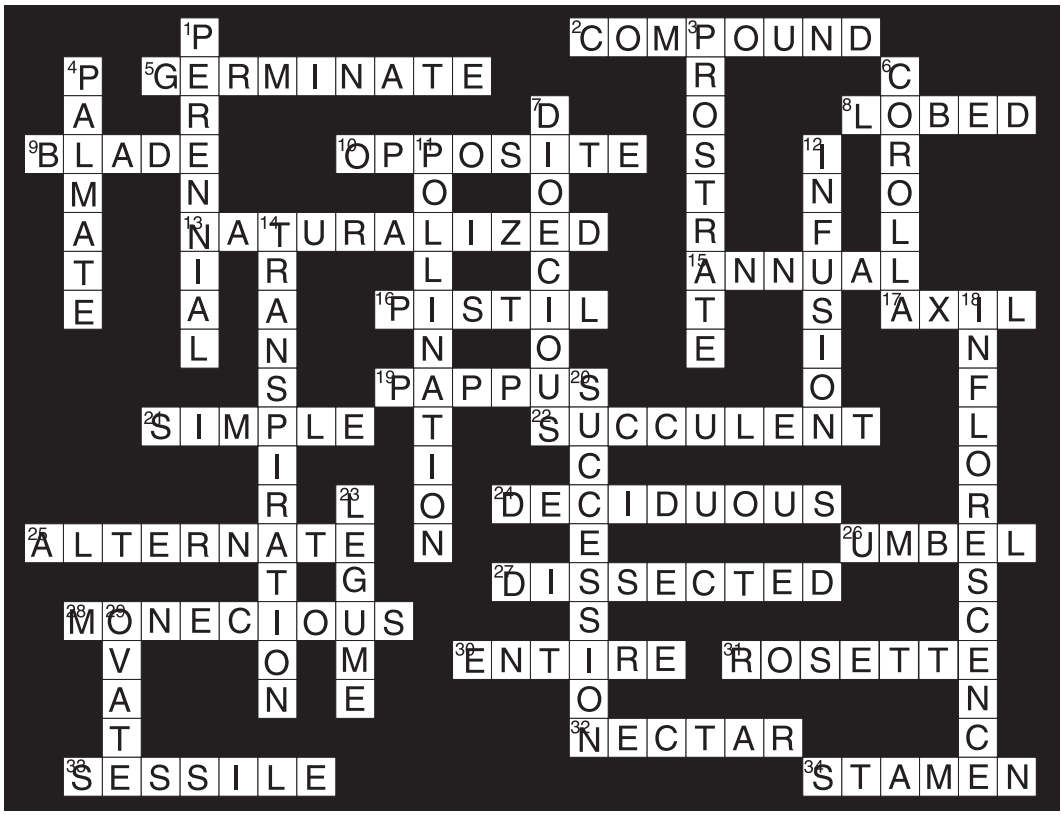
ACROSS

2 One leaf contains several leaves
5 To sprout
8 Leaves with round or wavy edges
9 The leaf itself
10 Leaves directly across from one another
13 Taking over natural range of native plants
15 Plants that die after 1 year
16 Female part of a flower
17 Where the leaf attaches to the stem
19 A tuft of hair
21 A leaf with only one segment
22 A plant with thick, fleshy leaves
24 Plants that lose leaves when it gets cold
25 Leaves not directly across from each other
26 A convex-shaped inflorescence
27 Leaves that look feathery
28 Male and female flowers on one plant
30 Leaves with straight, smooth edges
31 Circular cluster of leaves at plant base
32 Sweetish liquid in flowers
33 Having no stalk
34 Male part of a flower

DOWN

1 Plants that resprout without being replanted
3 Lying flat or trailing along the ground
4 Leaves shaped like a hand
6 Petals of a flower
7 Species with male and female plants
11 Leads to fertilization and seed production
12 Liquid extract
14 Loss of water from plants
18 The flowering part of a plant
20 Progressive changes in nature
23 A plant with nitrogen-fixing bacteria
29 Leaves that are egg-shaped

Vocabulary Word Puzzle (Key)



Perspectives

SUMMARY
Students meet members of the Golden Gate National Recreation Area education staff and learn about National Park Labs. They view a slide show about the transformation of the Presidio into a national park site. They participate in an activity that familiarizes them with the mission of the National Park Service. As an introduction to Environmental Justice issues, students identify and question stereotypes they may have about environmentalists.

TIME
50 minutes
30 minutes for preparation

MATERIALS
- Presidio timeline event cards
- Restoration/seasonal cycle poster
- Wild in the City poster
- Photographs of students doing restoration work
- Slide projector and slide show
- Activity pack for National Park Service mission lesson

Lesson

Introduction - 5 minutes
Park staff introduce themselves. They explain that the landscape of San Francisco has changed a great deal over the years and that the students will have a role in returning some open space to its indigenous plant ecosystem. The class discusses the questions students formulated in the Restoration Cycle and Formulating Questions lesson and the role the students will play in their restoration project.

Timeline - 10 minutes
Park staff pass out the Presidio timeline event cards to students. The students read the cards aloud to the rest of the class. The class tries to put the events in the correct order without looking at the dates. One of the students adds a picture of a class doing restoration work to the Presidio timeline events. Adding the picture helps illustrate that the students become a part of the events that shape the park.

Slide Show - 10 minutes
Park staff present a slide show giving a brief overview of the history of the Presidio, explaining how different cultures that lived near and on the Presidio impacted the land.

NPS Mission - 10 minutes
Students are divided into small groups and given thirteen phrases, some of which are part of the National Park Service's mission statement. Students choose what they feel are the eight most important phrases to be included in a statement about what the National Park Service should accomplish. The class discusses their choices and the actual mission statement of the National Park Service.

What Is an Environmentalist - 10 minutes
Students envision an environmentalist and then draw this person. Students share and describe their drawings. As they present their work, park staff ask questions about their pictures to help clarify their perspectives and identify any subconscious assumptions or stereotypes:

- What type of environmental issue is your environmentalist supporting?
- How much money does your environmentalist make a year?
- What is the education level of your environmentalist?
- What is your environmentalist wearing?
- What is the race and gender of your environmentalist?
- Where does your environmentalist live?

Park staff facilitate a discussion about the drawing exercise:

- How are these examples of environmentalists similar?
- How are these examples different?
- Are there types of people (race/gender) who are not represented in these drawings?
- What environmental issues concern the people in the drawings?
- What is the definition of an environmentalist?

Conclusion - 5 minutes
Park staff brief students on what to expect during their site visit, remind them to dress in layers and wear clothing that they can get dirty (sneakers, no white shoes or pants), and instruct them to bring water and a snack.

Journal
As homework, students write a paragraph in their journals answering the following question: Are you an environmentalist? Why or why not?

Top Ten Environmental Rights

SUMMARY
Students create a list of Top Ten Environmental Rights. They compare their ideas about fundamental environmental rights with the National Park Service mission and the *Principles of Environmental Justice*, created at the First National People of Color Environmental Leadership Summit. Students think about what they might see in a national park that would indicate that the National Park Service fulfills its mission and supports Environmental Justice.

TIME
50 minutes
10 minutes for preparation

MATERIALS
- *Principles of Environmental Justice*
- National Park Service mission

Lesson

Introduction - 10 minutes
Teacher divides the class into groups of 3 or 4 students. Groups brainstorm at least three environmental rights everyone deserves.

Top Ten List - 10 minutes
Class creates their list of Top Ten Environmental Rights by combining their lists.

Comparing Viewpoints - 15 minutes
Students receive the *Principles of Environmental Justice* and the National Park Service mission handouts. They identify the similarities and differences between their Top Ten Environmental Rights, the Principles of Environmental Justice, and the National Park Service mission.

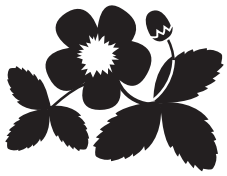
Analysis - 15 minutes
Students discuss what physical evidence they might see at a national park that would indicate that the National Park Service fulfills its mission and supports Environmental Justice. Teacher prompts the students to think about the diversity of people (different languages, disabilties, children, elderly, etc.) they might find in a

national park and the things that make parks accessible to specific groups (multilingual signs, curb cuts, children's activities, wheelchair-accessible trails).

Journal

As homework, students add to or revise the questions they have in their journals, based on this lesson.

Principles of Environmental Justice



PREAMBLE

We, the People of Color, gathered together at this multi-national People of Color Environmental Leadership Summit, to begin to build a national and international movement of all peoples of color to fight the destruction and taking of our lands and communities, do hereby re-establish our spiritual interdependence to the sacredness of our Mother Earth; to respect and celebrate each of our cultures, languages and beliefs about the natural world and our roles in healing ourselves; to insure Environmental Justice; to promote economic alternatives which would contribute to the development of environmentally safe livelihoods; and to secure our political, economic and cultural liberation that has been denied for over 500 years of colonization and oppression, resulting in the poisoning of our communities and land and the genocide of our peoples, do affirm and adopt these Principles of Environmental Justice:

1. Environmental Justice affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.

2. Environmental Justice demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.

3. Environmental Justice mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.

4. Environmental Justice calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and poisons and nuclear testing that threaten the fundamental right to clean air, land, water and food.

5. Environmental Justice affirms the fundamental right to political, economic, cultural and environmental self-determination of all peoples.

6. Environmental Justice demands the cessation of production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and the containment at the point of production.

7. Environmental Justice demands the right to participate as equal partners at every level of decision-making including needs assessment, planning, implementation, enforcement and evaluation.

8. Environmental Justice affirms the right of all workers to a safe and healthy work environment, without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.

9. Environmental Justice protects the right of victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.

10. Environmental Justice considers governmental acts of environmental injustice a violation of international law, the Universal Declaration On Human Rights, and the UN Convention on Genocide.

11. Environmental Justice must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.

12. Environmental Justice affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and providing fair access for all to the full range of resources.

13. Environmental Justice calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.

14. Environmental Justice opposes the destructive operations of multi-national corporations.

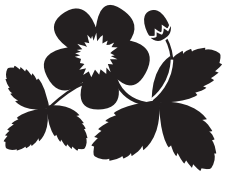
15. Environmental Justice opposes military occupation, repression and exploitation of lands, peoples and cultures, and other life forms.

16. Environmental Justice calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.

17. Environmental Justice requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth's resources and produce as little waste as possible; and make the conscious decision to challenge and reprioritize our lifestyles to insure the health of the natural world for present and future generations.

Adopted, Washington, D. C., October 1991
First National People of Color Environmental Leadership Summit

Principios de Justicia Ambiental



INTRODUCCIÓN

Nosotros, la Gente de Todas las Razas, estamos unidos aquí en este Encuentro de Liderato Ambiental multi-nacional, para construir un movimiento nacional e internacional de gente de todas las razas, y para luchar contra la destrucción y apropiación de nuestras tierras y comunidades, por la presente restablecemos nuestra interdependencia espiritual con la santidad de nuestra Madre Tierra; para respetar y celebrar cada una de nuestras culturas, nuestras lenguas y creencias sobre el mundo natural y nuestra responsabilidad por nuestra propia salud; para garantizar la Justicia Ambiental; para promover alternativas económicas que contribuyan al desarrollo de trabajos que sean saludables ambientalmente; y para asegurar nuestra liberación política, económica y cultural, la cual nos ha sido negada durante más de 500 años de colonización y opresión, lo que ha ocasionado el envenenamiento de nuestras comunidades y nuestras tierras y el genocidio de nuestros pueblos, afirmamos y adoptamos estos Principios de Justicia Ambiental:

1. La Justicia Ambiental afirma lo santidad de la Madre Tierra, la unidad ecológica y la interdependencia de todas las especies, y el derecho a vivir libre de destrucción ecológica.

2. La Justicia Ambiental demanda que la política pública este basada en la justicia y el respeto mutuo de todos los pueblos, libres de toda forma de discriminación o prejuicio.

3. La Justicia Ambiental establece el derecho al uso ético, balanceado y responsable de la tierra y los recursos renovables, en beneficio de un planeta que pueda sustentar a los seres humanos y otras formas de vida.

4. La Justicia Ambiental requiere protección universal contra las pruebas nucleares y la extracción, producción y disposición de desperdicios tóxicos y peligrosos: venenos y pruebas nucleares que amenazan el derecho fundamental de aire, tierra, agua y alimentos sanos.

5. La Justicia Ambiental afirma el derecho fundamental a la auto-determinación política, económica, cultural y ambiental de todos los pueblos.

6. La Justicia Ambiental demanda que se ponga fin a la producción de todo tipo de toxinas, desperdicios peligrosos y materiales radioactivos, y que todos los productores pasados y presentes sean estrictamente responsables ante la gente, de desintoxicar y contener estos materiales.

7. La Justicia Ambiental demanda el derecho a participar como socios iguales a todo nivel en la toma de decisiones, incluyendo la determinación de necesidades, planificación, implementación, cumplimiento de la ley y evaluación.

8. La Justicia Ambiental afirma el derecho de todos los trabajadores a un ambiente de trabajo sano y seguro, sin que sean forzados a escoger entre el desempleo o una vida insegura. Además afirma el derecho de aquellos que trabajan desde su hogar a estar libres de riesgos ambientales.

9. La Justicia Ambiental protege los derechos de las víctimas de injusticia ambiental a recibir reparación y compensación total por daños al igual que atención médica de calidad.

10. La Justicia Ambiental considera las acciones gubernamentales de injusticia ambiental como una violación de las leyes internacionales, de la Declaración Universal de Derechos Humanos y de la Convención de las Naciones Unidas Sobre Genocidio.

11. La Justicia Ambiental debe reconocer que existe una relación natural y legal especial entre los Pueblos Indígenas y el gobierno de los Estados Unidos mediante tratados, acuerdos, convenios y obligaciones que afirman la soberanía y la auto-determinación.

12. La Justicia Ambiental afirma la necesidad de políticas ecológicas en áreas rurales y urbanas sobre la limpieza y reconstrucción de nuestras ciudades y campos en armonía con la naturaleza, honrando la integridad de nuestras comunidades y proveyendo a todos justo acceso a toda la variedad de recursos.

13. La Justicia Ambiental requiere el cumplimiento estricto de los principios de consentimiento y un alto a las pruebas experimentales de procedimientos médicos y sobre reproducción , y a la vacunación de personas de color.

14. La Justicia Ambiental se opone a las operaciones destructivas de las corporaciones multi-nacionales.

15. La Justicia Ambiental se opone a la ocupación militar, la represión y explotación de tierras, pueblos, culturas y otras formas vivientes.

16. La Justicia Ambiental demanda la educación de generaciones presentes y futuras con énfasis en asuntos sociales y ambientales, basada en nuestra experiencia, y una apreciación de nuestras diferentes perspectivas culturales.

17. La Justicia Ambiental requiere que nosotros, como individuos, hagamos decisiones como personas y consumidores para utilizar lo menos posible los recursos de la Madre Tierra, producir el menor desperdicio posible y tomar la decisión consciente de poner a prueba y reflexionar sobre nuestros estilos de vida, para garantizar la salud del mundo natural para las generaciones presentes y futuras.

Adoptado en Washington, D.C., Octubre de 1991
El Primer Encuentro de Liderato Ambiental de Gente de todas las Razas

National Park Service Mission

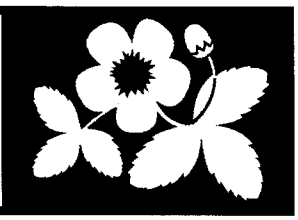
To conserve the scenery and the natural and historic objects and wildlife therein, and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Declaración del Servicio Nacional de Parques

Conservar el paisaje, sus estructuras naturales e históricas y la vida silvestre que ahí se encuentra, y hacer posible el disfrute del mismo de tal manera y por tales medios que se mantenga inalterado para el disfrute de las generaciones futuras.

Plant Propagation

SUMMARY OF INSTRUCTIONAL ACTIVITIES



Return of the Wild! - page 11

- Students play Return of the Wild! game and learn about the benefits of biodiversity.

Plant Propagation - page 17

- Students participate in a variety of nursery operations which may include:
  - propagating plants sexually and/or asexually
  - transplanting seedlings
  - maintaining pots and leach tubes
  - cleaning seeds
  - planting or weeding in the demonstration garden

Students learn about plants and nursery operations:

- use microscopes to identify and study plant pathogens
- calculate the number of plants to put in a restoration area
- calculate the number of plants that nursery staff must propagate
- examine and draw characteristics of plants in the demonstration garden
- write a short paragraph describing how sexual and asexual propagation impact diversity (integrated assessment)

Seed Experiments - page 23

- Students will:
  - germinate seeds under varying conditions
  - compare plant growth and health
  - introduce further variations on plant treatment, including changing soil quality
  - test soil pH, nitrogen, phosphorous, and potassium levels
  - analyze data gathered, create lists of most favorable and least favorable conditions for plant viability, and graph some aspect of their experiment results (integrated assessment)
  - write a paragraph relating genetic diversity to species viability under changing environmental conditions

Standards
Plant Propagation

SFUSD Science Content Standard 12: Diversity
Students understand that the variation of organisms within a species increases the likelihood that at least some of the members of the species will survive under changed environmental conditions, and that the great diversity in species increases the chance that at least some living things will survive in the face of large changes in the environment.

- *Performance Standard:* Students can explain the relationship of diversity to species and ecosystem survival. Students can name several ways in which the National Park Service attempts to increase the diversity within the natural areas under its stewardship.

SFUSD Math Content Standard 3: Function and Algebra
Students demonstrate their knowledge of basic skills, conceptual understanding, and problem solving in function and algebra.

- *Performance Standard:* Students can write appropriate algebraic equations to answer questions about propagation needs at the native plant nursery (based on SFUSD Performance Standard 3.2.6).

National Life Skills Standard: Contributes to the overall effort of a group
Students demonstrate respect for others in the group, take initiative when needed, engage in active listening, and contribute to the development of a supportive climate in group.

- *Performance Standard:* Students can contribute effectively to their groups during park and classroom group activities.

Plant Propagation

GOLDEN GATE NATIONAL RECREATION AREA NATIVE PLANT NURSERIES

Golden Gate National Recreation Area (GGNRA) has six nurseries specializing in the propagation of plants indigenous to the San Francisco Bay Area. Plants raised in the nurseries generally replace invasive exotic species removed from habitat restoration sites throughout the park. NPS staff propagate approximately 150 different plant species—from grasses to trees—in these nurseries. This large number reflects the wide diversity of the park's ecosystems, ranging from sand dunes to coastal chaparral to redwood forests.

The Presidio Native Plant Nursery is the largest of the six nurseries. Its structures and facilities are typical of those found in many commercial plant nurseries. The three greenhouses are equipped with automatic irrigation systems and motorized fans to control humidity and temperature. Several shade houses protect the young, delicate seedlings from the harsh rays of the sun while they are hardening off. These structures and their fittings control the principal environmental conditions that influence plant growth: light, water, temperature, carbon dioxide, and oxygen. This optimizes seed germination and helps ensure high survival rates in the nursery. It allows nursery staff to remove less seed from the wild than they would need to without these structures.

GENETIC DIVERSITY

A high level of genetic diversity allows some plants to survive after being planted into the restoration site even if it is a dry year or a wet season, or if animals nibble on the seedlings in April. Genetic diversity in GGNRA is maintained by collecting seeds at different times, by transplanting seedlings that have sprouted both early and late, and by planting both small and robust plants. Native plants are propagated carefully because once they are planted out in their native environment, they are left to nature's whim, with no human intervention.

What is Plant Propagation?

Plant propagation is the multiplication of plants by either sexual or asexual methods. Sexual propagation involves seeds, while asexual propagation is done using cuttings, layering, division, or grafting. At the Native Plant Nursery, staff prefer to propagate plants sexually, using seeds collected in the park. This results in genetically diverse plants, which are more likely to succeed in the face of disease or variations

in environmental conditions. Asexual propagation is used when there is not enough seed available for collection or when propagating plants that reproduce asexually in the wild. The drawback to asexual propagation is that all the new plants are clones of the mother plant, and therefore have no genetic diversity.

Asexual Propagation:Vegetative Methods

Using runners, stem cuttings, and crown divisions are common methods of vegetative propagation in nurseries and at home. All vegetative propagation methods produce plants with genotypes that are identical to the mother plant and, therefore, limit genetic diversity. However, such methods have the advantage of producing a large plant in a short period of time.

Runners

A runner is a specialized stem that develops from the axil of a leaf at the crown of a plant. It grows horizontally along the ground and forms a new plant at one of the nodes. Two plants in the park that produce runners are the beach strawberry (Fragaria chiloensis) and yerba buena (Satureja douglasii).

Vegetative propagation by runners involves removing a runner from the mother plant, dividing it into sections, and planting these sections in potting soil. Within two or three weeks, adventitious roots develop at intervals (every other node in the case of the beach strawberry) along the runner to produce "daughter" plants, which can then be transplanted into pots.

Sexual Propagation:

Seeds are the main method by which plants reproduce themselves in nature. Because seeds from different species of plants vary greatly in size, shape, and structure, plants can often be identified by looking at the seeds they produce. Regardless of their size, shape, or structure, all seeds have three basic parts -- the embryo, food storage tissues, and seed covering.

Embryo

The embryo is a new plant formed from the union between a male and female gamete during fertilization. It consists of an embryo axis that has a growing point at both ends—one develops into the shoot and one develops into the root—and one or more seed leaves (cotyledons) attached to the embryo axis. Plants can be classified according to the number of cotyledons they have. For example, monocotyledonous plants (grasses, corn, and bulbous plants) have one cotyledon while dicotyledons, or dicots, (all broadleaf plants, lupines and most of the herbaceous and woody shrubs in the Presidio) have two cotyledons. Dicots and monocots are both examples of angiosperms (plants whose seeds are borne within a mature ovary, or fruit). Gymnosperms, such as conifers, are plants whose seeds are not enclosed in an ovary.

Food storage tissues

The successful germination of a seed and the emergence above ground of the resulting seedling depend on energy produced from complex storage products (carbohydrates, fats, oils, and proteins) laid down in the seed by the mother plant.

Seed covering

Nearly all seeds are surrounded by one or two seed coats (testa) which help to protect the embryo from damage. The outer seed coat is usually dry and hard.

Seed Transport

Because plants are unable to move from one place to another, they depend on wind, water, and animals to distribute their seeds. Plants have adapted special characteristics to help their seeds disperse. For example, wind-dispersed seeds tend to be very small and light and have physical features that enable them to be carried by air currents; coyote bush (Baccharis pilularis) and mock heather (Ericameria ericoides) have feathery "parachutes" (the botanical name for this parachute is pappus). Some seeds have small claw-like protrusions on their seed coat that enable them to stick to the hide of an animal such as a raccoon or deer. Other seeds are borne in fruits or berries that are eaten by birds or other animals. The seeds inside these berries usually have tough coats that cannot be completely digested by the animal. Consequently, the whole seed passes through the animal and is dispersed wherever the animal relieves itself!

Propagación de Plantas

LOS VIVEROS DEL ÁREA NACIONAL RECREATIVA GOLDEN GATE

El Área Nacional Recreativa Golden Gate tiene seis viveros que se especializan en la propagación de plantas nativas del Área de la Bahía de San Francisco. Las plantas cultivadas en los viveros por lo general sustituyen las especies exóticas invasoras que han sido removidas de hábitats bajo restauración de todo el parque. El Servicio Nacional de Parques (NPS) propaga aproximadamente 150 especies diferentes de plantas – hierbas y árboles – en estos viveros. Este elevado número refleja la amplia variedad de ecosistemas del parque, que incluyen dunas arenosas, chaparrales costeros (maleza impenetrable de arbustos o pequeños árboles) y bosques de redwoods (coníferas).

El Vivero de Plantas Nativas del Presidio es el mayor de los seis viveros. Sus estructuras e instalaciones son similares a las de muchos viveros comerciales de plantas. Los tres invernaderos están equipados con sistemas automáticos de riego y abanicos eléctricos para controlar la humedad y la temperatura. Varias casas de sombra protegen a las jóvenes y delicadas semillas de los fuertes rayos del sol mientras se fortalecen. Estas estructuras y sus artefactos controlan las condiciones ambientales principales que influyen en el crecimiento de las plantas: luz, agua, temperatura, bióxido de carbono y oxígeno. Esto hace más posible la germinación de las semillas y ayuda garantizar un promedio alto de supervivencia en el vivero. Esto a su vez le permite al personal del vivero remover menos semillas del ambiente natural, de las que tendrían que remover si no existieran dichas estructuras.

DIVERSIDAD GENÉTICA

Una amplia diversidad genética le permite a algunas plantas sobrevivir luego de ser sembradas en el lugar de restauración, tanto en años de sequía como en temporadas lluviosas y aun cuando los animales piquen o roan las semillas en abril. La diversidad genética en el Área Nacional Recreativa Golden Gate se mantiene recogiendo semillas en diferentes épocas, transplantado semillas que germinan lo mismo tarde que temprano y sembrando plantas pequeñas pero robustas. Las plantas nativas son propagadas cuidadosamente porque una vez han sido sembradas en su ambiente nativo, se dejan a merced de la naturaleza sin intervención humana.

¿Qué es propagación de plantas?

Propagación de plantas es la multiplicación de plantas por medios sexuales y asexuales. La propagación sexual se realiza con semillas, mientras que la propagación

asexual se realiza cortando, replantando, dividiendo tallos o mediante injertos. En el vivero de plantas nativas el personal prefiere la propagación sexual usando semillas recogidas en el parque. Esto resulta en plantas con una diversidad genética que tienen más probabilidades de crecer y vencer las enfermedades y los cambios del clima. La propagación asexual se utiliza cuando no es posible recoger suficientes semillas o cuando son plantas silvestres que se reproducen asexualmente. La desventaja de la propagación asexual es que todas las plantas nuevas son copias de la planta madre y no tienen diversidad genética.

Propagación Asexual: Métodos Vegetativos

Los estolones (retoño rastrero), trozos de tallos y coronas son métodos comunes de propagación vegetativa en viveros y hogares. Todos los métodos de propagación vegetativa producen plantas con genotipos o estructuras genéticas idénticas a las de la planta madre y, por lo tanto, limitan la diversidad genética. Sin embargo, estos métodos tienen la ventaja de que producen una planta grande en un período de tiempo corto.

Estolones (vástagos rastreros)

Un estolón es un tallo especializado que se desarrolla de la axila en la corona de una planta. Crece horizontalmente echado en el suelo y forma una planta nueva en cada uno de sus nódulos. En el parque hay dos plantas que producen estolones: la fresa playera o "beach strawberry" (fragaria chiloensis) y la yerbabuena o menta (satureja douglasii).

La propagación vegetativa por medio de estolones consiste en remover un pedazo de la planta madre, dividirlo en secciones y sembrar dichas secciones en macetas con tierra. En dos o tres semanas se desarrollarán raíces adventicias a intervalos a lo largo del estolón (cada otro nódulo en el caso de la fresa playera) para producir "hijos" que pueden entonces ser transplantados a tiestos.

Semillas

Las semillas son el método principal por el cual la plantas se reproducen en la naturaleza. Debido a que las semillas de diferentes especies de plantas varían mucho en tamaño, forma y estructura, a menudo las plantas pueden ser identificadas mirando las semillas que producen. Las semillas tienen tres partes básicas, no importa su tamaño, forma o estructura: el embrión, tejido para almacenar alimento y una cubierta o capa.

Embrión

El embrión es un planta nueva que se crea de la unión de gametos (células reproductoras) masculinos y femeninos durante la fertilización. Consiste de un eje embrionario que crece en ambos extremos – uno se desarrolla hasta formar un renuevo o

tallo nuevo y el otro se convierte en la raíz – con cotiledones (una o más hojas) de la semilla pegadas al eje del embrión. Las plantas pueden ser catalogadas de acuerdo al número de hojitas o cotiledones que poseen. Por ejemplo, las plantas monocotiledóneas (hierbas, maíz y plantas con bulbos) tiene un cotiledón, mientras que las dicotiledóneas (todas las plantas de hojas anchas, lupinos, la mayoría de las herbáceas y arbustos leñosos del Presidio) tienen dos cotiledones. Tanto las dicotiledóneas como las monocotiledóneas son tipos de angiospermas (plantas cuyas semillas están alojadas en un ovario maduro o fruta). Las gimnospermas son plantas cuyas semillas no están dentro de un ovario; las coníferas (como el redwood) son gimnospermas.

Tejido Almacenador de Alimento

La germinación exitosa de una semilla y el retoño que surge del terreno depende de la energía producida del almacenaje de productos complejos (carbohidratos, grasas, aceites y proteínas) depositados en la semilla por la planta madre.

Cubierta de la Semilla

Casi todas las semillas están cubiertas de una o dos capas (testa) que ayudan a proteger el embrión contra daños. La capa exterior de la semilla usualmente es seca y dura.

Transporte de la Semilla

Debido a que las plantas no pueden moverse de un lugar a otro, éstas dependen del viento, del agua, y de los animales para distribuir sus semillas. Las plantas han adoptado características especiales para ayudar a dispersar sus semillas. Por ejemplo, las semillas dispersadas por el viento tienden a ser muy pequeñas y livianas y a tener características físicas que permiten que sean llevadas por corrientes de aire: el arbusto Coyote Bush (Baccharis pilularis) y el matorral Mock Heather (ericameria ericoides) tienen "paracaídas" plumados (el nombre botánico de este paracaídas es pappus). Algunas semillas tienen protuberancias como diminutos ganchos en la cubierta de sus semillas que les permite pegarse de la piel de un animal como un mapache o un venado. Otras semillas son alojadas en frutas o bayas que consumen los pájaros y otros animales. Las semillas dentro de estas bayas a menudo tienen cubiertas duras que no pueden ser completamente digeridas por el animal. Como resultado, la semilla pasa completa por el animal y se dispersa en cualquier lugar que el animal deposite su excremento.

植物繁殖

金門國家康樂區
本地植物苗圃

金門國家康樂區 (GGNRA) 內有六個苗圃，專門用來繁殖舊金山灣區的本地植物。這些苗圃所培育的植物是用來取代那些已從公園的重建棲息區中除去的侵佔性外來品種。國家公園服務部的員工在這些苗圃中培育的本地植物，大約有一百五十多個品種--從青草到樹木都有。這個數字反映出公園內的生態系統極為多元，從沙丘、海岸灌木叢到紅木林不等。

Presidio 的本地植物苗圃是這六個苗圃中最大的，苗圃的結構和設施和很多商業苗圃所見的類似。三個溫室都備有自動化灌溉系統和馬達風扇，可以控制溫度和濕度。幾個有遮蔭的房間，在嬌嫩的幼苗進行耐寒的階段時，可以保護植物不會直接被太陽曬到。這些結構均提供影響植物生長的最佳環境：光線、水、溫度、二氧化碳和氧氣，使我們能達到最高的發芽率。有了這些結構之後，苗圃員工就可以從野外移除較少的種籽。

遺傳多元化

因為高度的遺傳多元化，使得一些植物即使遇到乾旱或是濕季，或是苗木在四月時被動物啃過，仍能在植入生態重建地之後存活。GGNRA 利用在不同的時間收集種籽，移植早或晚發芽的苗木，同時種植細小和粗壯植物等各種方式，來維護遺傳多元化。我們小心繁殖本地植物，因為它們一旦在其自然棲息環境中立足生根，等於就要自求多福，人類不會再介入。

什麼是植物繁殖？

植物繁殖是指以有性或無性方式增生植物的過程。有性繁殖要用種籽，而無性繁殖則要用插枝、壓條、分株或嫁接等方式。本地植物苗圃員工喜歡用從公園收集回來的種籽進行有性的植物繁殖。這樣一來，雖然面對病害或生長環境條件的變化，還是可以成功地培育出遺傳多元化的植物。如收集的種籽不夠，或在野生地進行植物繁殖，就會用無性繁殖。缺點是所有的新植物都是母植物的複製體，因此沒有遺傳多元化的特性。

無性繁殖：營養生殖方式

苗圃和住家經常使用長匍莖、插枝和花冠分株等的營養生殖方式。所有的營養生殖方式都

會產生基因型與母植物完全相同的植物，因此遺傳多元化有限。不過，此種方式的優點是可在短期之內生成一棵大型植物。

長匍莖

長匍莖是一種特別的莖，此莖是由植物花冠上的葉腋生成。它會沿著地面水平生長，可在其中一個節點形成一株新的植物。國家公園內的海邊草莓 (Fragaria chiloensis) 和yerba buena (Satureja douglasii) 兩種植物都會生出長匍莖。

用長匍莖進行營養生殖時，要先從母植物取下一條長匍莖，把它分段種入盆中的泥土。兩到三週以後，中段（海邊草莓會每隔一個節點）的地方會沿著長匍莖長出偶生根，形成"子"植物，然後可以移植到盆中。

有性繁殖：

自然界植物主要是靠著種籽自行生殖的。因為不同植物品質的種籽在顆粒、外型和構造彼此差異很大，所以植物所產生的種籽通常可用來辨識不同的植物。無論顆粒大小、外型或構造如何，所有的種籽都有三個基本部份 — 就是胚胎、食物儲藏組織和種皮。

胚胎

胚胎是在發芽時期一個雄性和雌性配子結合所形成的一株新的植物。它包括一個胚胎主莖，兩端各有一個生長點 — 一端發育成芽，另一端發育成根 — 上面還連著一到多個子葉 (cotyledons)。植物可以根據它們的子葉數加以分類。舉例來說，單子葉植物 monocotyledonous（草、玉米和球莖類植物）有一個子葉，而雙子葉植物 (dicotyledons 或 dicots，所有闊葉木、羽扇豆和大多數草本植物和 Presidio 的灌木叢) 則有兩個子葉。雙子葉和單子葉是兩個被子植物的例子（這種植物的種籽都長在成熟的子房或果實裡）。裸子植物，例如針葉樹，它們的種籽都長在成熟子房或果實的外面。

食物儲藏組織

一顆種籽能否成功發芽，並伸出地面長成幼苗，全看母植物傳給種籽的綜合儲存生成物（碳水化合物、脂肪、油脂和蛋白質）所產生的能量而定。

種皮

幾乎所有的種籽都由一或兩層種皮 (testa) 包裹，可以保護胚胎不受傷害。種皮的外層通常又乾又硬。

傳播種籽

因為植物無法移動位置，所以就有賴於風、水和動物來傳播它們的種籽。植物具有各種特徵來幫助它們傳播種籽。例如，藉風力散播的種籽通常都比較輕巧細小，它們這種特徵便於氣流將它們帶到別處；大草原灌木(Baccharis pilularis)和掃帚樹(Ericameria ericoides)有羽狀的「柔毛」("parachute" 的學名是「柔毛」"pappus")。有些種籽皮上面有像爪子一樣的小隆起物，可以黏在像浣熊或鹿這類動物的毛皮上。其他的種籽都包在果實或莓果裡，鳥或其他動物會吃這些果實。這些莓果內的種籽皮通常都很堅硬，動物無法完全消化掉。因此，整顆種籽就會通過動物的消化系統，隨著動物的排泄物散播在各處！

Return of the Wild!

SUMMARY
Return of the Wild! introduces students to the importance of maintaining biological diversity when propagating plants for habitat restoration projects. While playing Return of the Wild! students will discover that they score highest by collecting early-season, mid-season, and late-season germinators of a species. A post-game discussion helps students understand why this variation is essential. Return of the Wild! also familiarizes students with some of the more prominent species that grow in GGNRA. It presents some of the challenges that the NPS staff encounter in plant propagation, as well as some of the techniques they use to keep propagation success rates high. The game illustrates that it is impossible for people to entirely control the propagation process. Some cards in the compost pile describe things that can be controlled (how much water plants get, for example) but some describe things that cannot be controlled (a fox carcass rots and fertilizes a native plant community or a big storm wipes out the plants). Students find that the scores in Return of the Wild! fluctuate as these scenarios are encountered.

TIME
50 minutes
30 minutes for preparation

MATERIALS
- Return of the Wild! board games (provided by NPS)
- Discussion questions
- Score sheet

Lesson

Pass Out Games - 5 minutes
Park staff divide the class into groups of 2 to 5 students and pass out the game boards and pieces. They explain that the students are to begin playing the game as soon as they receive a board and pieces. Students start by drawing ten cards each, moving along the board, and following the instructions on the cards they pick up along the way. If they begin with BONUS cards, they can draw extra cards immediately.

Playing the Game - 15 minutes
Students play as much of the game as possible in fifteen minutes.

Scoring - 10 minutes
Park staff stop the games, pass out the score sheets, and walk the students through the scoring procedure.

Discussion - 15 minutes
Once scores are tallied, park staff facilitate a group discussion:

- Based on the scoring procedure, what is valued most in this game? Diversity.
- What types of diversity are valued? Diversity of species and genetic diversity within a species represented by early-season, mid-season, and late-season germinators.
- Why is it important to have early-season, mid-season, and late-season germinators within a species? So the species can better survive environmental disturbances. For example, early spring germinators may not survive an early spring frost but mid-spring and late-spring germinators probably will.

The key concept in successful ecological restoration with native plants is *natural selection, not cultural selection.* All aspects of the native plant nursery cycle emphasize the maintenance of genetic diversity; seeds are collected from many different plants, and both small (late-season germinators) and robust (early-season germinators) are transplanted.

Journal
Park staff pass out the discussion questions for students to complete as homework.

Closing - 5 minutes
Park staff explain that during the field visit to Golden Gate National Recreation Area, students will work alongside NPS staff, propagating plants and assisting with nursery operations. They remind students to dress in layers and wear clothing that they can get dirty (sneakers, no white shoes or pants), and to bring water and a snack.

Return of the Wild! Discussion Questions

1. Describe two actions or events that increased your final number of native plants and two actions or events that decreased your final number of native plants.

2. Describe a strategy that would give you the highest score at the end of the game.

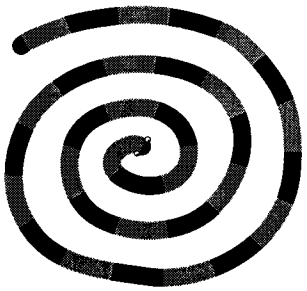
3. How is your strategy related to the plant propagation goals of the native plant nursery at the Presidio?

El Regreso de la Naturaleza

1. Describa dos acciones o eventos que aumentan su cantidad final de plantas nativas y dos acciones o eventos que disminuyen su cantidad final de plantas nativas.

2. Describa una estrategia que le daría la puntuación más alta al final del partido.

3. ¿Cómo se relaciona su estrategia con las metas de propagación de plantas nativas del vivero del Presidio?



回歸野外！
討論問題

1. 說明兩個可以增加本地植物的數目的行動或活動，和兩個可以減少本地植物的數目的行動或活動。

2. 說明你可以在遊戲最後取得最高分數的方法。

3. 你的方法，與 Presidio的本地植物苗圃的繁殖目標有什麼關係？

Return of the Wild! Score Sheet

INSTRUCTIONS:

- Check the boxes and circle the germination times that correspond to the plant cards in your hand. Give yourself one point for each plant you have checked.
- If you have all the plants in a community, check the community box. Give yourself one point for each community you have checked.
- If you have all three germination times for any plant, give yourself an additional 10 points for that plant. Total your points at bottom.

❑ FOREDUNE COMMUNITY

- ❑ Morning Glory early mid late
- ❑ Yellow Sand Verbena early mid late

❑ RIPARIAN COMMUNITY

- ❑ Bulrush early mid late

❑ DUNE SCRUB COMMUNITY

- ❑ Pearly Everlasting early mid late
- ❑ Coyote Brush early mid late
- ❑ Mock Heather early mid late
- ❑ Sticky Monkey Flower early mid late

❑ SERPENTINE BLUFF COMMUNITY

- ❑ San Francisco Wallflower early mid late
- ❑ Coast Buckwheat early mid late
- ❑ Yarrow early mid late

❑ SERPENTINE GRASSLAND COMMUNITY

- ❑ California Poppy early mid late
- ❑ Soap Plant early mid late

number of different plants _____

number of communities _____

number of diversity points _____

TOTAL POINTS _____

Plant Propagation

SUMMARY
Students work with nursery staff on plant propagation and other nursery operations. They gain an understanding of how nursery work fits into the restoration cycle. Students learn that a primary goal of the Presidio Native Plant Nursery is to increase genetic and species diversity of plants growing within GGNRA. Students who visit the nursery gain an appreciation for the vegetation that once thrived in the Bay Area and understand how our local ecosystem benefits from diversity. The class also knows that their work is crucial to park restoration, and that they are welcome to return to the nursery as a volunteer.

TIME
2.5 hours
45 minutes for preparation

MATERIALS
- Pots
- Propagation tags
- Plant information cards
- Demonstration plants
- Colored pencils
- Paper
- Calculators
- Whiteboards or flip charts (2)
- Markers
- Scrub brushes
- Microscope binder
- Specimen dishes
- Specimens for microscope station

Program

Arrival - 5 minutes
Students put personal belongings into the coat closet and gather at nursery entrance.

Welcome - 5 minutes
Park staff welcome the students and explain the nursery guidelines. Students divide into 4 groups.

Stations - 30 minutes each station x 4 stations = 2 hours
Students cycle through 4 stations with nursery staff (see station instructions below).

Clean up - 10 minutes
Staff and students clean up the stations.

Closing circle - 10 minutes
Students and staff form a circle. Students share a question from their journals, ask a new question, or tell something they learned during the day. Park staff thank the students for their work.

Station Guidelines

STATION 1 - TRANSPLANTING

Procedures:

- Park staff introduce the species the students will be transplanting.

- Park staff place the rack of seedlings in the center of the table and ask the students which plants seem best fit for transplanting; it is likely that students will choose the largest plants as the most vital. Park staff ask students to think back to the Return of the Wild! board game they played in the pre-visit lesson. Why would they want to transplant seedlings of various sizes? Park staff help the students understand that to promote genetic diversity they should transplant seedlings of various sizes, because the size of a seedling is an indicator of when its seed germinated, not its health. (Propagating a set of plants with a variety of germination rates will allow the species to cope with a larger range of climatic conditions. For instance, if San Francisco were to experience an especially cold winter month, the plants that germinate during that month are likely to freeze to death. However, if the plant community in the area includes early-season, mid-season and late-season germinators, the species is likely to survive the atypical weather conditions.)

- Park staff give a careful transplanting demonstration, followed by a demonstration by one of the students. Without a patient introduction to the process, the students may focus on finishing as many transplants as they can and disregard the quality of the work. During the transplanting, individual students sterilize pots, get more plants from the greenhouse, tag the finished transplants, and get soil.

- During transplanting students and staff may discuss previous experiences they have had working with plants, other volunteer work they have done, or what

plans they have for the future. Staff can also use the time to help students imagine the GGNRA landscape that they are helping to create—one that is richer each year with indigenous plant growth.

STATION 2 - DEMONSTRATION GARDEN

Procedures:

- The demonstration garden is a simulation of the plant communities that historically covered a large part of the Presidio of San Francisco and are now found only in small patches along the coastline and throughout GGNRA.

- Park staff take a few minutes to introduce the station. They point out the diversity of species in the demonstration garden and the lack of invasive behavior among native plants. Students look at a small section of the demonstration garden. Is there more or less plant diversity in the small section as in other areas around the nursery? Why don't the native plants overrun each other? Students compare the demonstration garden with a less diverse community in another area of the nursery. What is a monoculture? If you depended on the land for food and medicine, which hillside would you rather live near? How does the biodiversity of plants benefit animal populations? Are all of the plants in bloom? Are some of the plants in seed? How is it beneficial to insects and other animals to have a variety of plants blooming at different times of the year? Students discuss plant adaptation. The shorter, lighter-colored plants are generally found in the sunny, windy foredune community (represented at the bottom of hill). They compare this community with the backdune community midway up the hill and the oak woodland community at the top of the hill.

- Nursery staff may assign the group to a planting or weeding project, but the most common student activity in the demonstration garden is plant observation and drawing. Park staff distribute a plant card, a blank piece of paper, and colored pencils to each student. Students take 10 to 15 minutes to locate the plant on their card and represent it in some way on their paper. They can draw it or write a poem or descriptive paragraph about it. They should also study the plant card and prepare a one-minute presentation about the plant. During the last 5 to 10 minutes of the station, students share their work with each other. Did students observe many different plants? What types of variations are there between individuals of the same species?

STATION 3 - SEED CLEANING

Procedures:

- Park staff explain to the students that in the park no more than 5 percent of any plant's seeds are collected, and seeds are collected from at least 10 individual plants per species. By propagating seeds collected from a variety of plants within a species, genetic diversity is maintained within GGNRA. High genetic diversity helps ensure that the species will thrive when faced with a variety of environmental pressures (climate shifts, diseases, predators, etc.).

- Park staff demonstrate the appropriate seed cleaning technique.

- During seed cleaning, students and staff may discuss these seed-related questions:

  What are some of the different ways that seeds travel?
  (airborne, in feces, floating in water, stuck to animals' fur)

  How do you think the seeds we are working with today travel when they are in nature?

  Are you removing a dried fruit exterior, a flying mechanism, or a sharp shell?

  Does this seed remind you of any others you have seen?

- During the last ten minutes of the station, students work in pairs on the math problem described below.

  Group Math Problem:
  Park staff pose the following question and ask students what information they need to find the answer. As they call out the information they need (how big is the restoration site? how far apart are the plants spaced?, etc.), a volunteer writes the information on the whiteboard. If necessary, the group can draw a diagram. Students create an equation to calculate the answer (the equation should come from the students, NOT from the park staff).

  Question: You will be planting a foredune restoration site at Crissy Field. The length of the restoration site is 50 feet and the width is 130 feet. (Most sites are not a perfect rectangle, but instead of using calculus to determine the actual area, we choose the closest estimates of length and width.) The amount of space required by each plant in a restoration site depends on the habitat: Foredune plants are spaced 3.5 feet apart; serpentine plants are spaced 2 feet apart, transitional and backdune plants are spaced 3 feet apart. How many plants will be needed for this particular restoration area?

Sample Problem-solving Method: (Students may reach the answer in a variety of ways; park staff will let them follow their instincts.)

Calculate the area needed by each plant. Foredune plants are placed 3.5 feet apart, so each plant requires 12.25 square feet of space (3.5 x 3.5 = 12.25).

Determine the area of the site by multiplying the length times the width (50 x 130 = 6,500).

Calculate the number of plants needed by dividing the area of the restoration site by the area required for each plant (6500 ÷ 12.25 = 531)

Solution: 531 plants are needed.

STATION 4 - POT WASHING/MICROSCOPES

Procedures:

- Park staff explain to the students that they will clean and sterilize nursery containers, and then use microscopes to study the pathogens that make this cleaning and sterilizing a vital step in successful nursery operations. They discuss the importance of using bleach when cleaning pots. Students start thinking about the relationship of pot washing and disease and the relationship of disease and genetic diversity.

- Students spend the first portion of the station at the pot-washing sinks. Park staff assign each student a task: disassembling pots and racks, washing, rinsing, sterilizing, inspecting, and storing clean pots. After several minutes, students switch tasks.

- After approximately ten minutes of pot washing, the group moves to the microscope stations. Students should be careful of insects with stingers and of the hot light bulbs on the microscopes (the top light bulbs are the hottest). Students use the microscopes to examine the different diseases and insects. They match the pictures from the Microscopes binder with the specimens.

- Students discuss the relationship of genetic diversity to a species' ability to survive disease. (Some individuals in a species are more resistant to disease than others, so a diverse population has a better chance of surviving any given pathogen.)

- During the last five minutes of the station, students work together on the math problem described below.

Group Math Problem:
Park staff pose the following question and ask students what information they need to find the answer. As they call out the information they need (percentage of seeds that germinate and survive), a volunteer writes the information on the whiteboard. If necessary, the group can draw a diagram. Students create an equation to calculate the answer (the equation should come from the students, NOT from the park staff).

Question: Of the 531 plants needed for a restoration site, 80 are Sand Verbena. If the survival rate for Sand Verbena is 65 percent, how many seeds need to be propagated at the nursery to meet the goal for this species? Note: The survival rate is the percent of propagated plants that survive to be transplanted into the field. This percentage varies for each plant species and is determined by a germination test in which 100 seeds are sown and the sprouts that survive are counted. The average survival rate for plants grown in the park's native plant nurseries is about 60 percent.

Sample Problem-solving Method: (Students may reach the answer in a variety of ways; park staff will let them follow their instincts.)

Let n = number of plants to propagate, r = survival rate,
and z = number of plants needed for restoration site.

The number of plants propagated times the survival rate for the species equals the number of plants required for the restoration site (n x r = z).

n x 65% = 80 n = 80 ÷ 65% n = 123

Solution: You need to propagate 123 seeds in order to have 80 of them sprout and survive for planting into the restoration site.

Seed Experiments Program

SUMMARY

Students germinate seeds, compare plant growth and health, introduce variations on soil pH, test soil, and gather and analyze data on prime conditions for plant growth.

TIME

three 50-minute class periods
5 minutes each day for observing/recording for 3 weeks
60 minutes for preparation

MATERIALS

- Seeds
- Paper towels
- Pots
- Petri dish or plastic bag
- Soil
- Soil test kits (provided by NPS)
- Substances to change soil conditions, such as baking soda, vinegar, fertilizer, sand, clay, silt, etc.
- Observation Worksheet/Parts 1, 2, 3, and 4

Program

Part 1 - one 50-minute class period plus 5 minutes for observation/recording each day for the next week

- Teacher gives each student paper towels, petri dish or plastic bag, and two seeds. Yarrow, poppy and other California native plant seeds are available at local nurseries. Lima beans can also be used.

- Teacher distributes Observation Worksheet/Part 1 and asks students to make observations about their seeds' appearance.

- Students put their seeds between the paper towels, insert them into the petri dish or bag, and water them (a clean spray bottle works well). Towels should be moist, not wet; standing water encourages fungi. Students record their names on their petri dishes or bags.

- Students water seeds for one week (or longer if necessary) until most of the seeds germinate. During this time, students make daily observations and record important information on Observation Worksheet/Part 1.

Part 2 - one 50-minute class period plus 5 minutes for observation/recording each day for the next week

- At the end of the week (or when most of the seeds have germinated), the students compile their information on germination rates and complete the first part of Observation Worksheet/Part 2.

- In groups of two or three, students choose the types of variations they will introduce into their seedlings' soil medium. Possibilities include changing pH (by adding acidic or basic substances such as vinegar and baking soda), altering soil composition (sand/clay/silt ratio), using various fertilizers, and using store bought soil mix versus dirt from the yard. Altering soil conditions demonstrates the importance of soil composition and the effects of contaminants in soils. Students leave the soil of one or more seedlings unaltered to serve as the control group for their experiment.

- Students transplant seedlings into the altered soil.

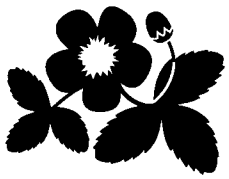
- Using soil testing kits, students test soil pH, nitrogen, phosphorous and potassium levels. Students then begin Observation Worksheet/Part 3.

Part 3 - one 50-minute class period plus 5 minutes for observation/recording each day for the next week

- Students monitor plant growth and health for one week and record their observations on Observation Worksheet/Part 3.

- At the end of the week, students compile their data and complete Observation Worksheet/Part 4.

Observation Worksheet Part 1



(Answer before sowing seeds)

1. What is the common name of your seed species?

_____

2. Describe the condition of your seeds. What do the seed coats look like? Is there any visible damage? Are the seeds robust or withered? etc.

_____

_____

_____

_____

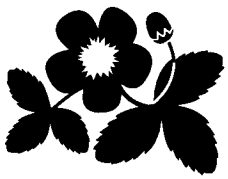
3. Predict the number of days it will take for your seeds to germinate.

_____

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

	Date	Time	Observation
Seed A			
Seed B			

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

2. Did your seed take a longer or shorter time to germinate compared to other seeds in your classroom?

(circle one) Longer Shorter

3. What is the average time that it took for all the seeds in your classroom to germinate?

_____

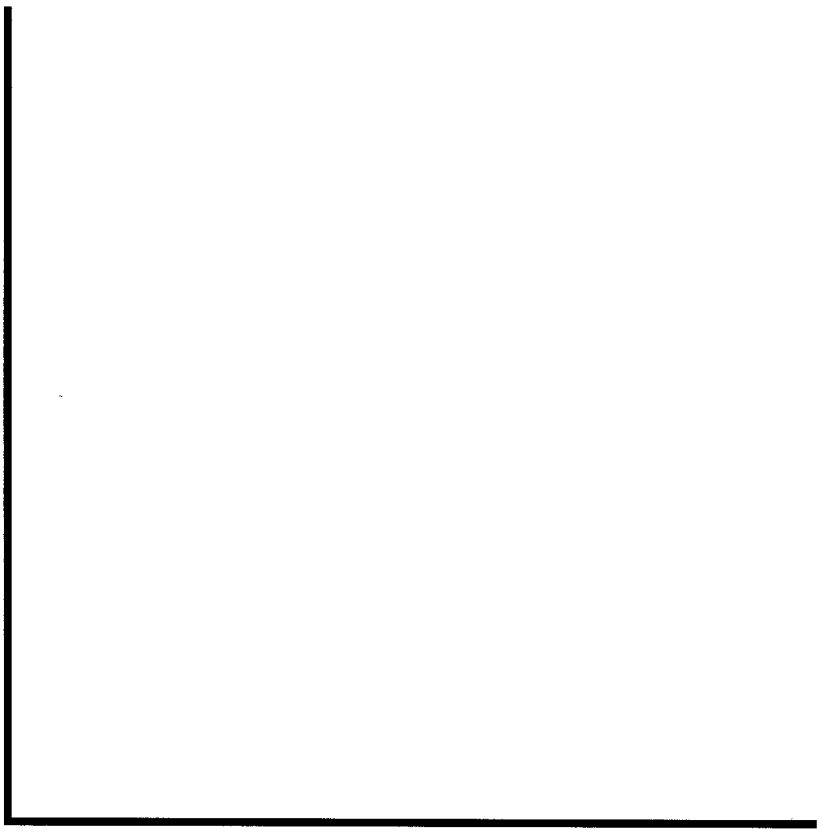
Sum of germination days ÷ Number of seeds =
Average days of germination

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

_____

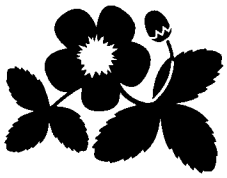
Number of germinated seeds ÷ Total number of seeds x 100 =
% germination rate

5. Graph the time it took for all the seeds to germinate. Label both axes.



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

Observation Worksheet Part 3



(Complete immediately after treating soil)

1. How was your soil treated?

Seedling A	Seedling B

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

Seedling A: pH _____ nitrogen _____

phosphorous _____ potassium _____

Seedling B: pH _____ nitrogen _____

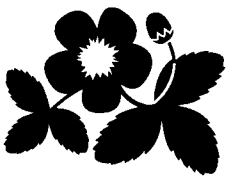
phosphorous _____ potassium _____

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

4. Monitor daily changes below:

	Date	Time	Observation
Seed A			
Seed B			

Observation Worksheet Part 4



(Complete one week after treating soil)

1. How has your experimental plant grown in comparison with your control plant?

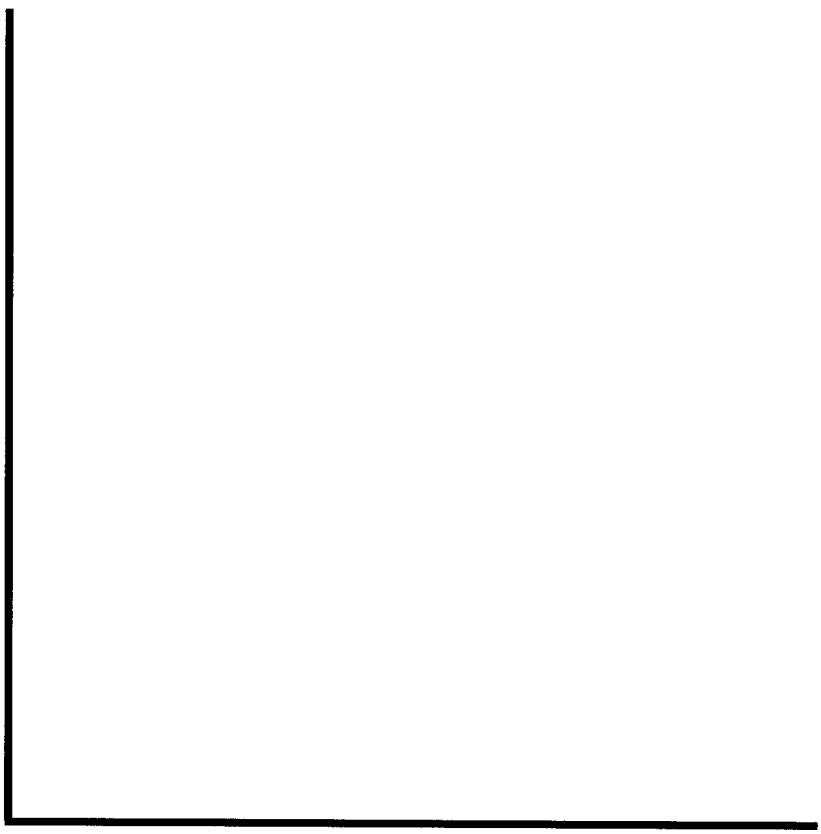
2. How has your plant grown in comparison with other plants in your classroom?

3. How does your actual plant growth compare to your prediction from Observation Worksheet/Part 2?

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

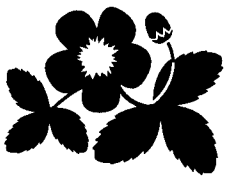
5. What are the least favorable conditions for plant growth?

6. Create a graph that compares plant growth under varying conditions. Include all details that you feel are important. Label both axes.



7. How do contaminants in soil affect genetic diversity?

Hoja de Trabajo para Observacíones - Parte 1



(Conteste antes de sembrar las semillas)

1. ¿Cuál es el nombre común de su especie de semillas?

_____

2. Describa la condición de sus semillas. ¿Cómo luce la cubierta o cáscara de las semillas? ¿Hay algún daño visible? ¿Están robustas o marchitas las semillas? Etc..

_____

_____

_____

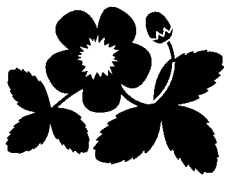
3. ¿Prediga el número de días que se tardará en germinar su semilla?

_____

4. Supervise los cambios diarios a continuación. Anote el día en que germinó la semilla.

	Fecha	Hora	Observacíones
Semilla A			
Semilla B			

Hoja de Trabajo para Observacíones - Parte 2



(Complétela una semana después de haber sembrado sus semillas)

1. ¿Cuánto tiempo se tardó en germinar su semilla?

Semilla A: _____ # días Semilla B: _____ # días

2. ¿Se tardó su semilla más o menos tiempo en germinar en comparación con las semillas de otras personas en su salón?

___ Más Tiempo ___ Menos Tiempo

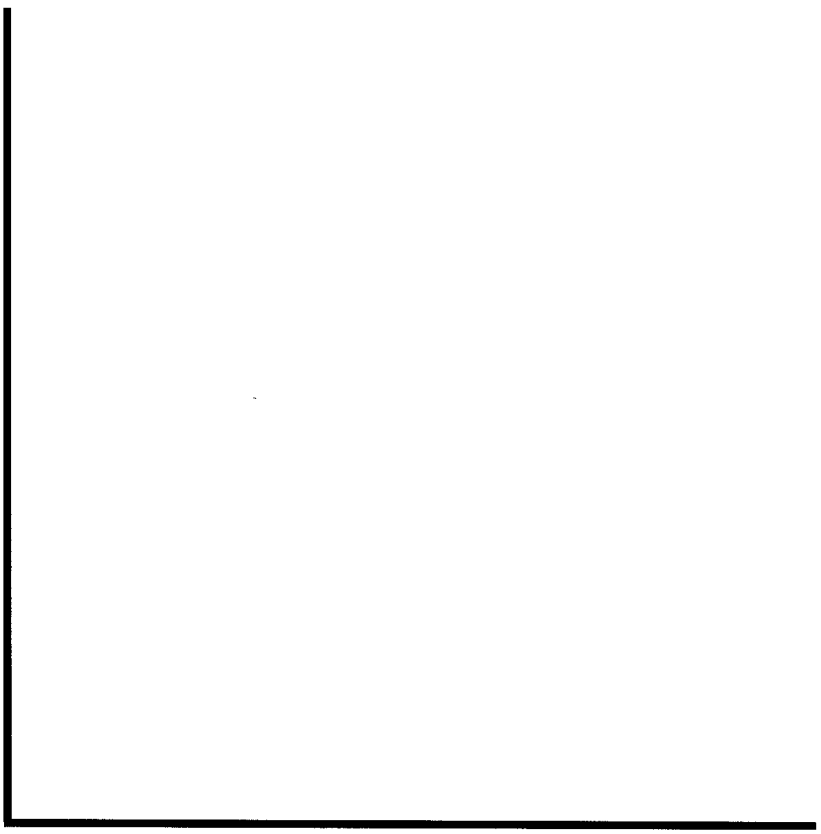
3. ¿Cuál fue el tiempo promedio que tardaron en germinar las semillas en su clase?

Suma de días que tardaron en germinar ÷ cantidad de semillas = promedio de días que tardaron en germinar

4. ¿Cuál fue la tasa de germinación (porcentaje de semillas sembradas que germinaron) en su salón de clases?

Numero de semillas que han germinado ÷ cantidad de semillas x 100 = % la tasa de germinación

5. Dibuje una gráfica del tiempo que se tardaron en germinar las semillas. Rotule ambos ejes.



6. ¿Cuáles son algunas de las razones por las cuales las semillas germinaron en días diferentes?

Hoja de Trabajo para Observacíones - Parte 3

(Complétela inmediatamente después de haber acondicionado la tierra)

1. ¿Qué tratamiento le aplicó a la tierra?

Semilla A	Semilla B

2. Mida los niveles de pH, nitrógeno, fósforo y potasio de la tierra y anótelos a continuación.

Semilla A: pH _____ Nitrógeno _____

Fósforo _____ Potasio _____

Semilla B: pH _____ Nitrógeno _____

Fósforo _____ Potasio _____

3. Prediga el crecimiento de la planta en terreno alterado (planta experimental) comparado con la planta control

_____

_____

_____

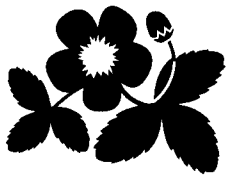
_____

_____

4. Supervise los cambios diarios a continuación:

	Fecha	Tiempo	Observacíones
Semilla A			
Semilla B			

Hoja de Trabajo para Observacíones - Parte 4



(Complétela una semana después de haber acondicionado la tierra)

1. ¿Cómo ha crecido su planta experimental en comparación con su planta control?

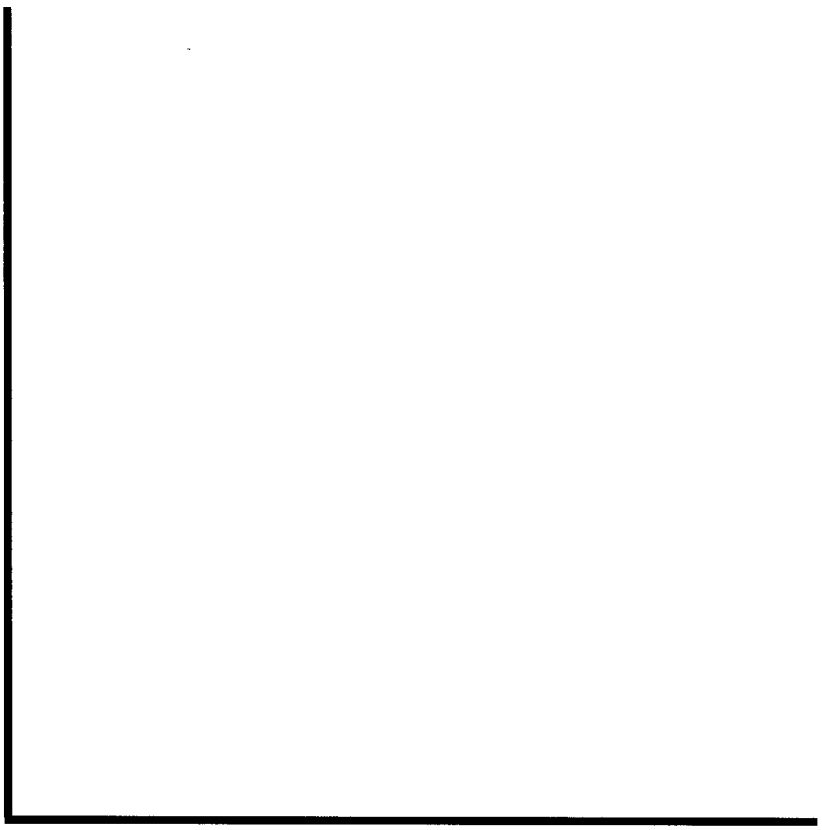
2. ¿Cómo ha crecido su planta en comparación con otras plantas de su salón de clases?

3. ¿Cómo compara el crecimiento de su planta al presente con su predicción de la hoja de trabajo para observaciones - Parte 2?

4. ¿Cuáles son las condiciones más favorables para el crecimiento de la planta?

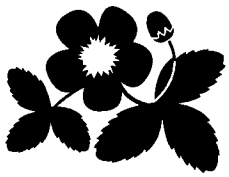
5. ¿Cuáles son las condiciones menos favorables para el crecimiento de la planta?

6. Dibuje una gráfica que compare el crecimiento de las plantas bajo condiciones variables. Incluya todos los detalles que usted piensa son importantes. Rotule ambos ejes.



7. ¿Cómo afecta la diversidad genética los contaminantes que hay en el terreno?

觀察記錄表
第一部份



(在播種以前回答)

1. 你的種籽品種俗名是什麼？

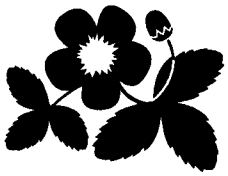
2. 說明你的種籽的狀況。種皮看起來如何，是否看得到任何損傷，種籽是健康還是枯萎的？等等。

3. 預測你的種籽需要多少天才會發芽。

4. 在下面記下每天觀察的變化。記下種籽哪一天發的芽。

	日期	時間	觀察結果
種籽 A			
種籽 B			

觀察記錄表
第二部份



（在播種之後第二週填寫）

1. 你的種籽花了幾天的時間發芽？

種籽 A: _____ 天　　種籽 B: _____ 天

2. 你的種籽和課堂上的其他種籽相比，發芽所花的時間比較長還是比較短？

（圈選一個）　長　短

3. 課堂上所有的種籽發芽的平均時間是多久？

發芽的總天數 ÷ 種籽數 =

平均的發芽天數

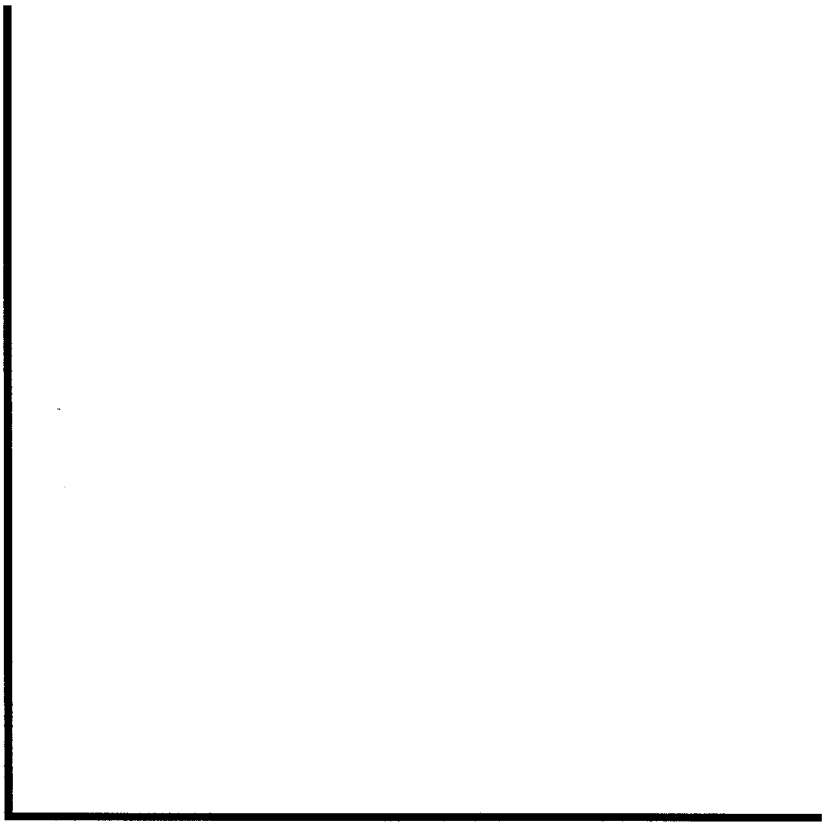
4. 課堂上的發芽率（播種的種籽發芽的百分比）如何？

發芽的種籽數 ÷ 種籽的總數 x 100 =

% 發芽率

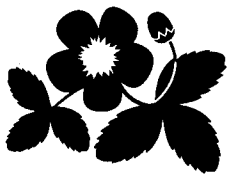
5. 用圖表表示出所有的種籽發芽需要的時間。

標出 X和 Y兩個軸線。



6. 種籽在不同天發芽的原因有哪些？

觀察記錄表
第三部份



（在測試土壤之後馬上填寫）

1. 你用什麼方法測試土壤？

苗木 A	苗木 B

2. 測量土壤的酸鹼值、氮、磷和鉀的濃度，然後記在下面:

苗木 A: 酸鹼值 _____ 氮 _____

磷 _____ 鉀 _____

苗木 B: 酸鹼值 _____ 氮 _____

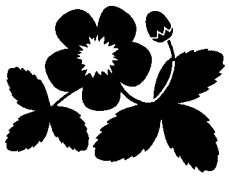
磷 _____ 鉀 _____

3. 預測更動過的土壤中的植物（實驗植物）和對照植物比較之下的生長情況。

4. 在下面記下每天觀察的變化:

	日期	時間	觀察結果
種籽 A			
種籽 B			

觀察記錄表
第四部份



（在測試土壤之後第二週）

1. 你的實驗植物和對照植物比較之下的生長情況如何？

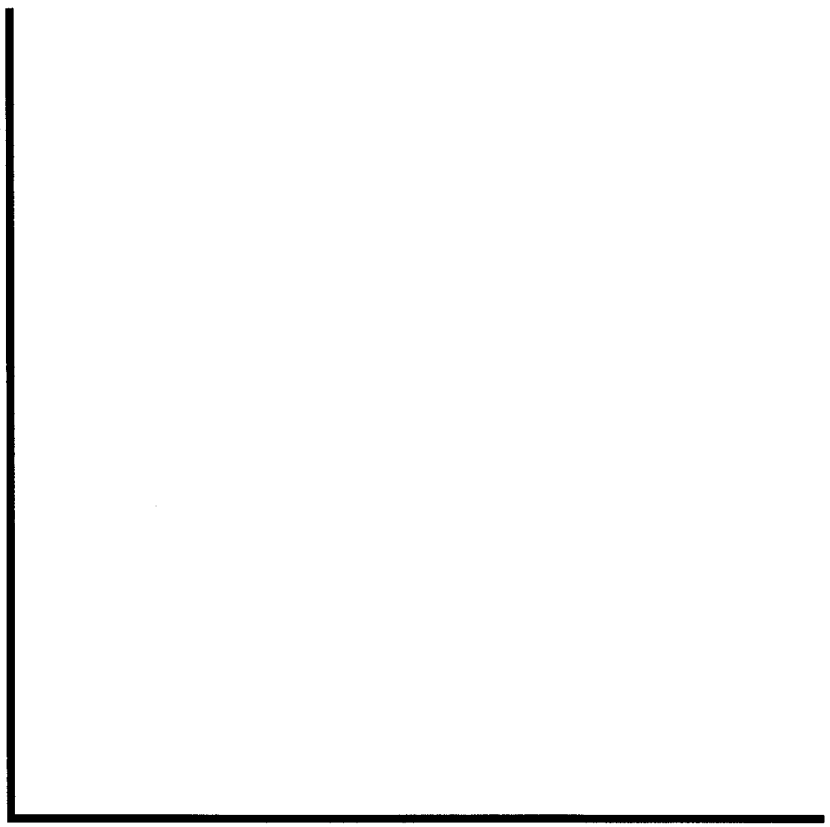
2. 你的植物和課堂上其他植物比較之下的生長情況如何？

3. 與觀察練習紙／第二部份所預測的比較之下，你的植物實際生長情況如何？

4. 對植物的生長最有利的條件是什麼？

5. 對植物的生長最不利的條件是什麼？

6. 繪出一個圖表，比較不同狀況下植物的生長情況。包括所有你認為重要的細節。標出X和Y兩個軸線。



7. 土壤被污染之後會對遺傳多元化產生什麼影響？

Rubric
Plant Propagation

Science (Diversity)

Needs Improvement: Students do not understand importance of diversity or how genetic and species diversity can be maintained.

Good: Students understand the importance of diversity but don't fully understand how genetic and species diversity can be maintained.

Excellent: Students understand the importance of diversity and can explain several ways genetic and species diversity can be maintained.

Math (Algebra)

Needs Improvement: Students cannot create equations to answer questions about propagation needs at the nursery without extensive help from the facilitator.

Good: Students can create equations to answer questions about propagation needs at the nursery but need prompting from the facilitator.

Excellent: Students can create equations to answer questions about propagation needs at the nursery with no help from the facilitator.

Life Skills (Cooperative Learning)

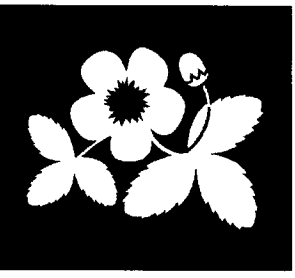
Needs Improvement: Students show incomplete interaction, often ignore comments, group efforts are easily sidetracked, some members uninvolved in group.

Good: More than half the members are actively involved, rarely are comments ignored, rarely stray from topic.

Excellent: All students participate equally, actively listen to one another, show respect for ideas, stay on task.

Invasive Plant Removal & Monitoring

SUMMARY OF INSTRUCTIONAL ACTIVITIES



The Private Life of Plants - page 11

- Students watch *The Private Life of Plants* video and answer focus questions. (integrated assessment)

Mystery Plants - page 15

- Students are introduced to the use of a dicholomous key by identifying the Mystery Plants on the National Park Labs web site.

Invasive Plant Removal & Monitoring - page 19

- In small groups, students perform qualitative and quantitative monitoring of a restoration site.
- Students identify and remove invasive plants from a restoration site.
- Students calculate the rate of weeding for their group and use that calculation to estimate how many people-hours it will take to weed all the restoration sites in the park.
- Students discuss the contributions of volunteers in national parks.
- Students write a journal entry predicting the impact of removing invasive plants from the restoration area. (integrated assessment)

Community Forum Role Play - page 29

- In The Case of the Vacant Lot students play the roles of different community members during a planning process for a fictional deserted lot near their school.
- Students reflect on the Environmental Justice issues addressed in the planning process and write journal entries about the role-play activity. (integrated assessment)

Habitat Restoration Around the World - page 47

- Students read articles about habitat restoration projects in other parts of the world.
- Students discuss articles and answer focus questions.

Standards
Invasive Plant Removal & Monitoring

SFUSD Science Content Standard 14: Interdependence
Students understand that the maintenance of ecosystems depends upon biotic and abiotic factors, including the effects of water, nitrogen, and carbon cycles on the system.

- *Performance Standard:* Students recognize that indigenous and exotic plants interact differently with abiotic and biotic components of the ecosystem (based on SFUSD Performance Standard 14.3).

SFUSD Math Content Standard 1: Number and Operations
Students demonstrate their knowledge of basic skills, conceptual understanding, and problem solving in number and operations.

- *Performance Standard:* Students use number sense and estimation skills in determining the number of volunteer hours necessary to complete projects within the park (based on SFUSD Performance Standard 1.1).

National Behavioral Studies Standard 4: Conflict, cooperation, and interdependence among individuals, groups, and institutions
Students understand that conflict between people or groups may arise from competition over ideas, resources, power, and/or status.

- *Performance Standard:* Students understand that decisions regarding open space may cause conflict between people who compete for access to the resource.

National Life Skills Standard: Contributes to the overall effort of a group
Students demonstrate respect for others in the group, take initiative when needed, engage in active listening, and contribute to the development of a supportive climate in group.

- *Performance Standard:* Students can contribute effectively to their groups during park and classroom group activities.

Exotic Plants

WHAT ARE EXOTIC PLANTS?

The National Park Service defines exotic or "non-native" species as those occurring in a given place as a result of deliberate or accidental actions by humans. Exotic plants have been introduced to North America for a variety of reasons, including livestock grazing, agriculture, forestry, ornamental landscaping, and soil stabilization.

The exchange of food plants around the world has immeasurably enriched human cultures. Potatoes, peppers, chocolate, and tomatoes, once found only in Central and South America, now thrive in gardens around the world. These species evolved on continents where their populations were kept in check by various environmental factors such as climate, disease, and herbivores. However, when they arrive in a new environment free of such ecological constraints, many become weeds along roadsides and in other disturbed areas. Some spread into natural areas, and a number of these can be classified as invasive. Exotic invasive plants dramatically reduce biodiversity by covering extensive areas so completely that other species cannot co-exist.

The spread of invasive species is one of the worst threats to biological diversity in National Parks. For example, more than 1,000 acres in Everglades National Park are lost every year to the Brazilian pepper tree and other invasive species that spread rapidly through the wildlands. Iceplant, a threat to the natural areas of California, forms thick mats in California's coastal sand dunes. Very few indigenous plants can co-exist in this iceplant monoculture. Iceplant was brought to California from South Africa more than a hundred years ago to stabilize soil and prevent sand movement across roads. Researchers have since learned its faults as a soil stabilizer and invasive weed, but too late to prevent its spread throughout coastal California.

The park targets iceplant for removal, not just because of its status as an exotic species, but because it is invasive. It is not naturally a "bad" plant. Iceplant became problematic in California due to lack of predators. Natural resource managers, needing to control the worst invasive species, remove iceplant from areas where it directly threatens endangered species habitat. Other exotic species that successfully coexist with natives are left in place, and have become a permanent element of the California flora.

Many invasive species share biological characteristics that enable them to spread rapidly. Among these are:

- Exceptional reproductive abilities including vegetative reproduction (from stems, roots, or both), massive seed production, and extremely effective seed dispersal methods.
- Adaptation to frequent disturbance.
- Ability to survive in highly compacted or low-nutrient soils.
- Ability to produce chemicals that inhibit growth of nearby vegetation.

Monitoring

Natural resource managers need a systematic method to record information and detect changes that occur in natural systems over time: year after year, season after season, or at some other regular time interval. Monitoring is the regular collection and analysis of data at regular intervals over time, to predict or detect natural and human-induced changes, and to provide the basis for appropriate management response. The collection of baseline information on natural resources, as well as the initiation of long-term monitoring programs to alert management to changes, are essential parts of the natural resource program in a national park. In Golden Gate National Recreation Area, park staff monitor approximately 2 percent of a site. This conforms to constraints in time and personnel. There are many different methods of monitoring. Specific management objectives determine which method is used.

QUALITATIVE MONITORING

Qualitative monitoring tracks the quality of the natural resources in a site. The quality of natural resources includes plant health and size, as well as the general appearance of an area. Photomonitoring is one type of qualitative monitoring. Photomonitoring (as opposed to random picture taking) is the photographing of a site from precise documented locations at specific times of the year. The purpose of this form of monitoring is to visually document the changes in a landscape over a period of time. By photographing at the same time of year, seasonal changes are eliminated from the documentation. In addition to these monitoring photos, many sites in the park have a site journal in which the stewards of that area record in writing and drawings the changes that occur.

QUANTITATIVE MONITORING

Quantitative monitoring is used to get more detailed information about changes in an area. Information on the diversity of plant or wildlife species, or the number of individuals of a particular species, may be gathered. Use of a vegetative transect is one method of quantitative monitoring. Transects require precision and consistency. During transect monitoring, plants are sampled every one-fifth of a meter for 10 meters, using a sampling rod. Any plant species touching the rod at a given point is recorded. Plants are identified using a dichotomous key and the information is recorded. The percentage of cover for each species found on the transect can then be calculated.

Another method of quantitative monitoring is quadratic monitoring. A quadrat is a rectangle of one square meter or less. The quadrat is placed randomly in the site and information regarding the percent cover of each species that lies within the quadrat is recorded.

Plantas Exóticas

¿QUÉ SON PLANTAS EXÓTICAS?

El Servicio Nacional de parques define especies exóticas ó "no-nativas" como aquéllas que se dan en un lugar en particular, como resultado de las acciones deliberadas o accidentales de parte de los humanos. Las plantas exóticas han sido introducidas en Norteamérica por una variedad de razones, incluyendo pastizales para el ganado, agricultura, forestación, paisajes artificiales y estabilización del terreno.

El intercambio de plantas por todo el mundo ha enriquecido inmensamente las culturas humanas. Las patatas o papas, la pimienta, el cacao (chocolate) y los tomates, que antes existían solo en América Central y Sur América crecen ahora en huertos en todo el mundo. Estas especies evolucionaron en continentes donde sus poblaciones fueron controladas por varios factores ambientales, como el clima, las enfermedades y los animales herbívoros. Sin embargo, cuando llegaron a nuevos ambientes que no tenían tales limitaciones ecológicas muchas se convirtieron en hierbas creciendo a la orilla de los caminos y en otras áreas afectadas. Algunas se difundieron por áreas naturales y un número de éstas pueden ser clasificadas como invasoras. Las plantas exóticas invasoras redujeron la diversidad dramáticamente al cubrir grandes áreas de manera tan extensa que otras especies no lograron co-existir con ellas.

La difusión de especies invasoras es una de las peores amenazas a la diversidad biológica en los parques nacionales. Por ejemplo, más de 1,000 acres de los Everglades de Florida se pierden todos los años debido al árbol Brasileño de pimienta y otras especies invasoras que se difunden rápidamente por las tierras silvestres. El Iceplant, una amenaza a las áreas naturales de California, forma gruesas alfombras en las dunas costeras de California. Muy pocas plantas indígenas pueden coexistir con este monocultivo del Iceplant. El Iceplant fue traído a California de África del Sur hace más de cien años, para estabilizar el terreno y evitar que la arena se moviera hacia las carreteras. Los investigadores desde entonces descubrieron sus defectos como estabilizador de terreno y por ser hierbas invasoras, aunque muy tarde para prevenir su difusión por toda la costa de California.

El parque tiene como objetivo remover el Iceplant, no solo por ser una especie exótica sino porque es invasora. No es en términos naturales, una planta "dañina." El Iceplant se convirtió en un problema en California debido a que ésta no tiene enemigos naturales (depredadores). Los manejadores de recursos naturales, quienes necesitan controlar las especies invasoras más dañinas, remueven el Iceplant de áreas donde esta amenaza directamente los hábitats de especies en peligro de extinción.

Otras plantas exóticas que coexisten exitosamente con las plantas nativas se dejan en el lugar y se han convertido en elementos permanentes de la flora de California.

Muchas plantas invasoras comparten características biológicas que les permite difundirse rápidamente. Algunas de estas características son:

- Capacidad de reproducción excepcional, incluyendo reproducción vegetativa (de tallos, raíces o ambos), producción masiva de semillas y métodos de dispersión muy efectivos.
- Adaptación a perturbaciones frecuentes.
- Capacidad para sobrevivir en terreno muy compacto o bajo en nutrientes.
- Capacidad para producir sustancias químicas que inhiben el crecimiento de la vegetación vecina.

Monitoreo (Supervisión)

Los manejadores de recursos naturales dependen de un método sistemático para recoger información y detectar los cambios que se dan en sistemas naturales a través del tiempo: año tras año, temporada tras temporada o a cualquier otro intervalo regular. Monitoreo es la recopilación y análisis de datos a intervalos regulares a través del tiempo, para predecir o detectar cambios naturales o inducidos por seres humanos y para proveer una base para responder con la acción apropiada. La recopilación de información que sirva de base, sobre recursos naturales, así como el inicio de programas de monitoreo a largo plazo para alertar a los administradores sobre cambios, son parte esencial del programa de recursos naturales de una Parque Nacional. En el Área Nacional Recreativa Golden Gate el personal del parque supervisa aproximadamente un 2% de un lugar específico. Esto se debe a limitaciones de tiempo y personal. Hay muchos y diversos tipos de monitoreo. Los objetivos administrativos específicos determinan que método se va a utilizar.

MONITOREO CUALITATIVO

El monitoreo cualitativo evalúa la calidad de los recursos naturales en un lugar específico. La calidad de los recursos naturales incluye el tamaño y estado de salud de la planta y la apariencia general del área. Monitoreo con fotografías (photomonitoring) es un tipo de monitoreo cualitativo. El monitoreo con fotografías (a diferencia de tomar fotos al azar) es tomar fotos de un lugar desde puntos documentados con precisión en momentos específicos del año. El propósito de esta forma de mon-

itoreo es documentar visualmente los cambios en el paisaje a través del tiempo. Tomando fotos en la misma época del año, los cambios debidos a cambios en temporada son eliminados de la documentación. Aparte de estas fotos documentales, muchos lugares del parque mantienen un registro en el cual los encargados de esas áreas anotan e ilustran con dibujos los cambios que se dan.

MONITOREO CUANTITATIVO

El monitoreo cuantitativo se usa para obtener información más detallada de los cambios en un área. Se puede recoger información acerca de la variedad de plantas o especies de vida silvestre, o sobre el número de individuos de una especie en particular. El uso de tractos o segmentos vegetativos es uno de los métodos de monitoreo cuantitativo. El uso de tractos requiere precisión y consistencia. Cuando se realiza monitoreo por tractos se toman muestras de las plantas cada quinta parte de un metro por diez metros, usando un vara de muestreo. Cualquier especie de planta que toque la vara en un punto dado es anotada. Las plantas son identificadas y se registra la información utilizando una clave dicotómica (dos partes). El porcentaje que cubre cada especie hallada en el tracto puede entonces ser calculada.

Otro método de monitoreo cuantitativo es monitoreo cuadrático. Un cuadro (quadrat) es un rectángulo de un metro cuadrado o menos. El cuadrado se coloca al azar en el lugar y se registra la información sobre el porcentaje cubierto por cada especie que cae dentro del cuadro.

外來植物

什麼是外來植物？

國家公園服務部將那些在特定的地點經由人類蓄意或偶然行為所帶來的產物定義為外來或“非本地”品種植物。很多外來植物由於各種原因而被引進北美，例如用來發展農業、放牧、造林、裝飾造景及穩固土壤等。

世界各地所進行的食品植物交換大幅度地充實了人類文化。薯仔、辣椒、朱古力和西紅柿等，從前是中南美洲的特產，現在卻在全球各地的菜圃中繁殖。這些品種在大陸演化，但是受到如氣候、病害和草食動物啃食等各種環境因素的限制，無法大量繁殖。不過，當它們來到一個沒有這類生態限制的新環境時，便成為雜草，在路旁和其他天然災害蹂躪的地區叢生蔓延。一些蔓延到自然區域，其中又有一些可以歸類為侵佔性植物。外來的侵佔性植物完全覆蓋了廣大的區域，其他的植物品種根本無法與之共存，也因此大大的降低了生物多元性。

侵佔性品種不斷繁衍擴生，對國家公園的生物多元性帶來了很大的威脅。舉例來說，Everglades國家公園每年都有一千多英畝的地被巴西辣椒樹和在野地裡快速繁殖的其他品種侵佔。冰葉日中花威脅到加州的自然區域，在加州的海岸沙丘長成厚厚的蒲葦叢。只有很少數的本地植物可以和冰葉日中花共存。冰葉日中花是一百多年以前從南非帶進加州用來穩固土壤，防止沙土橫跨路面的植物。研究家後來發現它是一種侵佔性的野草，不適合用來穩固土壤，但是已來不及阻止它在整個加州沿海地區蔓延。

公園當局一直將冰葉日中花列為清除的目標，不只因為它是外來品種，也因它具有侵佔性。雖然它本身並非“不好的”植物。因為沒有其他靠啃食冰葉日中花而生存的動物來將它清除，冰葉日中花成為加州最頭痛的一個大問題。為了及時控制這種影響最深的侵佔性品種的蔓延，自然資源管理人士便從直接危害到瀕臨絕種的植物棲息區將冰葉日中花清除。其他能與本地植物共存的外來品種都被保留下來，已成為加州植物的永久成員。

很多侵佔性品種都具有可以快速繁殖蔓延的生物特徵。其中包括：

- 不尋常的繁殖能力，包括營養生殖方式（從莖、根或兩者），產生大量的種籽，以及極為有效的種籽傳播方法。
- 對經常性的干擾的適應力。
- 可以在非常擁擠或貧脊的土壤中生存。
- 可以製造化學成份，會抑制附近植被的生長。

監視

自然資源管理人士需要一套有系統的方法來記錄資料並且偵測自然系統隨著時序的移轉所發生的變化：年復一年，季節輪替，或是其他定期間隔時段。監視是指在一段時間內，定期收集和分析資料，以便預測或偵測天然和人為變化，並作為採取適當管理措施的依據。天然資源基礎資料的收集和長期監視計劃的實施以提高管理階層的警覺，從而因應所面臨的變化等，都是一個國家公園的自然資源計劃重要的一部份。在金門國家康樂區，公園員工負責監視一塊生態重建地大約百分之二的部份。這麼低的百分比，是由於時間有限，人力也不足。監視方法有很多種，要根據特定的管理目標來決定採用哪一種方法。

質量監視

質量監視追縱生態重建地自然資源品質。自然資源的品質包括植物的健康和大小，以及一個地區的一般地貌。攝影監視是一種質量監視。攝影監視（相對於隨機照相）是在一年的特定時間內，從一個有記錄設備的地點，對一塊生態重建地所做的攝影監視。這種監視方式旨在以視覺的方法記錄一個風景地帶在一段時間之內的變化。通過在每一年的同一個時間的攝影監視，毋須顧慮季節性的變化。除了這些監視攝影之外，公園內很多生態重建地都有一份日誌，公園員工用書寫和繪圖的方式，記載發生的所有變化。

數量監視

數量監視是用來取得有關一個地區變化的詳細資料。可以收集有關植物或野生物品種的多元性，或是一特定品種的數目等資料。數量監視的一種方法是使用一個植物營養生植的樣條。使用樣條時要精確一致。在進行樣條監視時，用一個樣條在每十公尺的距離內就採樣

五分之一公尺的植物，並把在特定的地點接觸樣條的植物品種記錄下來。從二叉式檢索表上找到植物，並記錄相關資料。最後計算出樣條上找到的每一個品種的覆蓋面百分比。

另一種數量監視的方法就是樣方監視。樣方是一塊大約一平方公尺大小的長方形地。隨意在生態重建區內找出一塊像這樣的地皮，並記錄有關每一個品種在此樣方內的覆蓋面百分比資料。

The Private Life of Plants

SUMMARY
Students watch the video, *The Private Life of Plants*, and answer discussion questions. The video explains how certain plants disperse their seeds with the assistance of biotic and abiotic components of the environment. Through the focus questions, students begin to understand that plants have many ways of dispersing seed, utilizing wind, water, and animals.

TIME
Two 50-minute class periods
15 minutes for preparation

MATERIALS
- Discussion questions
- *The Private Life of Plants* video (provided by the NPS)

Lesson

Day 1

5 minutes
Students read the discussion questions.

45 minutes
Before starting the video teacher asks the students to pay particular attention to issues of interdependence depicted in the video. Students watch the video.

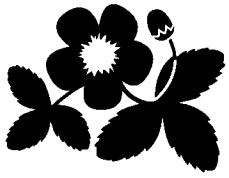
Day 2

15 minutes
Students answer the discussion questions.

25 minutes
Students discuss their answers to the discussion questions.

10 minutes
Students formulate two questions they have about the video. Students enter these questions into their journals.

Private Life of Plants



Discussion Questions

1. What are four different ways plants disperse their seeds?

2. Usually, we think of animals as dependent on plants. The video shows plants that depend on specific animals for the survival of the species. Give one example of a plant that depends on an animal to disperse its seed.

3. The video shows many complex interactions between abiotic and biotic components of the environment. Describe how a severe drought would affect the interactions in a normally wet ecosystem.

Vida Individual de las Plantas

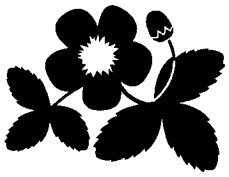
Preguntas sobre Opiniones

1. ¿De qué cuatro maneras las semillas se dispersan?

2. Por lo general consideramos que los animales dependen de las plantas. La videocinta muestra plantas que dependen de animales específicos para que su especie sobreviva. De un ejemplo de una planta que depende de un animal para dispersar sus semillas.

3. La videocinta muestra muchas interacciones complejas entre los componentes bióticos y abióticos del ambiente. Describa como una sequía severa afectaría las interacciones en un ecosistema que normalmente está mojado.

植物的“私生活”



討論問題

1. 植物傳播種籽有哪四種方法？

2. 我們通常認為動物是要依賴植物為生。錄影帶指出，植物亦需要依靠動物才可以生存。舉出一個植物依靠一種動物來傳播種籽的例子。

3. 錄影帶指出環境中的無生命成份和有生命的成份之間，會發生很多複雜的互動。說明嚴重的乾旱會如何影響一般潮濕地帶的生態系統成員之間的互動關係。

Mystery Plants

SUMMARY
Students are introduced to the process of using a dichotomous key by investigating the Mystery Plant section of the National Park Labs web site.

TIME
50 minutes
10 minutes for preparation

MATERIALS
- Computers with Internet access
- Mystery Plants Worksheet

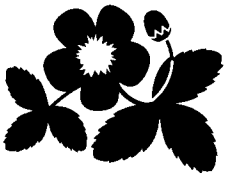
Lesson

Introduction - 5 minutes
Teacher explains to the students that a dichotomous key is an important tool used by biologists to identify plants. The user of a dichotomous key must answer a series of questions about the plant he/she is trying to identify. Some of the questions are easy to answer but some take knowledge of plant biology or special vocabulary. Identifying the Mystery Plants on the National Park Labs web site will help students understand how to use a dichotomous key and learn some of the terms necessary to identify plants.

Mystery Plant Worksheet - 35 minutes
Teacher distributes the Mystery Plants Worksheet. Students access the National Park Labs web site. Students complete the worksheet as they identify the Mystery Plants.

Conclusion - 10 minutes
The class discusses the process of identifying plants. What kinds of things need to be observed in order to identify a plant? What new terms did students learn? Students will use their observation skills and their new vocabulary when they identify which plants to remove during their next visit to Golden Gate National Recreation Area.

Mystery Plants Worksheet



- Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs.

- Locate the section titled Can YOU Use a Dichotomous Plant Key?

At each step in a dichotomous key you are asked to choose between _____ for the plant you're trying to identify.

Mystery Plant #1

What is a simple leaf? _____

What is the common name for this plant? _____

Mystery Plant #2

What is an inflorescence? _____

What is the Latin name for this plant? _____

Mystery Plant #3

What are rhizomes? _____

Draw a picture of this plant on the back of this page.

Mystery Plant #4

What are dissected leaves? _____

This plant is a member of what family? _____

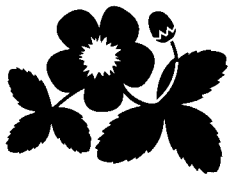
Mystery Plant #5

What are pedicels? _____

In what part of the world does this plant originate?

_____

Las Plantas Misteriosas



Llegue hasta la dirección electrónica del Laboratorio Nacional del Área Nacional Recreativa Golden Gate en la Internet: www.nps.gov/goga/park-labs. Localice la sección titulada ¿Puede USTED USAR una clave de plantas dicotómica?

A cada paso en una clave dicotómica se le pide que escoja entre _____ para la planta que usted está tratando de identificar.

Planta Misteriosa #1

¿Qué es una hoja simple? _____

¿Cuál es el nombre común de está planta? _____

Planta Misteriosa #2

¿Qué es una planta inflorescente? _____

¿Cuál es el nombre de esta planta en Latín? _____

Planta Misteriosa #3

¿Qué son rizomas? _____

Dibuje una ilustración de esta planta al dorso de esta página.

Planta Misteriosa #4

¿Qué son hojas disecadas o diseccionadas? _____

¿De qué familia es miembro esta planta? _____

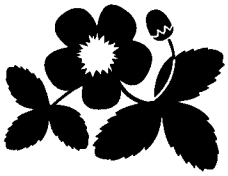
Planta Misteriosa #5

¿Qué es un pedúnculo? _____

¿En qué parte del mundo se origina esta planta?

_____

神秘植物記錄表



- 請造訪金門國家康樂區的國家公園實驗室網站：
  www.nps.gov/goga/parklabs.
- 找到標示“你能否使用一個二叉式植物檢索表？”(Can YOU Use a Dichotomous Plant Key) 的段落

在一個二叉式檢索表中，每個步驟會要求您在 _____ 兩者中選擇您想辨識的植物。

神秘植物一號

什麼是單葉？ _____

這種植物的俗名是什麼？ _____

神秘植物二號

什麼是花序？ _____

這種植物的拉丁名是什麼？ _____

神秘植物三號

什麼是根莖？ _____

在本頁背面繪出這種植物。

神秘植物四號

什麼是多裂葉？ _____

這種植物屬於哪一科？ _____

神秘植物五號

什麼是花梗？_____

這種植物原來產自世界上哪一個地區？

_____

O Invasive Plant Removal & Monitoring

SUMMARY
Students learn to compare the ecological roles of indigenous and exotic plant species in an ecosystem, and to assess the impact of removing invasive plants based on interdependencies within the system. They use math and estimation skills to complete GGNRA Work Performed Data Sheets and to estimate the total people-hours it will take to weed an area of the park. Students come to recognize the important role of volunteers in national parks.

TIME
2.5 hours
45 minutes for preparation

MATERIALS
- World map and dry-erase markers
- Restoration Cycle (visual aid)
- Photomonitoring example
- Weeding priority boards
- Clipboards
- Digital cameras and diskettes
- Small whiteboard & dry-erase marker
- Compasses
- Vegetation quadrat
- Gloves
- Picks
- Pencils
- Meter rollers
- Trash bags
- Plant species cards
- Journal entry questions
- Diagram of the photomonitoring points and a list of photo coordinates (NPS Natural Resources will provide)
- GGNRA Work Performed Data Sheet (NPS Natural Resources will provide master copies)

Program

Welcome - 10 minutes
Park staff welcome students back to the park. A few students share questions from their journals. (These questions are used as discussion topics during the station rotations.) The class discusses key concepts of invasive plants, quantitative monitoring, and qualitative monitoring. Students offer their ideas of what these concepts mean. Park staff use the restoration cycle visual aid to illustrate how today's projects relate to other work the students have done in the park.

Introduction - 15 minutes

Yurt

This activity serves as an "ice-breaker" and demonstrates the concept of interdependence. Park staff assign ecosystem "roles" to the students, either verbally or by handing out cards: bumblebee, yarrow, sand, carbon, rain, wind, gopher, poppy, sun, etc. Students announce their role and whether they are a biotic (living) or abiotic (non-living) part of the ecosystem. Park staff ask every other student in the circle to turn and face the outside (one staff member joins the students if there is an odd number). Students then become a yurt (a round, self-supporting structure) by holding hands or linking at the elbows, leaning back with their arms in front of them, and finding balance. The yurt illustrates the delicate balance in any ecosystem.

Park staff take the role of invasive species, attempting to break the balance of the ecosystem by pulling the students' hands apart. Some sections stick together and others split apart, but the overall balance of the structure is broken. Students discuss the interdependence of the biotic and abiotic elements of an ecosystem, and how invasive plants affect the interdependencies. Can a yurt support itself in two or more separate pieces? How was the yurt affected when the interdependencies were broken? How is this a model of nature? How do invasive plants affect an ecosystem?

Map

Park staff divide the students into 6 groups. Each group receives a plant species card. Each group studies its card and determines if its plant should be removed from the restoration area. The group creates an argument for or against the plant species being removed. Groups present their arguments to the class. During the presentations students show where their plant is from using the world map and dry-erase markers. Note that many invasive plants come from places with climates similar to California's.

Discussion questions:

- How did invasive plants get to California?
- Is it possible for California native plants to grow invasively?
- Under what circumstances?

Stations - 25 minutes each station x 4 stations = 2 hours

Students cycle through 4 stations with nursery staff (see station instructions below).

Conclusion - 10 minutes

Students gather in a large group. Park staff thank the class for their hard work and explain the importance of volunteers working on restoration projects in GGNRA.

Students are a part of a community of people from around the world who have contributed to habitat restoration in the park. Humans are a part of the complex system of interdependencies of the natural world.

Journal
Students complete the questions as homework or in class.

Station Guidelines

STATION 1 - VEGETATION MONITORING

Procedures:

- Park staff introduce the station by discussing the fragility of an ecosystem and the effects of human impact on it. Park staff ask the students to think about the background reading that explained different types of monitoring. How might the quadrat be used for monitoring? Do you think it is for qualitative or quantitative monitoring? (Quantitative)

- Park staff hand out a quantitative monitoring log to each student.

- A student tosses the quadrat into the area to be monitored.

- The group counts the number of different species growing within the quadrat. Using the plant key and the visual aids, students identify the species and determine if they are indigenous or exotic. Students agree on an estimation of the percent of the quadrat area that each species covers. If the students have difficulty estimating percent cover, they may draw some examples on the whiteboard (a pie chart of 50 percent, 30 percent, 10 percent, etc.).

- One student records on the whiteboard the numbers and percentages that are found.

- Students toss the quadrat and repeat the data gathering process at least three times.

- Some questions for discussion:

Is it better to have some bare ground or total plant cover inside the quadrat? (Bare areas can be a natural part of a healthy, evolving system. The soil is an abiotic component of the ecosystem; the plants and the soil are interdependent.) What is monoculture? Have we found any monocultures within the quadrat? Is an ecosystem with a

monoculture or a high diversity of plants healthier? Why? What can you predict about insect and animal populations from the information regarding plant cover? How many quadrats would you have to analyze to get a good representation of the restoration site as a whole?

STATION 2 - PHOTOMONITORING

Procedures:

- Park staff familiarize the students with proper compass use. If there are students who have used a compass before, they should help their classmates who are less familiar with it. The students can begin by learning to face north. Students line up the "N" on the dial of the compass with the black arrow (called the "travel" or "directional" arrow) on the face of the compass. Holding the compass flat and with the directional arrow pointing in front of them, the students spin slowly around until the red end of the suspended needle falls within the red outline of an arrow. (This is called "putting the red in the shed.") Once the red is in the shed, they are facing north.

- Park staff demonstrate the use of the digital camera. Students are warned not to drop the camera as it is very fragile and will break if dropped. (It is best for them to put the strap around their necks when they are using it.)

- One student uses the diagram with the monitoring points to lead the group to the first monitoring point.

- A second student uses the compass and the list of photo coordinates to line up the angle for the first photo.

- A third student takes the photograph and a fourth student completes the photomonitoring log.

- The remaining students are responsible for agreeing on the angle for each photo, guiding the photographer, and collaborating on the correct information for the photomonitoring log.

- Students repeat the photomonitoring for all the monitoring points and coordinates, shifting responsibilities for each photo.

- Some questions for discussion:

Why are the photographs taken from these positions? (What is the logic behind the positioning? What features are included/excluded from the photos?) What can you predict about insect and animal populations from the information you are gathering regarding the appearance of the restoration site? How many years' worth of photos are necessary to get a good picture of any trends in the restoration site? Are there any drawbacks to photomonitoring? (Varying quality of photos, inexact angles, photos taken at different times of day/year.) What are some ways that photomonitoring benefits a restoration project? (Brings restoration to life for interested parties: new employees, funders, people who cannot see the project in-person).

STATION 3 & 4 - INVASIVE PLANT REMOVAL

Procedures:

- Park staff show students the boundaries of the weeding area, and an example of the invasive species to be removed. They point out any indigenous plants in the area that are endangered or especially delicate; removal of invasive species in the field is important but students must still remember to preserve the indigenous plants in the area. Students will be more likely to move carefully through plant habitat and remove invasive plants conscientiously if they have some understanding of the importance and fragility of the indigenous plants in the area.

- Before weeding, park staff give a careful safety demonstration with any tools that the group will use. Tools will be collected from any student who is using them in a way that endangers him/herself, other students, or staff. Students who are not using picks or weed wrenches safely can help weed by hand or take responsibility for bagging weeds and consolidating piles.

- Some discussion questions for the weeding stations:

What do you predict will happen in this ecosystem now that the invasive plants are removed? Can you describe the interactions between the indigenous plants and the invasive plants? (The invasive plants crowd the native plants, limit their growth and sometimes kill them.) Is it better to remove the roots of one plant or pull the top off of ten plants? (Remove the roots.) Has this species gone to seed? (If so, ensure that the seeds are being piled up with the weeds, not spread around the site.) Have you seen any of these plants before?

- When weeding is complete, students discuss the importance of keeping accurate records of work that was accomplished. Students should complete the GGNRA Work Performed Data Sheet.

- During the last five minutes of the station, students work together on the math problem described below.

Group Math Problem:
Park staff pose the following question and ask students what information they need to find the answer. As they call out the information they need (size of area weeded today, number of students weeding, etc.), a volunteer writes the information on the whiteboard. If necessary, the group can draw a diagram. Students create an equation to calculate the answer (the equation should come from the students, NOT from the park staff).

Question: You are the natural resources manager for a large park. You and your team have determined that invasive plants are severely disrupting the ecosystem of a 25-acre area of the park. You need to recruit volunteers and plan work days to accomplish the enormous task of removing the invasive plants. Based on your experience today, how many people-hours (1 person doing 1 hour of work) do you estimate will be required to accomplish the weeding?

Sample Problem-solving Method: (Students may reach the answer in a variety of ways; park staff will let them follow their instincts.)

Determine the area of the site the group weeded today by multiplying the length times the width. (The students should measure the length and width with the meter wheel.) For example, if width is 40 meters and length is 30 meters, area equals 40 meters x 30 meters = 1,200 square meters.

Convert the area of the site from square meters into acres (4,047 square meters = 1 acre). For example, let Y equal the area of the site in acres:

4047 sq. meters ÷ 1200 sq. meters = 1 acre ÷ Y acres

4047 x Y = 1 x 1200

Y = 1200÷4047

Y = .3 acre

Calculate the number of people hours it took to weed the site today.
For example, 12 students x .3 hours (20 minutes) = 4 people-hours

Calculate the number of people hours for the 25-acre site. It took 4 people-hours to weed .3 acres; how many people hours will it take to weed 25-acres. Let Z equal the number of people hours required to weed all 25 acres.

Z people-hours ÷ 4 people-hours = 25 acres ÷ .3 acres

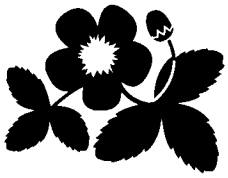
Z ÷ 4 = 83.33

Z = 83.33 x 4

Z = 333.2 people hours

Solution: 333.2 people-hours will be required to get all the weeding done (33 volunteers who each work a little over 10 hours).

Invasive Plant Removal & Monitoring



Journal Entry

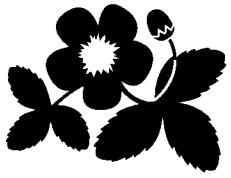
1. Why do we remove invasive plants?

2. What would happen to this ecosystem if we left the invasive plants alone? Do you think we are interfering with nature? Why or why not?

3. Predict the impact of the work you did in the park today. How have you changed the park? Is this a lasting change? What do you predict will happen next year?

4. What question do you have about the work you and your class did today?

Remoción y Monitoreo de Planyas Invasoras



Preguntas para el Diario

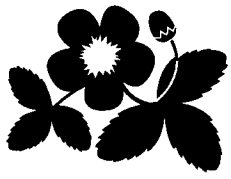
1. ¿Por qué removemos las plantas invasoras?

2. ¿Qué le ocurrirá a este ecosistema si no tocamos las plantas invasoras? ¿Cree usted que estamos interfiriendo con la naturaleza? ¿Por qué sí, o por qué no?

3. Prediga el impacto que su trabajo tuvo en el parque el día de hoy. ¿Cómo ha cambiado usted el parque? ¿Será duradero este cambio? ¿Cuál es su predicción sobre lo que ocurrirá el año próximo?

4. ¿Cuáles preguntas tiene usted sobre el trabajo que realizaron usted y su clase?

侵佔性植物的清除和監視



日誌項目

1. 我們為什麼要清除侵佔性的植物？

2. 如果我們不清除這些侵佔性的植物，這個生態系統會發生什麼？你認為我們在干擾大自然嗎？為什麼？為什麼不？

3. 預測你今天在公園內所做的工作會產生什麼作用。你如何改變了公園？這是一個永久性的改變嗎？你能預測明年會發生什麼事嗎？

4. 你對自己和同學今天所做的工作有什麼問題？

Community Forum Role Play: The Case of the Vacant Lot

SUMMARY

Students participate in a debate regarding the fate of a fictional vacant lot in the neighborhood of their school. They come to understand many different players and views, and the Environmental Justice issues that need to be resolved for successful planning. Through role-play, students work as a team to design a plan that meets the needs of a diverse community.

TIME

50 minutes
30 minutes for preparation

MATERIALS

- The Case of the Vacant Lot
- Role cards
- Laminated site maps
- Dry-erase markers
- Journal entry

Lesson

Welcome - 5 minutes

Park staff remind the students that they have been studying environmental issues in GGNRA, a national park. There are similar environmental issues within the city, and in even in the students' neighborhoods. Today's activity will help them understand the complexity of open-space planning in a city environment.

Introduction - 5 minutes

Two students introduce the class to the day's activity. The students read aloud The Case of the Vacant Lot that describes a fictional but realistic scenario set in the neighborhood of their high school. The scenario involves a vacant lot for which four competing projects have been proposed. The volunteers read summaries of each competing project. After hearing about the competing projects, the class votes for their favorite option.

Group Work - 15 minutes

- Park staff explain to the students that they will now be asked to view the four proposals from someone else's perspective.

- The class divides into groups of 4 or 5 students. Each group receives a laminated site map, dry-erase markers, and role cards representing stakeholders in the vacant lot project.

- The role cards should be distributed carefully so that each group contains students representing a variety of roles.

- Students read their role card aloud to the rest of their group.

- Each group formulates a plan for the site that is acceptable to all the stakeholders in their group. The plan may or may not contain elements of the original four proposals.

- If the groups have trouble moving the discussion forward, park staff can assign any of the following responsibilities to group members: Leader, Scribe, Vote Manager, Plan Designer, Presenter.

Presentations - 15 minutes

Student groups describe which stakeholders were represented in their groups and present their final project plan to the rest of the class.

Discussion - 10 minutes

The class discusses the following two principles of Environmental Justice and how those principles relate to urban planning:

> *Environmental Justice calls for universal protection from nuclear testing, and extraction, production and disposal of toxic/hazardous wastes and poisons that threaten the fundamental right to clean air, land, water, and food.*
>
> Points for discussion: The creation of new jobs for the community must be weighed against the possible danger of pollution from the paper recycling plant; how do economic factors effect the location of businesses that create pollution?

Environmental Justice demands the right to participate as equal partners at every level of decision making, including needs assessment, planning, implementation, enforcement, and evaluation.

Points for discussion: Do all stakeholders have their voices heard? What causes some voices to be heard over others? What can be done to create more equity in the urban planning process?

Recall the Top Ten Environmental Rights lesson; how do the students' plans for the vacant lot support their list of Top Ten Environmental Rights?

Journal

Students complete journal entry as homework.

The Case of the Vacant Lot

Background Information

SCENARIO:
Money has been allotted by the local government to begin work on the rehabilitation of an empty two-acre demolition site in our neighborhood. We are asking you, the local residents, to listen closely to the following four project proposals and vote on the proposal that you think will be the most valuable addition to the neighborhood.

Community Recreation Center
With basketball courts, tennis courts, and a large conference room, this facility will provide a place for young people to spend time after school and for our local community groups to hold meetings, dances, and other large events.

Native Plant Restoration Project
This project will bring people from the community together to return a small part of the area to what it was before the urban development of San Francisco. Young and old people will learn about our local natural history while they beautify a corner of our neighborhood.

Paper Recycling Plant
Our neighborhood needs stronger recycling programs and more new jobs. A new paper recycling plant would provide both. Selling the land to a recycling corporation would bring money into the local economy and hundreds of our unemployed residents would have new, good-paying jobs available to them.

Health Clinic
A new health clinic would bring low-cost medical care to our community. Services would include immunizations, prenatal care, private counseling, parenting courses, dental care, pregnancy testing, and STD prevention programs.

PLEASE VOTE FOR THE PROJECT THAT YOU THINK WOULD MOST BENEFIT OUR COMMUNITY.

El Caso del Lote(Solar) Vacío

Trasfondo

ESCENARIO: El gobierno local ha asignado dinero para comenzar el trabajo de rehabilitar un solar de dos acres de nuestro vecindario, que ha sido demolido. Le estamos pidiendo a ustedes, los residentes locales, que consideren cuidadosamente las cuatro siguientes propuestas para proyectos, y que voten por la propuesta que ustedes piensan será la aportación más valiosa a la comunidad.

Centro de Recreación Comunitario Con canchas de baloncesto, tenis, y una amplia sala de conferencias, estas instalaciones proveerán un lugar para que la gente joven pase el tiempo después de la escuela y para que grupos locales celebren sus reuniones, bailes y otros eventos grandes.

Proyecto de Restauración de Plantas Nativas Este proyecto reunirá a la gente de la comunidad para restablecer un área pequeña a cómo era antes del desarrollo urbano en San Francisco. Los jóvenes y los mayores aprenderán acerca de nuestra historia natural local a la vez que una esquina de nuestro vecindario será embellecida.

Planta de Reciclar Papel Nuestra comunidad necesita programas de reciclaje más efectivos y más empleos. Una nueva planta de reciclaje proveería ambas cosas. La venta del solar a una compañía de reciclaje le traería dinero a la economía local y cientos de nuestros residentes, que están desempleados, obtendrían trabajos buenos y bien pagados.

Clínica de Salud Una nueva clínica de salud le ofrecería servicios médicos a costo moderado a nuestra comunidad. Dichos servicios incluyen vacunación, cuidado pre-natal, consejería privada, educación a los padres, cuidado dental, pruebas de embarazo y programas de prevención de enfermedades trasmitidas sexualmente (STD).

POR FAVOR VOTE POR EL PROYECTO QUE USTED CONSIDERA MÁS BENEFICIOSO PARA NUESTRA COMUNIDAD.

空地利用的個案討論

背景資料

情況：

當地政府已撥款，打算在我們附近的一塊兩英畝建築物業已拆毀的空地上開始改造工作。我們現在請身為當地居民的您，仔細聽取下面的四個計劃方案，並選出你認為對鄰里社區最有價值的方案。

社區康樂中心

這個設施內備有籃球場、網球場和一個大型會議室，可以提供年輕人下課後的正當去處，同時提供當地社區團體用以集會、舉辦舞會和其他大型活動的場所。

本地植物重建計劃

這個計劃將結合社區群眾，將這一小塊地區恢復三藩市開發之前的原有風貌。無論男女老少，在合力美化我們的鄰里之餘，還可以附帶瞭解本地的自然歷史。

廢紙回收廠

我們的社區需要更有效的回收計劃和更多的就業機會。新的廢紙回收廠是雙管齊下的解決方案。把土地賣給回收公司，可以為本地的經濟帶來足夠的財力，而我們數以百計的失業居民也能找到待遇良好的新工作。

衛生所

一家新的衛生所可以為我們的社區提供廉價的醫療服務。這些服務包括預防接種、產前檢查、私人諮詢、準父母課程、牙齒保健、孕期檢驗和性病防治計劃等。

請投票選擇你認為最能造福我們的社區的計劃。

The Case of the Vacant Lot

Stakeholder Role Cards

THE PLAYERS:

The Environmental Action Team

You are the Director of a small non-profit agency located in San Francisco. Although you have only four staff people and fifty members, you are well respected by the community. You oppose the recycling plant because you feel that the city already has far too many industrial sites, and the high rate of diseases like emphysema and asthma in your neighborhood may be linked to industrial pollution. The new plant would create jobs for many unemployed, but you feel residents should not have to sacrifice the community's health for jobs.

The Mayor's Office

You are the Representative of the Mayor's Office. From your viewpoint, the restoration project will do very little for the local economy and for the residents as a whole. You support any plan to bring jobs to the city's neighborhoods and would like to boast about how San Francisco is the nation's champion recycling city. The recycling company is a very wealthy corporation that could bring valuable tax dollars to San Francisco.

Police Officer

You support the Community Center and Recreation Area. You believe that youth violence can be curbed if the community would put more resources toward giving young people healthy recreational opportunities. If the recreation center is built, you intend to start a midnight basketball league to help keep youth off the streets at night.

The Solid Waste Management Program

As the Director of the Solid Waste Management Program, your job is to reduce the amount of solid waste produced by San Francisco. You would like to see the recycling plant built because without it, there is no way San Francisco will reduce its waste 50 percent by a mandated target date. Your program's reputation and funding depend on meeting this goal.

Dog Owner
You walk your dog every day in the neighborhood and would like a place for your dog to run. There are very few areas in this city where dogs are permitted to run freely without a leash. Dog walking provides exercise for you and your dog, and you know many elderly people whose only exercise is walking their dog. You will support the native plant restoration area if it includes an area for dogs to run off-leash, however, you prefer that the entire site be made into a dog park.

Historian & Director of the Center for Indian Culture
You are aware of the Ohlone Indian heritage that has all but disappeared in the Bay Area, and you feel that the indigenous plant restoration project would pay tribute to a neglected part of local history. Native plants that were an important part of the indigenous culture of the area could be grown in the restoration area, and people could learn about their traditional uses. You would also like to see some archeological work done at the site, with hopes of finding some sacred artifacts and remnants of the seasonal camps of the Ohlone.

Wheelchair User
You are an outdoorsperson who uses a wheelchair. You love to visit San Francisco's natural areas, but many of them are not wheelchair accessible because they do not contain paved pathways. You would like to be close to nature. You support the Native Plant Restoration Project if it is accessible to wheelchair users.

UC Berkeley Ecologist
You support the Native Habitat Restoration Project. You are aware of the dwindling habitat for indigenous plants and wildlife. Even though the proposed site is extremely small, it will be an important educational tool to help the public understand the significance of genetic and plant diversity and the delicate balance of nature that must be restored for the health of all living things.

The Eco Club President
You are the President of a nationwide environmental organization. You have over 150,000 members across the country and an operating budget of $75 million. Your headquarters is in San Francisco but you

live in Marin County. You recognize the need for increased paper recycling services in the Bay Area. Paper recycling saves natural resources and keeps landfills from filling up.

Parent

You are the parent of three children. Your family does not own a car, therefore, services in other parts of the city are difficult for you to reach. You would support either the health clinic or the recreation center. You know that your children would benefit from either project.

Health Care Professional

You support the Health Clinic. Every day at the hospital across town where you work, you see people from your community being treated for problems that could be avoided if they had better access to health care. Immunizations, well-baby check-ups, and prenatal care at the new clinic would be far less expensive than treating the problems that result when people do not have access to this type of care. You know that many people in the community do not have cars and getting to health clinics and hospitals in other areas of the city is very difficult for them.

Citizens for Economic Development

You are the head of a group of unemployed residents trying to bring new jobs and steady paychecks into the community. Your community has suffered from poverty for too long, and it needs new businesses to bring economic life back into the area. The Community Recreation Center would employ some people but at relatively low wages. The heath clinic would employ mostly skilled healthcare workers. You support the recycling plant because it would employ many local jobless people at livable wages.

Local High School Student

You are a local high school student. You came to the meeting today because you are interested in the future of your neighborhood. You are willing to listen to all the alternatives with an open mind and then give your opinion about how the vacant lot should be used.

El Caso del Lote (Solar) Vacío

Tarjetas de Roles de los Promovientes

LOS ACTORES:

El Equipo de Acción Ambiental Usted es el director de una pequeña agencia sin fines de lucro en San Francisco. Aunque usted solamente tiene cuatro empleados y 50 miembros, la comunidad respeta mucho su agencia. Usted se opone al proyecto de reciclaje porque considera que la ciudad ya tiene demasiados espacios industriales y la alta tasa de enfermedades en su comunidad, como la enfisema y el asma pueden estar relacionadas con la contaminación industrial. La nueva planta crearía empleos para muchos desempleados pero usted cree que los residentes no deben sacrificar la salud de la comunidad a cambio de trabajos.

La Oficina del Alcalde Usted es un Representante de la Oficina del Alcalde. Su opinión es que el proyecto de restauración no contribuirá mucho a la economía local y no hará mucho por los residentes en términos generales. Usted apoya cualquier plan que traiga empleos a las comunidades de la ciudad y le gustaría promover el orgullo de que San Francisco es la primera en la nación entre las ciudades que reciclan. La compañía de reciclaje es muy rica y podría traer muchos dólares de los contribuyentes a San Francisco.

Oficial de la Policía Usted apoya el Centro Comunitario y el Área Recreativa. Usted cree que la violencia juvenil puede reducirse si la comunidad invierte más recursos para proveerle a los jóvenes oportunidades recreativas saludables. Si se construye el centro recreativo usted está dispuesto a iniciar un liga de baloncesto nocturno para ayudar a sacar la juventud de la calle durante la noche.

Programa para el Manejo de Desperdicio Sólidos Como Director del Programa para el Manejo de Desperdicio Sólidos su trabajo es reducir la cantidad de desperdicios sólidos producidos por San Francisco. A usted le gustaría que se construyera la planta de reciclaje porque sin ésta no hay manera que San Francisco pueda reducir sus desperdicios un 50 por ciento antes de la fecha ordenada legalmente. La reputación

y los fondos de sus programa dependen de que se logre esta meta.

Dueño de Perro Usted pasea su perro todos los días por el vecindario y le gustaría tener un lugar donde su perro pueda correr. Hay muy pocas áreas en la ciudad donde se permite a los perros correr libremente sin cadena. Pasear al perro hace que usted y su perro hagan ejercicio y usted conoce mucha gente mayor cuyo único ejercicio es pasear a sus perros. Usted apoya la restauración del área de plantas nativas si incluye un área para que los perros corran libremente, sin embargo usted preferiría que toda el área fuera usada como parque para perros.

Historiador y Director del Centro de Cultura de Indios Americanos Usted está consciente de que el patrimonio de los Indios Ohlone casi ha desparecido del Área de la Bahía, y usted piensa que el proyecto de restauración de plantas indígenas sería un justo tributo a una parte olvidada de la historia local. Plantas nativas que fueron parte importante de las culturas indígenas del área podrán ser cultivadas en el área de restauración y la gente podría aprender acerca de sus usos tradicionales. A usted le gustaría también ver que se haga algún trabajo arqueológico en el lugar, con la esperanza de hallar algunos objetos sagrados y residuos de los campamentos temporeros de los Ohlone.

Usuario de Silla de Ruedas Usted es una persona que está en silla de ruedas pero disfruta del aire libre. Le encanta visitar las áreas naturales de San Francisco pero muchas de estas no pueden acomodar sillas de rueda porque no tienen veredas pavimentadas. A usted le gustaría estar cerca de la naturaleza. Usted apoyó el Proyecto de Restauración de Plantas Nativas si lo hacen accesible a personas en sillas de rueda.

Ecólogo de la Universidad de Berkeley Usted apoya el Proyecto de Restauración de Plantas Nativas. Usted está consciente de cómo va reduciéndose el hábitat de plantas indígenas y vida silvestre. Aunque el lugar propuesto es muy pequeño, el mismo sería un importante recurso educativo para ayudar al público a entender el significado de la diversidad vegetal y genética y el delicado balance de la naturaleza que debe ser restablecido para la salud todas las cosas vivientes.

El Presidente del Club Ecológico Usted es el Presidente de una organización ambiental nacional que tienen más de 150,000 miembros por

todo el país, y opera con un presupuesto de $75 millones. Sus oficinas principales están en San Francisco pero usted vive en el Condado de Marín. Usted reconoce la necesidad de más servicios de reciclaje de papel en el área de la Bahía. El reciclaje de papel conserva los recursos naturales y evita que se llenen los basureros.

Padre Usted es el padre de tres chicos. Su familia no tiene automóvil por lo que le resulta difícil llegar a otras parte de la ciudad para obtener algunos servicios. Usted apoyaría la clínica de salud al igual que el centro recreativo. Usted sabe que sus hijos se beneficiarían de cualquiera de estos proyectos.

Profesional de Servicios de Salud Usted apoya la clínica de salud. Todos los días, en el hospital que queda al otro extremo de la ciudad, usted ve gente de su comunidad recibiendo tratamiento para problemas que podrían prevenirse si hubiese mayor acceso a servicios médicos. En la nueva clínica el costo de servicios como vacunas, cuidado médico infantil y pre-natal sería menor que atender problemas causados porque la gente no tiene acceso a este tipo de servicios. Usted sabe que mucha gente de la comunidad no posee automóvil y les resulta muy difícil llegar a clínicas de salud y hospitales que están en otras áreas de la ciudad.

Ciudadanos en pro del Desarrollo Económico Usted encabeza un grupo de residentes desempleados que están tratando de traer nuevos empleos y salarios estables a la comunidad. Su comunidad ha sufrido la pobreza por mucho tiempo y necesita nuevos negocios para recobrar la vitalidad económica del área. El Centro de Recreación Comunitario emplearía algunas personas pero con salarios bajos. La clínica de salud le daría empleos principalmente a trabajadores de la salud diestros. Usted apoya la planta de reciclaje porque emplearía más de la gente desempleada y con mejores sueldos.

Estudiante de Escuela Superior de la localidad Usted es un estudiante local de escuela superior. Usted vino a la reunión hoy porque está interesado en el futuro de su vecindario. Usted está dispuesto a considerar todas las alternativas con una mente abierta para entonces dar su opinión sobre cómo debe de utilizarse el solar vacío.

空地利用的個案討論

利益相關者意願卡

參與者：

環保人士

你是三藩市當地一家小型非營利機構的主任。雖然你只有四名僱員和五十位會員，在本社區你是一位得高望重的人物。你反對建造回收廠，因為你認為三藩市已經有太多的工業區，而且工業污染疑似造成當地如肺氣腫和氣喘等高患病率的主因。新的工廠固然可以為很多失業的人創造新工作，但你認為居民不該為了工作而犧牲掉社區人的健康。

市長辦公室

你身為市長辦公室的代表。就你的個人觀點而言，重建計劃對當地經濟以及整體居民來說助益不大。但你支持任何能為三藩市創造工作機會的計劃，並想宣傳三藩市如何成為全個的冠軍回收市。回收公司財源豐富，可以為三藩市帶進數量可觀的稅金。

警員

你支持社區活動中心和康樂區。你相信如果社區把資源放在提供給年輕人更多的康樂機會，就可防治年輕人的暴力犯罪。如果要籌建一個康樂中心，你打算組織一個午夜籃球隊，好讓年輕人夜晚不在街上遊蕩。

固體廢物管理計劃

身為固體廢物管理計劃的主任，你的職責是減少三藩市製造的固體廢棄物。你希望見到回收廠的順利建造，因為若沒有它，三藩市不可能在規定的期限之內把廢棄物的量減少百分之五十。你的計劃是否獲得迴響和金錢上的資助，全靠它是否能達成預期的目標。

寵物狗主人

你每天在附近遛狗，希望你的狗有一個自由奔跑的地方。三藩市大部份的地方都不准把狗鍊子拿掉。遛狗對你本身還有你的狗都是很好的運動，你也認識很多老年人，他

們唯一的運動就是遛狗。如果本地植物的重建區計劃包含一個讓狗自由走動的特區，你就會支持這項計劃。不過，你希望把這一整片地都變成一座遛狗公園。

歷史學家和印第安文化中心主任

你發覺 Ohlone印第安人的傳統幾乎在灣區銷聲匿跡。你認為本地植物重建計劃將可對當地歷史不受重視的一面有所貢獻。重建區應該培育佔當地文化很重要一部份的本地植物，讓人們明白這些植物的傳統用途。你也希望見到設立一些古代文物的陳列所，供人鑑賞 Ohlone人隨著季節而遷移的營地中所用的宗教儀式工藝品和遺物。

輪椅殘障人士

你是一位愛好戶外活動的殘障人士，靠輪椅行動。你喜歡遊訪三藩市的自然區，但是很多地方都不適合座輪椅的人進出，因為沒有鋪設輪椅專用步道。你希望接近大自然。如果本地植物重建計劃可以提供坐輪椅的殘障人士更多便利的設施，你就會支持它。

柏克萊大學生態學家

你支持本地重建棲息生態專案。你發覺本地植物和野生物的棲息地面積逐漸減小。即使提案中的重建區並不大，它仍然能夠起到很重要的教育作用，幫助大眾瞭解遺傳和植物多元化，及為了所有生物的健康著想，我們必須恢復人類與自然之間的微妙平衡的重要性。

生態保育俱樂部主席

你是一個全國性的環保組織的主席。你在全國各地擁有超過十五萬名會員，以及美金七千五百萬推行環保工作的預算。你們的總部設在三藩市，但是你住在馬連縣。你認為灣區有必要加強廢紙回收的服務。廢紙回收可以節省自然資源，免得垃圾場的垃圾堆積如山，造成垃圾無處可去。

家長

你是三名子女的家長。你們家不開車，因此，你很難享用三藩市其他地區的服務。你會支持蓋衛生所或康樂中心。你知道子女會因任一設施的設立而受益。

健保專業人士

你支持衛生所。你每天在本市另一頭的醫院裡工作，都能看到你社區裡的人前往就醫。但是，如果附近有方便的醫療服務，就能避免大老遠跑去醫院看病的麻煩。在新診所接受預防接種、寶寶健康檢查和產前檢查，要比沒有這種醫療服務而要到他處就醫便宜得多。你知道社區裡的很多人都沒有車，要到市內其他地區的診所或醫院看病並非易事。

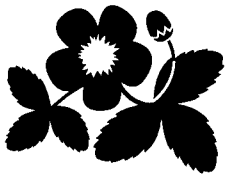
主張經濟發展的市民

你是一群失業居民團體的領袖，企圖為社區創造新的工作機會和穩定的收入。你的社區長久以來一直受到貧窮的困擾，需要靠新的商業活動把經濟活力帶回此地。社區康樂中心會雇用一部份人，但薪資並不高。而衛生所雇用的大部份都是訓練有素的醫護人員。你支持回收廠的計劃，因為它將以足夠養家活口的報酬，雇用很多當地的失業人士。

本地中學生

你是一名本地的中學生。你今天來參加這個會議，是因為你很關心社區的未來。你願意抱持客觀的心態來聽取所有改善本社區的可能方案，然後提出你個人利用這塊空地的意見。

The Case of the Vacant Lot



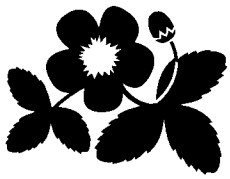
Journal Entry

1. Explain your personal point of view on The Case of the Vacant Lot.

2. How does your personal view address principles of Environmental Justice?

3. What question do you have about city planning in regards to open space?

El Caso del Lote (Solar) Vacío



Notas para el Diario

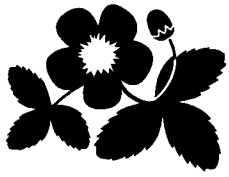
1. Explique su punto de vista personal sobre El Caso del Lote (Solar) Vacío.

2. ¿Cuál es visión personal acerca de los principios de Justicia Ambiental?

3. ¿Qué preguntas tiene usted sobre cómo se relaciona la planificación en la ciudad con los espacios abiertos?

空地利用的個案討論

日誌項目



1. 解釋你個人就空地利用個案的觀點。

2. 你的個人觀點如何符合環境正義原則的要求？

3. 你對於有關空地的都市規劃有什麼問題？

Habitat Restoration Around the World

SUMMARY
Students are introduced to habitat restoration projects around the world. They compare these projects with each other, and with the restoration projects in the Golden Gate National Recreation Area.

TIME
50 minutes
30 minutes for preparation

MATERIALS
- Four articles on restoration projects (These can be found using a simple Internet search)
- Discussion questions

Lesson

Introduction - 5 minutes
Teacher explains to the class that the park restoration project they have been working on fits into a much larger picture of restoration projects worldwide. Today students will learn about some other restoration projects and have a chance to compare them to Golden Gate National Recreation Area's restoration project. Each student is given one of the four articles on restoration projects.

Reading - 5 minutes
Students read their articles.

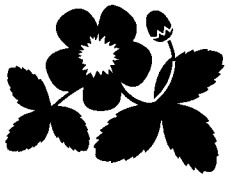
Group Work - 15 minutes
- After reading the articles, students divide into groups by article.
- In their groups, students discuss their article and answer questions 1 to 7.

Group Work - 15 minutes
- Students "jigsaw": Form new groups of 4 in which one representative from each of the original groups is present in the new group.
- In the new groups, students present the restoration project they read about.
- Students answer questions 8 to 10.

Discusion - 10 minutes

- Student regroup into a single unit.
- They discuss the purpose of restoration. In Golden Gate National Recreation Area, the goal of restoration is to increase plant and animal diversity. Is this a valid goal? How does it compare to the goals of the other restoration projects?
- Considering other environmental problems, how important is restoration?
- Who benefits from restoration of natural areas?

Restoration Around the World



Discussion Questions

TO BE DISCUSSED IN FIRST GROUP:

1. What is the goal of this restoration project?

2. Who or what will benefit from this project, if successful?

3. Does this project benefit people of all economic classes? Why or why not?

4. Who is sponsoring or funding this restoration work?

5. Does this project show collaboration between interest groups or is it a one-sided effort?

6. Who might be against this project? Who or what does it affect negatively?

7. What is your opinion of this project?

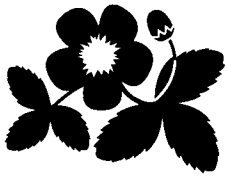
TO BE DISCUSSED IN SECOND GROUP:

8. Do you think one of these projects is more important or valuable than another?

9. If you had to choose only two of the four projects, which two would you choose? Why?

10. Compare these projects to the restoration project you have been working on in the Golden Gate National Recreation Area. Which is more valuable? Why?

La Restauración en el Mundo



Preguntas sobre Opiniones

PARA SER CONTESTADAS POR EL PRIMER GRUPO:

1. ¿Cuál es la meta de este proyecto de restauración?

2. ¿Quiénes o qué ha de beneficiarse por este proyecto, de tener éxito?

3. ¿Beneficia este proyecto a personas de todas las clases sociales? ¿Por qué sí o por qué no?

4. ¿Quién está patrocinando o proveyendo fondos para este trabajo de restauración?

5. ¿Demuestra este proyecto que existe colaboración entre grupos de interés, o es un esfuerzo de algunos solamente?

6. ¿Quién querría oponerse a este proyecto? ¿A quiénes o a qué afecta este negativamente?

7. ¿Cuál es su opinión sobre este proyecto?

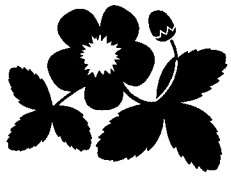
PARA SER CONTESTADAS POR EL SEGUNDO GRUPO:

8. ¿Piensa usted que uno de estos proyectos es más importante o más valioso que los otros?

9. ¿Si tuviera usted que seleccionar dos de los cuatro proyectos, cuáles escogería usted? ¿Por qué?

10. Compare estos proyectos con el proyecto de restauración en el cuál usted ha estado trabajando en el Área Nacional Recreativa Golden Gate. ¿Cuál es más valioso? ¿Por qué?

全球各地的重建工作



討論問題

第一組討論內容：

1. 這項重建計劃目的何在？

2. 如果這項計劃成功，受益者會是什麼（人）？

3. 這項計劃是否造福所有經濟階層的人？為什麼？為什麼不？

4. 誰在贊助或資助這項重建工作？

5. 這項計劃是否展現了利益團體間的合作或只是單方面的努力？

6. 誰可能反對這項計劃？它會對誰或什麼帶來負面影響？

7. 你對這項計劃有何意見？

第二組討論內容：

8. 你是否認為這些方案中，有一個計劃比其餘的計劃重要或有意義？

9. 如果你只能選擇四個方案中的兩個，你會選擇哪兩個？為什麼？

10. 比較這些計劃與你在金門國家康樂區所參與的重建計劃。哪一個比較有意義？ 為什麼？

Rubric
Invasive Plant Removal & Monitoring

Science (Interdependence)

Needs Improvement: Students do not understand the interrelationship of biotic and abiotic elements of the environment.

Good: Students grasp the complexity of an ecosystem's web of life but do not fully understand their own impact on that ecosystem.

Excellent: Students grasp the complexity of an ecosystem's web of life and show a clear awareness of their own impact on that ecosystem.

Math (Person-hours)

Needs Improvement: Students cannot estimate the number of people-hours it will take to complete a project without extensive help from the facilitator.

Good: Students can estimate the number of people-hours it will take to complete a project but need prompting from the facilitator.

Excellent: Students can estimate the number of people-hours it will take to complete a project with no help from the facilitator.

Environmental Justice (Equal access)

Needs Improvement: In planning activity, students do not attempt to include others' views and do not attempt to see issue from other points of view.

Good: In planning activity, students are aware of the importance of including many voices in planning a public space.

Excellent: Students are able to see more than one side of the issue and attempt to compromise between as many different interests as possible.

Life Skills (Cooperative Learning)

Needs Improvement: Students show incomplete interaction, often ignore comments, group efforts are easily sidetracked, some members uninvolved in group.

Good: More than half the members are actively involved, rarely are comments ignored, rarely stray from topic.

Excellent: All students participate equally, actively listen to one another, show respect for ideas, stay on task.

Planting

SUMMARY OF INSTRUCTIONAL ACTIVITIES

Plant Structure & Adaptation - page 5

- Students locate and study a flowering plant on their school grounds.
- Students describe the plant and label the parts of the plant.
- Students discuss pollination and plant adaptation.
- Students use the Plant Guide on the National Park Labs. web site to categorize plants by adaptation or structures.

Planting - page 10

- Students examine and describe for other students the adaptations of various indigenous plants.
- Students participate in the restoration of an area by planting native plants.
- Students write a journal entry comparing characteristics of two more native plant species. (integrated assessment)

Plant Quilt - page 16

- Students use the Plant Guide on the National Park Labs web site and additional resources to create a multicultural depiction of plants and plant uses.

Creating a Community Garden - page 18

- Students choose and measure an area of their school grounds as a proposed site for a community garden.
- Students consider who will have access to the garden and who will take responsibility for its day-to-day upkeep; determine the number, type, and placement of plants; propose funding sources.
- Students write a detailed proposal to create this garden and submit the proposal to their school's principal.

Standards
Planting

SFUSD Science Content Standard 11: Structure and Function
Students understand that different species of living things have analogous structures that carry out similar functions, contributing to the continued viability of organisms in their specific environments.

- *Performance Standard:* Students should be able to compare and contrast characteristics of various plant species showing similarities by function. (based on SFUSD Performance Standard 11.1)

National Behavioral Studies Standard 1: Group and cultural influences over human development, identity and behavior
Students understand that heredity, culture, and personal experience interact in shaping human behavior.

- *Performance Standard:* Students understand that views about plants and nature are shaped by culture and personal experience.

National Life Skills Standard: Life Work
Students learn the proper use of new instruments by following instructions in a manual or by taking instructions from an experienced user.

- *Performance Standard:* Students should be able to demonstrate the proper use of picks for planting and discuss several safety measures that should be observed when using tools.

Revegetation

To revegetate means to provide an area with new plant cover. In the Golden Gate National Recreation Area, revegetation usually refers to placing indigenous plants in areas from which park staff and volunteers have removed invasive, exotic plant species.

Why is it necessary for park staff to revegetate restoration sites? Why not just remove invasive plants and then let natural ecological processes revegetate the area gradually over time? Although this is the preferred option, it takes many years for an area to revegetate naturally. The site must be visited repeatedly to prevent the establishment of exotic invasive species that may out-compete native seedlings. Additionally, many disturbed areas no longer have a native seedbank remaining in the soil. Growing plants in the nursery and introducing them into an area when they are relatively mature, or sowing seeds directly on-site, helps resource managers speed up the natural process. The indigenous plant community will reach a state of resiliency more quickly, and provide habitat for other members of the ecosystem. For example, by introducing mature silver lupine (Lupinus albifrons) to a site such as Milagra Ridge, park staff are able to provide much-needed habitat for the endangered Mission Blue butterfly.

REVEGETATION METHODS

Planting and direct seeding are the two methods used in the park to revegetate restoration areas. Planting involves transplanting seedlings that have been raised in the nursery and are already relatively mature. Direct seeding entails sowing seeds on-site and letting them germinate and develop naturally.

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¿Por qué es necesario que el personal del parque restaure la vegetación de lugares particulares? ¿Por qué no simplemente remover las plantas invasoras y dejar que el proceso ecológico natural le devuelva la vegetación al área gradualmente según pasa el tiempo? Aunque esta es la alternativa preferida, le toma muchos años a un área recobrar la vegetación de modo natural. Un lugar así tiene que ser visitado repetidas veces para prevenir el restablecimiento de especies exóticas invasoras que puedan derrotar las semillas nativas. Por otra parte, muchas áreas afectadas ya no cuentan con la presencia de un banco de semillas en su terreno. Cultivar plantas en el vivero e introducirlas a un área cuando ya están relativamente maduras, o sembrar las semillas directamente en el lugar, ayuda a los manejadores de recursos a acelerar el proceso natural. La comunidad de plantas indígenas se hará resistente más rápidamente y proveerá hábitat para otros miembros del ecosistema. Por ejemplo, introduciendo el lupino plateado (Lupinus albifrons) ya maduro, a un lugar como la sierra Milagra Ridge, el personal del parque logra proveer el hábitat que tanto necesita la mariposa Blue Mission, que está en peligro de extinción.

MÉTODOS DE RESTAURACIÓN VEGETAL

Los dos métodos utilizados en el parque para devolverle la vegetación a las áreas de restauración son, replantando y sembrando semillas directamente. Replantar consiste en transplantar las semillas que han germinado en el vivero y que ya están relativamente maduras. Siembra directa consiste en sembrar las semillas en el lugar y permitirles que germinen y se desarrollen naturalmente.

Las semillas y estolones (propagules) que se utilizan para propagar plantas en el vivero o sembrándolas directamente, son recogidas del lugar de la restauración o de los alrededores. Es preferible recoger propagules lo más cerca posible del lugar, porque el genotipo (la estructura genética) de las plantas puede ser diferente a distancias muy cortas. Algunas veces las semillas o los estolones de la especie requerida no están disponibles en el área cercana y deben ser recogidos en un lugar más alejado. Por lo general, sin embargo, es mejor recoger propagules dentro de los límites de la corriente de agua donde se encuentra el lugar de restauración.

Plant Structure & Adaptation

SUMMARY

Students draw and label the parts of a flowering plant. They use the Plant Guide on the National Park Labs web page to compare and group plants according to the plants' adaptations.

TIME

Two 50-minute class periods
10 minutes for preparation

MATERIALS

- Plant Structure Worksheet
- On the second day of the lesson, students will need computers with Internet access

Lesson

Day 1

25 minutes

Students locate flowering plants on or near their school grounds.

Students examine the plant and describe the texture and color of the leaves, stem, and petals.

Students draw the parts of the flowering plant, including each of the following structures:

a. Roots
b. Stem
c. Sepals
d. Petals
e. Pistil (stigma, style and ovaries)
f. Stamen (filament and anther)

15 minutes

Students complete the Plant Structure Worksheet by labeling the parts of the flowering plant, matching the parts with their functions, and describing the process of pollination.

10 minutes

Teacher leads a discussion about flowering plants:

- What role do insects play in the process of pollination?
- What type of insects might visit your plant for food?
- Why?
- How do leaves help you determine which plants use a lot of water?
- How have flowering plants adapted to survive?

Day 2

10 minutes

Students access the National Park Labs web site and find the Plant Guide.

40 minutes

Students create a chart that categorizes and sorts the plants in the Plant Guide. Students create their own categories and organization for the chart, using at least five different categories.

Plant Structure Worksheet

Directions:
1. Locate a flowering plant near your school. Examine the textures and colors of the leaves, stem and petals of the plant. Complete the following.

a. Draw and label the plant in the box below.
b. Match the part with its function on the left.

_____
where photosynthesis occurs

_____
develops into a fruit

_____
absorb nutrients

_____
receives pollen

_____
supports the flowers and leaves

_____
protects flower buds

_____
supports the anther

_____
attract insects with color

_____
connects the stigma and ovary

_____
releases the pollen

2. Describe the process of pollination in detail.

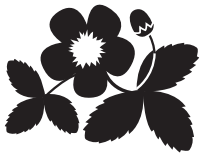
_____

_____

_____

_____

Estructura de la Planta Hoja de Trabajo



Instrucciones:
1. Localice un negocio de flores que esté cerca de su escuela. Examine la textura y los colores de las hojas, los tallos y los pétalos de las plantas. Conteste lo siguiente:

a. Dibuje y rotule la planta del cuadrado que está abajo.
b. Indique la parte que corresponda a la función de la derecha.

_____
donde ocurre la fotosíntesis

_____
se convierte en fruta

_____
absorbe nutrientes

_____
recibe el polen

_____
da soporte a flores y hojas

_____
protege los capullos de las flores

_____
da soporte a la antera (órgano masculino, contiene el polen)

_____
atrae insectos con su color

_____
conecta el estigma con el ovario

_____
expele el polen

2. Describa en detalles el proceso de polinización.

_____

_____

_____

Planting

SUMMARY

Students study adaptations of plants and compare and contrast the essential functions that these adaptations serve. Students plant a restoration site.

TIME

2.5 hours
30 minutes for preparation

MATERIALS

- Picks
- Meter-wheel
- Clipboards
- Gloves
- Plants
- Pencils
- Plant adaptation cards
- Restoration Cycle (visual aid)
- Journal entry questions
- GGNRA Work Performed Data Sheet (copies provided by NPS Natural Resources)

Program

Welcome - 5 minutes

- Park staff welcome students to the park. Using the Restoration Cycle visual aid, park staff ask the students to point out what step in the restoration cycle they think they will perform today.

- Park staff explain the planting project.

- They ask the students why revegetation is important. (The hope is that after establishing an indigenous plant community, various native animals will return, including many birds, insects, pocket gophers, alligator lizards, and skunks.)

Small Group Activity - 15 minutes

- The class divides into groups of 2 or 3 students.

- Each group receives a plant and a matching plant card with a plant adaptation on the back. Plant adaptations might include small leafs, sticky leafs, low-grow-

ing foliage, light green-grey colored plant, etc. The students attempt to figure out why a plant would develop the adaptation. (Small leaves help the plant conserve water in sunny habitats, sticky leaves deter pests, low-growing foliage helps a plant survive a windy environment, light green-grey coloration helps reflect sunlight in sunny habitats, etc.)

- Each group introduces their plant and adaptation to another group.

- Staff help students understand that different adaptations may serve the same function such as conserving water in a sunny habitat.

Spread Plants - 10 minutes

- Students are introduced to the species that their group will be planting.

- Park staff explain the basics of plant spacing and ask the students to work in pairs to properly space the plants throughout the planting area.

Planting - 1 hour, 15 minutes

- Park staff give a planting demonstration and explain pick safety rules.

Plants can survive rough handling, but will always respond better if handled with care. Transplanting can disturb root systems: Roots are the principal pathway by which plants take up water and nutrients, and any damage to the fragile root hairs will reduce the plant's ability to feed itself. Once planted in its natural habitat, the plant will not be watered or given fertilizer. Therefore, the bigger and healthier the root system, the better the plant will be able to remove water and nutrients available in the soil. One moment of rough or poor handling can ruin months of careful preparatory work in the nursery!

- Students and staff plant.

Data Sheet - 10 minutes

- Each group completes the GGNRA Work Performed Data Sheet.

Optional Activity - 30 minutes

Plant-walk activity (to be done if planting is completed early).

Each One Teach One:

- Park staff divide students into pairs.
- One staff member remains with the class at the starting point for the activity and sends each pair of students down the path at two-minute intervals.

- The first pair of students (Pair 1) goes with a second staff member into the planting area.
- Park staff help the first pair identify a plant, review its name, and learn one adaptation or indigenous use.
- Pair 1 remain at their plant and introduce it to Pair 2.
- Pair 2 proceeds down the path with the second staff member to the next plant; they review the name and information for the second plant.
- In the meantime, Pair 1 introduces Pair 3 to the first plant. This continues until all the groups are standing next to a plant.
- Pair 1 begins to walk along the chain, learning about each plant from the other students.
- Pair 2 follows, then Pair 3, etc., until the entire class has gathered at the other end of the plant walk.

The staff member who is with the class at the beginning of the activity can have each student name two important things about revegetation while they are waiting to begin down the path. The staff member who is with the class at the end of the activity can have the students write the names of two plants and adaptations (other than the one they taught) on a piece of paper. The staff member uses these notes to review adaptations with the class once everyone has finished (the last few students to finish won't need to write).

Closing Circle - 5 minutes

- Staff and students form a circle.

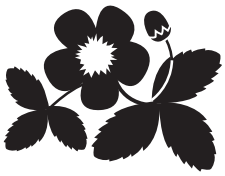
- Staff review adaptations and functions with the class, emphasizing that different adaptations serve the same function for different plants. All plants have some method to regulate water loss, protect themselves from weather and insects, and disperse their seeds. Park staff thank the class for their hard work during the planting.

Journal

Students complete journal entry questions as homework.

Planting

Journal Entry



1. Name three plants that you worked with today.

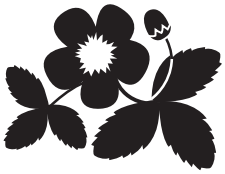
2. Describe a few characteristics of each plant (for example, "Beach Strawberry has dark green, waxy leaves.").

3. How are the plants alike? What features do they have in common?

4. What environmental factor (or factors) forced these plants to adapt similar structures?

5. What questions do you have about plant adaptations and the functions they serve for plants?

Trabajo con Plantas



Preguntas para el Diario

1. Nombre tres plantas con las que trabajó hoy.

2. Describa algunas características de cada planta (por ejemplo, la Fresa Playera tiene hojas enceradas color verde oscuro).

3. ¿Qué tienen de similar estas plantas? ¿Qué características tienen en común?

4. ¿Qué factor (o factores) ambientales forzaron estas plantas a adaptarse creando estructuras similares?

5. ¿Qué preguntas tiene usted sobre las adaptaciones de las plantas y las funciones que estas desempeñan?

Plant Quilt

SUMMARY

Using the Plant Guide on the National Park Labs web site and additional research, students create a "quilt" depicting different ways cultures view and use plants.

TIME

50 minutes on Day 1
35 minutes on Day 2
30 minutes for preparation

MATERIALS

- Old magazines
- Scissors
- Glue
- Tape
- 12" x 12" squares of white paper
- 14" x 14" squares of construction paper (various colors)
- Computers with Internet access
- Additional research material on cultural uses of plants

Program

Day 1

Introduction - 10 minutes

Students brainstorm about how different cultures view and use plants. (For some cultures, certain plants are food or medicine while for others they are not. Some cultures use plants ornamentally; some use them for religious ceremonies. Plants that are considered weeds for some people are desirable for others.) Teacher prompts the students to think about plants from various viewpoints.

Small group activity - 35 minutes

Students divide into small groups. Each group receives a piece of the white paper. Using images and ideas from the National Park Labs web site (www.nps.gov/goga/parklabs), the resource material, and the magazines, they begin creating a quilt square depicting what they understand as one culture's view of a particular plant.

Clean up - 5 minutes

Students clean up; teacher tells them that they must be ready with their quilt square by the beginning of the next class session.

Day 2

5 minutes

Each group glues its completed quilt square onto a piece of the construction paper.

10 minutes

The entire class places the squares together in the shape of a quilt. Once the class agrees on the arrangement of the squares, the class tapes the squares together.

20 minutes

The class hangs the quilt on the classroom wall. Each group describes its square to the other students.

Creating a Community Garden

SUMMARY
This is an optional lesson for classes that wish to extend the planting module. Students write a proposal that suggests a site for a community garden on their school grounds. The proposal identifies users of the space and their needs, depicts plans for a space that can meet these needs, and specifies the work involved in transforming the site.

TIME
50 minutes
10 minutes for preparation

MATERIALS
- Community Garden Planning Questions
- Tape measures (one for each group)

Lesson

Introduction - 5 minutes
Teacher explains to the students that they are going to create a proposal for a community garden at their school. The first step is to think about what kind of garden would serve their community. Students should refer to the research they did for the Plant Quilt. Who lives in their neighborhood? How do they view plants?

Small Group Activity - 15 minutes
Students choose a site for the garden. What factors will be involved in choosing the site? (Accessibility to the users, not disruptive to the traffic patterns of people walking from class to class, quality of soil in the area.)

Teacher divides the students into groups of four or five. Each group goes out onto the school grounds and chooses a proposed site for their community garden. The group measures the parameter of the site. The groups return to the classroom.

Planning Questions - 25 minutes
Distribute one copy of the Community Garden Planning Questions to each group. Groups complete the planning questions.

Discussion - 5 minutes
The class discusses planning issues. What were the hardest decisions to make in the planning process? What were the easiest? Did groups consider issues of equal access? Does it matter if all students, teachers, and community members have equal access to the resource they are creating?

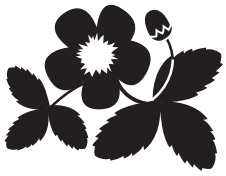
Extension to Optional Post-visit Lesson
Creating a Community Garden

Students and teachers may extend this lesson by actually creating and maintaining the garden. We strongly urge teachers to seek assistance before beginning a school garden.

For technical, logistical, and educational support contact:

School Garden Coordinator
San Francisco League of Urban Gardeners (SLUG).
Phone: (415) 285-7584
Voice mail: (415) 255-4497
Fax: (415) 285-7586

Community Garden



Planning Questions

1. What cultures are represented in the residents who surround your school?

_____

_____

_____

2. Are there any plants that might be of particular interest to these residents?

_____

_____

_____

3. List the plants you want to plant in your garden.

_____

_____

_____

4. Will you grow your plants from cuttings or seeds? Why?

_____

_____

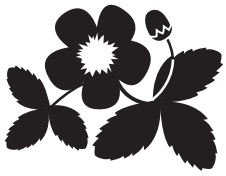
5. What are the dimensions of your site? _____

6. On a separate sheet of paper, draw your site. Show the types of plants and the location of each plant.

7. Who will be responsible for the upkeep of your garden? List what will need to be done to keep your garden healthy. How often will these tasks need to be done?

8. On a separate piece of paper, write a proposal for this garden that could be submitted to the principal of your school. You should include all the details about how the garden will be created and maintained as well as the benefits it will provide. Good luck!

Jardín Comunitario



Preguntas sobre Planificación

1. ¿Qué culturas están representadas entre los residentes que viven alrededor de su escuela?

_____

_____

_____

2. ¿Hay algunas plantas que puedan ser de interés particular para estos residentes?

_____

_____

_____

3. ¿Indique las plantas que usted quiere sembrar en su jardín?

_____

_____

_____

4. ¿Qué va a utilizar para cultivar sus plantas, ¿estolones o semillas? ¿Por qué?

_____

5. ¿Cuáles son las dimensiones de su área? _____

6. Dibuje su área en una hoja de papel separada. Ilustre los tipos de plantas y la localización de cada planta.

7. ¿Quién será responsable del mantenimiento de su jardín? Indique que es necesario hacer para mantener saludable su jardín. ¿Con que frecuencia deben realizarse estas tareas?

8. En una hoja de papel separada escriba una propuesta para este jardín que pueda someterse al principal de su escuela. Usted debe incluir todos los detalles sobre cómo se creará y mantendrá el jardín y qué beneficios proveerá. ¡Buena Suerte!

Rubric
Planting

Science (Structure and Function)

Needs Improvement: Students can describe one or two plants, but cannot compare or group plant parts with similar functions.

Good: Students can compare two plants and find parts with similar functions.

Excellent: Students can compare three or more plants, pointing out structures with specific functions and adaptations for the environment.

Environmental Justice (Equal access)

Needs Improvement: Students do not understand that various groups of people view plants and nature differently.

Good: Students understand that various groups of people view plants and nature differently but make no attempt to understand why.

Excellent: Students understand that various groups of people view plants and nature differently and they realize that these views are shaped by heredity, culture, and personal experience.

Life Skills (Cooperative Learning)

Needs Improvement: Students show incomplete interaction, often ignore comments, group efforts are easily sidetracked, some members uninvolved in group.

Good: More than half the members are actively involved, comments are rarely ignored, rarely stray from topic.

Excellent: All students participate equally, actively listen to one another, show respect for ideas, stay on task.

Planting

SUMMARY OF INSTRUCTIONAL ACTIVITIES

Plant Structure & Adaptation - page 5

- Students locate and study a flowering plant on their school grounds.
- Students describe the plant and label the parts of the plant.
- Students discuss pollination and plant adaptation.
- Students use the Plant Guide on the National Park Labs. web site to categorize plants by adaptation or structures.

Planting - page 10

- Students examine and describe for other students the adaptations of various indigenous plants.
- Students participate in the restoration of an area by planting native plants.
- Students write a journal entry comparing characteristics of two more native plant species. (integrated assessment)

Plant Quilt - page 16

- Students use the Plant Guide on the National Park Labs web site and additional resources to create a multicultural depiction of plants and plant uses.

Creating a Community Garden - page 18

- Students choose and measure an area of their school grounds as a proposed site for a community garden.
- Students consider who will have access to the garden and who will take responsibility for its day-to-day upkeep; determine the number, type, and placement of plants; propose funding sources.
- Students write a detailed proposal to create this garden and submit the proposal to their school's principal.

Standards
Planting

SFUSD Science Content Standard 11: Structure and Function
Students understand that different species of living things have analogous structures that carry out similar functions, contributing to the continued viability of organisms in their specific environments.

- *Performance Standard:* Students should be able to compare and contrast characteristics of various plant species showing similarities by function. (based on SFUSD Performance Standard 11.1)

National Behavioral Studies Standard 1: Group and cultural influences over human development, identity and behavior
Students understand that heredity, culture, and personal experience interact in shaping human behavior.

- *Performance Standard:* Students understand that views about plants and nature are shaped by culture and personal experience.

National Life Skills Standard: Life Work
Students learn the proper use of new instruments by following instructions in a manual or by taking instructions from an experienced user.

- *Performance Standard:* Students should be able to demonstrate the proper use of picks for planting and discuss several safety measures that should be observed when using tools.

Revegetation

To revegetate means to provide an area with new plant cover. In the Golden Gate National Recreation Area, revegetation usually refers to placing indigenous plants in areas from which park staff and volunteers have removed invasive, exotic plant species.

Why is it necessary for park staff to revegetate restoration sites? Why not just remove invasive plants and then let natural ecological processes revegetate the area gradually over time? Although this is the preferred option, it takes many years for an area to revegetate naturally. The site must be visited repeatedly to prevent the establishment of exotic invasive species that may out-compete native seedlings. Additionally, many disturbed areas no longer have a native seedbank remaining in the soil. Growing plants in the nursery and introducing them into an area when they are relatively mature, or sowing seeds directly on-site, helps resource managers speed up the natural process. The indigenous plant community will reach a state of resiliency more quickly, and provide habitat for other members of the ecosystem. For example, by introducing mature silver lupine (Lupinus albifrons) to a site such as Milagra Ridge, park staff are able to provide much-needed habitat for the endangered Mission Blue butterfly.

REVEGETATION METHODS

Planting and direct seeding are the two methods used in the park to revegetate restoration areas. Planting involves transplanting seedlings that have been raised in the nursery and are already relatively mature. Direct seeding entails sowing seeds on-site and letting them germinate and develop naturally.

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Two 50-minute class periods
10 minutes for preparation

MATERIALS

- Plant Structure Worksheet
- On the second day of the lesson, students will need computers with Internet access

Lesson

Day 1

25 minutes

Students locate flowering plants on or near their school grounds.

Students examine the plant and describe the texture and color of the leaves, stem, and petals.

Students draw the parts of the flowering plant, including each of the following structures:

a. Roots
b. Stem
c. Sepals
d. Petals
e. Pistil (stigma, style and ovaries)
f. Stamen (filament and anther)

15 minutes

Students complete the Plant Structure Worksheet by labeling the parts of the flowering plant, matching the parts with their functions, and describing the process of pollination.

10 minutes

Teacher leads a discussion about flowering plants:

- What role do insects play in the process of pollination?
- What type of insects might visit your plant for food?
- Why?
- How do leaves help you determine which plants use a lot of water?
- How have flowering plants adapted to survive?

Day 2

10 minutes

Students access the National Park Labs web site and find the Plant Guide.

40 minutes

Students create a chart that categorizes and sorts the plants in the Plant Guide. Students create their own categories and organization for the chart, using at least five different categories.

Plant Structure Worksheet

Directions:
1. Locate a flowering plant near your school. Examine the textures and colors of the leaves, stem and petals of the plant. Complete the following.

a. Draw and label the plant in the box below.
b. Match the part with its function on the left.

_____
where photosynthesis occurs

_____
develops into a fruit

_____
absorb nutrients

_____
receives pollen

_____
supports the flowers and leaves

_____
protects flower buds

_____
supports the anther

_____
attract insects with color

_____
connects the stigma and ovary

_____
releases the pollen

2. Describe the process of pollination in detail.

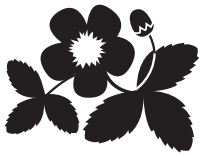
_____

_____

_____

_____

Estructura de la Planta Hoja de Trabajo



Instrucciones:
1. Localice un negocio de flores que esté cerca de su escuela. Examine la textura y los colores de las hojas, los tallos y los pétalos de las plantas. Conteste lo siguiente:

a. Dibuje y rotule la planta del cuadrado que está abajo.
b. Indique la parte que corresponda a la función de la derecha.

_____
donde ocurre la fotosíntesis

_____
se convierte en fruta

_____
absorbe nutrientes

_____
recibe el polen

_____
da soporte a flores y hojas

_____
protege los capullos de las flores

_____
da soporte a la antera (órgano masculino, contiene el polen)

_____
atrae insectos con su color

_____
conecta el estigma con el ovario

_____
expele el polen

2. Describa en detalles el proceso de polinización.

_____

_____

_____

Planting

SUMMARY

Students study adaptations of plants and compare and contrast the essential functions that these adaptations serve. Students plant a restoration site.

TIME

2.5 hours
30 minutes for preparation

MATERIALS

- Picks
- Meter-wheel
- Clipboards
- Gloves
- Plants
- Pencils
- Plant adaptation cards
- Restoration Cycle (visual aid)
- Journal entry questions
- GGNRA Work Performed Data Sheet (copies provided by NPS Natural Resources)

Program

Welcome - 5 minutes

- Park staff welcome students to the park. Using the Restoration Cycle visual aid, park staff ask the students to point out what step in the restoration cycle they think they will perform today.

- Park staff explain the planting project.

- They ask the students why revegetation is important. (The hope is that after establishing an indigenous plant community, various native animals will return, including many birds, insects, pocket gophers, alligator lizards, and skunks.)

Small Group Activity - 15 minutes

- The class divides into groups of 2 or 3 students.

- Each group receives a plant and a matching plant card with a plant adaptation on the back. Plant adaptations might include small leafs, sticky leafs, low-grow-

ing foliage, light green-grey colored plant, etc. The students attempt to figure out why a plant would develop the adaptation. (Small leaves help the plant conserve water in sunny habitats, sticky leaves deter pests, low-growing foliage helps a plant survive a windy environment, light green-grey coloration helps reflect sunlight in sunny habitats, etc.)

- Each group introduces their plant and adaptation to another group.

- Staff help students understand that different adaptations may serve the same function such as conserving water in a sunny habitat.

Spread Plants - 10 minutes

- Students are introduced to the species that their group will be planting.

- Park staff explain the basics of plant spacing and ask the students to work in pairs to properly space the plants throughout the planting area.

Planting - 1 hour, 15 minutes

- Park staff give a planting demonstration and explain pick safety rules.

Plants can survive rough handling, but will always respond better if handled with care. Transplanting can disturb root systems: Roots are the principal pathway by which plants take up water and nutrients, and any damage to the fragile root hairs will reduce the plant's ability to feed itself. Once planted in its natural habitat, the plant will not be watered or given fertilizer. Therefore, the bigger and healthier the root system, the better the plant will be able to remove water and nutrients available in the soil. One moment of rough or poor handling can ruin months of careful preparatory work in the nursery!

- Students and staff plant.

Data Sheet - 10 minutes

- Each group completes the GGNRA Work Performed Data Sheet.

Optional Activity - 30 minutes

Plant-walk activity (to be done if planting is completed early).

Each One Teach One:

- Park staff divide students into pairs.
- One staff member remains with the class at the starting point for the activity and sends each pair of students down the path at two-minute intervals.

- The first pair of students (Pair 1) goes with a second staff member into the planting area.
- Park staff help the first pair identify a plant, review its name, and learn one adaptation or indigenous use.
- Pair 1 remain at their plant and introduce it to Pair 2.
- Pair 2 proceeds down the path with the second staff member to the next plant; they review the name and information for the second plant.
- In the meantime, Pair 1 introduces Pair 3 to the first plant. This continues until all the groups are standing next to a plant.
- Pair 1 begins to walk along the chain, learning about each plant from the other students.
- Pair 2 follows, then Pair 3, etc., until the entire class has gathered at the other end of the plant walk.

The staff member who is with the class at the beginning of the activity can have each student name two important things about revegetation while they are waiting to begin down the path. The staff member who is with the class at the end of the activity can have the students write the names of two plants and adaptations (other than the one they taught) on a piece of paper. The staff member uses these notes to review adaptations with the class once everyone has finished (the last few students to finish won't need to write).

Closing Circle - 5 minutes

- Staff and students form a circle.

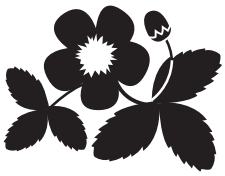
- Staff review adaptations and functions with the class, emphasizing that different adaptations serve the same function for different plants. All plants have some method to regulate water loss, protect themselves from weather and insects, and disperse their seeds. Park staff thank the class for their hard work during the planting.

Journal

Students complete journal entry questions as homework.

Planting

Journal Entry



1. Name three plants that you worked with today.

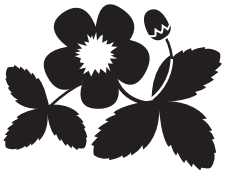
2. Describe a few characteristics of each plant (for example, "Beach Strawberry has dark green, waxy leaves.").

3. How are the plants alike? What features do they have in common?

4. What environmental factor (or factors) forced these plants to adapt similar structures?

5. What questions do you have about plant adaptations and the functions they serve for plants?

Trabajo con Plantas



Preguntas para el Diario

1. Nombre tres plantas con las que trabajó hoy.

2. Describa algunas características de cada planta (por ejemplo, la Fresa Playera tiene hojas enceradas color verde oscuro).

3. ¿Qué tienen de similar estas plantas? ¿Qué características tienen en común?

4. ¿Qué factor (o factores) ambientales forzaron estas plantas a adaptarse creando estructuras similares?

5. ¿Qué preguntas tiene usted sobre las adaptaciones de las plantas y las funciones que estas desempeñan?

Plant Quilt

SUMMARY

Using the Plant Guide on the National Park Labs web site and additional research, students create a "quilt" depicting different ways cultures view and use plants.

TIME

50 minutes on Day 1
35 minutes on Day 2
30 minutes for preparation

MATERIALS

- Old magazines
- Scissors
- Glue
- Tape
- 12" x 12" squares of white paper
- 14" x 14" squares of construction paper (various colors)
- Computers with Internet access
- Additional research material on cultural uses of plants

Program

Day 1

Introduction - 10 minutes

Students brainstorm about how different cultures view and use plants. (For some cultures, certain plants are food or medicine while for others they are not. Some cultures use plants ornamentally; some use them for religious ceremonies. Plants that are considered weeds for some people are desirable for others.) Teacher prompts the students to think about plants from various viewpoints.

Small group activity - 35 minutes

Students divide into small groups. Each group receives a piece of the white paper. Using images and ideas from the National Park Labs web site (www.nps.gov/goga/parklabs), the resource material, and the magazines, they begin creating a quilt square depicting what they understand as one culture's view of a particular plant.

Clean up - 5 minutes

Students clean up; teacher tells them that they must be ready with their quilt square by the beginning of the next class session.

Day 2

5 minutes

Each group glues its completed quilt square onto a piece of the construction paper.

10 minutes

The entire class places the squares together in the shape of a quilt. Once the class agrees on the arrangement of the squares, the class tapes the squares together.

20 minutes

The class hangs the quilt on the classroom wall. Each group describes its square to the other students.

Creating a Community Garden

SUMMARY
This is an optional lesson for classes that wish to extend the planting module. Students write a proposal that suggests a site for a community garden on their school grounds. The proposal identifies users of the space and their needs, depicts plans for a space that can meet these needs, and specifies the work involved in transforming the site.

TIME
50 minutes
10 minutes for preparation

MATERIALS
- Community Garden Planning Questions
- Tape measures (one for each group)

Lesson

Introduction - 5 minutes
Teacher explains to the students that they are going to create a proposal for a community garden at their school. The first step is to think about what kind of garden would serve their community. Students should refer to the research they did for the Plant Quilt. Who lives in their neighborhood? How do they view plants?

Small Group Activity - 15 minutes
Students choose a site for the garden. What factors will be involved in choosing the site? (Accessibility to the users, not disruptive to the traffic patterns of people walking from class to class, quality of soil in the area.)

Teacher divides the students into groups of four or five. Each group goes out onto the school grounds and chooses a proposed site for their community garden. The group measures the parameter of the site. The groups return to the classroom.

Planning Questions - 25 minutes
Distribute one copy of the Community Garden Planning Questions to each group. Groups complete the planning questions.

Discussion - 5 minutes
The class discusses planning issues. What were the hardest decisions to make in the planning process? What were the easiest? Did groups consider issues of equal access? Does it matter if all students, teachers, and community members have equal access to the resource they are creating?

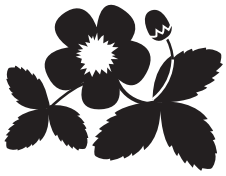
Extension to Optional Post-visit Lesson
Creating a Community Garden

Students and teachers may extend this lesson by actually creating and maintaining the garden. We strongly urge teachers to seek assistance before beginning a school garden.

For technical, logistical, and educational support contact:

School Garden Coordinator
San Francisco League of Urban Gardeners (SLUG).
Phone: (415) 285-7584
Voice mail: (415) 255-4497
Fax: (415) 285-7586

Community Garden



Planning Questions

1. What cultures are represented in the residents who surround your school?

_____

_____

_____

2. Are there any plants that might be of particular interest to these residents?

_____

_____

_____

3. List the plants you want to plant in your garden.

_____

_____

_____

4. Will you grow your plants from cuttings or seeds? Why?

_____

_____

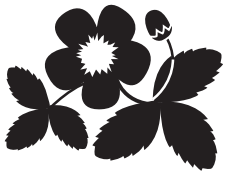
5. What are the dimensions of your site? _____

6. On a separate sheet of paper, draw your site. Show the types of plants and the location of each plant.

7. Who will be responsible for the upkeep of your garden? List what will need to be done to keep your garden healthy. How often will these tasks need to be done?

8. On a separate piece of paper, write a proposal for this garden that could be submitted to the principal of your school. You should include all the details about how the garden will be created and maintained as well as the benefits it will provide. Good luck!

Jardín Comunitario



Preguntas sobre Planificación

1. ¿Qué culturas están representadas entre los residentes que viven alrededor de su escuela?

_____

_____

_____

2. ¿Hay algunas plantas que puedan ser de interés particular para estos residentes?

_____

_____

_____

3. ¿Indique las plantas que usted quiere sembrar en su jardín?

_____

_____

_____

4. ¿Qué va a utilizar para cultivar sus plantas, ¿estolones o semillas? ¿Por qué?

_____

5. ¿Cuáles son las dimensiones de su área? _____

6. Dibuje su área en una hoja de papel separada. Ilustre los tipos de plantas y la localización de cada planta.

7. ¿Quién será responsable del mantenimiento de su jardín? Indique que es necesario hacer para mantener saludable su jardín. ¿Con que frecuencia deben realizarse estas tareas?

8. En una hoja de papel separada escriba una propuesta para este jardín que pueda someterse al principal de su escuela. Usted debe incluir todos los detalles sobre cómo se creará y mantendrá el jardín y qué beneficios proveerá. ¡Buena Suerte!

Rubric
Planting

Science (Structure and Function)

Needs Improvement: Students can describe one or two plants, but cannot compare or group plant parts with similar functions.

Good: Students can compare two plants and find parts with similar functions.

Excellent: Students can compare three or more plants, pointing out structures with specific functions and adaptations for the environment.

Environmental Justice (Equal access)

Needs Improvement: Students do not understand that various groups of people view plants and nature differently.

Good: Students understand that various groups of people view plants and nature differently but make no attempt to understand why.

Excellent: Students understand that various groups of people view plants and nature differently and they realize that these views are shaped by heredity, culture, and personal experience.

Life Skills (Cooperative Learning)

Needs Improvement: Students show incomplete interaction, often ignore comments, group efforts are easily sidetracked, some members uninvolved in group.

Good: More than half the members are actively involved, comments are rarely ignored, rarely stray from topic.

Excellent: All students participate equally, actively listen to one another, show respect for ideas, stay on task.

Culminating Project: Applying Knowledge

CLASSES CHOOSE ONE PROJECT

Student Exhibitions - page 2

(facilitated by park staff and classroom teacher)

- Individuals or small groups of students create exhibitions illustrating an aspect of their experience in the program.
- Students give presentations for NPS staff, other students, and teachers.
- NPS staff award participation certificates to students.
- Students learn about summer internships and job opportunities in local parks and environmental organizations.
- Students display their exhibitions in their schools, in park visitor centers, on the National Park Labs web site, at restoration fairs, and/or at community centers.

or

Neighborhood Restoration - page 4

(facilitated by park staff and/or a cooperating community agency)

- Students apply concepts learned during the program while participating in a restoration or beautification project in their school or a local park.
- NPS staff award participation certificates to students.
- Students learn about summer internships and job opportunities in local parks and environmental organizations.

Standards
Culminating Project

SFUSD Science Content Standard 14: Interdependence
Students understand that the maintenance of ecosystems depends upon biotic and abiotic factors, including the effects of water, nitrogen and carbon cycles on the system.

- *Performance Standard:* Students should be able to discuss the positive effects that their intervention has had on the ecosystem of their restoration area (based on SFUSD Performance Standard 14.3).

National Life Skills Standard: Working with Others
Students demonstrate leadership skills by celebrating accomplishments and recognizing the contributions of others.

- *Performance Standard:* Students should be able to celebrate the restoration work they have accomplished during the program, as well as recognize the contributions that their classmates and others have made to restoration efforts.

National Life Skills Standard: Life Work
Students make general preparations for entering the work force by understanding occupational apprenticeships and other training opportunities.

- *Performance Standard:* Students should be able to describe several available environmental internships. Students should be able to describe how the skills they gained during National Park Labs can help them pursue an environmental career.

Culminating Activity
Option 1: Student Exhibitions

SUMMARY
Whether classes choose the student exhibitions or the neighborhood restoration project, the culminating activity is an opportunity to reflect on the concepts learned during the program and celebrate the students' contributions to habitat restoration. Students learn how they can continue working for the health of the environment through paid and unpaid internships offered by the National Park Service and other agencies.

TIME
Part 1: Two 50-minute class periods plus 30 minutes for preparation
Part 2: One 50-minute class period plus 90 minutes for preparation

MATERIALS
- Sample exhibits from previous years
- New or recycled materials to create exhibitions
- Reference material such as plant information cards, nursery handbook, textbooks, curriculum guide
- Scissors, straight-edge, colored pencils, pens, etc.
- Notes and assignments from National Park Labs activities
- Digital pictures of students participating in National Park Labs activities
- Internship announcements
- Certificates

Program (facilitated by NPS staff and teacher)

Part 1, Day 1 (facilitated by teacher)

5 minutes
Teacher congratulates students on accomplishing a great deal of vital restoration work. In order to share the knowledge they have gained during their restoration project, students will make an exhibition covering a specific aspect of what they learned. Exhibitions will be displayed in their school, at park visitor centers, on the National Park Labs web site, at restoration fairs, and/or at community centers.

10 minutes
Students refer to the journal questions they formulated during the National Park Labs lessons. Have any of these questions been answered? Students now formulate five new questions about any aspect of the program. The teacher helps the students determine which of these questions would be good topics for exhibitions.

10 minutes
The teacher divides students into small teams to create the exhibitions. (Some students may elect to work independently but should still complete a comprehensive exhibition.) Each group meets for a short time and decides on a topic for their display. The teacher approves the topics before students are allowed to proceed.

25 minutes
Each group sketches a plan for their exhibition and divides the work among the group members. The teacher approves the plan before students begin work on the actual exhibitions.

Part 1, Day 2 (facilitated by teacher)

50 minutes
Students work in their teams to complete their exhibitions.

Part 2:
Creating Exhibitions (facilitated by NPS staff)

5 minutes
Park staff greet the class, congratulate the students, and thank them for their hard work during the program.

30 minutes
Students present exhibitions.

5 minutes
Staff give certificates to each student and the teacher.

10 minutes
Students learn about summer internship opportunities and enjoy refreshments.

Culminating Activity
Option 2: Neighborhood Restoration Project

SUMMARY
Whether classes choose the student exhibitions or the neighborhood restoration project, the culminating activity is an opportunity to reflect on the concepts learned during the program and celebrate the students' contributions to habitat restoration. Students learn how they can continue working for the health of the environment through paid and unpaid internships offered by the National Park Service and other agencies.

TIME
2 hours
90 minutes for preparation

MATERIALS
- Internship announcements
- Certificates

Program (facilitated by NPS staff and/or a cooperating agency)

Preparation - 90 minutes
Park staff arrange with a local agency (SF Recreation and Park Department, SLUG, etc.) for the class to work on a restoration or beautification project at an area near their school. The class may do a project on their school grounds.

Students, teacher and staff meet at the chosen project site.

Welcome - 10 minutes
Park staff or cooperating agency staff welcome students to the site, introduce the project, and explain the work procedure.

Project - 80 minutes
The class works on the project. During the work, park staff help the students make intellectual connections between today's project and the restoration project the students completed in Golden Gate National Recreation Area.

Discussion - 10 minutes
When the work is complete, students discuss the similarities and differences between this work and what was done in Golden Gate National Recreation Area. Which project is more important? Who are the stakeholders in each project? Who has access to which open spaces? Park staff ask the students to recall the "Case of the Vacant Lot" scenario. What other options might have been proposed for this open space?

Reflection - 10 minutes
Students refer to the journal questions that they formulated during the National Park Labs lessons. Have any of these questions been answered? How have the students' views changed during the program? Park staff help the students understand that learning is a lifelong process, and often, questions lead not only to answers but to more questions. Students now formulate five new questions they have about any aspect of the program.

Conclusion - 10 minutes
Park staff give certificates to each student and the teacher. Students learn about summer internship opportunities and enjoy refreshments.

Glossary

Achene: a small, dry fruit with one seed inside.

Adventitious: arising from an unusual place, such as buds emerging from places other than leaf axils, roots growing from stems or leaves. Also, roots developed by cuttings to aid in water and nutrient uptake.

Allelopathic: the inhibition of growth of one plant species by another due to the release of chemical substances.

Alternate leaves: not directly across from each other along the stem.

Angiosperm: plants whose seeds are borne within a mature ovary or fruit.

Annual: completes its life cycle in one growing season and dies back each year (compare to perennial).

Asexual propagation: plant propagation by cuttings, layering, division, or grafting.

Astringent: having a quality that contracts body tissues and slows down secretions such as bleeding.

Axil: the angled space between a plant part, like a leaf and where it attaches to the plant's axis or main supporting structure, such as a branch or stem.

Basal leaves: growing from the base of a stem.

Biological diversity: the variety of life in a given ecosystem.

Blade: the leaf itself; the flattened part of a leaf not including the petiole.

Bract: a modified leaf often near the flower or inflorescence of a plant; sometimes looking like a petal when brightly colored.

Browser: an animal that nibbles on leaves, twigs, and the buds or shoots of young plants.

Co-exist: to exist together without harming one another.

Compound: when a leaf is made up of completely separate segments called leaflets (compare to simple leaves).

Corolla: term used when referring to all the petals of a flower.

Cotyledon: seed leaf; a modified leaf present in the seed, often functioning for food storage.

Crown: the base of the plant from which leaves and runners originate.

Cyme: a flower cluster in which the central or terminal flower blooms earliest.

Deciduous: loses its leaves in response to the cold season; opposite of evergreen.

Decoction: an extract of essence or flavor produced by boiling down.

Dentate: a term used when the teeth on the margins of a leaf are rather large.

Dichotomous key: a tool used to determine the identity of plants.

Dioecious: has separate male and female flowers that are found on separate plants.

Dicotyledons: or dicots have two cotyledons or seed leaves. Dicots consist of broadleaf plants, lupines and most of the herbaceous and woody shrubs in Golden Gate National Recreation Area.

Direct seeding: a method of revegetation in which seeds are sown directly on a restoration site.

Dissected leaves: separated into many narrow segments; often feathery looking.

Drainage: an area through which run-off water drains; usually lower than surrounding areas.

Dune scrub: shrub vegetation that occurs inland from the foredune community.

Dunescape: a landscape covered in dunes.

Ecosystem: all populations living together and the physical factors with which they interact.

Elliptic leaves: shaped like an ellipse, with the center part of the leaf blade widest and the two ends of the blade the same size.

Embryo: a new plant formed from the union of a male and female gamete during

fertilization; it consists of an embryo axis which has a growing point at both ends—one develops into the shoot and one develops into the root—and one or more seed leaves (cotyledons) attached to the embryo axis.

Entire leaf: the margins, or edges, of the leaf are smooth and without teeth or lobes.

Exotic plant species: plant species that did not evolve in its present environment, but was introduced, deliberately or accidentally, by humans.

Exude: to ooze or seep out.

Foliage: the leaves of a plant or tree.

Food storage tissues: complex storage products (carbohydrates, fats, oils, and proteins) laid down in the seed by the mother plant.

Genetic diversity: the variability in genetic or hereditary make-up among individuals within a single species.

Genotype: genetic makeup of a plant.

Germinate: to sprout.

Gymnosperms: plants whose seeds are not enclosed in an ovary; conifers are gymnosperms.

Habitat restoration: to restore or bring back ecological integrity by actively removing invasive exotic plants, propagating native plants, and monitoring the resulting changes.

Hardening off: the process by which a young plant adjusts to high sun intensity.

Hottentots: nomadic, pastoral people of Africa.

Inflorescence: the flowering part of a plant; almost always used when referring to a flower cluster.

Infusion: a liquid extract produced by steeping or soaking (like tea, etc.) to extract flavors or other qualities.

Interdependent: mutually dependent; elements in an ecosystem depend on one another for survival.

Invasive plants: plant species, usually exotic, that have competitive survival and reproductive characteristics, and can therefore outcompete non-invasive, native plant species.

Lanceolate leaves: lance-shaped; several times longer than wide with the widest part at the base and tapering to a point at the apex.

Leaflets: one of the segments (looks like a small leaf) in a compound leaf.

Legume: a plant belonging to a large family of plants that includes peas, beans, clovers, etc.; the fruit is usually a pod; most legumes have special nodules on their roots with nitrogen-fixing bacteria that can take nitrogen out of the air and "fix" it into the soil thus increasing the richness of soil for all plants.

Linear leaves: narrow and flat with sides parallel (such as a grass leaf blade).

Lobed leaves: rounded, curvy, or wavy in shape.

Microclimates: the essentially uniform local climate of a usually small site or habitat; in Golden Gate National Recreation Area, the introduction of exotic trees created small microclimates by trapping moisture from the fog and providing increased shade.

Monecious: having separate male and female flowers (i.e., the stamens are found in one flower and the pistils are found in a separate flower) that are found on the same plant.

Monitoring: the collection and analysis of data at regular intervals to record natural and human-induced changes and provide the basis for appropriate management response.

Monoculture: an area covered exclusively by one species.

Monocotyledonous (monocot): plants that have one cotyledon (or seed leaf) on the embryo.

Naturalized: when a plant has taken over the natural range of indigenous plants and acts as though it has always been a part of the original landscape.

Nectar: the sweetish liquid in many flowers used by bees in the making of honey.

Non-native (see also, exotic) plant species: plant species that did not evolve in its

present environment, but was introduced, deliberately or accidentally, by humans.

Oak woodland: a woodland area dominated by Coast live oak trees.

Oblanceolate leaves: inversely lanceolate; the tapered end attaches to the petiole (or stalk) and the widest end is at the apex of the leaf blade.

Oblong leaves: two to four times longer than wide with the sides being nearly parallel.

Opposite leaves: directly across from each other along the stem.

Ovate leaves: vaguely egg-shaped and connected at the broader end to a stem or branch.

Palmate leaves: vaguely hand-shaped, either because it is palmately lobed like a simple leaf or because, in a compound leaf, all leaflets radiate out from a central point.

Palmate veins: when the veins of a leaf radiate from a central point so that the pattern is vaguely hand-shaped.

Panicle: a compound inflorescence with the youngest flowers being at the apex.

Pappus: a tuft of hair on the seed of a plant that helps disperse the seed.

Parallel veins: when the veins on a leaf run parallel from tip to tip along the leaf; typical of grasses and grass-like leaves.

Pedicel: the stalk of a single flower in an inflorescence or cluster of flowers.

People-hour: a unit used to describe one hour of work by one person.

Perennial: a plant whose life cycle lasts for several years; a plant that comes back year after year without having to be replanted each year.

Petiole: the stalk of a leaf blade that attaches it to a branch of a plant.

Photomonitoring: a method of monitoring using photography, especially useful in monitoring overall changes in landscape over time.

Pinnately compound leaves: compound leaflets on opposite sides of a long axis.

Pioneer plant species: plant populations that are physiologically capable of colonizing highly disturbed areas of land.

Pistil: the seed-producing part of a flower; often referred to as the female part of a flower.

Plant communities: defined by the dominant plant species found within the community; examples of plant communities found in Golden Gate National Recreation Area are dune scrub, oak woodland, and serpentine grassland.

Pollination: when pollen is transferred to the stigma of flower's pistil leading to fertilization and seed production.

Poultice: a warm cloth or medicinal mixture applied to a sore or inflamed part of the body.

Propagation (sexual and asexual): the reproduction of plants using seed (sexual) or by cuttings, layering, or division (asexual); all vegetative propagation methods produce a plant that has an identical genotype to its mother plant.

Prostrate: lying flat or trailing along the ground.

Purgative: something that purges or gets rid of something from the body.

Quadrat: a plot (usually rectangular) used for ecological or population studies.

Raceme: an inflorescence with pedicelled flowers (the flowers having little stalks) on a long axis (stem or branch) with the youngest flowers at the apex (top).

Revegetate: to reestablish vegetation in a restoration site by planting and seeding of indigenous species.

Rhizome: a thickened stem that looks like a root and grows horizontally along the ground just at or beneath the surface.

Rosette: a basal cluster of leaves arranged in a circular fashion (such as the leaves of the common dandelion).

Seed covering: the outer protective layer of the seed.

Seedbank: all seeds that exist in the soil.

Serpentine grassland: the plant community that grows on serpentine soil.

Serrated leaves: toothed; jagged "teeth" directed forward toward the tip of the leaf.

Sessile: having no stalk of any kind.

Simple leaves: singular; only one segment between the stem of the leaf and the tip of the leaf blade (compare to compound leaves).

Spike: an inflorescence with sessile flowers (the flowers having no stalk of any kind) on a long axis (stem or branch) with the youngest flowers at the apex (top).

Stamens: the pollen bearing organs of a flower.

Stigma: the part of the pistil (female part of the flower) that receives the pollen.

Succession: progressive change in the plant and animal life of an area.

Succulent: a plant that has thick, fleshy tissues that store water and help the plant resist drought conditions.

Toothed leaves: jagged-edged.

Transect: a representative strip of vegetation from which data is collected.

Transpiration: the loss of water from a plant through small openings in the plant's leaves.

Umbel: a convex or flat-topped inflorescence, where all the flowers arise from one central point.

Understory: the plants of a forest undergrowth; an underlying layer of low growing plants.

Invasive Plant Removal Worksheet #4

- Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs.
- Locate the section titled Can YOU Use a Dichotomous Plant Key?

At each step in a dichotomous key you are asked to choose between _____ for the plant you're trying to identify.

MYSTERY PLANT #1

What is a simple leaf?

What is the common name for this plant?

MYSTERY PLANT #2

What is an inflorescence?

What is the Latin name for this plant?

MYSTERY PLANT #3

What are rhizomes?

Draw a picture of this plant on the back of this page.

MYSTERY PLANT #4

What are dissected leaves?

This plant is a member of what family?

MYSTERY PLANT #5

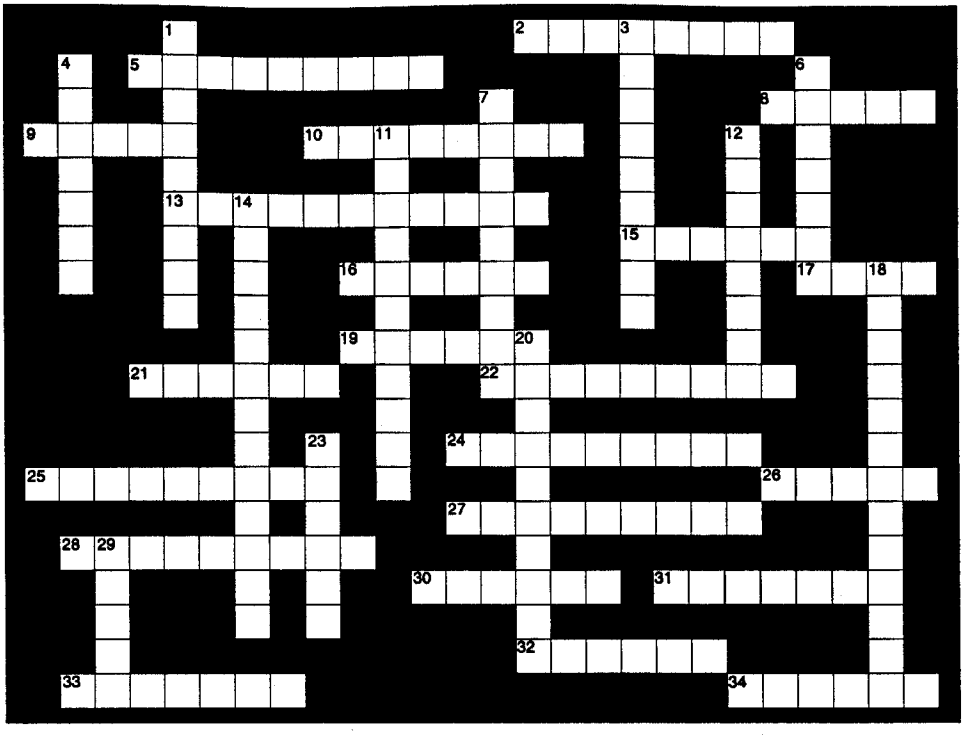
What are pedicels? _____

In what part of the world does this plant originate?

_____

Vocabulary Word Puzzle

Directions: Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs/. Find the Glossary. Find the words that match the definitions.



ACROSS

2 One leaf contains several leaves
5 To sprout
8 Leaves with round or wavy edges
9 The leaf itself
10 Leaves directly across from one another
13 Taking over natural range of native plants
15 Plants that die after 1 year
16 Female part of a flower
17 Where the leaf attaches to the stem
19 A tuft of hair
21 A leaf with only one segment
22 A plant with thick, fleshy leaves
24 Plants that lose leaves when it gets cold
25 Leaves not directly across from each other
26 A convex-shaped inflorescence
27 Leaves that look feathery
28 Male and female flowers on one plant
30 Leaves with straight, smooth edges
31 Circular cluster of leaves at plant base
32 Sweetish liquid in flowers
33 Having no stalk
34 Male part of a flower

DOWN

1 Plants that resprout without being replanted
3 Lying flat or trailing along the ground
4 Leaves shaped like a hand
6 Petals of a flower
7 Species with male and female plants
11 Leads to fertilization and seed production
12 Liquid extract
14 Loss of water from plants
18 The flowering part of a plant
20 Progressive changes in nature
23 A plant with nitrogen-fixing bacteria
29 Leaves that are egg-shaped

Planting Worksheet #1

Directions:
1. Locate a flowering plant near your school. Examine the textures and colors of the leaves, stem and petals of the plant. Complete the following.

a. Draw and label the plant in the box below.
b. Match the part with its function on the left.

_____ where photosynthesis occurs

_____ develops into a fruit

_____ absorb nutrients

_____ receives pollen

_____ supports the flowers and leaves

_____ protects flower buds

_____ supports the anther

_____ attract insects with color

_____ connects the stigma and ovary

_____ releases the pollen

2. Describe the process of pollination in detail.

_____

_____

Planting Worksheet #2

Directions: Go to Golden Gate National Recreation Area's National Park Labs web site: www.nps.gov/goga/parklabs. Locate the section titled Plant Guide and complete the following:

1. Create a chart below that categorizes and sorts the plants in the Plant Guide. Use at least 5 categories.
2. Explain how and why you chose the categories.

2. Write two questions about plant adaptation.