FINDING URBAN NATURE

An Educators' Guide to Exploring San Francisco Natural History

FINDING URBAN NATURE

An Educators' Guide to Exploring San Francisco Natural History

About the cover: The delicate plant pictured on the cover is Yerba Buena—the "good herb." This low-growing mint lent its name to a tiny Mexican village that later became known as San Francisco. This modest plant reminds us that the places we live, work, and recreate are inextricably and compellingly linked to the rich natural history that connects us to one another and to generations past and future.

COPYRIGHT © 2010 BY THE CRISSY FIELD CENTER

ALL RIGHTS RESERVED. TEXT AND ILLUSTRATIONS FROM THIS PUBLICATION MAY BE REPRODUCED FOR ACADEMIC PURPOSES ONLY AND NOT FOR RESALE. ACADEMIC PURPOSES REFER TO LIMITED USE EXCLUSIVELY WITHIN CLASSROOM AND TEACHING SETTINGS. PERMISSION REQUESTS TO REPRINT ANY PORTION OF THIS BOOK FOR OTHER PURPOSES SHOULD BE ADDRESSED TO CRISSY FIELD CENTER, P.O. BOX 29410, SAN FRANCISCO, CA 94129. THE PHOTOGRAPHS IN THIS BOOK ARE FROM A VARIETY OF SOURCES AND MANY HAVE USE RESTRICTIONS OR REQUIRE PERMISSION TO REPRODUCE. PLEASE SEE PHOTOGRAPH SOURCES AT THE END OF THIS BOOK FOR MORE INFORMATION.

PROJECT MANAGERS: NANCY CAPLAN AND CHARITY MAYBURY WRITER: ANNE HAYES ILLUSTRATOR: NICOLE A. V. JUNG PROJECT PHOTOGRAPHER: TUNG CHEE MAPMAKER: JONATHON MULLER EDITOR: SUSAN TASAKI DESIGN CONSULTANT: BILL PROCHNOW DESIGN: BILL REUTER/REUTER DESIGN



Golden Gate National Parks Conservancy

The Golden Gate National Parks Conservancy is a nonprofit membership organization created to preserve the Golden Gate National Parks, enhance the experiences of park visitors, and build a community dedicated to conserving the parks for the future. To become a member, phone (415) 4R-PARKS, or visit *www.parksconservancy.org.*



National Park Service

The National Park Service was created in 1916 to preserve America's natural, cultural, and scenic treasures, and to provide for their enjoyment for future generations. For information about the Golden Gate National Parks, phone (415) 561-4700, or visit *www.nps.gov/goga*.

THE CRISSY FIELD CENTER IS A PARTNERSHIP OF THE GOLDEN GATE NATIONAL PARKS CONSERVANCY AND THE NATIONAL PARK SERVICE.

THE CONTENTS OF THIS GUIDE WERE DEVELOPED UNDER A GRANT FROM THE U.S. DEPARTMENT OF EDUCATION. HOWEVER, THESE CONTENTS DO NOT NECESSARILY REPRESENT THE POLICY OF THE DEPARTMENT OF EDUCATION, AND ENDORSEMENT BY THE FEDERAL GOVERNMENT SHOULD NOT BE ASSUMED.

INTRODUCTION 6

PART ONE 8 Starter Kit

Tips for Teaching Outdoors 9 The Dirty Two Dozen: 24 Outdoor Activity Ideas 11 Three Great Websites to Help You Locate More Resources 14

PART TWO 15 Natural History Basics

Geology 16 Weather 22 Watersheds 29 Plants 33 Insects 38 Reptiles and Amphibians 42 Birds 48 Mammals 55 Waste, Hazards, and Pollution 62

PART THREE 68 San Francisco Watersheds

Introduction 69 Marina 70 Downtown 78 Islais Valley 85 South Basin 91 Visitacion Valley 95 Westside 98 Lobos Creek 102

PART FOUR 104 Parks and Natural Areas

Baker Beach 105 Bayview Hill 110 Bernal Hill 114 Brooks Park 119 China Beach 124 Crissy Field 127 Corona Heights 133 El Polin Spring & Inspiration Point 138 Fisherman's Wharf Area 142 Fisherman's Wharf Municipal Pier, Aquatic Park, Maritime Museum Hyde Street Pier Fort Funston 147 Glen Canyon 154 Golden Gate Park 159 Oak Woodland Strybing Arboretum Chain of Lakes Heron's Head Park & India Basin Shoreline 169 Hilltop Park 174 Lafayette Park 178 Lake Merced 182 Lands End & Sutro District 187 Lands End Fort Miley Sutro Heights Point Lobos, Sutro Baths, Seal Rocks, Farallon Islands Balboa Natural Area Lobos Creek Dunes 195 McLaren Park 200 Mountain Lake 204 Mount Davidson 209 Ocean Beach 214 SOMA Rec Center 219 Sunset Heights 225 15th Avenue Steps Grandview Park Rock Outcrop Golden Gate Heights Park Hawk Hill Telegraph Hill 233 Twin Peaks 239 Walton Square 243

PART FIVE 247 Species Cards

Flora 248 Arroyo willow Beach strawberry California blackberry Chamisso lupine Coast buckwheat Coast live oak Coyote brush Indian paintbrush Live forever Poison oak Sticky monkey flower Yarrow

Fauna 260

Insects Cabbage white butterfly Mission blue butterfly Painted lady butterfly Dragonfly

Water strider

Reptiles and Amphibians Arboreal salamander Western fence lizard Western pond turtle

Birds

Allen's hummingbird Brewer's blackbird Brown pelican California quail Great blue heron House finch Red-tail hawk Rock dove Snowy egret Song sparrow Western gull

Mammals Coyote

Raccoon Red fox Valley pocket gopher

ACKNOWLEGMENTS 284 PHOTOGRAPH SOURCES 285 APPENDICES 286

INTRODUCTION

In 2003, the education staff at the Presidio's Crissy Field Center received a grant from the federal Department of Education to help Bay Area students master state and local academic standards through the study of their local natural history. Staff members conducted surveys and held focus group meet-ings. The outcome was gratifying—in general, the teachers and students who had participated in Crissy Field Center programs were satisfied with them and wanted to see little changed. The majority of participants, however, voiced one strong desire: greater support for studying nature near their schools. There was plenty to explore at the Presidio when teachers brought their students there, but could they also do some of that exploration and education in the neighborhoods where they teach day in and day out?

The answer is yes, and this guide is intended to help you do just that. It will help you locate and learn about parks and natural areas near your schools, as well as provide enough background information so that you will feel comfortable exploring these areas with your students.

Finding Urban Nature: An Educators' Guide to Exploring San Francisco Natural History is not curriculum or a book of activities. It is written for adults who have an interest in natural history—and who are also educators. The text that follows is meant to catch your attention, spark your curiosity, and give you material you can adapt for use in (but mostly outside!) the classroom. Whether or not you are well-versed in the whys and hows of the natural world, we hope this guide will enable you to be a naturalist and to share that experience with your students.

THE GUIDE DESCRIBED

The guide begins with three short chapters that will help you get started. The first provides Crissy Field Center staff members' best tips for planning and conducting a teacher-led field trip. It is followed by a list of two dozen easy activities you can do with students in a variety of outdoor settings. After that come descriptions of three sure-fire websites that will provide creative inspiration as well as practical guidance for taking your classes outside.

After this "starter kit," Part Two provides background information. The basic topics of natural history are covered here geology, weather, watersheds, plants, insects, and so on. This part ends with a chapter that considers the impacts humans have on the natural world, particularly those associated with different kinds of waste.

Part Three of the guide provides portraits of San Francisco's seven watersheds. It includes a map that shows all the watersheds as well as a map of each one individually. These individual maps show the locations of all the schools and featured natural areas in that watershed. The watershed descriptions focus on cultural (human) history as well as natural history.

Part Four is the core of the guide. Here, you'll find descriptions of more than 35 of San Francisco's parks and natural areas. San Francisco is blessed with a great number of parks, and we could not cover them all. We chose locations that could not be ignored—the biggest and best—as well as smaller sites with exceptional natural or recreational value. We also chose locations that provided geographic spread—which, we hope, means that a place near you is included. The descriptions are written in a travel-guide style; many include a "Going Deeper" section that focuses on a particular natural history topic, such as testing for water quality, San Francisco's first observatory, or the growing number of Bay Area ravens.

Part Five provides materials you can give your students. Thirty-six species cards—one-page descriptions of common San Francisco plants and animals—feature a photo, scientific name, common name, historical uses, and interesting facts about these organisms. The cards are short and easy to read and can be used in any number of ways, some of which are described in "The Dirty Two Dozen: 24 Outdoor Activity Ideas" on page 11. Despite being only a small fraction of the many wild species – some indigenous and some exotic – found in and around San Francisco, we feel that these thirty-six represent a good variety of adaptations and trophic levels.

At the end of the guide, you will find tables that lay out the main features of each natural area in an easy-to-grasp format.

Like the natural world itself, the information in this book connects and interconnects. The discussion of pond organisms in Golden Gate Park can also be put to use for explorations at El Polin Spring or Islais Creek in Glen Canyon. The tables in the appendices will help you choose where to go and what to expect when you get there.

A FINAL WORD-SEND US YOURS!

The scope of this guide is ambitious, and the time in which it was put together was fairly short. We ask that you forgive our infelicities; we hope that you will help us correct our errors. And please let us know what works for you and what doesn't. All comments may be sent to Nancy Caplan at *ncaplan@ parksconservancy.org.*

PART ONE Starter Kit

TIPS FOR TEACHING OUTDOORS

These tips come from park and classroom educators with decades of experience in outdoor teaching. We hope they will serve as convenient reminders for those of you who are veterans in facilitating outdoor lessons, and that they will help build confidence in those of you with less experience. We wish you many memorable and stress-free outdoor adventures!

Visit a site prior to taking your class. This will give you a chance to assess trail conditions, locate facilities, and verify the plants and animals your class may find. If possible, use the mode of transportation that your class will be using to help you estimate travel time and locate bus stops or parking.

Use a backpack as an emergency kit. Stock it with first-aid supplies, student health forms, a list of student allergies, plastic bags, paper towels, and tissues. Program emergency phone numbers into your cell phone before leaving for a field trip.

Remind your students and chaperones to dress

for the occasion. They should wear sunscreen and closed-toe walking shoes with good tread, and dress in layers to accommodate quickly changing weather. You might want to have your class wear their school uniforms or designate a color for caps or scarves, which can help you keep track of your group.



This student is prepared for rain or shine.

Plan for the unexpected. If your lessons depend on finding things, bring samples or pictures of items that may be hard to locate. Scope out a sheltered area in case of windy or wet weather. Have at the ready one or two easy alternative activities in case you finish your lesson early.



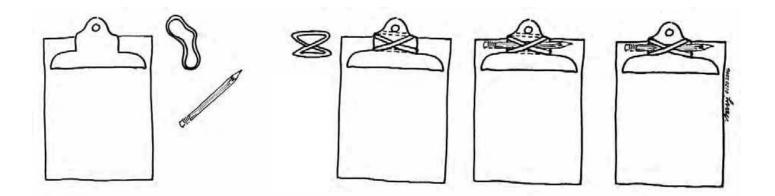
Using a simple digital camera enhances this student's outdoor experience.

Bring lots of drinking water.

Bring learning aides such as binoculars, field guides, magnifying glasses, bug boxes, digital cameras, and the species cards from this book.

Allow adequate time for your activities and build in extra time for "teachable moments" that may arise. Allow for unstructured free play and exploration.

Set clear geographical boundaries for your students before sending them off to do an activity or giving them free play.



Learn to identify all seasonal forms of poison

oak. Bring poison oak ointment in case of accidental exposure. Bring photos of poison oak so you can show your students. Teach your class "Leaves of three, let it be. If it's prickly and hairy, it's probably a berry."

Remind your students to avoid putting anything in their mouths, including berries, mushrooms, and fruits. You may be sure items aren't poisonous and haven't been sprayed with pesticides, but if you model "edible nature" for students, they're likely to nibble when you're not there to supervise.



This instructor faces the sun so her students don't need to look into the glare to see her.

When talking to your group, position yourself so your students have the sun at their backs and don't have to strain to see you.

If some of your students are frightened or grossedout by bugs, try sharing interesting facts about different species or talking about bugs' place in the ecosystem.

A rubber band is a handy way to attach a pencil to a clipboard.*

Remind your chaperones to model engaged behavior during your field trip. If adults display wandering attention by talking with each other or on cell phones, students will also have trouble engaging.

Teach your students a healthy land ethic. Remind your class to leave an area cleaner than they found it. If your class knows to "take only memories and leave only footprints," they will be welcome guests in natural areas.

THE DIRTY TWO DOZEN 24 OUTDOOR ACTIVITY IDEAS

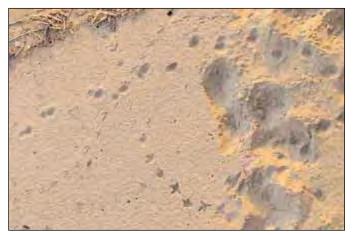
The following activities made our list of favorites because they can be adapted for a wide range of grade levels, connected to academic standards in many subject areas, and require little in the way of special equipment. A quick Internet search will yield background information and instructions for any of the activities we reference here.

Make leaf rubbings. This can be done with leaves that have either already fallen to the ground or are still attached to their stems; there is no need to pull leaves from plants. Use the leaf rubbings to study leaf structure or adaptations, compare and contrast features, make a plant guide, or create cards and collages.

Do tree geometry. Measure the height of a tree and its circumference. Figure out the diameter and radius of a tree trunk. Calculate the volume of a tree trunk.

Study the history of a site. What vegetation and animals were found there 100 years ago, 200 years ago, 1,000 years ago? How has the site been used? Who were the primary users? What kind of impact did they have on the area? Use the information to write an article for the school newspaper.

Search for animal evidence. Look for tracks, scat, holes, nests, webs, and feathers. Use field guides to identify the animal that left the evidence. Create a scavenger hunt. Flag the evidence and do a show-and-tell hike. Theorize why different animals come to the area.



Animal tracks can often be found in sand and mud.



Predicting, measuring, and graphing water temperature are inexpensive and easy ways to begin a water investigation.

Use the species cards from this book. Take some cards to a site and look for the species. Appoint class experts for each species. Do additional research and create posters and reports. Use the cards as models to create your own set of species cards and give the new cards to a younger grade. Use the cards for an "Each One Teach One" hike.

Test the water. Graph the results for temperature, pH, phosphates, nitrates, and other parameters. Predict and then measure water flow and water depth in different seasons or before and after rainstorms. Compare and contrast parameters at different sites. Revisit a site several times, repeat the tests, and graph the trends.

Do a transportation study. Count the number of passers-by during a fixed time period. Interview people at a site to find out if they used public or private transportation to get there. Graph how people get to and travel through the site.



Keeping their bodies in three points of contact with the rocks is the safest way for students to explore the riprap.

Have a discussion about how human transportation has an effect on natural areas.

Identify rocks. Study the rocks in easily accessible riprap. Look at a geological map of California or San Francisco and theorize where rocks came from. Categorize rocks by color, shape, size, and/or type. Use magnifying lenses or field scopes to examine sand and sort the grains by size and type. Discuss the rock cycle.

Keep journals. Make sketches and write descriptions of the plants and landscapes you see. Make repeat visits to a site throughout the year and record the changes from season to season. Note differences in weather, vegetation, water levels of streams and ponds, animal activity, erosion, size of beaches, wave activity, human usage, etc.

Conduct an aquatic macro-invertebrate study.

Identify the organisms present in a body of water. Determine whether the organisms are pollution-tolerant or -intolerant. Calculate the biodiversity index.

Plan a picnic. Research nutritional requirements for specific ages. Use math to adjust recipe quantities for large groups. Graph the calories and nutrients in each serving of food.

Study interdependence. Categorize elements at a site as biotic or abiotic. Investigate how each element interacts with the others at the site. Play a "food web game." Make a poster depicting the interconnections between species in an ecosystem.

Measure the weather. Make tools such as wind socks, weather vanes, and anemometers. Predict and measure the weather in different areas and at different times of the year. Discuss and map Bay Area microclimates.

Conduct a soil study. Gather soil from different areas of a site. Compare and contrast the color, texture, and particle size. Make soil shake jars to determine the percentage of sand, silt, clay, and organic matter in the samples.



Students use math skills to plan a picnic lunch and develop a sense of teamwork while cooking together.

Study habitats. Observe and take notes about a site and discuss how the resources meet the needs of the animals who live or visit there. Consider the impact of humans on the animal populations. Do a study of how people use the area, and write a report on how human actions can positively or negatively affect animals.

Follow a controversy. Track current events regarding the use of a specific site. Visit the site and conduct interviews with people using the area. Invite an expert to speak to your class about the issues. Have a class debate. Allow students

to form their own opinions about the controversy and write letters to appropriate authorities.

Write poetry. Go to a natural area and write about whatever is inspiring. Try haiku, cinquains, limericks, or free verse.

Focus on solid waste. Map the garbage at a site. Make an "unnatural trail." Discuss how solid waste affects wildlife. Organize a litter clean-up with the appropriate agency.

Go birding. Research common birds or use the species cards from this book. Think about each bird's beak, feet, and other features and predict which birds you might see before visiting an area. Use a tally sheet to keep track of the birds you encounter. Discuss the ways different birds are adapted to the resources in an area. Study a map of the Pacific Flyway and try to determine which birds are migratory and which are year-round residents.



Even young students enjoy identifying common birds.

Study watersheds. Visit a site with a view of the city and see how many watersheds and subwatersheds you can identify. Predict where water will flow when it rains and check your predictions on a rainy day. Build a water cycle model in a jar to take out on a sunny day. Visit several sites in the watershed in which your school is located and map the impact of human activity.



Small animals are common and can easily be observed with a field scope or hand lens.

Get musical. Use musical instruments to mimic the natural sounds you hear. Make rainsticks and other instruments from natural materials.

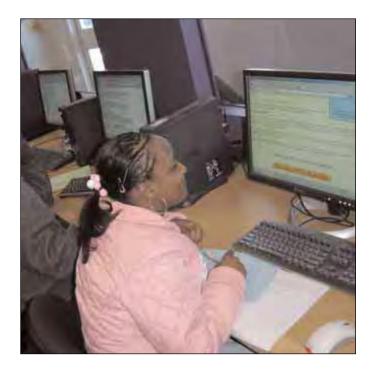
Do a noise study. Create sound maps of an area, or map several areas and compare them. Reflect on the ways various noise types and volumes affect people's moods. Discuss how urban noises and natural noises affect the atmosphere and enjoyment of natural areas.

Create a tour of a natural area. Use mapping skills to draw a route. Research interesting facts about the plants and animals that might be observed while following this route. Use math to estimate the walking time between stops and the length of the tour.

Study the reasons nature is important to humans.

Note the different kinds of plants, minerals, soils, and rocks at a site. List as many everyday uses for these items as you can. Make a class mural depicting the ways that people enjoy our natural areas. Try to imagine a world without natural areas.

THREE GREAT WEBSITES TO HELP YOU LOCATE MORE RESOURCES



SAN FRANCISCO UNIFIED SCHOOL DISTRICT ECOLITERACY

www.sfecoliteracy.com

This SFUSD website offers a compendium of resources that includes fieldtrip opportunities, service learning programs, classroom and assembly presentations, curriculum materials, school projects, and teacher resources.

CALIFORNIA REGIONAL ENVIRONMENTAL EDUCATION COMMUNITY NETWORK

www.creec.org/region4

The CREEC Network's website features a searchable directory of environmental education programs and resources by topic, location, and grade level. This site also incorporates a discussion group, a newsletter, and a calendar of events and professional development opportunities.

SAN FRANCISCO EDUCATION FUND

www.sfedfund.org

This website includes information for educators on professional development grants, classroom volunteers, and service learning. You'll also find resources for students and a calendar of events.

PART TWO Natural History Basics

FINDING URBAN NATURE: BASICS/GEOLOGY



GEOLOGY

When compared to other planets, ours is not terribly large. Even so, if you could take an elevator from the Earth's surface to its center, you would descend almost 4,000 miles. You would bore through cold, hard rock and super-hot molten rock before reaching Earth's dense core. The top layer, where we live and breathe, is as thin as an eggshell compared to the Earth's interior, but from a human point of view, the Earth's surface is the most interesting part of the planet.

THE GROUND WE WALK ON

The very uppermost surface, the Earth's skin, so to speak, is soil. These tiny particles of rock and organic material have been broken down by wind, water, and living organisms to become the medium in which nearly all plants grow and upon which much of life depends. Depending on circumstance, soil may be a few inches or many feet deep. There are many different kinds of soil. At Point Lobos and Lands End, the ground is a sticky clay, while at nearby Ocean Beach, it is not even soil, strictly speaking—it's pure sand. The character of soil is determined partly by climate but mainly by source material—that is, by the rock from which it comes.

WHAT'S A ROCK?

Rocks are fundamental. They're composed of minerals, which themselves are either single or compound elements. Minerals are—or are a combination of some of the basic building blocks for all matter on Earth. The most common elements in mineral rock are oxygen and silicon. How these elements are developed or combined, however, is the story of how rocks are formed on Planet Earth.

SEDIMENTARY ROCKS OF SAN FRANCISCO

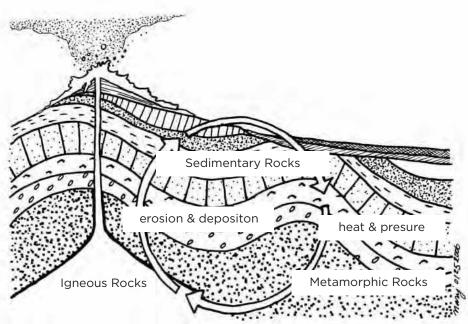
Because it was easy to observe, one of the first rock-forming processes that

geologists came to understand was the creation of *sedimentary rocks*. Wind and moving water both carry sediment—particles of soil and rock. Wherever they slow down, they drop their load. So dunes pile up behind beaches, and mud collects at slow places in a river or slowly builds up on the ocean floor. These layers of sediment, over long, long stretches of time, compact and harden into stone.

There are several different kinds of sedimentary rock in San Francisco. The most common is *graywacke*, a kind of sandstone. It is dark gray when newly exposed but weathers



Graywacke



Burial (subduction)



Chert

to light brown or orange. It is very hard and underlies many of San Francisco's hills, especially on the eastern side of the city. It breaks into square-shaped chunks that feel gritty, like sandpaper.

Chert is another San Francisco sedimentary rock. It can be many colors—black, red, green, brown, or white—but in San Francisco, it is most often red. It is made of the skeletons of tiny sea organisms called *radiolaria*, which appear as gray dots when seen through a lens. Chert is very hard and smooth and breaks into rectangular pieces that have sharp edges. Where it is exposed on hillsides and road cuts, you can often see its sedimentary layers. It is sometimes called *ribbon chert* because its layers look like long, wavy ribbons.

Chert and graywacke are San Francisco's most common rocks and can be found in numerous locations throughout the city. paste that have been squeezed from the tube. In most places where it is visible today, though, the pillows are no longer evident. Our basalt is a porous rock that is easily weathered, so its surface changes relatively quickly. In its weathered form, it is dark orange or brown and nubbly to the touch. When it is fresh, it is dark green and has a slightly smoother surface. Pillow basalt breaks in curves rather than straight lines.

IGNEOUS ROCKS OF SAN FRANCISCO

The second main grouping, *igneous rock*, is not layered and doesn't contain sedimentary particles that have been cemented by pressure and time. The word "igneous" comes from the same root as the word "ignite." This is a reference to fire and, to put it poetically, the fires in the Earth from which such rocks were formed. Igneous rock is the solidification of magma, molten rock inside the Earth. Such fiery origins are sometimes highly visible, such as on the islands of Hawai'i. The

PVC pipe is used to define a study area for pre-service teachers attending a National Park Service geology training.

lava that flows down the sides of Hawai`i's volcanoes cools and hardens into rock. (When magma reaches the sea floor or Earth's surface, it's called *lava*.)

Some igneous rocks, such as granite, form beneath the Earth's surface. We don't have any in San Francisco, but granite can be found not far away, at Point Reyes and in Yosemite. San Francisco does feature an igneous rock that formed on the Earth's surface, but underwater, on the ocean floor. Called *pillow basalt*, it was once rounded in shape, like big rolls of tooth-



Serpentinite

and Twin Peaks.

METAMORPHIC ROCKS

You can find it on Corona Heights

OF SAN FRANCISCO

The third great group of rocks is *metamorphic*. However, unlike caterpillars that become butterflies, rocks do not undergo complete metamorphosis. Within the Earth's crust, metamorphic rocks are subjected to enough heat and pressure to form new minerals, but they keep some of their old characteristics as well. Greenstone is one of San Francisco's metamorphic

rocks—it is basalt that's been pressurized. It has a rough texture, like basalt, but is denser, gray-green in color, and breaks in uneven chunks. There are greenstone outcrops along the coastal trail at Lands End and at Corona Heights.

Our state rock, *serpentinite* (see sidebar), is also metamorphic. It is common in parts of our state but uncommon in much of the United States. A big vein of serpentinite runs diagonally through San Francisco, from northwest to southeast. Serpentinite was formed in the upper part of the mantle, below an oceanic plate, when it collided with a continental plate. The serpentinite was squeezed up and water was forced into it, much the way steam is forced into food in a pressure cooker. Serpentinite is smooth, light to dark green, and slick to the

SERPENTINE VS. SERPENTINITE

When California legislators designated serpentine as our state rock, they made a mistake. Serpentine is the mineral group that makes up the rock; the name of the rock itself is *serpentinite*.

18

touch, like the skin of a serpent. It breaks into angular blocks. Serpentinite can be seen at Fort Point; Baker Beach and Inspiration Point (in the Presidio); at the old US Mint on Market Street (which sits atop a huge block of it); and in parts of Potrero Hill, especially at Starr King Elementary School.

BEDROCK AND FORMATIONS

All of the rocks we've described so far are basement rocks the older parts of the geological landscape. Geologists distinguish between basement, or bedrock, and younger rocks that have been created or deposited more recently. The mix of bedrock in our area is called the Franciscan Complex. In some places, these rocks are right at the surface, while in others, the bedrock lies beneath younger rocks that have formed on top. There are two formations of younger rock in San Francisco, called the Merced and Colma formations. They are sedimentary rock layers that occur mostly in the western part of the city. And in many places, there's sand on top of them.

Bedrock is what gives San Francisco its hills. Hard rocks such as graywacke and chert resist erosion and so remain standing, while weaker rocks—such as shale—are worn down. These weaker rocks are less common in the landscape because they've been eroded away.

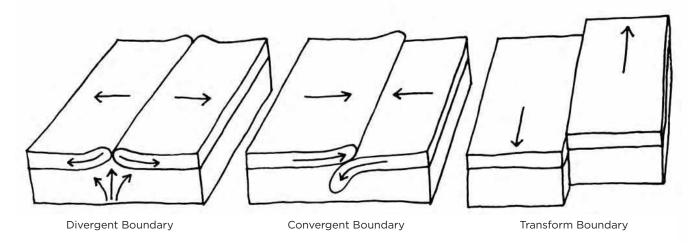
CRUST AND MANTLE

Franciscan bedrock and the formations above it are part of the Earth's crust—the varied units of rock that make up the surface of the Earth. The crust covers both areas we can see on land, and where we can't, under all the oceans. On land, the crust can be up to 30 miles thick. (The Franciscan Complex is about 6 miles deep.) The crust covering the ocean floor is thinner—only about 3 miles deep. The character of the Earth's crust also differs on land and at sea. Oceanic crust contains heavier, harder, and darker rock because it is made of basalt, which is heavy, molten mantle material.

If you compare the Earth to an egg, the crust is its shell. The yolk is the Earth's core, and the white—the layer between the core and the crust—is called the *mantle*. It, too, is made of rocks, but they are molten and, because they have more iron and magnesium in them than surface rocks do, are heavier and denser than rocks in the crust. At places along the seafloor where there are breaks in the Earth's crust, mantle rock slowly oozes out, adding material to the planet's surface. Geologists also have evidence that the mantle is in motion—imagine a pot of boiling water—and that it is causing the Earth's crust to move, as well.

PLATE TECTONICS AND THE TERRANES OF SAN FRANCISCO

Rather than being a solid mass, the Earth's crust is made up of separate pieces, or plates. There are twelve large and many smaller plates, tightly fitted but nonetheless in motion. They're either oceanic or continental, and they move away from each other, toward each other, or past each other. Here in San Francisco, we see the effects of all three kinds of motion. The seafloor splits and new rock flows out, creating a boundary between plates. Another boundary can be found





A pre-service teacher uses a loupe to examine a rock specimen during a National Park Service educators' workshop.

where ocean plates meet continental plates, such as along the full extent of the Pacific Coast. In California, we owe the variety of our rocks, our topography, and our earthquakes to the fact that we live at the meeting place of two of the Earth's great plates.

In San Francisco, we are on the edge of the North American Plate. It rubs up against the Pacific Plate, which is moving, as a result of seafloor spreading, at the rate of about 2 inches per year. (This may not sound like much, but over millions of years, those inches add up.) The Pacific Plate is trending in a northwestern direction, a fact that you can see reflected in the orientation of the mountains of the peninsula. San Bruno Mountain, for example, runs in a northwest-to-southeast line.

Where two plates converge, there is immense compression. Because it is thinner and heavier, the oceanic plate gives way to the continental, sliding underneath it. It descends back into the mantle in a process called *subduction*. During subduction, pieces of the descending plate get scraped off and left behind. These accreted rocks, called *terranes*, end up piled at the edge of the continental plate. Most Franciscan rocks— San Francisco's basement rock—are these broken-off edges of the Pacific Plate.

San Francisco has three terranes and two melange zones. (*Melange* is a French word meaning mixture. In melange zones, the rocks are a big mix rather than being distinct, congruent units.) These five swaths of stone are visible in the San Francisco landscape. The Marin Headlands Terrane, for example, is a band of mostly chert that extends through the middle of the city and across to Marin County. Standing at Twin Peaks, one can look north to the Marin Headlands and see the same kind of rocks underfoot and on the other side of the Golden Gate. And the band of serpentinite described earlier is a part of the Hunter's Point melange zone that was squeezed up between the terranes.

FAULT LINES

When plates move toward each other, they are subject to compression and subduction. But plates in motion don't have to hit head-on; they can also slide past one another.

This form of plate interaction is called *transform* motion. There is a very well-known transform plate boundary in San Francisco: the San Andreas Fault. It marks the meeting place of the Pacific and the North American plates. The San Andreas sponsors, if you will, a system of related faults fractures in the Earth's crust—including the Hayward Fault in the East Bay.

Though we describe the plates as sliding past one another, this action is rarely smooth. The plates' edges are uneven, rocky, and brittle. As they move past one another, rather than slide, they grind. They catch. The rocks bend. Pressure builds up in

ZONE OR LINE?

Geologist Deborah Harden reminds us that "the actual boundary between the Pacific and North American plates is best thought of as a wide zone, rather than a line. The effects of plate motion, such as earthquakes and mountain ranges, are seen across the state. The question 'Where is the exact boundary between the Pacific and North American plates?' has no precise answer." places where the plates get stuck. When the rocks finally move and that pressure is released, there's an earthquake. Most earthquakes take place close to the surface of the Earth's crust along transform faults such as the San Andreas.

EARTHQUAKES

The force of an earthquake can be measured in two ways the Richter Scale and the Modified Mercalli Scale. The Richter Scale is better known and is based on seismograph records. It is a base 10 logarithmic scale, so a magnitude 8 earthquake is ten times stronger than a magnitude 7. The 1906 earthquake in San Francisco measured 8.3 on the Richter scale; 1989's Loma Prieta earthquake was a 7.1.

The Modified Mercalli measures earthquake intensity based on damage to buildings. This scale is easier to grasp in some ways, because it makes reference to what we experience during an earthquake—hanging objects swinging; dishes, windows, and doors rattling; houses moved off foundations. To distinguish it from the Richter scale, the Modified Mercalli uses Roman numerals from I to XII.

Energy released by an earthquake travels through the ground in waves. This is the rumbling that we hear and feel. The effect of an earthquake is determined to some extent by the kind of rock through which these waves travel. To quote retired geologist Ted Konigsmark, "Where rocks are solid and hard, the earthquake waves travel fast and shaking is minimized. In soft, unconsolidated rocks, the waves travel slowly and the shaking is maximized, like shaking a bowl of Jell-O." Loose ground can amplify shaking by as much as ten times.

In San Francisco, unconsolidated rocks (sand and mud) can be found in the land along the bayshore, where marshes once were or where fill has been added. The places that shake the least are Franciscan bedrock—our hilltops.

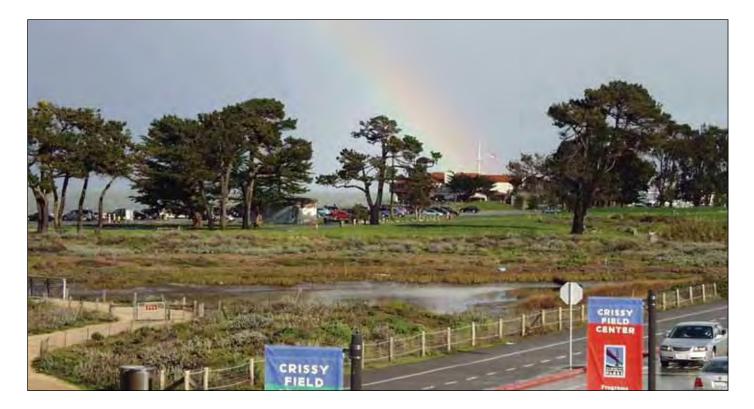
FOR MORE INFORMATION

As part of a five-year program to involve more high school students in earth science studies, San Francisco State University has developed San Francisco-based curriculum materials that are accessible online. To learn more, visit *sf-rocks.sfsu.edu*. Especially interesting is the section on defining watersheds, which can be found at *sf-rocks.sfsu.edu/old_rocks/watershed.htm*.

To help volunteers and rangers who give geology talks in national parks, the National Park Service has posted some very helpful basic geology information online at www.nature.nps.gov/geology/usgsnps/project/interp.html.

The introductory chapters of Ted Konigsmark's *Geologic Trips: San Francisco and the Bay Area* (Geopress, 1998) provide good local information in nontechnical language, as well as an illustration of San Francisco terranes, a useful chart of San Francisco rocks and their main characteristics, and so on.

The US Geological Survey also has a wealth of information online, including web pages designed specifically for educators. Visit *education.usgs.gov*. San Franciscospecific information can be found at *sfbay.wr.usgs.gov*.



WEATHER

One aspect of the natural world that is always available to us is the weather. And there are few places in the Northern Hemisphere with weather like San Francisco's—our "summer" comes in October, and blazing warm spells in November and February are not uncommon. In August, though the days are long, the keynote is fog.

Above all, the city's weather is influenced by its proximity to the ocean. But there is another ocean that also affects San Francisco and is the seat of the whole world's weather. Our atmosphere—the ocean of air above and around us—is like the skin of an apple, a thin covering that protects and shields what's inside. The atmosphere is thin relative to the size of Earth, but thick—that is, tall—when compared to human stature. The whole of our atmosphere extends more than 300 miles above us and has several layers. All of Earth's weather takes place in one of them, the troposphere, a seven-mile-high layer of air around and directly above us.

Our atmosphere is the medium for all our weather, but it is not the cause. In the book *Skywatch West: The Complete Weather Guide* (Fulcrum, 2004), author Richard Keen says that five ingredients are needed to make weather. "Give your planet some air," he writes, then "heat it with sunlight, rotate the planet to get air currents turning, add some water (how else could you get rain?), put in some continents and oceans for variety, and Eureka!" You've got weather.

SUN AND WIND

The energy of the Sun catalyzes weather on Earth. Just as it warms our skin, sunlight warms the air, land, and water upon which it falls. But because the Earth is tilted in relation to the Sun, not all parts of the Earth and atmosphere are warmed evenly.

At the Equator, sunlight hits the Earth directly. North or south of the Equator, it strikes at an angle. Where sunlight comes in at an angle, its beams are more spread out. The same amount of energy travels to the Equator as elsewhere on the globe, but



at the Equator, its energy is concentrated over a smaller area and it generates more heat. At the North and South poles, where the Sun's angle to the land is greatest, the sun provides much less warmth—as evidenced by the low temperatures and great sheets of ice at both poles.

The fact that part of the globe is always being warmed while other parts are not is the main force behind the weather, because these differences in temperature result in air movement and change. Warm air at the Equator rises while the cold air of the poles descends, creating "cells" of air flow that are comparable to the motion of water boiling in a pot.

Add to this mix the rotation of the Earth, and air movement which is to say, wind—becomes more complex. But certain patterns do emerge: between the Equator and 30 degrees latitude, there are reliable easterly winds, while in the mid-latitudes, roughly between 30 and 60 degrees, westerlies prevail. (The names of winds refer to the direction they come from, not the direction toward which they're blowing.) San Francisco, at 37 degrees north, is in the mid-latitudes. Most of our wind comes off the Pacific.

The factors that cause wind and influence its direction are complex, but there are a couple of patterns that are easy to grasp, and they explain quite a bit of what we experience day-to-day. To make sense of these, you have to first understand that, thanks to gravity, air has weight. It presses down on the Earth. Its force is measured with a barometer. Air pressure in any given locale can change based on several variables, the most important of which is temperature. Cold air tends to weigh more—it presses down with greater force. Hot air, which rises, creates areas of low pressure.

PACIFIC OCEAN HIGH

One of the influences in our weather is the Pacific High an area of high pressure that frequently occurs over the Pacific Ocean, according to Harold Gilliam, "somewhere between San Francisco and the Hawaiian Islands. Air is warmed by the hot sun over the Equator," he explains, and "rises and heads northward toward the Arctic. Some of it cools off and sinks to the ocean surface several thousand miles to the north, where it becomes the Pacific High—a 'mountain' of cool air weighing heavily on the water surface." Some of our best weather occurs when this high drifts closer to shore and becomes stationary, sitting over us like a gigantic transparent dome, keeping skies clear and bright.

More often, however, the Pacific High is farther offshore. In the fall it often lies to the south of us; in the spring it often migrates north. Wherever it is, the Pacific High pushes air out away from it—"air always blows outward from an area of high pressure," Gilliam writes. This movement of air from highto low-pressure areas is also known as wind.





THE INFLUENCE OF THE LAND

In central California, the land can also draw wind to it, especially in the spring, when the days are lengthening and temperatures are rising. In these conditions, air pressure is likely to be lower over land, and westerly winds—pushed by the high and drawn by the low—come rushing across the ocean toward shore.

In many places, however, they are blocked from flowing onshore. The winds meet the Coast Range—"there," writes Gilliam, "they are prevented from moving inland... and so they blow on down the coast, breaching the mountain barrier only where gaps and passes in the range permit tongues of ocean air to penetrate inland."

As the wind moves south along the coast, it pushes the surface of the ocean in front of it. As the surface waters are displaced, cold water wells up from below. As a result, throughout the summer, we get the chilly water for which our beaches are known. We also get fog.

FOG CITY

When the wind comes into contact with this cold water, the moisture it has picked up from blowing over the surface of the ocean condenses into sea-level clouds, also known as fog. The fog hovers along the coast—it "may range in width from a hundred yards to more than a hundred miles, in height from a hundred feet to half a mile," Gilliam tells us. And because the Golden Gate offers a mile-wide break in the Coast Range, the fog flows in through it. We see this pattern especially in the summer, when temperatures inland are at their highest.

When Gilliam wrote the first edition of his book, this was as far as his discussion of summer weather patterns went. More has been learned since then, and the second edition, published in 2002, includes a discussion of the jet stream, a phenomenon that was discovered

over the Pacific during World War II. Then, pilots flew higher than they ever had before—and ran into steady currents of wind flowing like rivers through the sky. Today, they are known as jet streams.

RIVERS OF AIR

As with so much of our weather, jet streams are triggered by differences in air temperature. Air pressure also comes into play, creating superfast winds that whip and writhe like water



WEATHER WATCHING

In the opening of the chapter "Watching the Weather," author Richard Keen describes the interest that our first, third, and fourth presidents took in this subject. George Washington kept an "Account of the Weather" for thirtythree years; Thomas Jefferson kept one for forty. "They understood," Keen writes, "that the best way to learn about something is to participate in it, and to participate in the changing weather means to observe it closely."

Close observation can be as simple as looking at the sky each day, or it can be as involved as measuring multiple parameters with state-of-the-art equipment. The most essential tool, according to Keen, "is some form of recordkeeping. Memories change with time," he explains, "with big storms getting bigger and small storms smaller." Without a notebook, Keen laments, "most days disappear entirely. If you only have a dollar to spare," he says, "invest in a notebook."

As for what to record in that notebook, here are the basics.

• **Temperature.** Air temperature is a function of air source. Our cold air, for example, comes from the north. "Cold air masses responsible for the low tem peratures at any location in the West form over the arctic regions of northwest Canada, Alaska, and Siberia," Keen explains. Whatever warmth the air there may have, it loses it during the winter, when these areas receive very little sunlight. "The longer the air stays," Keen continues, "the colder it gets. Eventually, these refrigerated air masses are taken south by cyclones forming along their southern boundaries"— and we get cold weather. In a similar way, our warm temperatures come from the warm air of the south.

To measure the temperature, post your thermometer in the shade—a north-facing fence post is good. Keen recommends a maximum/minimum (max/min) thermometer, which will tell you the day's high, low, and current temperatures. It has indicators you can use to mark the high and low; when you return the next day, you can compare current readings with yesterday's. Pick a consistent time of day to read the thermometer—the best time is when the temperature is midway between high and low, which turns out to be about 9 a.m. (or 10 p.m.).

• **Dew Point.** All air carries water; the dew point is the temperature at which water condenses out of the air. So to measure the dew point is to measure the amount of moisture in the air—the higher the dew point, the higher

the moisture level. The tool for this is a wet bulb hygrometer, which Keen says can be had for \$30 to \$40. It's worth having one because, according to Keen, tracking dew point demonstrates "how the air's moisture content changes with different air masses.... In coastal regions, the dew point changes sharply as winds switch to and from the ocean."

• **Rainfall.** Per Harold Gilliam, the rainfall measurements given in the newspaper are "based on observations made in one place—Duboce Park." But, he goes on to say, those readings might not fully reflect conditions elsewhere in the city because "the city's hills and valleys may cause variations." None have been officially measured, however. Gilliam says that any such variations "remain speculative and offer opportunities for amateur weather buffs to make their own discoveries."

To make your own discoveries, or to compare your rainfall with that of Duboce Park, all you need is a rain gauge. A decent one can be had for about \$10 (Keen recommends the plastic "wedge" made by Tru-Chek); better ones are about \$30. Post the gauge away from anything that might block the rain; the general rule is to place it at a distance at least equal to the height of any obstruction. Read the rain gauge daily during the school year, starting with the first rain.

- Wind Speed and Direction. High wind speed makes for some of our most memorable storms; wind direction, as described earlier, is an integral part of understanding stormy weather. The standard tool for measuring wind speed is a gauge known as an anemometer. There are a variety of models, ranging from \$40 at the low end to \$300 or so. You can make do without one, however, relying instead on the Beaufort Scale, which correlates wind speed to visible phenomena such as smoke rising, the movement of trees, and damage to buildings. High-end anemometers also measure wind direction; a good old weather vane, or a wind sock, posted high, will do the same thing.
- **Barometric Pressure.** "Pressure—that number read off a barometer—is simply the weight of the overlying air," says Richard Keen. Though Keen warns that the conventional correlation of high pressure and fair weather, low pressure and storms doesn't always apply in the western US, he recommends buying a barometer— "decent ones are \$20 and up"—and reading it once or twice a day. Get one and see for yourself.

FINDING URBAN NATURE: BASICS/WEATHER

streaming from the end of a hose. Though speeds of 150 miles per hour are more common, jet streams sometimes move at 250 miles per hour or more. Always, they remain at very high altitudes, 3 to 7 miles above the Earth. According to the authors of *Weather: A Visual Guide* (Firefly, 2004), "they can be thousands of miles long, hundreds of miles wide, and just a mile or so deep."

There are two jet streams in each hemisphere; the one we are most affected by on the West Coast is the polar jet, so-called not because it runs all that close to the North Pole, but because it is the northernmost jet stream in the Northern Hemisphere. "Its normal summer track," according to Gilliam, "is across central Canada." In the winter, as the temperature differential between the Equator and the poles increases, the polar jet is more likely to dip south, sometimes traveling directly over the Bay Area, moving air and clouds and weather with it.

The jet stream's speed is often greater in winter, and that speed has an impact on the upper air. "When the jet blows too fast," writes Richard Keen, "it starts to buckle. The buckling takes the form of troughs and ridges in the upper atmosphere." It's as though the air high above us gets bunched up in places and loosened in others. The ridges become areas of high pressure; the troughs become low-pressure spots. Gilliam describes these fluctuating pressure areas as "recurrent waves of high- altitude pressure changes... [that] advance from west to east, over the ocean and onto the continent, much like successive crests and troughs of ocean waves."

Though all of this is taking place miles above us, these upperlevel phenomena have an effect on the lower part of the atmosphere, where we experience the weather. Disturbances above can result in storms below.



STORMY WEATHER

On the ground, we experience storms as cloudy weather, strong winds, and rainfall. If we were hovering above the jet stream at the height where satellites fly, and looking down on these storms, we would see each one as an enormous, slow-spinning spiral of clouds. Meteorologists call all storms cyclones, and each has the circling pattern that we associate with tornadoes and hurricanes. A typical cyclone, however, lacks the stupendous power of some of the tropical hurricanes that strike the United States' Eastern Seaboard and Gulf Coast.

Though their intensity varies, every storm is caused by the meeting of two air masses—one cold, one warm. Their interaction results in some of our most memorable weather. "The two masses do not immediately merge," Gilliam tells us, "but may flow past each other in opposite directions." Eventually, however, they begin to influence one another. Typically, a pocket of warm air will rise above the cold air. "As it rises," writes Gilliam, "it creates a low pressure area, which sucks in wind from all directions to replace the air that has risen." Because the Earth rotates, the wind curves as it rushes in, and that, according to Gilliam, causes "the entire air mass to begin to move around in a counterclockwise direction, forming an eddy." This is a cyclone. "At the center of the cyclone the rising warm air cools and its moisture condenses into rain." Thus, concludes Gilliam, "a storm is born."

On the ground here in San Francisco, "the onset of a storm," Gilliam tells us, is often signaled by "a change in wind direction accompanied by low cloudiness." Our storms come from the Pacific, borne in on our westerly winds. But the spinning winds of the storm itself will cause a shift in wind direction on As a storm passes across the Bay Area, its winds will continue to change direction, "usually from south to west and finally to north," according to Gilliam. As the storm abates, the wind will shift to the west and, according to Gilliam, be accompanied by lighter rainfall. A north wind often marks the tail end of a storm; it "brings intermittent showers as the low-pressure storm center moves on to the east."

WERE IT NOT FOR THE CLOUDS

During a storm, the clouds above us can look and feel like nothing more than a weighty gray ceiling that blocks sunlight and drops too much rain. Fog, too, can seem equally obscure—

the ground. Winds circling the low pressure center of the storm "will come to the Bay Region from a southerly direction," writes Gilliam. "The exact direction... depends on whether the storm center is to the northwest or southwest.

"A storm center may move toward the coast from any part of the Pacific between the

Gulf of Alaska on the north and the Hawaiian Islands on the south," he continues. "Storms from the Alaska region begin



being in a cloud, or just below one, gives us little opportunity to see what it is we're experiencing. When observed under a variety of conditions, however, clouds can be seen, to borrow Gilliam's words, as "signs of momentous happenings in the atmospheric regime." Clouds provide us, he says, with "clues to the weather and broad currents of air passing overhead." What's more, they're often beautiful.

with a southwest wind and tend to bring cold air. They occasionally bring snow to Bay Region mountaintops," as they did in early spring 2006. Storms from the vicinity of Hawaii, on the other hand, are warmer and wetter.

The winds that announce the arrival of these storms come from the southeast. Because they develop from warmer air masses, they carry more water—warm air has a greater capacity to hold water than cold air does. These storms bring heavy rains and often cause flooding. Clouds are water vapor become visible. Our winds, which all come off the Pacific, collect moisture as they cross that vast body of water, evaporating it from the ocean's surface. Though the amounts of water in the air are minute, "that small concentration of water in the air," writes Richard Keen, "is responsible for much of what we call weather. In fact," he says, "nearly all the visible phenomena that make the weather so interesting are... water in one form or another." Chief among these are the clouds.



revalence in the popular imagination. Cumulus clouds can also grow to great heights, burgeoning upward, as Gilliam so eloquently describes, "around the shores of San Francisco Bay during late winter and early spring, rising above the surrounding mountains to reflect and refract the sunlight in resplendent architectural structures that slowly change shape."

Stratus clouds, which form in flat layers, have been described elsewhere in this guide (see the Telegraph Hill site description). There are two other kinds of clouds—cirrus and cumulus. Cirrus are always high clouds, occurring between 20,000 and 40,000 feet. At those altitudes, the air's moisture condenses into ice particles that often appear as wisps or "mare's tails" in the sky. Very high cirrus can spread out, according to Gilliam, in "a thin, hazy sheet of ice vapor barely visible high in the sky, perhaps forming a ring around the Sun or Moon."

When cirrus clouds clump together, they become cirrocumulus, borrowing part of their name from that other great category of clouds—the cumulus. Their name has much in common with the word "accumulate," which makes them easy to remember and to understand. Cumulus are the clouds of children's drawings—flat-bottomed and puffy-topped. Low cumulus those within a few thousand feet of the ground— are considered fair-weather clouds, which perhaps explains their

FOR MORE INFORMATION

The best one-stop source for an explanation of our local weather is *Weather of the San Francisco Bay Region* by Harold Gilliam (UC Press, 2nd edition, 2002). If you want to teach this topic, this book is a must-have.

Though the forces that create weather are global, we experience it locally—and on a day-to-day basis. Weather is a part of our daily lives and of the daily news. To begin tuning in to what's going on with the weather, read the weather page and watch the Weather Channel.

There are also a host of online weather-watching sites. Start with the National Weather Service at *www.wrh.noaa.gov.* If you're looking for pictures of the basic cloud types, visit *www.cloudman.com.* For a delightful consideration of clouds, read the manifesto of the Cloud Appreciation Society at *www.cloudapprecia tionsociety.org.* The organization's founder, Gavin Pretor-Pinney, also published *The Cloudspotter's Guide* (Perigee Trade, 2006), a humorous and eclectic but nonetheless informative look at all the world's clouds.



WATERSHEDS

Not so long ago, a small stream flowed from the slopes of Twin Peaks. It wound down toward the Mission District, gaining momentum, carving a channel, cascading over rocks. Where it came out of the hills, there was a waterfall. It was "a beautiful arroyo which, because it was the Friday of Sorrows, we called the *Arroyo de los Dolores*," wrote Pedro Font. "I concluded that this place was very pretty and the best for the establishment of one of the... missions."

The year was 1776. It was springtime. The streams were flowing and the wildflowers were in full bloom. Pedro Font was enchanted. He and Juan Bautista de Anza spent two days walking the unmapped land we now call San Francisco. "I think if it could be well settled like Europe, there would not be anything more beautiful," Font wrote. To found San Francisco, Anza and Font chose sites near water.

WATER SUPPLY

San Francisco's first inhabitants, the Ohlone, took water directly from the land's many springs and streams. So did the early settlers. Then came the Gold Rush. As thousands of people poured into San Francisco enroute to the gold fields, and then to stay, the demand for water outstripped supply. Engineers and entrepreneurs began to draw from larger sources and transport water over greater distances. The city began to reach outside its boundaries for new sources of water.

The first outside source was Marin County. Water was shipped across the bay by steamer. Then pipes began to be laid in the city. Lobos Creek was dammed; flumes and pipelines carried its water 2 or 3 miles along the northern shore to deliver it downtown. Next, the city looked south, building dams and reservoirs on the peninsula. After that, the city looked southeast, across the bay, buying land and building water systems in Santa Clara and Alameda counties. Finally, the citizens of San Francisco extended their grasp well beyond nearby watersheds, reaching 160 miles across the Central Valley to obtain water from what was once a part of Yosemite National Park.



Lake Merced, taken from the north side of the lake near the area now called the Mesa, 1904. The wooden flume was used to transport water. Fort Funston is visible in the background.

THE BEGINNINGS OF SAN FRANCISCO'S WATER SYSTEM

"During the somnolent days of Yerba Buena . . . before the Gold Rush, San Franciscans took their water from a few streams, springs, and wells. These sources were no longer adequate by 1849, so householders bought water by the barrel. Water peddlers competed in the streets with barrels in carts serving regular water routes. Some had barrels slung across the back of a donkey...

In 1851, the Sausalito Water and Steam Tug Company was barging the precious fluid across the bay by tank steamer from springs on the Marin shore using some 65 water carts to supply San Francisco householders.

The water-wagon stopped at the door, if possible. If the customer lived on a height, as many did, his barrel of water was delivered at the foot of the hill and he toted the water home in buckets."

Excerpted from San Francisco Water and Power: A History of the Municipal Water Department and the Hetch Hetchy System (San Francisco Public Utilities Commission, 2005), and San Francisco Water: An Outline (Spring Valley Water Company, 1922 and 1923). Each of these systems has been expanded upon since first developed and, with the exception of Marin County, all of them still provide water to San Francisco.

Today, just under 1,200 miles of pipes carry water to San Francisco—that's a distance longer than the California coastline. San Francisco consumes 85 million gallons per day. Over the course of a year, this is enough to cover the entire City and County of San Francisco with 3 feet of water.

San Francisco is now densely developed. Almost all of the lakes and streams that once were present have been built over. But rain still falls and creeks and springs still flow in a few natural areas and unnamed places. And now we are able to draw pure Sierra Nevada water into our homes at the turn of the tap. Water is no less crucial to the well being of every person today than it was two hundred or two thousand years ago.

SAN FRANCISCO WATERSHEDS

To emphasize the importance of water in our lives, many educators have begun in recent years to teach about watersheds. A watershed is a drainage area, defined by its surrounding hilltops and ridges, where rainfall and ground-water collect in a common body of water, such as a river, bay, or aquifer. Watersheds can be large or small; the water that drains into San Francisco Bay, for example, comes from an area that covers 40 percent of the state. Within that very large watershed, however, there are thousands of smaller ones, including seven in the City of San Francisco.

The names and boundaries of the watersheds used in this book are based on mapping done by the San Francisco Public Utilities Commission. The commission tracks both above-and below-ground water flow. The watersheds are:

- Marina
- Downtown
- Islais Valley
- South Basin
- Visitacion Valley
- Westside
- Lobos Creek

Each is described in more detail in its own section of this book.



Excessive phosphates (from detergents) and nitrates (from fertilizers) can indicate poor environmental practices within a watershed.

MAKING YOUR WATERSHED YOUR OWN

In *Science and Human Values* (HarperCollins, 1988), author Jacob Bronowski describes a Sherpa on Mount Everest who has known two sides of the mountain all his life but has never recognized them as one. He describes the process through which the Sherpa makes the connection:

The leading Sherpa knows the features of Everest from the north, as Shipton [the British explorer] does. And unlike Shipton, he also knows them from the south, for he spent years in this valley. Yet he has never put the two together in his head. It is the inquisitive stranger who points out the mountains which flank Everest. The Sherpa then recognizes the shape of a peak here and of another there. The parts begin to fit together; the puzzled man's mind begins to build a map; and suddenly the pieces are snug, the map will turn around, and the two faces of the mountain are both Everest.

"All acts of recognition," says Bronowski, "are of this kind.... We know the thing only by mapping and joining our experiences of its aspects." Like the Sherpa, we city-dwellers are similarly accustomed to experiencing the world from just one point of view. Our perceptions are shaped by the built environment that we inhabit.

The simplest way to start seeing the shape of the land beneath our buildings and streets is to start looking. And walking. Start building a mental map. You can start small—what is the land like on your block?—and expand your view over time. Get to know your neighborhood's natural landmarks, then, using cars and buses to move you farther, begin to look across the whole city.

To help with your reconnaissance, you'll need maps. You'll want both a decent road map and a topographic or relief map. Determining watershed boundaries can best be done using one of these—trace the ridge lines and you've drawn a watershed boundary. Because it highlights natural areas, the *Nature in the City* map is also very helpful.

THE UNIVERSAL SOLVENT

We know that water can wear away rock, but what happens to those minute particles of eroded material? Some are left intact and moved as sand or bits of stone. But some are broken down even further, into their chemical constituents. Because it can dissolve so many different substances and hold them in solution, water is sometimes referred to as the universal solvent. What's more, water is typically an inert solvent—it doesn't chemically change the elements it carries.

These properties of water are tremendously important for all living beings. If water didn't carry other chemical components, it would be much harder for many terrestrial plants and animals to take in all the materials they need in order to survive. Some of the minerals that plants depend upon, for example, may be present in the soil but can only be taken up by the plant after they have been dissolved in water.

In urban areas, water's tendency to pick up and carry whatever it runs across means it can become polluted. Every city in the San Francisco Bay Area has a legal responsibility to prevent water pollution—and you can help. Put litter in its place. Fix car leaks. Use less-toxic products in the home and avoid pesticides or fertilizers in the garden. Keep our waterways and San Francisco Bay clean and safe.

RAINFALL—WHERE DOES IT GO?

Like a mind that traces the land's hills and valleys, when rain falls on the streets of San Francisco, it follows paths dictated by gravity and topography. In the past, much of this was surface flow, which formed San Francisco's historic lakes and streams. Now, however, most of this runoff is channeled through pipes underground.

The storm drains on our streets collect water and direct it into the sewer system, which is unusual. Most Bay Area cities have two systems: one network of pipelines and channels directs stormwater (a.k.a. rainfall) into the ocean or the bay, while the other collects wastewater from city buildings and conveys it to a treatment plant before releasing it. In San Francisco, the two systems are combined.



Galileo High School students develop a better understanding of San Francisco's wastewater system during a tour of the Oceanside Water Pollution Control Plant.

The runoff from our streets and the used water from our homes and workplaces is channeled to one side of the town or the other—east or west. The Southeast Water Pollution Control Plant, which is located on Phelps Street in Bayview Hunters Point, treats the majority of the city's wastewater and releases it into the bay. The Oceanside Water Pollution Control Plant, which is next to San Francisco Zoo, collects water from the west side and pumps it, once treated, almost 5 miles out to sea. To prevent overflows of untreated sewage into the bay and the ocean, there is also a treatment facility on the north end of town that is only used during storms. Nine hundred miles of sewer lines connect these facilities with the rest of our intricate water system.

FOR MORE INFORMATION

The San Francisco Public Utilities Commission publishes a variety of educational materials, including posters, fact sheets, a video, and a booklet on the history of San Francisco's water system (quoted previously). To get copies of these free materials, contact the Communications office at (415) 554-3289. The commission also offers tours of its treatment plants.

Tracing local watersheds is part of a larger movement called "bioregional mapping," which emphasizes local knowledge of our home places. Many bioregional maps are interpretive rather than literal, and their makers use a variety of means to visually express what home means to them. A book that provides good examples of this approach is titled *Giving the Land a Voice: Mapping Our Home Places* (Land Trust Alliance of British Columbia, 1999). Peter Berg, founder of San Francisco's Planet Drum Foundation, is one of the progenitors of this way of thinking.



PLANTS

For anyone who'd like to learn more about the natural world, plants offer the great advantage of being stationary. You can approach a plant and it won't run or fly away. You can get down on your belly and scrutinize it or, in the case of a tree, you can climb it.

The rootedness of plants does not mean they don't change, however. Many plants can look very different in their youth than they do in maturity; they may lose their leaves annually, or they may keep them; most have flowers in one season and seeds in another. Those seeds may be packed in fleshy fruit, or they may be enclosed in a dry, hard case. That case may stay closed indefinitely, or it may open during a predictable time period.

Many people are attracted to plants because of their architectural or structural beauty. Others enjoy the challenges of taxonomy—of knowing the names of plants and distinguishing their characteristics. Most of us appreciate their sensual qualities of scent and color and texture.

For biologists, ecologists, and naturalists, plants are the foundation of all life. Plants are the primary producers without whom the energy of the sun would not be converted into forms that can be used by other living organisms.

GETTING TO KNOW PLANTS

If the advantage of studying plants is that they're always available, the disadvantage is that there are so many different kinds of plants to look at, especially in an urban environment. Where to begin? How to proceed?

The best way to learn about plants (or any aspect of the natural world) is in the company of people who know more than you do. Generally speaking, the nature-watchers of the world—whether they be birders, botanists, ichthyologists, entomologists, meteorologists, or specialists in another discipline—are in love with their subject and will be only too happy to share their knowledge with you. Seek them out. Begin a happy apprenticeship.

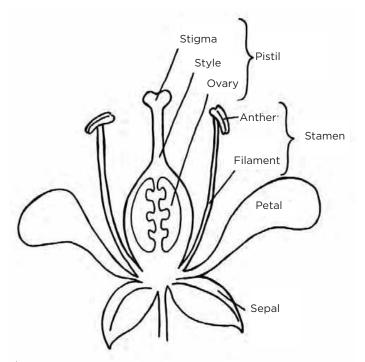
It is also true, however, that there is a direct correlation between the effort you expend and the rewards you reap. It behooves you, therefore, to take the time to practice what you learn from others and to make discoveries on your own.

To start to do this, focus less on identifying individual plants and more on getting to know their parts. Plant identification is based primarily on physical characteristics, so becoming familiar with the structures of plants in general will make it possible to identify individual plants in particular.

CONSIDERING THE PARTS

One way to start paying attention to plant parts is to consider what we eat.* Carrots are roots. A bunch of celery is a bundle of plant stems. Lettuce is leaves; so are spinach, cabbage, and parsley. Broccoli is flower buds. And you can see the seeds on the outside of a strawberry.

From there, you can begin to look at those parts in more detail. Depending upon the time of year, this can be as simple as looking at different leaf textures, colors, shapes, and sizes, or it may involve comparing flowers, searching for seed pods, and so on.



*This activity idea adopted from Daniel Edelstein, A Program Planner for Naturalists and Outdoor Educators (Joy of Nature, 1990).

As you progress, you will want to turn to field guides and possibly a botany text. There are plenty to choose among. Perhaps because plants are so available for study and appreciation, a great deal has been written about them. But you can use this fact to your advantage—you'll find it's helpful to use more than one guide.

ABOUT FIELD GUIDES

The simplest way to use a field guide is by looking at the pictures. Field guides that are organized by color facilitate this process, and it's good to have one of these on hand to help you narrow down the possibilities. But such guides can only take you so far. Relationships between plants can be obscured when they are grouped only by color. A yellow bush lupine, for example, will be located far away from some of its nearest relatives, which it closely resembles, simply because they have purple flowers and it doesn't.

Most field guides are organized by plant family. They rely on keys—a series of guided choices based on plant structure—to help you figure out the identity of any given plant. Most focus on the structure of flowers and fruit. To use a key, you must learn the specialized names of these parts of a plant. There's no reason to resist this. The language of botany (and all the sciences) has great beauty and utility. Be fearless! Wade into the world of petals, sepals, and bracts; filaments and anthers; styles and stigmas. Your efforts will be richly rewarded. These words are a bridge between the human mind and the natural world. Above all, they reflect the organization inherent in the natural world itself.

Bear in mind, too, that the term "field guide" can be used liberally. Many of the field guides that use keys focus only on our indigenous plants. If you want to learn about garden plants, your handiest reference may be the *Western Garden Book* published by the same company that publishes *Sunset* magazine—which certainly has no keys. In city, state, and national parks, interpretive signs serve as on-site field guides—they provide some of the best, most localized information you'll find. (For field guide recommendations, see "For More Information," at the end of this section.)

SCIENTIFIC NAMES

No discussion of field guides and technical language would be complete without some mention of the importance of scientific names. Though many people resist them, they're worth learning. Scientific names reveal traits and explicate relationships. They also reduce confusion. A plant may have a multitude of common names, but it will have only one scientific name.

For many of us, the biggest stumbling block to using scientific names is doubt about how the words should sound. There is no one way to pronounce scientific names, so whether you're reading or speaking, just take a guess. As one scholar has noted, "botanical Latin is essentially a written language, but the scientific names of plants occur in speech. How they are pronounced really matters little, provided they sound pleasant and are understood by all concerned."

In addition, The Jepson Manual offers these words of advice:

- Divide the word carefully into syllables and pronounce each syllable (co-to-ne-as-ter, not cot-on-east-er).
- At first, attempt to accent all syllables equally; this is likely to show you where accents fall naturally.
- Listen to others and practice what sounds good to your ear; conviction is important.
- When someone presumes to correct your pronunciation, a knowing smile is an appropriate response.

WHAT'S A VASCULAR PLANT?

Botanists distinguish between plants that have a circulatory system (vascular) and those that do not (nonvascular). The latter are older, simpler plants such as mosses that, in addition to lacking a complex circulatory structure, are low-growing and lack roots. Mosses also differ from the majority of vascular plants in that they reproduce from spores rather than seeds.

Ferns and their relatives are the only vascular plants that, like the mosses, use spores to reproduce. The rest of the vascular plant world uses seeds. This hierarchy of organization—from nonvascular to vascular, from nonseed to seed-producing reflects our understanding of the evolutionary development of plants.



Most of the plants that we notice in our daily lives or begin to study in the field are vascular plants. They have a root system, a stem, and leaves. (They are also sometimes called "higher plants.") Amongst these plants there is wondrous diversity, from the tallest redwood to the smallest, slenderest grass. And yet another division is made amidst them, between those that produce seeds in cones and those that produce them using flowers.

GYMNOSPERMS VS. ANGIOSPERMS

The cone-bearing plants, called *gymnosperms* (gymno=naked, sperm=seed), are considered older and simpler from an evolutionary standpoint. All pine trees are gymnosperms. They bear their seeds in hard, woody, often prickly cones. Another hallmark of gymnosperms (and pine trees) is that their leaves are long and thin, like needles, or made up of small scales. Redwoods are gymnosperms, as are Monterey cypress and Monterey pine.

Gymnosperm cones look like flowers—they're sort of hardened proto-flowers. But with the advent of the *angiosperms*, the true flowering plants, something new happened. The seed ceased to be formed in the "flower" itself; its genesis was moved into an enclosed part dedicated to the development of the seed (angio=enclosed; sperm=seed). This casing—the ovary—can take a variety of shapes and forms. An apple is a seed case; so is a strawberry (even though the seeds are on the outside). And the flowers that are the forerunners to all these fruits are equally varied—think of snapdragons and sunflowers, orchids, irises, and marigolds. Angiosperms are the latest and most successful form of plant life on the planet.

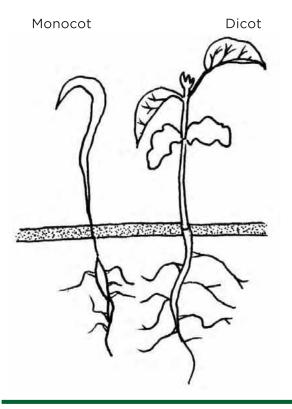
MONOCOTS VS. DICOTS

Almost all vascular plants begin life as seedlings.

When they emerge from the ground, the first leaf or leaves to unfold are called *cotyledons*. A cotyledon is not even a leaf, really, but a part of the seed that moves upward with the stem as the young plant extends above ground. Some plants start out with one cotyledon; these are the monocots. The dicots start out with two cotyledons.



The leaves of monocots are often shaped like blades.



Exposed Gymnosperm Seeds

Enclosed Angiosperm

While this may seem like a small detail, it signals a big difference in the world of plants. Monocots are some of the most widespread plants in the world, and humans rely upon them for our main sources of food. The cereals—wheat, barley, oats, corn—are all monocots. So are bamboo, lilies, and irises. Monocot leaves often take the shape of a blade; the veins in their leaves run parallel. Often, monocot flower parts come in multiples of three. Many field guides and checklists group monocots and dicots separately.

Mary 0125206

ANNUALS VS. PERENNIALS

Another common distinction made between plants is based on how long they live. Those plants that live only a year—they sprout, flower, set seed, and die within twelve months—are called annuals. Many of our loveliest wildflowers are annuals. Perennials, on the other hand, are those plants that last more than a year. Trees are all perennial; so are many shrubs.

WOODY VS. HERBACEOUS

Trees and shrubs are recognized as woody plants. The opposite of woody is *herbaceous*—green, soft-sided, flexible. Annuals are all herbaceous; some perennials are, too. Many garden flowers that grow from bulbs are herbaceous perennials—though their stems die back, their underground parts remain alive, growing fresh, soft stems year after year.

PLANT FAMILIES

As with birds, frogs, snakes, lizards, and a host of other organisms, plants are grouped by family. Plants in the same family share similar traits, such as the bell-shaped flower of some heath-family plants or the long, thin seed pods of many mustard-family plants. Becoming familiar with these traits makes it much quicker to identify individual species.

PLANT COMMUNITIES

Last but not least, plants can also be understood in terms of *communities*, assemblages of different plants that grow together in the same place. Plants in the same community have a tolerance or preference for certain conditions, whether that be the rocky shoreline or a dry, sunny hillside. Philip Munz, an influential California botanist of the mid-twentieth century, defined plant communities this way:

A plant community is an aggregation of plant species and other organisms that live together, interact with each other, and adapt to a specific set of environmental conditions.... Whenever a given set of environmental conditions occurs, one expects to find the plant community that is adapted to these conditions as well.

This definition appears in *Munz's Introduction to Shore Wild-flowers of California, Oregon, and Washington* (University of California Press, 2003). The environmental conditions of the beach are quite distinct, and the plants that grow there form a distinct community.

Thinking in terms of plant communities is useful because it requires us to move beyond single organisms and look at the broader picture. We begin to see how different plants—and plants and animals—interact. Ultimately, as Munz points out, a plant community includes not just plants, but all the organisms that live within it. To emphasize this fact, plant communities are sometimes referred to as *biotic* (bio=life) communities.

The biotic communities that occur in San Francisco are:

- Coastal strand
- Rocky shore
- Freshwater wetland
- Salt marsh

- Coastal dunes
- Northern coastal scrub
- Coastal prairie
- Grassland
- Oak woodland
- Riparian woodland
- Broadleaf forest
- Pine forest
- Urban Forest

Each of these is described in more detail in the sections to come. At the end of the book, you'll find a table listing all the natural areas described in this book and the plant communities that occur in each.

FOR MORE INFORMATION

To assist you in learning about scientific names, look for *How Plants Get Their Names*, by L. H. Bailey, and the *Dictionary of Word Roots and Combining Forms,* by Donald J. Borror.

Many of the plants that are most common in our urban environment are weeds. Often, these plants are not included in natural history guides, which tend to focus on indigenous species. One book that will help you identify not only the plants but the common birds, insects, and mammals of the urban environment is *Natural History of Vacant Lots* by Matthew F. Vessel and Herbert H. Wong (University of California Press, 1987).

A good starter book is *A Field Guide to Pacific States Wildflowers: Washington, Oregon, California,* by Theodore F. Niehaus (Houghton Mifflin Company, 1998). It is organized by color but also uses icons keyed to flower shape and other anatomical traits.

Plants of the San Francisco Bay Region by Linda Beidleman and Eugene Kozloff is a standard botanical guide with keys, and is geared to newcomers to the field (University of California Press, 2003).

The Jepson Manual is the authoritative field guide to California plants. Because of its scope (all the vascular plants in the state), its keys and plant descriptions are necessarily telegraphic and very technical. It includes an excellent glossary and illustrations (University of California Press, 1993).



INSECTS

Regardless of how you might feel about them, insects are a part of our daily lives. In temperate California, it's possible to spot those darlings of the insect world, the butterflies, almost any month of the year. When the days are long and the temperatures higher, bug-watching possibilities are almost endless, from an errant beetle stolidly walking across the kitchen floor or a moth fluttering against the lamplight to a bevy of bees and flies buzzing around a blooming shrub or midges and gnats rising in clouds above a damp lawn at twilight.

The opportunities to encounter insects are numerous because insects themselves are very, very numerous. Entomologist Eric Grissell frames it this way: "Insects, at an estimated weight of 27 billion tons, outweigh the human population by about six times." Eighty percent of the world's animals are insects.

In addition to being the most successful life form on the planet, insects lead odd and fascinating lives. What other class of animals has members that, in order to reach maturity, undergo complete metamorphosis, entirely altering their internal constitution and external appearance? And who else engages in *parthenogenesis*, a form of asexual reproduction in which females give birth to more females, for generations on end, with nary a male in sight? When the time is right, however, these same females also have the ability to give birth to both male and female young, which though immaculately conceived, have the option of mating.

Insects are also an intrinsic part of the great web of life. Insects eat each other, and many other animals eat them, from the smallest hummingbird to large mammals such as bobcats and coyotes. Besides being food, insects offer other vital ecosystem services, such as pollination and decomposition. Plants are the primary producers, but without all the creepy crawlies out there, life as we know it would soon be halted.

DEFINING AN INSECT

There are more kinds of creepy crawlies than there are insects, however. As numerous as they are, insects only make up a portion of the world of small organisms that buzz, scuttle, and squirm their way through our lives.

Insects are defined as creatures that have three major body parts—head, thorax, and abdomen—and three pairs of legs. Those legs all originate in the thorax, or midsection of an insect's body. A spider, on the other hand, has four pairs of legs, and its body has only two parts. So it is not an insect. It is in a class of its own, the Arachnida, which it shares with other eight-legged, two-body-parted creatures such as mites and ticks and daddy-long-legs. Not only are they different structurally, but these animals' genetic makeup and physiological functioning differs from that of insects.

What makes spiders and similar creatures seem like insects is that they have exoskeletons. Insects, which are in the class Insecta, and spiders and their kin in



APPRECIATING INSECTS

While a small percentage of little boys are lucky enough find themselves interested in insects at an early age, most of us have to work a little harder to want to learn about them. Some of this bias may be biological, but mostly it is cultural. It is learned, and it can be unlearned. The fact that insects are weird and funny-looking can be seen as a positive, rather than a negative.

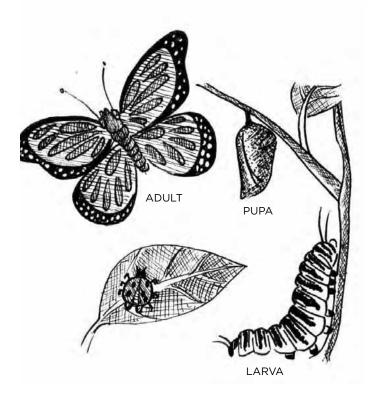
One of the main obstacles to learning about bugs is their size. Many of them are small, and their particular body parts are even smaller. A hand lens is all you need to overcome this. And it's not hard to come by specimens— because their lives are so short, at least a few insects will die at your front door (or in your closet, or on the side-walk). All of these obliging little animals can be saved for later scrutiny. And in taking a closer look, you will be well on your way to appreciating these important planetary citizens—the insects. the class Arachnida, are both members of the phylum Arthropoda. Arthropods all have jointed legs, and they wear their skeletons on the outside. Other familiar arthropods that are not insects are centipedes (class Chilopoda); sow bugs and pill bugs (class Malacostraca); and shrimps, crabs, and lobsters (class Crustacea).

GETTING BIGGER, CHANGING SHAPE

The hard shell of an insect presents some interesting challenges for the animal. Growth is one of them: How do you get bigger when you've got hard outsides that won't change size? The answer to this question is metamorphosis. There are a couple of different kinds.

The first of these, simple metamorphosis, solves the problem of growth. About 20 percent of all insects go through only simple metamorphosis (which can also be called gradual or incomplete). When they hatch from eggs, these insects already have their adult form, but in miniature. In order to get larger, they grow a new, soft skeleton inside the hard outer one, secrete a fluid that causes the outer shell to split, and then crawl out. At first, the newer exoskeleton is soft, which permits the insect to expand in size. It soon hardens, however, and before long, the insect will go through the process again. Each such growth phase is called a *molt*; the period between molts is called an *instar*. Until it reaches its final adult size, the immature insect is called a *nymph*.

Complete metamorphosis, on the other hand, involves the drastic shape-changing for which butterflies are so well known. The majority (about 80 percent) of insects experience complete metamorphosis—bees, wasps, ants, beetles, flies, and fleas do it, too. When they hatch from eggs, they look nothing like they will as adults. They begin life as larvae. They look sort of like worms with legs. Or caterpillars, which are a kind of larva. Each larva may go through gradual metamorphosis—that is, it may shed its "skin" several times—as it grows. As it approaches maturity, however, it enters a separate phase. The insect creates a container for its body—the *pupa*—within which it changes form completely.





WINGED CREATURES

Whether they go through incomplete or complete metamorphosis to get there, one of the things that sets adult insects apart from their immature forms is wings. The vast majority of insects (99 percent) have wings, and they have them in their adult forms. In simple metamorphosis, the wings develop externally, growing gradually with each molt. In complete metamorphosis, the insect develops them internally, as it pupates. There are exceptions to this, of course, particularly among aquatic insects and aphids and male scale, thrips, and whiteflies. Developmental differences aside, however, wings are an indicator that an insect has reached its final form. They are also one of the characteristics we use to classify insects.

Because there are so very many insects in the world, it frequently takes a specialist to identify them to the level of genus and species. For most people, it is sufficient to become familiar with some of the orders of insects, and perhaps a few insect families. Even at these more generalized levels of description, there is still enough information for you to get to know the common insects of garden, park, and natural area. To get you started, eight of these orders are listed below (for a listing of sources to find more, see "For More Information." Many of their names are descriptions of their wings (*ptera* means "wing").

- Lepidoptera (scaly-wing): butterflies, moths, skippers
- Hymenoptera (membrane-wing): wasps, bees, ants
- Diptera (two-wing): true flies
- Coleoptera (sheath wing): beetles
- Hemiptera (half-wing): true bugs
- Homoptera (same-wing): cicadas, aphids, leafhoppers, whiteflies, scales.
- Orthoptera (straight-wing): grasshoppers, katydids
- Odonata (toothed): dragonflies

To get started, two of the best kinds of insects to study are butterflies and dragonflies. They're big, bright, and attractive. As ecologist and environmental educator Josiah Clark says, they are good ambassador species.

FOR MORE INFORMATION

Good resources for learning more about local butterflies include the books *Common Butterflies of California* (West Coast Lady Press, 1997) by Bob Stewart, which features full-page photos of all the butterflies you're likely to see, and *A Field Guide to the Western Butter*flies(Houghton Mifflin, 1999) by Paul Opler, which offers a good overall introduction to the lives of butterflies in general and species accounts of our common flutter-bys.

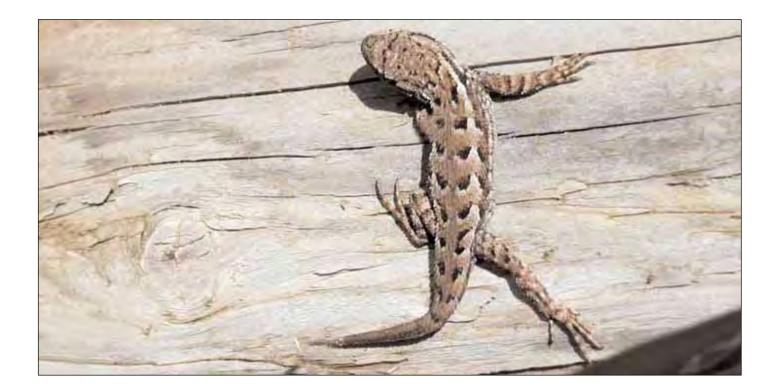
For dragonflies, look for *Common Dragonflies of California: A Beginner's Pocket Guide* (Azalea Creek Publishing, 2000), by Kathy Biggs. Put together by an amateur who wanted to find out more about the dragonflies she was seeing at her garden pond, this is a good source of information about our local dragonflies.

For species accounts of dragonflies, butterflies, and many other insects, get a copy of *California Insects* (University of California Press, 1981) by Jerry Powell and Charles Hogue.

For an excellent introduction to insects and the roles they play in the garden, read *Insects and Gardens* (Timber Press, 2001) by Eric Grissell. Not only is the text smart and entertaining, but the close-up photos bring you right into the world of insects in a very sympathetic way.

For a more general treatment of insects, with lots of good stories about the odd things they do, look for *Life on a Little-Known Planet* (Lyons Press, 1993), by H. E. Evans, and *Broadsides from the Other Orders: A Book of Bugs* (Random House, 1993), by Sue Hubbell.

For online support, go the City Bugs website. Described as a "a collaborative outreach project between UC Berkeley's College of Natural Resources and the Oakland Unified School District," this site is built for use by teachers. It includes pages on "Insect Basics," ID photos, an "Ask the Experts" link that permits you to email questions to UCB professors, and curricula and activities developed by local educators. The "Resources" page includes additional links to many other classroom ideas. Find it all at www.cnr.berkeley.edu/citybugs.



REPTILES AND AMPHIBIANS

The word *amphibian* means double-lived, and it refers to the fact that many amphibians, including frogs and salamanders, are born in water but as adults live on land. One could invent a similar term—*diabian*, perhaps—to mean living-through, and apply it to both reptiles and amphibians, because they developed early in the Earth's history and have lived through many eras. Their ways of life were the first to be exercised by the planet's four-legged creatures.

In the pathways through time, amphibians go back farther than reptiles. They preceded them, appearing about 350 million years ago, during the Paleozoic era. By that time, some plants and arthropods had traveled onto land but, until the advent of amphibians, all the world's vertebrates lived in water.

ORIGIN OF AMPHIBIANS

"There seems little doubt that amphibians arose from lobefinned bony fishes," writes Robert Orr, author of *Vertebrate Biology* (Saunders College Publishing, 1982). The bones in those early fishes' fins were the precursors to legs and feet. Perhaps the earliest amphibians inhabited the shallows, where they could remain aquatic but would also have a muddy surface in which to gain some traction and put four legs to use. One theory suggests that legs may have developed in order for these proto-amphibians to lift themselves out of the water to breathe. "Lungs appeared early in the evolution of bony fish," Orr tells us, probably as an alternative means of obtaining oxygen in water where little or none was available. (Fish are better known for extracting oxygen from water by means of gills. But some fish also take oxygen from the air. They swim to the surface, gulp air in through their mouths, and "swallow" it to their lungs.) So it is possible that the first four-leggeds already had lungs and used their legs to get some air.

With enough of the necessary equipment, then, what was once a fish began to walk on land. As is reflected in its name, however, this long-ago amphibian—and all its present-day relatives—have retained a lifelong affiliation with moisture.

ANCIENT TRAITS

When early amphibians began to move to land, they took with them a trait they still share with fish—that of *ectothermy* (ecto = outside, therm = heat). Fish, amphibians, and lizards all rely on their environment to regulate their body temperatures. For fish, who live in a medium that changes temperature little and slowly, one can see the advantages of this way of life. On land, however, where the medium through which creatures live and move is air, there are frequent and greater fluctuations. Ectothermic land animals have developed modes of living that accommodate this basic fact of their lives. In his field guide *Reptiles and Amphibians of California* (UC Press, 1972), Robert Stebbins uses reptiles to explain a phenomenon that has elsewhere been called "the original (ancestral) state of life."

Like amphibians and all other animals except birds and mammals, reptiles are ectothermic, deriving their body temperature chiefly from their surroundings. When their temperature is well below ours, they feel cold to us [hence the term *cold-blooded*]. Most of them, however, exercise control over their temperature by moving from sunlight to shade, from land to water, or in and out of the ground. In this way, many species are able to keep their temperature at a nearly constant level, and often well above air temperatures, during periods of activity. Some lizards, for example, can maintain their temperature at or above that of man. Consequently, during most of the day, they may actually be as "warm-blooded" as many mammals.

MOISTURE AND SKIN

The amphibians living in North America today are frogs and salamanders. Most of them are born in freshwater and return to it to reproduce. Even those species that have become entirely terrestrial stick to damp places, such as the underside of logs, all their lives.

The need for constant moisture is also reflected in amphibians' skin. Despite the fact that some amphibians have lungs, most also breathe through their skins. In order to do so, their skin must be moist. According to George Zug, author of *Herpetology* (Academic Press, 1993), "gaseous exchange in all vertebrates requires a moist surface. Drying alters the cell surfaces," he



Arboreal salamander

explains, "and prevents diffusion across cell membranes." Like water through a filter, oxygen passes through an amphibian's moist skin, where it is picked up by a network of blood vessels and distributed through the animal's body. Carbon dioxide is released through the same system.

Most frogs have lungs, but 60 percent of salamanders don't. The lungless salamanders are an American phenomenon, occurring only in North and South America (it is thought that they once had lungs but lost them). The only member of this family that can be found in San Francisco is also the city's most common amphibian, the slender salamander (*Batrachoseps attenuatus*).

As a terrestrial species, the slender salamander lays its eggs on land. The eggs are soft and gelatinous—sort of watery. While in the egg, the developing animal has gills, which it uses for respiration. Like other amphibians, the young undergo metamorphosis, but they do so within the egg. This is called *direct development*. When they hatch, they have their adult form.

The slender salamander does not follow the stereotypical reproductive cycle of an amphibian, which includes transition from water to land and metamorphosis from an immature aquatic form to an entirely different mature terrestrial form. This is the story of most frogs, and it is one of the most familiar tales of biology.

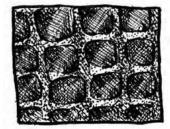
HIGH AND DRY: THE ARRIVAL OF REPTILES

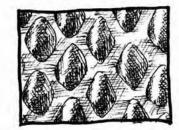
In shifting away from this mode of life, the slender salamander has something in common with a related class of animals, the reptiles. Amphibians preceded reptiles on the evolutionary scene, but not by much. Soon after amphibians developed, reptiles descended from them, but they struck off on a different trajectory. As George Zug describes it, "While amphibians took the amphibious path, [early reptiles] and their descendants became increasingly terrestrial in all phases of their life."

One of the ways in which reptiles cut their ancestral connection with water was through changes in their skin. One of the hallmarks of reptileness—one of the characteristics by which we know a reptile as a reptile—is tough, scaly skin. But since even tough skin is not usually captured in the fossil record, we have to guess how this change came about. Zug suggests that "the initial adaptive step was to increase skin thickness by adding more cell layers and to keratinize the externalmost layer(s)... thereby making the skin less permeable." Keratin is a protein found in the dead outer skin layer, and in horn, hair, feathers, hoofs, nails, claws, bills, and so on. Contemporary reptiles have skin keratins that are, according to Zug, "uniquely reptilian."

Thicker, less permeable skin would, in turn, have had an impact on respiration. "As the skin became increasingly resistant to water loss, cutaneous respiration would have become less effective and pulmonary respiration more so," writes Zug. "Lungs probably changed in several ways.... When and where [these changes] occurred may be partially identified by examining rib structure and the appearance of a complete rib cage." Lizards and snakes have ribs; most frogs and salamanders do not.

Along with developing harder skin and a more complex pulmonary system, reptiles also began to lay eggs that were both harder on the outside and contained more protection and nourishment within. One of the chief reptilian innovations was an egg that contained an *amnion*—a membrane that encloses the fetus in a bath of nourishing fluid. This is a main feature of many subsequent life forms, especially birds and





The size, shape, and arrangement of scales can be useful in identifying reptile species.

mammals (including humans—whether she's had a baby or not, every woman knows something about amniotic fluid). For early reptiles, the amniotic egg was a major evolutionary advancement because it permitted them the freedom to reproduce on dry land.

REPTILES AND AMPHIBIANS OF SAN FRANCISCO

With the exception of the slender salamander, you have a better chance of finding frogs, lizards, and salamanders in the city's natural areas than in your backyard. Take a walk at Bayview Hill on a sunny day, for example, and you're likely to see alligator lizards basking on the rocks—they'll scramble for safety as you walk by. Snake skins have been found on Bernal Hill, and a new population of Pacific tree frogs was recently discovered at Crissy Field.

Following are the amphibians and reptiles that occur in San Francisco. All are indigenous except those marked with an asterisk (*). This list is based on one put together by Dan Mulcahy and posted on the San Francisco Preservation Society website (see "For More Information," p. 47) and on the list of animal species (Appendix C) that appears in the Rec and Park Department's "Significant Natural Resource Areas Management Plan."

SALAMANDERS

Salamanders look like lizards—their bodies have the same shape. But salamanders have soft, moist skin that is often smooth but sometimes granular. Salamanders don't have claws on their feet (lizards do). Their front feet have four (or fewer) digits, instead of five; their back feet usually have five, but not always. Salamanders and lizards move alike; the animals, to quote George Zug, "share gait patterns and considerable lateral body undulation when walking or running." There are four indigenous salamanders in San Francisco.

- California slender salamander (*Batrachoseps attenuatus*)
- Sellow-eyed salamander (Ensatina eschscholtzii)
- Arboreal salamander (*Aneides lugubris*)
- Coast range newt (*Taricha torosa torosa*)

SPECIES FOCUS CALIFORNIA NEWT

Newts, a kind of salamander, are members of a single family (Salamandridae). According to Stebbins, "newts differ from all other California salamanders in having rough and rather dry skin when on land." In California, our newts all belong to the genus *Taricha*. San Francisco's coast range newt (*Taricha torosa torosa*) is closely related to the California newt (*Taricha torosa*), which is still fairly common in some parts of the Bay Area.

The California newt exemplifies the typical amphibian reproductive cycle. The males and females migrate to ponds to court and mate. The female attaches her eggs to plant stems in the water; the male fertilizes them. The eggs develop and tiny larvae hatch, staying close to the eggs and continuing to feed from them until their mouth parts develop. These larvae—the same term is used to describe immature insects—are born with legs, but also with gills and tail fins. Like tadpoles, they are aquatic animals.

In preparation for its transfer to terrestrial life, the California newt's tail fins simply shrink or fall away, the gills are absorbed, and the skin changes consistency. For it and other salamanders, further "modifications may occur in the head region," according to Robert Stebbins and Nathan Cohen, authors of *A Natural History of Amphibians* (Princeton University Press, 1995)."Eyelids develop," they tell us, "there are changes in dentition, and a fleshy tongue forms, often of elaborate structure."

FROGS

Frogs are well known and widespread. They are, according to Zug, "the most successful living amphibian.... Their diversity and the ancientness of many lineages make frogs difficult to classify." There are 20 or more families of frogs in the world.

Unlike their brethren the salamanders, adult frogs don't have tails. The scientific name for frogs is *anurans*, which means "tailless" (salamanders, on the other hand, are called *caudata*, which means "with tail"). Frogs and salamanders are the only vertebrates able to raise and lower their eyes, which they can do thanks to a muscle in the roof of their mouth.

Large eyes are a characteristic of frogs; so are, according to Stebbins and Cohen, their "long hind legs, webbed and unclawed toes,... and smooth or warty moist, glandular skin." Four kinds of frogs can be found in San Francisco today.

- Pacific tree frog (*Hylla regilla*)
- Red-legged frog (*Rana aurora*)
- Bullfrog (*Rana catesbeiana*)*
- California toad (*Bufo boreas*)



LIZARDS

Lizards and snakes are in the same family— Squamata—and are often described together. Zug says they are the "dominant and most abundant group of extant reptiles.... They live everywhere but on Antarctica and a few remote, desolate oceanic islands." They all have notched tongues and shed their skins in one piece.

Like salamanders, lizards can be recognized by their body shape. They have the tough skins characteristic of all reptiles, and they have claws at the ends of their toes. According to ecologist Josiah Clark, a lizard—the northern alligator lizard—is the most common reptile in San Francisco. Three other lizards also occur here.

- Northern alligator lizard (*Elgaria coerulea*)
- Southern alligator lizard (*Elgaria multicarinatus*)
- Western skink (*Eumeces skiltonianus*)
- Western fence lizard (Sceloporus occidentalis)

TURTLES

Many turtles are examples of reptiles that have retained an aquatic lifestyle. They live their whole lives in water but, in an inversion of the typical amphibian's way of life, they lay their eggs on land.

All turtles have bony shells and lack teeth. In North America, we only have *cryptodire* turtles—those who pull their heads directly back into their shells. There are also sea turtles, freshwater turtles, and terrestrial turtles. We have one indigenous and two introduced turtles in San Francisco; they are all freshwater species.

- Western pond turtle (*Emys marmorata*)
- Red-eared slider (*Trachemys scripta*)*
- Soft-shell turtle (*Apalone* sp.)*

SNAKES

In cultures around the world, snakes have been portrayed as sources of great power and great evil. For those who have lost their fear of snakes—or who never felt it in the first place these slim, streamlined creatures are beautiful and fascinating. Their way of life is a quiet one.

Some of the fear of snakes may come from their stare, which, as it turns out, is physiological, not attitudinal. "No snake," according to Stebbins, "has movable eyelids." Their other main characteristic—limblessness—may also make them seem foreign to us (though we are hardly threatened by this trait when



Red-legged frog

we find it in a worm). There are six species and one subspecies of snakes in San Francisco.

- Ring-neck (Diadophis punctatus)
- Gopher (*Pituophis catenifer*)
- Pacific rubber boa (*Charina bottae bottae*)
- Common racer (*Coluber constrictor*)
- King snake (*Lampropeltis getulus*)
- Garter snake (*Thamnophis* sp.)
- San Francisco garter snake (*Thamnophis sirtalis tetrataenia*)

WHAT'S A HERP?

Herpetology is the branch of zoology that deals with reptiles and amphibians, and sometimes you will hear or see these animals referred to as herps. Both words come from ancient Greek. *Herpeton* means "creeping thing"— and both its sound and meaning have much in common with the word serpent. The word *herpes* also appears in medicine. Chickenpox, shingles, and cold sores are all forms of the herpes virus.

FOR MORE INFORMATION

Though now out of print, *Amphibians and Reptiles of California*, by Robert C. Stebbins (University of California Press, 1972), is worth tracking down. Stebbins, a UCB professor for many years, studied herps locally and around the world. He is a skilled artist, and this field guide is illustrated with many precise and lovingly drawn renderings. Though some of the scientific names have changed since Stebbins wrote his book, his observations about the animals' life histories are no less accurate. Scan the natural history shelves at your favorite used bookstore, or look for this small book online.

There is a recent checklist, with links, photos, and range maps, of San Francisco's amphibians and reptiles on the website of the San Francisco Preservation Society. Based on the research of Dan Mulcahy, this is one of the most up-to-date references regarding the presence and distribution of reptiles and amphibians in San Francisco. To see it, go to www.sfpsociety.org/SFherps.htm.

An older checklist, based on research done in the 1960s, is also posted online at the Shaping San Francisco web⁻ site. This posting provides a bit of historic background and cites a study that describes not only what was found, but where. Go to *www.shapingsf.org* and search for "Amphibians and Reptiles."

The California Academy of Sciences has live reptiles on display in its Steinhart Aquarium. You'll also find corals, penguins, and a host of other creatures sure to delight and awaken wonder. At the Naturalist Center, students can take advantage of various programs while you get help researching your own questions about the natural world. For a preview of the possibilities, visit *www.cala cademy.org.*



BIRDS

Symbols of freedom and models of flight, wild birds have inspired humans for centuries. For the urban naturalist of the twenty-first century, wild birds offer the advantage of accessibility—many live in (or at least pass through) places where we can easily observe them. Birds are also worthy of study because so many people have done so before us. A wealth of lore and learning awaits the person who takes an interest in birds.

CLASSIFICATION OF BIRDS

Initially, our experience of birds—a fleeting glimpse through leaves, an upward gaze at a hawk—may seem to have little to do with classification. But in fact, whether we are aware of it or not, we are constantly sifting and categorizing the sensory data streaming around us. The formal classification of birds (and all other biota, for that matter) is simply a structured version of a process we engage in all the time. And when we want to begin to learn more about birds, a little classification comes in handy.

Birds are members of the class Aves. Within that class are several orders, and within each order are families. Field

guides to birds follow a standard order, grouped by families and based on ornithologists' understanding of the evolution of birds. The oldest families in North America, all of them water birds, are listed first. About 77 families are listed in field guides to the birds of North America.

The latter half of these field guides is dedicated to families and species that fall into a single order—the Passeriformes, or passerines. They are the perching birds, named for their ability to hold tight to small branches. About 60 percent of all bird species are passerines. They're in the majority because, in the natural world, their way of life has been a successful one. Adapted to move quickly and capitalize on a variety of food sources, passerines can be found on all the continents except Antarctica, but are most numerous in the tropics, where food sources are abundant. In North and South America, there are 370 passerine species.

IT'S ABOUT FEET...

Because they are so numerous, many of the birds we see in town and field are passerines. They may vary in size, color, habit, and habitat, but they all share one trait: the shape of their feet. They have three toes forward and one toe (which is comparable to our thumb) that points back. This gives them the ability to grab even slender stems of grass. Compare their feet to those of a gull—you're unlikely to see one of these large, web-footed birds clinging to a bending branch!



The American avocet has a particularly distinctive bill.

...AND OTHER BODY PARTS

A bird's bill also provides clues to its identity and way of life. For some, such as the pelican, the bill is a singularly distinctive feature. It tells us not only who it is but how it catches its food. The hooked beak of an eagle provides a similar example. In smaller birds, the size and shape of the bill may be less obvi-ous, but even so, it too can give you clues to the bird's lifestyle.

FIELD MARKS

The size and shape of a bird's body parts are considered field marks. Taken singly, each field mark is a clue, a piece in the puzzle that is the bird as a whole. Other characteristics we can observe and by which we know a bird include its overall size and shape; its plumage; coloring; and markings such as rings, speckles, spots, stripes, and streaks. A bird's silhouette can also help you figure out who you're looking at.

LOCATION

If appearance is one way to know birds, location is another. The gull, again, provides us with an excellent example. His feet are of a certain type because of where he lives—on the beach and the water. It may seem obvious that one may know birds by where you find them, and in the case of shorebirds, perhaps it is. But in many environments, a bird's adaptations are less obvious, its haunts less distinct. Where is the bird when you see it—on the ground? In some bushes? Climbing up the trunk of a tree? Each of these locations gives you clues about what kind—and what species—of bird you're observing.

ONE TREE, FIVE NICHES

In an essay that appears in *The Birder's Handbook* (Fireside, 1988), the authors describe what they call a classic study in species interaction. This work was done by the late Robert MacArthur, "a birder with a great talent for seeing the essence of biological problems."

MacArthur looked at the behavior of five warblers that live and breed in the same place (conifer forests) and eat the same food (insects). Since the five species seemed to have identical roles in their biotic community, it was assumed that they occupied the same niche.

To find out whether or not this was the case, Mac-Arthur defined zones within the spruce, fir, and pine trees used by the birds, and he recorded where he saw them. He found that each species used different parts of the tree— one stayed at the top of the tree on the outside, for ex-ample, while another stuck more to the inside middle. He also noticed that the birds' foraging patterns—the way they ate—differed, and even that they nested at slightly different times.

His findings demonstrated that while these five warblers relied on the same food source, each exploited it differently. Rather than occupy the same niche, each species created a separate one.

BEHAVIOR

In addition to paying attention to where you're seeing it, give thought to what your bird is doing. (Depending upon the species, this can be harder than it sounds.) Birds in the aptly named flycatcher family, for example, catch (and eat) insects in flight. They perch, swoop, and perch again in a very distinctive manner. A bird's habits—how it wags its tail, whether it walks or hops, what it is eating, and how—are as indicative of a spe-

cies as its field marks. Over time, the satisfaction of looking for birds and learning their names is greatly augmented by the many rewards of becoming familiar with their behaviors.

FLIGHT

How a bird flies is also an integral part of its identity. Ravens can be distinguished from crows, for example, by the way they fly—"ravens often soar," according to the Sibley guide, but "crows never do." Some birds' flight



Red-tailed hawk

is steady, others' is undulating. Some lumber, while the hawk and the raven glide. When a mourning dove takes to the air, not only do its wings have a distinctive shape, but they make a distinctive sound—swish-flap-flap—which you've probably heard but may not have paused to consider.

If flight is a behavior we can observe locally, it is also the trait that enables birds to travel far, far away. The habits and behaviors that we can observe in the moment are part of larger patterns of behavior that play out seasonally. Flight enables the best known of these, of course: migration.

MIGRATION

Despite the fact that there are nearly 800,000 human residents in San Francisco, a much greater number of migrant birds also spend some portion of their lives within city limits. San Francisco provides a wintering home for some, a summer breeding ground for others, and a stop en route for still others. (There are also, of course, those species that live here yearround. Roughly 50 percent of San Francisco bird species are year-round residents.)

Very broadly speaking, migrating birds spend winters in the south and summers in the north, where they also breed. For decades, ornithologists have puzzled over this behavior, because it requires no small effort on the part of the birds.

> Such long flights are risky and take huge amounts of energy. So why do they do it? What are the advantages?

Migration is thought to be a result of bird diversity. Especially in southern, tropical habitats, there has been such tremendous radiation of species—that is, so many different species have developed —that birds began to migrate in order to find new food sources and, above all, open breeding sites. Migration is a response to avian success.

Migration is also a response to environmental change. The Earth's periodic glaciations have likely played a role in fostering migration; today, human-induced changes, ranging from habitat destruction to the use of bird feeders, also influence bird migrations.

WHERE DO THEY GO?

Knowing that birds migrate is one thing; getting to know who goes where is another matter entirely. There are different kinds of migrations—one species may move only a short distance while another goes to an entirely different continent.

The Townsend's warbler, which has a bright yellow head and breast, a black cap, and a striking black eye stripe and ear patch, is often spotted during fall and spring migrations. It follows the general pattern of wintering south and breeding north. But there's more to it than that. The Townsend's warbler spends winters in central Mexico and Costa Rica—and along the California coast. According to ecologist Josiah Clark, the Townsend's warbler is the second most common warbler in San Francisco during the winter (the yellow-rumped warbler is the first). The same is true up and down the coast, from Humboldt County to Los Angeles. For many Townsend's warblers, Northern California is their southern wintering ground.



Townsend's warbler

During migration, this species disperses across the western United States, except for the eastern part of Washington, where the sagebrush steppes are not to its liking; this is a species that prefers forests. To breed, the Townsend's warbler moves into northern Idaho and the Pacific Northwest, much of British Columbia, the Yukon, and southern Alaska.



The black-bellied plover migrates along the Pacific Flyway and can be seen wintering at Bay Area beaches and estuaries.

SPECIES FOCUS THE NORTHERN FLICKER

This beautiful bird was favored by many indigenous Californians for its bright orange feathers, which they used to decorate baskets and clothing. The bird's gray back, orange wing and tail feathers, and white rump make the northern flicker easy to identify in flight. Though the flicker is a woodpecker, it can often be seen scratching the ground to turn up insects. Ants are its favorite food and also apparently have a health benefit—the flicker puts the ants on its body when it preens, and the formic acid secreted by the ants kills bacteria and parasites.

The flicker was a year-round resident in San Francisco until about twenty years ago. Now we only see them in the city in the winter. Ecologist Josiah Clark has suggested that the flicker's association with ants may be linked to this change in its distribution. The spread of Argentine ants—and the subsequent loss of as many as thirty native species of ants in San Francisco could be having an effect on the northern flicker. Overall there are fewer ants for the flicker to eat and, what's more, the formic acid carried by the Argentine ants may have a different chemical composition, which could also be affecting San Francisco's northern flickers.

Migrations of the northern flicker, a gray-and-orange woodpecker, follow a different pattern. Field guides show that the flicker is a year-round resident in Northern California. In warmer weather, however, some "resident" flickers move from one elevation to another, expanding into higher altitudes in the Coast Range and the Sierra, migrating to elevations as high as 10,000 feet. In the fall, these altitudinal migrants return to lower ground, where food sources are more numerous and conditions less harsh over the winter.

Shorebirds, on the other hand, make some of the most farflung migratory trips. The sanderling, a pale, midsize sandpiper that can be seen in numbers along the California coast in the spring, circumnavigates the continent. Each year, according to *The Birder's Handbook*, the sanderling flies "east across the top of North America and down the Atlantic Coast in the autumn to their wintering grounds in Chile and Peru, and back north in the spring through the western United States to their arctic breeding grounds." Sooty shearwaters, which can be seen swarming the off-shore waters of our coast in June and July, nest on islands in Australia and New Zealand.

Generally, long-distance fliers fly higher. While most birds go no higher than about 500 feet during day-to-day flight, when migrating, many species start out at ten times that height and keep climbing until they reach 20,000 feet. "Just like jet aircraft," say the writers of *The Birder's Handbook*, "the opti-

mum cruise altitude of migrants increases as their 'fuel' is used up and their weight declines."

In addition, those going the distance usually fly by night. This is especially true of the passerines, who take to the air at twilight and land at dawn to spend the day foraging and resting. When they are flying over water or over land that's inhospitable, they may fly around the clock. "Not uncommonly," *The Birder's Handbook* tells us, "passerines lose one-fourth to one-half of their body weight during overwater



The Western sandpiper is the most numerous bird migrating along the Pacific Flyway.

migration." Birds that catch flying insects—such as swallows—eat on the wing and fly nonstop.

HOW DO THEY FIND THEIR WAY?

In migration, birds must both orient themselves—know in which direction they're flying—and navigate—figure out where they are. To do this, they use a variety of cues. They follow land forms—rivers, shorelines, mountains, and so on. Since so many fly at night, they orient themselves by the stars, and by the Earth's magnetic field. In daylight, they use the sun to guide them. And, like trout and salmon returning to spawn in their natal streams, birds use smells to help them know where they are.

With these tools, birds find their way to and from their breeding grounds. It is not a new trip every year. They follow four main flyways that, taken together, span the continent. One of these is the Pacific Flyway, which parallels the coast of North America. San Francisco Bay is an important stopover for many migrating species, especially shorebirds.

A lot of vagrants—birds that would normally be found on another migratory route—end up on the California portion of the Pacific Flyway as well. Vagrants from Asia and all over the continental United States may find themselves here, much to the delight of local birdwatchers. In 2003, for example, during

> the annual Christmas Bird Count, a Canada warbler was spotted at the San Francisco Zoo. This is a species that migrates through south-central Texas to breeding grounds in parts of the eastern US and across Canada. According to A Field Guide to the Warblers of North America (Houghton Mifflin, 1997), the Canada warbler spends winters "almost exclusively in northern South America." There were, the authors added, "no credible winter records for the US"until the San Francisco sighting.

until the San Francisco sightin Hundreds of birdwatchers came to see this single bird, which,

THOSE WHO STAY IN ONE PLACE

like all vagrants, stayed for a while then moved on.

Vagrants are migrant birds that are lost. They're off-course and tired. They land here because they have to, in order to rest and refuel. They may stay a few days, or even a season, but inevitably, they leave. Some bird species, however, have come from elsewhere and moved in permanently. These are not migrants, but birds who have extended their range.

The pygmy nuthatch provides an example. This four-inch bird with a short tail, pale undersides, and a gray-blue back is a pine *obligate*—it can't live without pine trees. It nests in their cavities, eats insects from their branches and seeds from their cones. The pygmy nuthatch is common in the Coast Ranges wherever pine trees grow; it can be found in the Bishop



Recording bird behavior is an interesting and informative exercise for very young bird enthusiasts.

pines of Point Reyes and the knobcone pines around Monterey Bay—and now, with the planting of so many Monterey pines, it has become very common in San Francisco.

According to ecologist Josiah Clark, parts of San Francisco currently provide "optimal pygmy nuthatch habitat." Not only have numerous conifers been planted here, but, having been planted at about the same time, the trees are reaching old age together, providing the pygmy nuthatch with lots of soft, dead wood in which to excavate nests. What's more, since the trees are at the end of their lives, they're producing a lot of seed, which in turn provides more food for the pygmy nuthatch. It's also possible that the aging trees are more susceptible to insect attack, which also translates to a larger food source for this bird, whose life is so linked to that of pines. Areas where pine forests have been planted—such as Sutro Heights, Lands End, and the Presidio—are strongholds of the pygmy nuthatch. Clark has suggested that, for the time being, the Presidio could be called "the world capital for pygmy nuthatches."

There are also old-timers in the local bird world—year-round residents that lived in San Francisco long before any humans ever did. Some of these are species that, like the pygmy nuthatch, have done well in the new landscape humans have created over the last two hundred years. Chickadees and bushtits, for example, both species that like woodlands, were probably restricted to the areas where oaks and willows grew in old San Francisco. As more trees were planted and much of the land was converted to a sort of woodland (with an understory of sidewalks and streets), these two species have been able to occupy more of San Francisco's natural real estate.

Other species, whose needs have not so neatly coincided with the effects of human action, have fared less well. Principal among these are scrub specialists such as the Bewick's wren, spotted towhee, and wrentit. For example, outside of San Francisco, the wrentit is not rare or endangered, but within San Francisco, it is dying out. There is now only one breeding pair in the city.

The wrentit is not a good flier; its wings are small. This is an advantage in scrub, where vegetation is dense and being able to flit from branch to branch is more important than being able to soar. But short wings become a disadvantage when scrub is scarce and a bird has to fly greater distances to find it. The range for the species is from Baja to the Hood River in Oregon, but individual birds spend their lives in very small areas—no more than a few acres.

NESTS!

Whether staying or going—whether resident or migratory species—one of the driving forces in any animal's life is reproduction. For birds, that means making a nest.

When we say the word *nest*, the image that comes to mind is a cup nest. Woven from grass, sticks, hair, and leaves and set up in the branches of a tree, they are amazing and wonderful. But cup nests are only one of many kinds of nests that birds build. *The Birder's Handbook* identifies nine. The list reads like a poem:

- Scrape
- Cup
- Saucer
- Platform
- Cavity
- Crevice
- Burrow
- Pendant
- Sphere



The Western meadowlark is known for its melodic song.

Some nests are on the ground, some are in shrubs, some are in trees. A few are underground. Using rough sticks and branches, great blue herons build platform nests in the tops of eucalyptus trees. Chestnut-backed chickadees are secondary cavitynesters—they move into tree-trunk holes excavated by pygmy nuthatches. Killdeers, whose haunting, high-voiced calls are as often heard over meadows and playing fields as along mudflats and shorelines, scrape a shallow depression in the ground and lay four speckled eggs in it.

EGGS

The purpose of a nest, of course, is to hold an egg. In the story of reproduction, nests are only half the tale. They are the housing, the setting, the stage. The egg is the baby begun but not yet complete, laid but not yet hatched.

Bird eggs come in myriad shapes and colors and sizes. They are as individual as the birds that lay them. Owls' eggs are spherical. Many seabirds' eggs are oval, with one end narrower than the other and roughly pointed. A hummingbird's egg is only a halfinch long. A robin's egg, of course, is a one-of-a-kind blue. Eggs are also what birds have in common with reptiles. The fact that birds, like lizards, turtles, and other reptiles, lay eggs tells us of their shared ancestry. Birds are descended from reptiles. From bare-skinned, terrestrial beginnings, birds grew wings and took flight.

BIRDSONG

And what's more, they developed voices. The tumbling trill of a winter wren. The shriek of a young hawk. The endless variety of the mockingbird's song. For some of the small song-birds that remain hidden in treetops, their songs may be the way we can best know them. Even with obvious species, such as the raven, voices are still distinct, an inseparable part of their identity.

FOR MORE INFORMATION

Though it is not the only one you'll want to own, the best field guide to start with is *Birds of Northern California* by David Fix and Andy Bezener. Published by Lone Pine Press, it features good, large illustrations and local information about each species. It is lovingly written.

When the *Sibley Guide to Birds* (Knopf) came out nine years ago, it set a new standard for field guides for birds. Written and illustrated by a man who began studying birds at age seven, this guide is the distillation of years of work in the field. Buy it and benefit from Sibley's knowledge and artistic skill.

Written as an "essential companion to your identification guide," *The Birder's Handbook: A Field Guide to the Natural History of North American Birds* (Fireside, 1988) provides life history information about every species of bird in the US. The field notes are interspersed with wonderful, insightful essays on all aspects of birds and bird ecology.

Though based in the East Bay, the Golden Gate Audubon Society is very active in San Francisco and around the bay. They offer free field trips throughout the year. To find out more, go to *www.goldengateaudubon.org*.



MAMMALS

Most wild mammals lose their first set of teeth. They're called milk teeth, rather than baby teeth, but they do what young humans' teeth do: They fall out. The second set is permanent.

In many cases, mammal identification comes down to teeth and, to paraphrase Lloyd Ingles, author of *Mammals of the Pacific States* (Stanford University Press, 1965), much of our knowledge of the evolution of mammals is based upon changes in the location and shape of their molars. To quote him more directly, "the success of the various mammals in eating different kinds of foods and then in occupying a variety of habitats has been largely attributed to the evolution of their teeth."

BY THEIR TEETH MAY YE KNOW THEM...

Mammals' front teeth are called incisors. Toward the side is a single pointed tooth called a canine. Behind that there are premolars and molars.

The incisors of rabbits, gophers, and other rodents keep growing for the animal's entire life. They are chisel-shaped

and, according to Ingles, they "are sharpened as the animal rubs the cutting edges together." These same mammals, as well as most of those with hooves, don't have canine teeth in their upper jaws because they don't eat meat. "Most mammals use the canines in fighting and tearing flesh," writes Ingles, so herbivores such as rodents, rabbits, and deer don't need them.

Carnivores, the meat eaters, have "canine teeth [that] are longer than the incisors and are adapted for seizing and holding their prey." Marine mammals show some of the most fantastic elaborations of canine-tooth evolution; walrus canines can grow to more than 20 inches and, Ingles tells us, "the nine-footlong spiral tusk projecting ahead of a narwhale is the left upper canine tooth."

With very few exceptions, adult mammals have teeth, and those teeth tell us who the animal is and what it eats.

...AS WELL AS BY THEIR SCAT AND TRACKS

What an animal eats can also be told by what it leaves behind. Scat, or fecal droppings, are, Mr. Ingles says, "another kind of information which the serious student of mammals will find very useful." Animal droppings *can* be fascinating—the hair, bones, leaves, seeds, and other things they contain tell clear stories about the life of the animal that left them. Usually, by the time you come upon scat, it is not stinky or moist; it will often be dried out and probably odorless—though not always. Add a little bit of water to cougar scat (should you find some!) and it will have the unmistakable smell of cat pee.

In a story that appeared in the Fall 1998 issue of *California Wild* magazine, writer Peter Friederici describes going tracking with a group of volunteers in San Diego. They found scat for cougar, bobcat, weasel, and coyote. Coyotes have been seen on Bernal Hill and in the Presidio in San Francisco; keep your eye out for scat that's "gray and hairy, four inches long, sprinkled with small white dashes of rodent bones."

Look for tracks, too. You can start by getting to know the paw prints of dogs—and how they differ from those of other animals. A good time to look is after a rain. This is an activity that may really appeal to your students; one of the San Diego volunteers described how, as a child, he was "always fascinated by stories of Native American scouts and how they could read a story about what animals were doing from just a few tracks." As an adult, this same man is now urging other volunteers to "learn about all aspects of the environment, because they all play into the reasons for a track being where it is. You have to ask," he says, "'What is this particular animal doing here? Why did it come here?'"

GETTING THE CONTEXT

It's true that you don't really know an animal until you know how it interacts with the world around it. This means getting to know its habits and learning something about its lifestyle. This is easier said than done because most mammals are shy. They're good at taking care of their needs while avoiding becoming somebody else's lunch. Birds have the advantage of flight, but only one kind of mammal—bats—has exploited that niche. Most mammals have developed other means of getting by and staying out of sight.



Raccoon tracks

UNDER COVER OF NIGHT

Bats have flight working in their favor, and they also have the cover of night. Being nocturnal is one good way to avoid predation, and quite a few mammals take advantage of that fact. It has been suggested that mammals moved into this niche (the nighttime) early in their evolution, when there were fewer of them and a lot more big reptiles strutting about during the daytime. Nowadays, in San Francisco, we humans strut and fret in the daylight. Several of the city's better-known mammals—raccoons, skunks, and opossums—come out at night.

GOING UNDERGROUND

Another strategy for staying alive is to go underground. Having a burrow to duck into can mean the difference between life and death if you're a rodent and there are raptors in the trees at the edge of the meadow.

Many small mammals live underground. Ecologists call this way of life *fossorial*. It is another example of niche exploitation; it is also an example of how evolution has played out in not just teeth, but whole limbs. To quote Lloyd Ingles, "the



Pocket gopher

burrowing or fossorial mammals show remarkable modifications of the forefeet for digging. The broad hand of a mole or the long claws of a pocket gopher are found duplicated on other continents in other fossorial mammals that are only distantly related to our own burrowing species. This phenomenon is called parallel or convergent evolution."

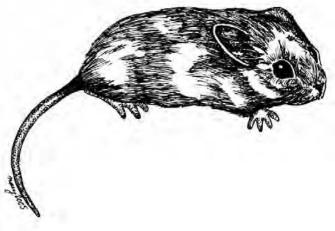
The burrowing of moles and gophers is considered a nuisance when it interferes with the work of humans, but in wild ecosystems, it can have a good effect, aerating the soil and returning organic matter to it.

ORDER RODENTIA

Many of the world's burrowers are rodents—members of the order Rodentia. All rodents are terrestrial; Ingles calls them "the familiar gnawing types" such as beavers, tree squirrels, ground squirrels, chipmunks, gophers, moles, rats, and many kinds of mice. In the Pacific states, Ingles says, "there are probably more individual animals belonging to this order... than belong to all the other orders combined." (In the class Mammalia, there are eighteen orders altogether. Ten of those occur in California.)

Rodents eat low on the food chain and then make up the next link in that chain. Primarily plant eaters, they are the main food for predaceous mammals and birds such as coyotes and hawks. This fact, and the job they do turning the earth, make rodents extremely important in the overall scheme of things. San Francisco's common rodents include:

- House mouse (*Mus musculus*) (exotic)
- Black rat (*Rattus rattus*) (exotic)
- Norway rat (*Rattus norvegicus*) (exotic)
- White-footed deer mouse (*Peromyscus maniculatus*) (indigenous)
- Meadow vole (*Microtus californicus*) (indigenous)
- Valley pocket gopher (*Thomomys* sp.) (indigenous)
- California ground squirrel (Spermophilus beecheyi) (indigenous)
- Eastern gray squirrel (*Sciurus carolinensis*) (exotic)
- Western gray squirrel (*Sciurus griseus*) (indigenous)



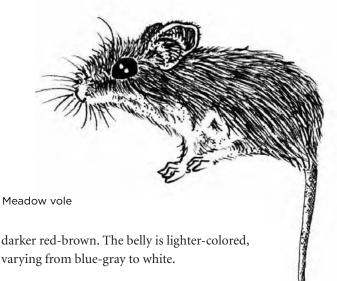
Mouse

SPECIES FOCUS MEADOW VOLE

Also known as California meadow mouse, the meadow vole is a member of a group of mice that typically have long hairs in front of their ears, which makes it look as though they have no ears at all.

The meadow vole is about 7 inches long, and his ears show up more than others of his kind. His fur is buffy brown or dark brown on his back, often with hairs in the middle that are a

FINDING URBAN NATURE: BASICS/MAMMALS



According to San Francisco ecologist Josiah Clark, meadow voles have made a comeback in some restoration areas in the city. As a grasslands dweller, this species is helped by tree removal. Clark says that meadow voles do well in bunch-grass prairies, but not as well where there's thatch and more herb cover. "A focused observer," he says, "can sometimes see their paths in the grass."

ORDER INSECTIVORA

Lloyd Ingles characterizes the mammals of this order as ones that are "for the most part small with long, pointed noses, with five toes armed with claws, and with conical points on the molar teeth." Josiah Clark says that this order is closely related to Order Chiroptera—the bats. "Their dentition," says Clark, "is different from rodents."

Different teeth means a different diet. Some members of this order do eat bulbs and seeds but, as their name suggests, most prefer something besides plant parts. They eat invertebrates insects, arthropods, worms. There are five main groups of insectivores; two of these, moles and shrews, are indigenous in California. At least three indigenous species can be found in San Francisco.

- Broad-handed (or broad-footed) mole (*Scapanus latimanus*)
- Ornate shrew (*Sorex ornatus*)
- Vagrant shrew (*Sorex vagrans*)

A LITTLE BIT ABOUT SHREWS

Shrews are like little mice, only with longer, bare snouts. Ingles tells us "they have small functional eyes and clearly visible external ears. The well-developed tail is scaly, with very short hairs."

Shrews are the world's smallest mammals. The smallest of the small, the pygmy shrew, weighs only 2.3 grams. (There are 28 grams in an ounce, and 16 ounces in a pound. That calculates to about 195 pygmy shrews per pound.) When San Francisco's vagrant shrew is born, it weighs only half a gram. By the time it is full-grown, it weighs 7 grams—a quarter-ounce.

Being small has special challenges. The smaller you are, the harder your body has to work to keep you warm. This is because, relative to your interior, you have a lot of surface area exposed. So, to keep themselves alive and warm, shrews have to eat every two to three hours, and they must eat an amount of food equal to their own weight every day.

ORDER LAGOMORPH

Shrews live and hunt above ground. They prey on spiders, insects, worms, and even mice. Here's one description of the mammals in this order: "Most of the species have long ears and short tails and hop instead of walking or running. They are strictly herbivorous." Hmm. Sounds like a rabbit. The Lagomorphs were once considered rodents, but for intricate morphological reasons, they've been moved into an order of their own. The order includes hares, cottontails, brush rabbits, pygmy rabbits, and pikas. Indigenous San Francisco species include:

- Brush rabbit (*Sylvilagus bachmani*)
- Black-tailed hare (*Lepus californicus*)

SPECIES FOCUS BROAD-HANDED MOLE

The following account of the broad-handed mole was written by Roger Luckenbach. It comes from the first edition of *The Natural History of the UC Santa Cruz Campus* (second ed., University of California, Santa Barbara, 2008).

[Broad-handed] moles are so highly adapted to a burrowing life that they have difficulty walking on land and can only row clumsily with their enormous front feet, or "hands." (The scientific name for the species—*latimanus*—means "broad-handed.") They have been known to construct tunnels up to 22 feet long in a single day, loosening the soil with their forepaws....

On close inspection, broad-handed moles seem Edwardian and exotic—with tiny flexible furred snouts, mere pinpoints of eyes, white gloves covering enormous hands, and luxurious, dark-chocolate fur. Their sensitive noses are adapted to finding earth-worms and insects underground.... Because moles live entirely underground, their eyes are superfluous and therefore reduced.

The mole's pelage is the original mole skin: soft, dense, and glistening. Beatrix Potter, the English writer of children's books and creator of Peter Rabbit, wrote a rhyme about the English mole. Naming her character "Diggory Delvet," she described him as "a little man in black velvet."

He digs and he delves And you can see for yourselves The mounds dug by Diggory Delvet.

European country folk used mole skins for shirts and apparel, patiently sewing the small patches together. The fur is napless, meaning that it can be brushed in any direction. This allows the mole to move comfortably both forward and backward in its tunnels.



Broad-handed mole

ORDER CARNIVORA

When we think of mammals, or animals in general, the image that most often comes to mind is probably a carnivorous mammal. Lions and tigers and bears. Domestic cats and dogs. Lloyd Ingles calls Order Carnivora "a great assemblage of mammals," and he reminds us that they are not all nor exclusively flesh-eaters. Just as some insectivores eat more than just insects, some carnivores consume more than meat. Lines can be drawn and generalizations made in the world of nature, but there are always variances.

Some characteristics do, however, hold true for all mammals in Order Carnivora. They have curved claws. They have long canine teeth that help them seize and hold prey. Almost all of them also have three incisors in their upper and lower jaws.

This order is divided into terrestrial and marine carnivores. In the terrestrial group there are, according to Lloyd Ingles, "seven rather well-defined families" that include cats (Felidae), (Canidae), and less well-known families such as the mustelids (Mustelidae) and the procyonids (Procyonidae).



Red fox

Ingles tells us that the mustelids are best known for their "well-developed anal musk glands." Another trait of this family is bushy tails. In San Francisco, the mustelids are represented by the skunk (*Mephitis mephitis*).



Another name for the procyonids could be "ring-tails." The raccoon (*Procyon lotor*) is our local representative.

That leaves cats and dogs. There are both wild and domestic species in San Francisco. On the wild side, canines are better represented than felines. The coyote, for example, has returned to the city after a fifty-year absence. According to ecologist Josiah Clark, the coyotes in the city now are part of a northern population, which suggests that they are coming into the city across the Golden Gate Bridge. Both red fox and gray fox can also be found here, though the gray fox is now being outcompeted by the red fox and so is becoming rare.

The most widespread member of the feline family in San Francisco is the domestic cat. This mammal enjoys the comforts of indoor living and the pleasures of outdoor sport. Domestic cats are hunters. Good hunters. Collectively, they kill hundreds of thousands of birds and small mammals each year in the United States. In San

Francisco, birdwatchers in Golden Gate Park have watched some birds' numbers plummet in the last fifteen to twenty years. In an article on the subject that appeared in *California Wild* magazine, ornithologist Douglas Bell is quoted as saying, "It's the near-ground-nesting birds like white-crown [sparrows], song sparrows, juncos, and quail that are hit the hardest by the influx of cats. Quail used to nest in abundance in Golden Gate Park. Now they are virtually gone."

Feline and canidae of San Francisco include:

- Coyote (*Canis latrans*) (indigenous)
- Gray fox (*Urocyon cinereoargenteus*) (indigenous)
- Red fox (*Vulpes vulpes*) (exotic)
- Domestic dog (*Canis familiaris*) (exotic)
- Domestic cat (*Felis domesticus*) (exotic)

Raccoon

NOTE

The previous account is but a partial one that focuses on just a few of our terrestrial mammals. Several orders, including bats, were left out. The marine mammals whales, seals, and sea lions—were likewise ignored. Time and space did not permit a full treatment of all of the mammals to be found in San Francisco.

FOR MORE INFORMATION

In addition to a variety of other programs, the Randall Museum holds live animal presentations and has live animal exhibits. For more information, call (415) 554-9600 or go to *www.randallmuseum.org.*

If you want to see mammals, go to the zoo! One of their newer residents is a grizzly bear. To find out more, look online at *www.sfzoo.org*.

The Natural History of Vacant Lots (University of California Press, 1989) by Matthew Vessel and Herbert Wong has been recommended elsewhere in this guide, but it can't be recommended often enough. It's the best field guide to buy, because it covers all the most common kinds of organisms—plants, insects, amphibians, reptiles, birds, and mammals—and describes the species you're most likely to find. It's also chockablock full of good activity suggestions.

The Nature in the City website has links to stories and descriptions of some of San Francisco's wildlife. Go to *www.natureinthecity.org* and select the "Wildlife" link.

The website for the Golden Gate National Recreation Area includes a field guide for all the animals (not just mammals) found throughout the GGNRA. Go to www. nps.gov/goga/naturescience/index.htm.

Local environmental educator Dixie Finley, who has taught animal tracking workshops in the Bay Area for ten years, has developed a teacher's tracking kit for use in the classroom. She frequently works with the Watershed Project in Richmond; call that organization at (510) 665-3546 for help with tracking down Dixie.

The Mammals of the Pacific States (Stanford University Press, 1990) by Lloyd Ingles, from which the text in this section draws heavily, includes illustrations of many common mammal scats.

FINDING URBAN NATURE: BASICS/WASTE, HAZARDS, AND POLLUTION



WASTE, HAZARDS, AND POLLUTION

"The most remarkable characteristic of living matter," according to the editors of *Gaia: An Atlas of Planet Management* (Anchor Press, 1984), "is that it is self-organizing. In contrast with the overall trend towards disorder or entropy evident in the universe," they explain, "life creates order from the materials around it." However, they also say this process necessitates "exporting waste." Both through creating order and creating waste, they conclude, "life has the capacity to influence its environment."

In the economy of nature, "waste" is not often wasted. The byproducts of life, be they fallen trees, dead beetles, or steaming dung, are made up of elemental, organic materials that are eventually broken down and taken back up into the ecosystem of which they are a part. In the industrialized world of human beings, on the other hand, we now generate wastes that are as varied and complex as our societies.

ONLY SO MANY WAYS TO DISPOSE OF IT

Regardless of the kind of waste you create, there are really only a few ways to dispose of it. Simply put, we can pile it on top of the ground, bury it underground, sink it in a body of water, or burn it. We can also reclaim much of our waste through reuse and recycling.

In addition to the question of how to dispose of waste, there's also the question of where to do so. Before the days of garbage collection (which began little more than a hundred years ago in San Francisco), a fair number of people employed all four approaches to waste disposal at home. The Ohlone made shell mounds or middens—shoreline trash deposits that sometimes also served as burial mounds; the size of some of these depos-



Street cleaners parked in front of the Street Cleaning Department, ca 1900. Before the advent of the automobile, horse manure had be cleaned from the streets on a daily basis. Here's the cart that was used—note the broad, flat-edged spades hanging from its sides and sliding lids covering its bed.

its, their accumulation over centuries and their contents suggest that shell mounds and middens were more complex than American-period dumps. Early settlers tossed their trash in their backyards—archaeologists working recently in the SOMA district have found evidence of garbage scattered across the surface of residential lots, and they have also uncovered waste pits.

In post-Gold Rush San Francisco, waste was also disposed of farther from home. Casual dumping at sites convenient to the dumper, such as creek ravines, was common; there were also better-known sites where individuals and haulers collectively dropped their waste. Many such dumps were along the shoreline. Crissy Field was long a dumping ground for the various military communities that occupied the Presidio; another dump was located near Fisherman's Wharf, north of today's Bay Street. At Mission Bay, according to Nancy Olmsted, "there was continuous casual filling from garbage dumps along the line of 7th and 8th streets, near Berry." And "south of Berry," Olmsted tells us, "between 6th and 7th streets, an informal garbage dump persisted from 1878 until 1895, gradually extending until it covered 20 acres south of the channel."

EARLY-DAY RECYCLING

Olmsted says that 300 wagon-loads of garbage a day were brought to the south-channel site. Before each was shoveled into the water, though, a loose-knit band of scavengers—Olmsted calls them "the dump trust"—sorted through the waste. She quotes from an newspaper article (circa 1889), in which the following description of the scavengers appeared: "With a general air of dejected doggedness, many were busily engaged with pitchfork, shovel, or stick, sifting each load as it was dumped from the reeking, overflowing carts. Rags, old bottles, scraps of iron, old sacks, bricks, oyster shells, half-decayed fruit and vegetables—all were prized."

This was no prize job, however. Working conditions were clearly not ideal, and the dump-pickers were discriminated against. Olmsted says "the police sporadically raided 'Dumpville,'" where the workers lived, "burning the shacks that were put on 'railroad lands.' The scavengers returned and business continued," however, "since there were no neighbors to complain." No one else lived nearby, in part because, according to Olmsted, "the degree of pollution at Channel Street and in Mission Bay became so great that the water was sickening to smell and deadly to fall into."

The stench and unsightliness of the growing dumps in many of America's cities led to a reform movement around the turn of the century. Many cities began to play a role in determining how garbage would be collected and where it would be disposed of. In some cases, garbage collection became a municipal function—the city itself provided the service—while in others, collection was managed by private organizations. In San Francisco, reform was slow, and the job of garbage collection was left to whomever would do it. Dozens of men, who used the job title "scavenger," collected garbage in the city. Most of them were Italian.

DOWN IN THE DUMPS, SINGING ALL THE SAME

"In the late nineteenth century and into the twentieth, garbage collection ('scavenging') was controlled by Italians from the area known as Lorsica," writes G. S. Williamson in the essay, "Scavengers," which appears on the Shaping San Francisco website. "When more workers were needed, they were hired from that province in Italy, rather than from among other Italians in North Beach. For the next quarter-century, the Lorsicani of San Francisco provided enough children to satisfy the need for new workers. This is the period fondly remembered by old-time residents, when scavengers wore straw hats (or, occasionally, silk... hats) and sang opera."

In the early 1920s, city officials finally joined the act, dividing the city into collection districts and setting rates. At that time, according to Williamson, there were about 400 garbage men in the city affiliated with numerous collectors' organizations. The largest one was the Scavengers Protective Association, which later changed its name to Golden Gate Disposal. Another, which incorporated in 1921, was Sunset Scavenger. In the 1930s, the city granted collection permits to these two companies; they continue to hold those permits today.

TWENTY-FIRST CENTURY WASTE MANAGEMENT

Garbage is now collected five days a week in San Francisco, 52 weeks a year. Garbage trucks follow more than 150 routes through the city to collect a total of 4 million pounds daily. They carry it to a transfer station near Candlestick Park, where it is loaded on to trailers that haul it 60 miles to the Altamont Landfill in eastern Alameda County and then drive back, a round-trip of 120 miles. The trailers make 100 trips a day, which means they travel 12,000 miles daily to move San Francisco's garbage to its final resting place.

That is the waste that is eternally consigned to the ground, never to be reclaimed. But San Francisco is doing an everbetter job of keeping materials out of the landfill. The San Francisco Recycling and Disposal center, which is located near the transfer station, takes in another 1.2 million pounds of recyclable materials each working day. Residential bins yield 800,000 pounds of paper, bottles, and cans, while commercial sources provide 400,000 more. Most of this get baled and shipped to Southeast Asia, where it is reprocessed and redistributed to industry.

The city's recycling program began in 1989, at about the same time federal and state laws were passed mandating a 50 percent reduction in waste by the year 2000. San Francisco met that goal and, in 2004, passed a resolution to divert 75 percent of its garbage from the landfill by 2010—and reach zero waste by 2020.



THE WASTESHED OF SAN FRANCISCO

Like water moving through the landscape after a rain, there is a stream of waste that continuously flows from homes, businesses, industry, government offices, and schools. Comparable to a watershed, a *wasteshed* is an area from which all the streams of refuse flow into the same landfill.

The wasteshed of San Francisco corresponds to the 49 square miles of the city—or does it? Since San Francisco's garbage is hauled 60 miles away, to the eastern side of the Livermore Valley, the city's wasteshed includes highways in the East Bay. And since other cities and counties also use the Altamont Landfill, San Francisco is actually part of a much, much bigger wasteshed.

REDUCING AND DIVERTING WASTE

For the city of San Francisco to achieve zero waste, two things are necessary. We all—residents and industrial waste-producers alike—have to (1) reduce the amount of waste we make, and (2) find more ways to reuse the waste we cannot avoid making. Doing this requires an "integrated" approach to waste management, which emphasizes the Four Rs—reduce, reuse, recycle, and rot (compost).

Common sense tells us that the best way to deal with waste is to not create it in the first place. Beyond that, we have to separate the various components of the waste we do create, because doing so makes it possible to reuse or recycle them.

The city has made it easy to separate much of our garbage by providing three disposal bins—one for trash, one for regular recyclables, and one for organics. Organic material—grass clippings, garden trimmings, kitchen scraps—constitute a large percentage of landfilled "waste" that could be separated out and recycled. Organic recycling has been underway in San Francisco for a couple of years and 400,000 pounds are now collected each day. The materials are transported, composted and then, according to the Department of the Environment website, "sold to farms across the Bay Area. These farms in turn grow vegetables, which are sold back to consumers in the city. That's called closing the loop."

A NEW DESIGNATION: UNIVERSAL WASTE

The state is also pushing for greater separation of trash and waste. A state law recently went into effect that designates a

FINDING URBAN NATURE: BASICS/WASTE, HAZARDS, AND POLLUTION

new kind of waste and bans it from our bins. Universal waste which consists of oh-so-common but nonetheless hazardous items such as batteries, fluorescent bulbs, thermostats, and electronic devices—must now be kept out of the garbage. These items may be disposed of at local drop-off facilities or picked up by special haulers. Many of these items can also be dropped off at the city's Household Hazardous Waste Collection Facility, located at 501 Tunnel Avenue, (415)-330-1405. Anything containing mercury should also be handled this way.

Defining a new kind of residential waste highlights the fact that many of our household products contain hazardous ingredients. The term "hazardous" is itself a legal designation; in 1976, when the federal government began to play a greater role in determining how wastes would be handled in this country, it defined *hazardous waste* as "a liquid, solid, sludge, or containerized gas waste substance that, due to its quantity, concentration, or chemical properties, may cause significant threats to human health or the environment if managed improperly."

The majority of hazardous waste comes from industrial sources, but much of what industry produces ends up in our homes. When we want to get rid of these products, they become household *hazardous waste*. The new legislation regarding Universal Waste shows that federal, state, and local govern-

FOOD TO FLOWERS! LUNCHROOM COMPOSTING

Almost all of San Francisco's 250 public and private schools recycle their paper, bottles, and cans, but relatively few are recycling organic materials such as food scraps. Capturing this untapped "resource" is important, since it could reduce typical school waste loads by as much as 38 percent.

To help schools start recycling organics, the city's Department of the Environment has launched the "Food to Flowers!" collection program. City staff members work with teachers, principals, and custodians to involve as many students as possible in collecting lunchroom waste. The collected materials are picked up by the school's regular waste hauler and taken to a facility where they are composted.

The program includes free K-12 assemblies and educational materials. For middle and high schools, SF Environment staff members work with students to conduct a waste audit, measuring the school's waste outputs before and after the organics recycling program begins.

For more information, call the Department of the Environment at (415) 335-3742 or email *environment@sfgov.org.*



ments are trying to direct this flow of hazardous waste away from landfills and into a facility designed for hazardous waste or—better yet—into a recycling system.

TAKING RESPONSIBILITY

Making the consumer responsible for properly disposing of Universal Waste means that the end user—and local municipalities—bear the cost of doing the right thing. With the implementation of the Universal Waste program, the City of San Francisco has begun calling for manufacturers to take responsibility for the cost of their products' disposal. In a press release about Universal Waste, Jared Blumenfeld, former director of the Department of the Environment, addresses this issue head-on.

Right now ratepayers and taxpayers are underwriting the cost of hazardous waste collection programs, which essentially subsidizes the manufacture of waste.... Manufacturers know that no matter what they produce and no matter how toxic the ingredients—local governments will foot the bill for recycling or disposal. We need to hold these manufacturers responsible for the toxic products they produce, and embrace the simple notion that the people who create toxic products should pay for their disposal.

In February 2006, the Board of Supervisors passed a resolution supporting statewide legislation and local initiatives that require manufacturers to take responsibility for collecting and recycling their products at the end of their useful life. According to the website of the Blue Ridge Environmental Defense League, which is running a "Zero Waste Campaign" and has been monitoring events in San Francisco, "this is the strongest statement yet from a local government in the United States."

The question of who bears responsibility has long been an issue in the arena of large-scale, industrial waste. Industry creates most of our hazardous waste, and, until relatively recently, there was little regulation regarding how this waste was disposed of.

A BRIEF HISTORY OF HAZARDOUS WASTE

The period after World War II was one of unprecedented growth in the United States. There was a boom in babies and just about everything else—including our ability to make and manipulate substances that can persist in the environment and harm human health. Pesticides such as DDT came on the market, for example, as did new-fangled plastics and polymers of all kinds. Many of these products were toxic in and of themselves; even more of them resulted in hazardous waste.

"Huge volumes of solid, liquid, and hazardous wastes were generated by a growing population and evolving industry," writes Mark Crawford, author of *Toxic Waste Sites: An Encyclopedia of Endangered America* (ABC-CLIO, 1997). "These chemical wastes were simply buried in unlined landfills, gravel pits, quarries, strip mines, or low-lying areas and wetlands, often under only a few feet of earth." In addition, Crawford recounts, "millions of gallons of industrial wastewater were pumped daily into waterways, dry wells, sewer systems, and holding ponds. Radioactive compounds, explosives, chemical warfare agents, and other dangerous wastes were buried by the US Military on sprawling bases across the United States."

These casual means of dealing with toxics was "accepted by government and industry," Crawford explains, "because the negative, long-term environmental and health impacts had not been seriously considered." But by the 1970s, the effects of our faulty waste management practices were becoming apparent to everyone. Pictures of a river in Ohio, covered in toxic oils and burning uncontrollably, appeared in the news. Residents stood outside city hall in Pittsburgh wearing gas masks, protesting industrial contamination of the air and ground around their homes. And residents of a subdivision built on an old landfill in New York became so sick that the entire town had to be shut down. In 1976, the federal government passed the Resource Conservation and Recovery Act, which mandated the regulation of hazardous waste from creation to final disposal. The Environmental Protection Agency (EPA), which had been established just six years before, was given the power to develop and implement the new regulations. Four years later, in 1980, Congress passed another act, often referred to as Superfund, which gave the EPA the power to find and require the clean-up of the most polluted places in America.



HAZARDOUS SITES IN SAN FRANCISCO

There is one Superfund site in San Francisco—the Naval Shipyard at Hunters Point. There, according to Mark Crawford, "waste products from operations such as oil reclamation, transformer processing, metal plating, and battery refurbishing were discharged or dumped into unlined pits or lagoons on the property. Testing in 1987 revealed that the soil and groundwater are contaminated with fuels, heavy metals, PCBs, pesticides, asbestos, and VOCs." The Navy began cleanup of the 900-acre site in 1988.

Most of the industry that remains in the city is located in Bayview Hunters Point, where a disproportionate number of people suffer from asthma, cancer, and other afflictions that can be linked to the pollution of the environment. According to the Bayview Hunters Point Mothers Environmental Health and Justice Committee, and others who prepared *A Toxic Inventory of Bayview Hunters Point, San Francisco* (available online at *www.greenaction.org*), "over half of the land in San Francisco that is zoned for industrial use is in Bayview Hunters Point." Their report goes on to paint a picture of what that means. "This small community of color has... ten times as many contaminated water dischargers on a per capita basis as the rest of San Francisco, four times as many polluted air dischargers, five times as many facilities storing acutely hazardous materials, three times as many underground storage tanks, and four times as many contaminated industrial sites."

The contamination of so many sites in southeastern San Francisco raises huge issues of environmental justice, which are beyond the scope of this work to address. Aside from those serious questions, however, the ugly legacy of our society's carelessness with toxics is obvious.

DO NOT DESPAIR

Though the worst damage has been done in San Francisco neighborhoods with the least resources, none of us is untouched by industrial waste. We live in a highly technological society, one heavily based on the manufacture and manipulation of human-made chemicals. These processes and products result in huge numbers of new substances—toxic or otherwise—being introduced into the environment. Some, such as pesticides and food additives, are intentionally introduced, while others are incidental or routine releases, such as emissions from a car's tailpipe or effluent from a sewage treatment plant. Others are released by accident, as when the Exxon *Valdez* foundered in Alaska's Prince William Sound.

As overwhelming as this may seem, it is not necessarily cause for despair. The management of all kinds of waste, hazardous or otherwise, is much better now than it was 30 years ago, and it continues to improve. Industries, too, are cleaner than they once were, as a result both of regulation and innovation.

As an individual, you also have the power to reduce the number of harmful chemicals in the environment. According to John Harte and the other authors of *Toxics A to Z* (UC Press, 1991), the three best ways to do so are to conserve energy, recycle more, and purchase less-toxic alternatives. "Conservation of energy is one of the easiest ways to reduce the amount of toxics in the environment," they write, "because conventional methods of producing energy create a host of hazardous substances." About recycling much has already been said, but here's a simple example, also from Harte et al: "Each ton of paper recycled saves 17 average-sized trees, along with 5 barrels of oil and 7,000 gallons of water used in manufacturing, and 3 cubic yards of landfill space."

Regarding the purchase of less-toxic alternatives, this is a variation on the theme of "reduce and reuse," which applies not only to waste, but to intake. Reduce your use of toxics and you are, de facto, reducing their presence in the environment. And your choices do have repercussions back up the industry chain. What buyers demand—or are willing to accept—is what they'll get. But what they reject may eventually fade away.

FOR MORE INFORMATION

"The Rotten Truth About Garbage," an online adjunct to an exhibit created by the Smithsonian Institution Traveling Exhibition Service and the Association of Science-Technology Center, offers good, basic information in a format that's easy for kids to use. To find out more, visit www.astc.org/exhibitions/rotten/rthome.htm.

The Department of the Environment Ed Program holds free field trips and assemblies. Suitable for grades K to 12, sign-ups take place in the fall. To find out more, visit *www.sfenvironment.org* or call (415) 355-3700.

Scorecard.org provides a variety of information about pollution problems and toxic chemicals, including a feature that allows the user to look up information by zip code.

Toxics A to Z. While some of the background information is a bit outdated, much is still relevant and all of the information regarding commonly encountered toxics is as useful as ever.

PART THREE San Francisco Watersheds



INTRODUCTION: WATERSHEDS

While working with San Francisco teachers on defining the content for this guide, we recognized a thread connecting the many communities throughout the city: watersheds.

In the following pages, you will find descriptions of the seven San Francisco watersheds as defined by the San Francisco Public Utilities Commission. Each piece in this section will give you a sense of the water flow above and below the surface, provide insights into the interconnections between various parts of the city, and add dimension to your understanding of the individual sites described in the next section of this book.

We hope the following pages will challenge you to think about how you and your students are connected to other neighborhoods, and to consider how different states and countries are inextricably linked by topography and the flow of water. Humans have found ingenious ways to both connect and disconnect ourselves from others. In our urban environment, we are connected by roads, waterlines, and the power grid. But, at the same time, we are disconnected by political boundaries, limited public transportation, and disjointed green space.

In San Francisco, we are all part of the San Francisco Bay watershed, which comprises approximately 40 percent of the state of California. We are also connected by water flowing in the sub-watersheds throughout the city. The destination of every drop of water that falls is determined by where it lands. Each follows a unique route that connects neighborhoods, natural areas, industrial zones, and eventually, the Pacific Ocean. Hundreds of miles of pipes carry the runoff from city streets in unnatural courses around the city, limiting ground water recharge and flushing water away to the bay or ocean.

We see "watersheds" as a great tool for understanding the intersection of open space and urban communities and the impact humans can have on areas both near and far. Understanding the Earth's natural boundaries and water flow provides insight into formerly unknown connections between human and non-human communities, connections that are both life-giving and life-threatening. Water has fascinating properties that many other molecules do not; water is able to carry nutrients and pollution throughout a watershed.

We hope you and your students will explore the Bay Area from the ridge tops to valleys with a fresh perspective and create new and exciting connections with the human and non-human communities that share your watershed.



MARINA WATERSHED

The Marina Watershed includes most of San Francisco's northern edge. Named for the Marina District, which was created by filling in a cove and tidal marsh for the Panama–Pacific International Exposition, the watershed covers the area from the foot of Van Ness Street to Baker Beach and from the shoreline to Broadway Street.

It includes all but the southwestern edge of the Presidio, which is part of the Lobos Creek Watershed. The neighborhoods within the Marina Watershed are Cow Hollow and the Marina District, as well as the Presidio.

Apart from the Presidio, the Marina Watershed was little-inhabited during the Spanish colonial period and the early days of the Gold Rush. It was a sandy place; some areas were covered with scrub, while others were sweeps of long dunes. But for all its apparent emptiness, the Marina Watershed had a fertile shoreline backed by many ponds, springs, and streams.

One of the best known of the Marina's historic water bodies, because of its size and because it appears in photographs, was Washerwoman's Lagoon.

WHERE WAS WASHERWOMAN'S LAGOON?

According to John Levinsohn, author of *Cow Hollow: Early Days of a San Francisco Neighborhood from 1776* (San Francisco Yesterday, 1976), the lagoon was "contained by the sand hills which rose at present Lombard Street and extended to Bay Street. The lagoon's south shoreline was at about Filbert Street. It reached from Franklin to about Octavia." It appears on early surveys of San Francisco; William Eddy's 1853 map included the "lagoon survey," a cluster of parcels adjacent to Washerwoman's Lagoon, that were set at an angle to the orderly grid of streets extending west from Yerba Buena Cove. Early surveys also show a second, smaller lake very near Washerwoman's Lagoon. It would have been roughly where you find Laguna Street today.



Cow Hollow and Washerwoman's Lagoon, ca. 1856. The sand hills to the right of the lagoon were in front of today's Fort Mason. Two smaller lakes can be seen in the middle of the photo; beyond them, in the hills, you can make out the quadrangle of the Presidio. Crissy Marsh and Strawberry Island are in the bay to the right of the Presidio.

Washerwoman's Lagoon was spring-fed. The porous sands of the Marina and the porous Colma Formation sandstone beneath them both drained and collected water, allowing it to flow underground and resurface. The dunes, too, formed occasional catchments, pooling water in still, small mirrors that reflected the sand and vegetation surrounding them.

Knowledge of many of these water bodies has been lost to time, but we know of two springs that were in the vicinity of the Presidio—Los Ojos de Figueroa, which was near the intersection of Lyon and Green streets, and El Polin, which can still be visited on the Presidio. Do not expect to find a gushing fountain at El Polin—look instead for a small cascade surrounded by a quiet seep, and think, in the words of park service docent Barbara Corff, "what a little trickle can do." El Polin is still one of the best sites for birds in the Presidio, and it has been used by humans for centuries.

EL POLIN AND THE LIFE OF JUANA BRIONES

The life of one woman, in particular, is closely linked with El Polin Spring. Born in 1802 in a town that would eventually be called Santa Cruz, Juana Briones came to the Presidio of San Francisco with her family when she was child. Her father served in the military and her family took up residence on the Presidio. Sometime between 1810 and 1820, Juana's sister married a Presidio soldier and they moved from the fort's main quadrangle to El Polin Spring. In 1820, Juana, too, married a cavalry soldier; shortly thereafter, they also moved to El Polin.

Though there were a lot of children playing in El Polin and the nearby streams, not all was well beside the spring. Juana's husband, Apolinario Miranda, drank too much and beat her. We know this because, even though Juana could not read or write, she petitioned the church in writing for permission to formally separate from her husband (we can assume that she dictated her request). Archaeologist Barbara Voss, who has done considerable research into the life and times of Juana Briones, translated the petition that Juana submitted to the church:

I do not fear to shoulder the conjugal cross that the Lord my Father and my Mother the Holy Church have asked me to bear, being in a state that I have freely chosen. What I truly fear is the loss of my own soul forever, and what is more, I fear the destruction of my unfortunate family due to the scandal and bad example of a man who has forgotten God and his own soul, whose only concern is drunkenness and all the vices that come with it, and who no longer cares about feeding his family, a burden that I alone carry with the labor of my own hands, a fact that I can prove with testimonials of exceptional strength if necessary. [...]

Your Lordship, none of the blows, beatings with clubs, and grave dangers that I have seen in my life, nor the



El Polin Spring

brutality and cruelty with which I have been treated, merit consideration because, if my sufferings were mine alone, I would not bear them with pleasure, but at least I would accept them as divine will [...] Your Lordship, my husband is the greatest obstacle placed before my children, because from him they learn nothing but swearing, blasphemy, and ugly, lewd, and dissolute behavior. How will I excuse myself before God, if I do not seek, as much as I can, all possible means of ridding my family of such a bad example?

(From *The Archaeology of Ethnogenesis: Race and Sexuality in Colonial San Francisco*, by Barbara L. Voss, published by University of California Press, 2008.)

Juana submitted this request in 1844, when she had been married to Apolinario for almost 25 years. But she had asserted her independence long before then—according to storyteller Olga Loya, who performs as Juana Briones, "she supported herself and her family in a number of ways: by selling hides and tallow, growing and selling vegetables, selling milk, and becoming a seamstress, since, like most women of her day, she had learned to sew at an early age." To keep her distance from her husband, she moved out.

Starting in 1833, Juana maintained several households. First, she and Apolinario applied for a land grant at the boundary of the Presidio, where today Lyon Street is intersected by Green. The site was called *El Ojo de Agua de Figueroa—ojo de agua* means, literally, "eye of water," or "spring." They built a house and corral and planted fruit trees. At the time, theirs was the only house between the Presidio and Yerba Buena Cove.

Not long afterward, about 1835, Juana applied for and received a land grant on her own. This one was in Yerba Buena, along the road between the Presidio and the cove. She built an adobe, now long gone, where Filbert and Powell streets meet, in today's North Beach. Her residence and life are commemorated on an historical plaque at Washington Square. Juana lived at Yerba Buena with her children and other members of her family. With their help and the help of servants, she sold the products of her rancho, and business was good. By the time Juana settled in Yerba Buena, Alta California was a Mexican territory and the government had authorized foreign trade. More ships were anchoring at Yerba Buena Cove, and their passengers and crew were probably hungry for fruit and vegetables and fresh eggs and milk. Juana sometimes took in the sick from these ships; as well as being a businesswoman, she was a *curandera*—a healer. For much of her life, Juana delivered babies and ministered to the ill.

Shortly before the Gold Rush, in 1844 (the same year that she filed for separation from her husband), Juana bought more land, this time on the peninsula. She named this site *Rancho la Purisima Concepción*; in the following years, she and her family moved to the town of Mayfield—now south Palo Alto—where she remained for the rest of her life.

Juana Briones died in 1889, having known California as a Spanish colony, a Mexican territory, an American territory, and, finally, a part of the United States. Despite hardship, she prospered, keeping close to the rest of her family, caring for others, and holding on to what she loved. "She liked horses and cattle," one of her grandsons said, "and everything that goes with ranching."



This historical plaque at Washington Square commemorates Juana Briones.

THE TENNESSEE HOLLOW WATERSHED

The spring beside which Juana first lived and farmed in San Francisco, El Polin, joins two other small streams that drain to the marsh at Crissy Field. This small watershed—called Tennessee Hollow—is situated within the larger Marina Watershed. Its boundaries lie almost entirely within the Presidio, with the southern boundary running the ridge of San Francisco's Presidio Heights neighborhood. Like the small spring that it contains, Tennessee Hollow has a long history of uses.

The watershed is named for the 1st Volunteer Regiment from Tennessee, which was formed at the turn of the twentieth century during the Spanish-American War and the subsequent Filipino "insurrection." Spain had occupied the Philippines and, in the wake of her surrender to the US, Filipino nationalists hoped to reclaim their land. It was not to be so—at least, not without a fight. President McKinley called for the annexation of the Philippines, and US troops were hastily mustered. They trained at, and shipped out from, the Presidio.

Among them were the members of the 1st Tennessee Regiment, which camped, in the words of military historian Erwin Thompson, "in low ground east of the Presidio's officers' row." This small drainage, along today's MacArthur Avenue downstream from the cul-de-sac at El Polin, became known as Tennessee Hollow. With the initiation of restoration work in this watershed, the whole watershed began to be called Tennessee Hollow.

WATERSHED CHARACTERISTICS

Groundwater and rainwater runoff within the watershed flow into three partially buried tributaries that converge to form the main stream in the Tennessee Hollow watershed, which empties into Crissy Field Marsh. The headwaters, which originate near the Pacific Avenue boundary of the Presidio, are spring-fed. In a report prepared for a class at UC Berkeley, students Richard Brody and Gabriella Condie state that "Tennessee Hollow Creek, at its longest point, from the headwaters of El Polin tributary to where it empties into the bay, is approximately one mile in length." The whole of the watershed is 270 acres, an area just a little smaller than that of McLaren Park.

By the time the boys from Tennessee were camping in the watershed, however, it had already changed considerably. To make use of Tennessee Hollow's water, the army had built dams, reservoirs, and exploratory tunnels. Much, though not all, of Tennessee Hollow's water had been forced underground.

A similar process was taking place downstream, at the slough that ran the length of what is now Crissy Field Promenade. According to Barbara Corff, the marsh had begun to be filled before the turn of the century; she says that process was accelerated—and completed—in the years leading up to 1915, when the Panama-Pacific International Exposition opened. Tennessee Hollow became a staging area for that event. Parks Superintendent John McLaren stored plants and trees there, including hundreds of pots of iceplant that were used to create a "living wall" that fronted the fairgrounds. Donna Ewald and Peter Clute, authors of San Francisco Invites the World (Chronicle Books, 1991), give us a picture: "The grounds of the exposition were enclosed on the city side by what was without a doubt the most unusual fence in the world... a vertical lawn, 30 feet high and 1,150 feet long. Planted with... ice plant, in certain seasons it was covered with delicate pink blossoms."



The Thompson Hollow restoration at the corner of Lincoln and Halleck. Note the grate in the upper right where water enters the site from under Lincoln Blvd.

If human impact is an inevitable part of every urban watershed's history, change is no less a part of its future. This is particularly true in the case of the Tennessee Hollow watershed, where active restoration is now taking place. Just as a portion of the Crissy Field Marsh has been reopened, parts of Tennessee Hollow have been too. Thompson Hollow, a stretch of the creek beside Halleck Street, just below Lincoln Boulevard, was recently daylighted—a word coined when community members and local government began to unearth buried creeks, opening them up once again to the daylight and to the benefit of all living things.

THE PROMISE OF TENNESSEE HOLLOW

Few of San Francisco's streams hold as much promise for restoration as those of Tennessee Hollow. As a small watershed that lies almost completely within national park lands, there is, in the words of a planning document developed by the Presidio Trust, a "unique opportunity to restore, enhance, and interpret the creek system as a whole."

According to Barbara Corff, who has done extensive research on Tennessee Hollow, "the restoration goal is to create more than a pretty place where one can walk beside a stream. A healthy and complete system," she says, "from the headwaters to the San Francisco Bay, will provide a wildlife corridor and an opportunity for species diversity which increases the long term health of the watershed." She encourages visitors to look at the watershed from the point of view of a great egret for such a bird, she says, "Tennessee Hollow Watershed is a nice route which leads up and over the crest of Inspiration Point into the next watershed at Lobos Creek. The restoration of Tennessee Hollow," she concludes, "could provide a bountiful corridor from Baker Beach to Crissy Beach."

The Presidio Trust, which is the agency responsible for planning and implementing projects in the watershed, also sees the potential for creating a greenway for wildlife—"an important aspect of the restoration," one of their planning documents states, "will be to daylight the creek and expand habitat so that a continuous wildlife corridor is established connecting rare habitat in the upper watershed (serpentine grasslands and seeps) to the lower watershed (salt water marsh)."

The Trust is engaged in a full-scale planning process regarding restoration options for the watershed. But it has also begun to take action, as at Thompson Hollow. So, even as planning goes on, more of the waters of Tennessee Hollow have begun to see daylight—and more visitors are beginning to see those waters, too. Volunteers are exploring the watershed and getting hands-on experience with the still-young science of restoration. On planting days, volunteers carefully place plants that have been nurtured from seed at the Presidio Native Plant Nursery. In the process, they learn about riparian systems, and become excited about returning to monitor the progress of their plantings. Students from Galileo High School have also gotten involved, coming out to the watershed one day a week during the school year to conduct projects such as testing air quality, studying wildlife, mapping vegetation and comparing habitats, and removing invasive plants. In this way, students and volunteers become part of a community of stewards who care for the land. And "stewardship," says Barbara Corff, "is one of the many ways to find recreation in a restored watershed."

When Charity Maybury, a staff member at the Crissy Field Center, was asked what story she'd tell about Tennessee Hollow, she said she'd talk about the culverted water. "It's a resource that's hidden," she said, "but is slowly being opened up. It would be an awesome thing," she continued, "to have the whole creek restored—to be able to start at the bay and follow the creek all the way up to the top of the watershed."

Six years ago, when Barbara Corff started to do research on Tennessee Hollow and lead walks in the watershed, daylighting the stream was one of her dreams. Now, it's becoming a reality.



Galileo students studying the Tennessee Hollow Watershed during a Project WISE class use models to study the direction of water flow.

ANOTHER HOLLOW, KNOWN FOR COWS

East of Tennessee Hollow, and east of the Presidio's eastern boundary, lies Cow Hollow. In his history of this neighborhood, John Levinsohn says that "by the 1870s, there were about 30 dairies" in Cow Hollow; the largest had "nearly 200 cows." There was also a tannery in the area; Levinsohn says it was unpopular because it "polluted the spring-fed waters of the lagoon. By the early 1880s, both cows and tannery were gone," relocated to the Islais and Yosemite watersheds and to Visitacion Valley.

Cow Hollow was the Marina District before the Marina District existed. It grew up along the old shoreline from Lyon Street (the border with the Presidio) to Van Ness. Today, as defined by its neighborhood association, the area of Cow Hollow is the rectangle "bounded by Greenwich Street in the north, Pierce Street in the east, Pacific Avenue in the south, and Lyon Street in the west." Some present-day residents of the area might extend the eastern boundary as far as Franklin or Van Ness.

Between 1850 and the 1880s, when Cow Hollow got its name, growth in the area was slow—the hustle and bustle was all taking place downtown. In 1854, the area was still known as Spring Valley, named, of course, for the many springs that could be found in the area (including one that can still be visited, in the courtyard of the Episcopal Church at the corner of Steiner and Union streets). At that time, according to Levinsohn, there were only "four homes occupying the entire tract between Octavia and Webster and Broadway and Filbert. The only thoroughfare across the valley was the Presidio Road, which came from the east and skirted the north end of Washerwoman's Lagoon."

RAISING VEGETABLES, MOVING SAND

As well as being the site of a laundry business, Levinsohn writes, the "fertile and well-watered lands near the lagoon were from the 1850s, a source of much produce for consumption in San Francisco." This use of the land in Cow Hollow spread— and persisted—into the 1900s. There were commercial gardens along much of Franklin Street, as well as closer to the Presidio. "The low land north of Lombard between Scott and Steiner was known as the Chinese vegetable gardens," Levinsohn tells us, "as were the gardens up the hill at Pierce and Green streets." At that time, the land between Scott and Steiner was very close to the shoreline, which arced inward about as far as today's Capra Way. But starting in the 1880s, Levinsohn tells us that "moving sand from one place to another occupied considerable energy," and much of that sand was used to fill in the edge of the bay. "[A contractor] cut the sand hills in the east of Cow Hollow... to fill in the tide lands north of Lombard and Chestnut streets. The project," Levinsohn continues, "included building a sea wall to contain the sand fill. The stones were brought from quarries on San Bruno Mountain and dumped by barges, after which the sand was moved by bucket conveyors to railway cars which ran along tracks to the shoreline." In this way, 26 acres that would eventually become part of the Panama–Pacific Exposition were completely filled in.

THE PANAMA—PACIFIC INTERNATIONAL EXPOSITION

When it opened in February 1915, the Panama–Pacific International Exposition stretched from Crissy Field to Fort Mason. At the center of it all, where Scott Street now meets the yacht harbor and Marina Green, there was a "City of Palaces," an orderly arrangement of large exhibit halls connected by courtyards and pedestrian avenues.

This was the crux of the fair, the place where San Francisco set out to impress. The palaces were vast and ornate, the walkways were lush with palms and other vegetation, and statuary was liberally placed. At 435 feet, the tallest building—the Tower of Jewels—could be seen from many parts of the city. Built in layers like a wedding cake, it featured columns and sculpture as well as more than 100,000 pieces of faceted glass, each backed by a mirror. The effect was supposed to be most impressive at night, under the lights.



The site of the Panama Pacific International Exposition, ca. 1910. The small lake at the left became the lagoon beside the Palace of Fine Arts. The open water in the center of the photo was filled in; today it is the Marina Green.



The Palace of Fine Arts, 2006.

FACTS ABOUT THE FAIR

The Panama-Pacific International Exposition celebrated the opening of the Panama Canal. It was also an occasion for large-scale civic boosterism. Rocked by the quake in 1906 and accusations of graft in City Hall between 1907 and 1910, San Francisco was eager to regain its footing and reassert its importance to the world come 1915. The Panama-Pacific Exposition provided San Francisco's powerful with a means to do so.

- The fair grounds covered 635 acres. "The exposition company purchased and razed over 400 dwellings scattered across the marshy Harbor View area, filling in acre upon acre previously under twenty-five feet of water, pushing, as in the 1850s, San Francisco farther into the bay." —Kevin Starr, Americans and the California Dream, 1850-1915 (Peregrine Smith, 1981)
- There were 68 buildings, not including "service buildings, kiosks, restaurants, and amusement zones." Of those 68, 11 were major exhibit halls, 21 were national pavilions, 26 were state or regional pavilions, 7 were commercial exhibitors' buildings, two were "colonial pavilions," and one was an art palace. —Burton Benedict, *The Anthropology of World's Fairs: San Francisco's Panama-Pacific International Exposition of 1915* (Scolar Press, 1983)
- The exposition was "organized in three roughly concentric bands: a tight inner core of palaces and courts, a secondary band of individual buildings and gardens, and a loose outer perimeter of amusements and areal concessions." —Gray Brechin, *The Anthropology of World's Fairs*

- The state and national pavilions were west of the Palace of Fine Arts, on Crissy Field. Beyond them were livestock buildings and racetracks. The eastern end of the fair, near Fort Mason, was the Zone—an amusement park, with rides, carnival booths, dance shows, and so on.
- The fair lasted just over nine months. Opening exercises were held on February 20, 1915; closing day was December 4, 1915.
- All of the buildings of the fair were dismantled or moved, with the exception of the Palace of Fine Arts.
- "The French Pavilion was re-erected in permanent materials in Lincoln Park as the Palace of the Legion of Honor, a copy of a copy of the original Legion of Honor in Paris." —Gray Brechin, *The Anthropology* of World's Fairs
- The old de Young Museum in Golden Gate Park (replaced in 2005 by a new, modern, copper-clad building) was based on the exposition's Court of Ages and built by the same architect.
- "The South Gardens were scraped clean of plantings, fountains, and sculpture, and small buildings were moved to the waterfront and barged throughout the Bay Area. The North Gardens (Marina Green) and Yacht Harbor remained, a gift of the exposition." —Gray Brechin, *The Anthropology of World's Fairs*
- Just under 19 million people attended the Panama-Pacific International Exposition. At the time, the population of California was about 2.5 million.

Though it may have dazzled, the Tower of Jewels was not the best-loved building at the fair. Popular sentiment favored the Palace of Fine Arts. Set apart from the main complex by a naturally occurring lagoon and framed by naturalistic plantings, this palace was grounded in the natural world, distinguished from the rest of the big exhibit halls by its quiet, romantic quality.

The "palace," which did indeed house works of art, is the only building that remains as it was, where it was, when the fair took place. Its high dome, which today dominates the Marina skyline, gives some sense of the scale of the exposition as a whole; altogether, eleven domed buildings graced the fair.

At the time of the exposition, the dome was a dark orange, much as it is today. In this respect it resembled the other palaces, which were equally colorful. The use of color-from the flower beds and footpaths to the uniforms worn by fair staff to the walls and buildings themselves-was perhaps the most effective way in which the fair promoted California. Exposition directors hired Jules Guerin as Chief of Color, and charged him with coordinating all of the fair's elements. He did so with the landscape in mind—"I saw the vibrant tints of the native wildflowers," he wrote, "the soft brown of the surrounding hills, the gold of the orangeries, the blue of the sea...."-and he determined that these should be his inspiration for the colors of the fair. Some years later, when a color was being chosen for the Golden Gate Bridge, the architect who recommended "International Orange" justified his preference, in part, by making reference to the colors of the Panama-Pacific International Exposition.

FOR MORE INFORMATION

Archaeologist Barbara Voss has done extensive research on the era of Spanish colonialism in San Francisco, and her Ph.D. dissertation focused on the Presidio (The Archaeology of el Presidio de San Francisco: Culture Contact, Gender, and Ethnicity in a Spanish-colonial Military Community, UC Berkeley Department of Anthropology, 2002). In the last few years, Voss has worked with a team from Stanford doing excavations at El Polin. The discoveries of the Tennessee Hollow Watershed Archaeology Project are chronicled online at www.stanford.edu/group/presidio. Voss's book, The Archaeology of Ethnogenesis: Race and Sexuality in Colonial San Francisco (University of California Press, 2008) includes a thoughtful account of Juana Briones, providing new information about and insights into the life of this extraordinary woman.

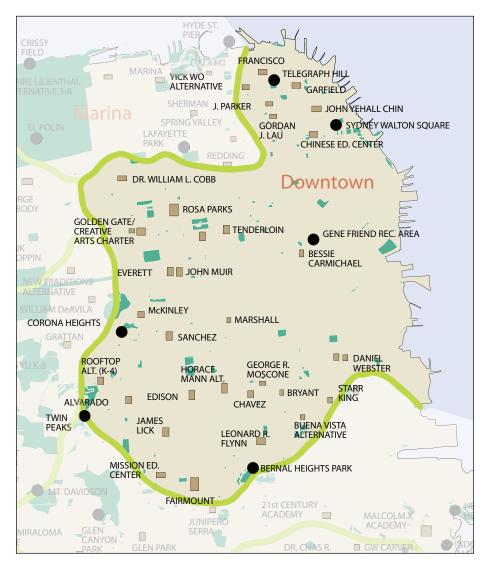
In addition to performing as Juana Briones, Olga Loya, a bilingual storyteller based in San Jose, tells many other stories, including Latin American folklore, California history, and family and personal stories, exploring the complexity of being bicultural. She performs in classrooms and at schools; to find out more, visit *www.olgaloya.com*.

The Watershed Project published a nice account of the Tennessee Hollow Watershed by Allison Stone, project manager for the Presidio Trust. For information on its availability, email *info@thewatershedproject.org.*

John Levinsohn's short history of Cow Hollow is well worth reading. The history room at the main library has several (noncirculating) copies; if you want to take it home, it can be photocopied fairly inexpensively. Here's the citation: Levinsohn, John H. *Cow Hollow: Early Days of a San Francisco Neighborhood from 1776.* (San Francisco Yesterday, 1976)

Presidio NPS rangers and docents offer free programs on Juana Briones, El Polin, and Tennessee Hollow. For a listing of upcoming programs, pick up a copy of *ParkNews*, available free at visitor centers and cafés throughout the Presidio, or view it online at *www.nps.gov/goga/parknews*.

FINDING URBAN NATURE: WATERSHED/DOWNTOWN



DOWNTOWN WATERSHED

The Downtown Watershed is San Francisco's second-largest, after the Westside. It includes Fisherman's Wharf and North Beach, the Embarcadero, the Financial District, South of Market, and the Mission, as well as the Civic Center, Hayes Valley, Fillmore, Western Addition, Noe Valley, and Castro districts.

Geographically, the Downtown Watershed's edges curve and wind through the eastern side of the city. Starting at Fisherman's Wharf, the boundary follows a north-south line along the crest of Russian and Nob hills, then curves west to follow the ridge of Pacific Heights. Its western edge runs through the middle of the city, meeting the Westside watershed at approximately Divisadero Street and Twin Peaks. The southern edge of the watershed traces a line along the lip of Glen Canyon, across the hills of Glen Park, and then up to the crest of Bernal Hill. The eastern edge of the Downtown Watershed is the northeastern shore of the San Francisco Peninsula.

Historically, the Downtown Watershed could be defined as the birthplace of San Francisco. Though it was founded by soldiers at the Presidio and padres at the Mission, the city we live in today really began downtown.



Yerba Buena Cove, 1851; a view of the ghost ships of Yerba Buena Cove. Note the sand in the foreground.

EARLY PATHWAYS

Elsewhere in this guide, Juan Bautista de Anza is credited with having founded San Francisco, for it was his party that chose the site for the presidio and mission in 1776 (see the Mountain Lake site description). But it was not he who settled San Francisco—that honor fell to one of his lieutenants, Jose Moraga, and to Father Francis Palou, who had explored the San Francisco Peninsula two years before, in 1774.

Moraga and his party—an offshoot of Anza's original group set out from Monterey in the summer of 1776. According to Nancy Olmsted, author of *Vanished Waters: A History of San Francisco's Mission Bay* (Mission Creek Conservancy, 1986), the party consisted of "some twenty soldiers, seven settlers and their families (including pregnant women and very small children), five vaqueros and muleteers to ride herd on 200 head of cattle, and a mule train carrying maize and beans."

It took them ten days to reach their destination—a lake that covered an area between today's 15th and 19th streets from Guerrero Street to South Van Ness. They named the lake in honor of *Nuestra Senora de los Dolores*; the mission they were to found on its shores would be called *San Francisco de Asis*.

SPAIN'S STRATEGY

To found its colonies in California, Spain used three institutions: the mission, the presidio, and the pueblo. The purpose of the mission was to convert the land's indigenous people to Christianity, and to make colonists of them. (The rationale was that the colonists would "save" the local people and make them citizens who could help get the local economy going.)

To assist in these efforts and defend the colony against other claims, the Spanish established a *presidio*, a fort or military installation. Its soldiers protected the colony from outside threats and enforced law and order within the community.

Last and, in the case of San Francisco, very certainly least, there was meant to be a pueblo—a town. "Spanish colonial law sought to encourage settlement in the form of pueblos around the nucleus of its presidios and missions," writes John Levinsohn, in *Cow Hollow: Early Days of a San Francisco Neighborhood from 1776* (San Francisco Yesterday, 1976). "Presidial commanders had the authority to grant land to soldiers and settlers both as a reward for their services and as an inducement to agricultural production and settlement."

FAILURE OF A COLONY

The mission and the presidio were formally dedicated with the firing of cannons in the fall of 1776. There are few accounts of what life was like during the next years in San Francisco. We know that the mission did not prosper— founded on a deeply flawed premise, it was doomed to terrible failure. "It is from the accounts of a handful of visitors, perhaps ten in all," writes Olmsted, "that we know how the Spanish tried and failed" at Mission San Francisco.

The presidio fared even worse. At best a poorly serviced outpost, by 1810 the little colony by the bay was positively neglected by the Spanish crown. Mexico was in revolt and



Yerba Buena Cove got its name from this wild mint.

both the clerics and soldiers in Alta (Upper) California had ceased to be paid. In addition, Olmsted reports, "government ships no longer stopped on any regular basis to pick up exports and drop off supplies." In 1816, when a Russian ship anchored at the Presidio, the naturalist on board, Adelbert von Chamisso, noted that when he and his companions "ate on shore, in a tent... our friends from the Presidio were always promptly on hand. The misery in which they languished... did not permit them to be hosts." Ten years later, Captain Frederick Beechey, who surveyed the bay in 1826 and 1827, had a grim and less sympathetic impression of the presidio.

As he noted, upon entering the bay, "So poorly did the place appear to be peopled that a sickly column of smoke rising from within some dilapidated walls misnamed the presidio... was the only indication we had of the country being inhabited."

By the time Beechey made his foray into the bay, Mexico had declared its independence from Spain, and technically, San Francisco was under Mexican authority. The new government gave little attention, however, to supporting the colonial institutions established by Spain. While the walls of the presidio crumbled and the world beyond San Francisco quickly changed, the soldiers and the mission fathers persisted in what they had begun. A. Lincoln, author of "The Beechey Expedition Visits San Francisco," (*Pacific Discovery*, 1969), tells us that Beechey "felt that the padres, who were by far the most intelligent men in the area, had been 'so long excluded from the civilized world that their ideas and their politics, like the maps pinned on the walls, bore the date of 1772."

YERBA BUENA COVE

Military officials had preferred that all ships anchor below the northern headlands, where the presidio was located. As the influence of the garrison waned, however, later expeditions, including Beechey's, began to favor Yerba Buena Cove. Situated on the east side of the peninsula, this small inlet provided shelter from the wind and tides without being too far from the entrance to the bay.

The cove was named for the sweet mint that grew wild in its shady nooks and moist places. The edge of the old cove, which has now been filled in, reached the intersection of Columbus and Montgomery streets. Today, if you extended Columbus beyond Montgomery, across Market Street, and all the way to Harrison Street, it would run the approximate length of Yerba Buena Cove.



Montgomery Street, 1865. Montgomery Street originally ran along the edge of Yerba Buena Cove, but by 1856, Battery Street had already been laid out east of Montgomery, on the filled-in shore. Both Battery and Montgomery are crowded with tall buildings, horse carts, and signs of frontier business. Because of frequent fires in the early city, brick and stone became the preferred building materials.

The same name—Yerba Buena—was given to the town that eventually grew along the shores of the cove. Mexico formally dissolved the missions in 1833, and two years later, in 1835, it legalized trade with foreign ships. Commerce was officially sanctioned, and a few early entrepreneurs wasted no time in setting up shop at Yerba Buena. That same year, according to John Levinsohn, "William Richardson raised his tent near Yerba Buena shore to do business with ships which stopped for trade with the inland regions of San Jose and Santa Clara. A seaman from one of those ships in the same year wrote home of a newly begun settlement of mostly Yankee-Californians called Yerba Buena."

"During the next ten years," Levinsohn continues, "growth of the settlement at Yerba Buena was very modest. Up to 1846 there were no more than twenty or thirty buildings at the cove and only about 200 permanent residents.... Fewer than 112 lots were granted within the town boundaries," which at that time extended as far as Dupont Street—better known today as Grant Street.

In 1846, Levinsohn tells us, "an American naval party led by Lt. John Montgomery... took Yerba Buena for the United States." A year later, Mexico formally ceded the lands of California to the US. In March of that year, the mayor changed the town's name to San Francisco. Its population, in June 1847, was 459.



Yerba Buena Cove, 1850; abandoned ships in a makeshift town. Ships were abandoned and tents hastily pitched as men hurried into and out of San Francisco en route to the gold fields.



Battery Street, 1856.

THE BEGINNINGS OF SAN FRANCISCO

With the shift to US authority came a profound shift in the laws governing property ownership. Whereas the Spanish and Mexicans had granted large areas of land that were to be occupied by the same family in perpetuity, the new government recognized land as a commodity that could be bought and sold by whomever had the means and interest in doing so. Real estate transactions—and inflated real estate prices—quickly became the order of the day in San Francisco.

To facilitate the sale of land, a map was needed. San Francisco mayor Washington Bartlett hired Jasper O'Farrell to do the job; he completed the task under Bartlett's successor, Edwin Bryant. The city blocks that O'Farrell drew up in 1847 will be familiar to modern-day San Francisco residents; they are the ones we still live and work on—including those streets that extend beyond the original shoreline of Yerba Buena Cove. At Bryant's urging, O'Farrell created salable land out of the tidal waters of the cove. In an essay about the growth of San Francisco, historian Eric Sandweiss describes the process:

Edwin Bryant determined to create additional property (and additional revenue [for the new city]) by dividing the mud flats east of Montgomery Street into city lots. Each of these "water lots," as the tidal lands were known, was 45 feet in width—significantly, the first property in the city to be divided at a relatively dense urban scale.... The waterlot auction, held in the summer of 1847, brought to the town a scene familiar across the rest of the American frontier but still alien to California: hundreds of men shouting and jostling one another for possession of divisions of land that were for the moment only as substantial as the paper on which they were depicted. (From *Eadweard Muybridge and the Photographic Panorama of San Francisco, 1850–1880,* Canadian Center for Architecture, MIT Press, 1993.)

Once the lots had been defined, however, and purchased by willing buyers, these pieces of property had an existence. Water-lot owners drove posts into the mud and erected buildings on them. In the 1860s, a seawall was built and the area inside it filled. Yerba Buena Cove slowly became a memory.

Yerba Buena Cove, date unknown; staking out lots. Water lots were sold to fill the cove.

NORTH OF MARKET STREET— AND SOUTH

O'Farrell's map defined our present-day downtown, which lies north of Market Street. But the map also included the area South of Market. There, O'Farrell had a problem to solve: how to handle the angle of Market Street and the lands that lay beyond it?

The tilt of Market Street is the result of Yerba Buena Cove. Market Street began at the center of the cove and extended straight out from it. This made sense when the town was limited to a few buildings clustered around this inlet, but as the town became a city—especially one that was laid out without regard to the actual landscape—that angle created an obstacle. The existing road did not conform to the northern grid laid out by O'Farrell.

His solution was to lay out another grid, but to orient it differently. He treated Market Street as a baseline and laid out long avenues parallel to it to the south—Mission, Howard, Folsom, and so on. Then he laid out cross streets at right angles— Fremont, 1st, 2nd, etc. This, of course, is the pattern we still have today. One of the reasons O'Farrell chose this solution may have been because Mission Street already existed. Also known as the Plank Road by 1851 (because it was built from wooden planks), Mission Road had been the only one in that area in the early years, and it led to the mission. Commentator David Harris, who curated a 1993 exhibit of early San Francisco maps and photos, has suggested that the streets of O'Farrell's South of Market layout, including the Mission Road, "were well oriented to the contours of Yerba Buena Cove... and also provided direct access to the settlement around the old Spanish mission."

THE CURVE OF MISSION BAY

Then as now, the Mission Road ran parallel to Market Street for twelve blocks or so, then curved south. The "O'Farrell Swing"—the way that Mission, Howard, Folsom, and Harrison streets curve at 12th and 13th streets—was necessitated by Mission Creek, whose path, like that of Market Street, formed a boundary for the South of Market area. The creek emptied into Mission Bay, which defined the southern edge the area; that bay's shape is also reflected in the course of some SOMA streets and freeways today.



Broadway Wharf, 1867. In the center, see the steam ships; on the right- and left-hand side of the photo are sailing ships with tall masts. The Broadway Wharf is on the left-hand side—a dirt road leads to a short wooden wharf. Note the laundry drying on top of the buildings to the right of the wharf.

Mission Bay suffered the same fate as Yerba Buena Cove it lost its life to water lots. In 1850, though, it was still a broad expanse of open water that extended from Steamboat Point roughly along King Street between 2nd and 3rd—to Potrero Point, at the foot of Potrero Hill. Between those two points, the bay curved inland. Between 4th and 5th streets, Brannan Street ran along its edge. At the bay's midpoint, Mission Creek emptied into it, in the vicinity of the foot of modernday 15th Street.

Nancy Olmsted estimates that Mission Bay once covered about 560 acres, an area almost twice as big as McLaren Park. In 1852, when Coast Survey personnel mapped San Francisco (creating a much more accurate picture of the city than that provided by O'Farrell's map), Olmsted suggests that "the tides had transformed the 300 acres above normal high-water into saltmarsh, leaving 260 acres of the shallow lagoon covered by a foot or more of water at low tide."

AN ABIDING PRESENCE

Thus, at the time Mission Bay began to be altered by human enterprise, it was as much marshland as open water. Developers and contractors ran afoul of these marshes in more than one location. Olmsted quotes J. S. Hittell, an early historian of San Francisco, who describes attempts to build a bridge over marshy land on the Mission Road at 7th Street:

The first pile, 40 feet long, at the first blow of the pile driver sank out of sight, indicating there was no bottom within 40 feet to support a bridge. One pile having disappeared, the contractor hoisted another

immediately over the first and in two blows drove the second down beyond the reach of the hammer... there was no foundation within 80 feet.... Pilings were abandoned, and cribs of logs were laid upon the turf so as to get a wider basis than offered by piles. The bridge made thus always shook when crossed by heavy teams and gradually settled till it was... about five feet below the original level.

In other places, builders dumped sand (taken from the down-town dunes) into the marshland; Hittell describes how the sand, too, would sink into the moist earth, leaving roads below grade and roadsides lumpy with displaced peat, pushed by the weight of the sand "eight or ten feet above [the marsh's] original level, in muddy ridges full of hideous cracks." BuildIngs, too, were thrown off kilter by the movement of marsh soil—"houses and fences built upon it were carried away from their original position and tilted up at singular angles." This was especially true in 1906—and again in 1989—when the precarious footing of many SOMA streets and buildings was further compromised by profound shaking of the earth (for more on this topic, see the SOMA Rec Center site description).

POCKETS OF WATER EVERYWHERE

Though it may be hard to believe today, much of the Downtown Watershed land was, like the area South of Market, dappled with water. The areas farther inland had freshwater streams and springs rather than saltwater marshes, but water was nonetheless plentiful.

Streams flowed from the eastern flanks of all the mid-town peaks, including Twin Peaks, Buena Vista hill, and Lone Mountain. According to Harry Fuller, author of a booklet entitled *Now and Then: San Francisco's Natural History* (towhee. net, 2001) one spring-fed stream could be found "following the route of today's Sacramento Street and feeding a small freshwater lake just east of where Sacramento intersects Montgomery today." Historian Greg Gaar relates that when the International Hotel was demolished at Kearny and Pacific streets, cattails grew up in the rubble, signaling the presence of a freshwater wetland in the past.

Near Duboce Park, in an area once called Sans Souci (Carefree) Valley, there was a small lake, and a stream that flowed from it down 14th Street. That stream fed into the extensive system of freshwater lagoons and wetlands created by Mission Creek on its way toward Mission Bay.

These are just a few of the many waters of the Downtown Watershed. Some of them are gone, but some are still with us. Joel Pomerantz, who wrote the essay, "San Francisco's Clean Little Secret," (which appears in the book *The Political Edge*, City Lights Foundation, 2004), promises that "the springs that feed Mission Creek can still be seen and heard all along the inclines and alleys of Mount Olympus and upper Eureka Valley."

Similarly, says Pomerantz, evidence of the Hayes River, a large groundwater stream that flows under Hayes Valley and the Civic Center, still abounds."Many Civic Center buildings employ full-time pumping operations to keep their basements dry," writes Pomerantz. The California State Automobile Association building at the foot of Van Ness draws the waters of the Hayes for use in its offices; the water in the fountain at United Nations Plaza comes entirely from this source, an outpouring of San Francisco's own.

FOR MORE INFORMATION

Yerba Buena Cove and Mission Bay were filled with any and all materials at hand. The downtown's great sand hills-such as the 80-foot dune that once blocked the path of Market Street between 2nd and 3rd streetswere carried away by wheelbarrow and steam shovel. Likewise, bedrock was mined-parts of Potrero Point were blasted into rubble and dumped into both Mission Bay and the cove at the mouth of Islais Creek. During the Gold Rush, whole ships were abandoned in Yerba Buena Cove. Along with these large-scale materials, smaller items such as such as bowls, shoes, and bottles also found their way into the mix. Today, when big building projects take place downtown, some of these items are unearthed and put on display. Artifacts from downtown bayshore fill can be seen at Rincon Center, Spear and Mission Streets, and in the lobby at 505 Montgomery.

An excellent resource for SOMA history is *Vanished Waters: A History of San Francisco's Mission Bay* by Nancy Olmsted. Look for it in used bookstores or online.

A characterization of early Mission Bay (which draws heavily from Olmsted) can be found online at the web site of the National Park Service's Southeast Archaeological Center, where numerous research projects are undertaken— including one focused on 5,500 years of history at the intersection of Mission and 7th streets. Go to www.cr.nps.gov/seac/research.htm and click on the link for "An Unvanished Story of San Francisco."

Sonoma State's Anthropological Studies Center also has a website that includes a SOMA-focused project specifically geared to teachers. To learn more, go to *www.sonoma.edu/asc/sfarchaeology.*

Getting a sense of the Downtown Watershed's many waterways requires piecing together information from a variety of sources. One good place to start is the website of the Oakland Museum. Find it at *www.museumca.org* (search for "creeks.")

FINDING URBAN NATURE: WATERSHED/ISLAIS VALLEY



ISLAIS VALLEY WATERSHED

One of the things that's special about the Islais Watershed is that it still has an above-ground creek. The tributary that remains on the surface today, running through Glen Canyon, now bears the name Islais, though when more of the streams of this watershed were open, the main stem—the Islais—originated southwest of the canyon, in the Outer Mission.

The area of the watershed is approximately 7 square miles. Its western side dips south to include parts of Ingleside and Oceanview, all of the Outer Mission, and some of the Excelsior. Its eastern side curves north, encompassing Glen Park, Bernal Heights, and parts of Bayview Hunters Point and Potrero Hill.

Highway 280 tracks the historic path of Islais Creek through San Francisco. So does Alemany Boulevard. For much of its length, Cayuga Street may actually lie in the old creek bed. The headwaters formed near where San Jose Avenue meets Alemany. The creek collected water from tributaries on both sides of the Islais Valley, then flowed northeast into a floodplain that reached as far inland as the tangle of roads where Highway 280 meets Highway 101 today. Precita Creek, which flowed more-or-less along today's Cesar Chavez Street, also emptied into this floodplain through the gap between Bernal Heights and Potrero Hill. There was also a lake in the watershed, in the vicinity of Balboa High School, called Lake Geneva.

In the early 1930s, much of Islais Creek was put in a pipeline that follows the course of the main creek. It empties into the bay at the mouth of Islais Creek Channel—a human-made embayment—just east of 280, at the corner of Selby and Islais streets.



Construction of the Islais Creek pipeline, April 1931. The men working in the pipe give a sense of its size. The plants in the foreground are probably cattail, a wetlands indicator. The roadcut in the background can still be seen from Highway 101.

SAN FRANCISCO RANCHOS

Islais Creek drains a portion of the San Miguel Hills, that cluster of high peaks in the center of the city. One of the big land grants awarded to early San Francisco residents also bears this name.

Rancho San Miguel was 4,444 acres—a square league—and was awarded to José de Jesus Noe. Today's San Jose Avenue was its southeastern boundary; the rancho included much of the northern side of Islais Creek. Another rancho of the same size, granted to José Cornelio Bernal, contained most of the rest of the watershed. The Bernal grants, which were called *Rincon Salinas y Potrero Viejo* ("the corner of the salt marsh and the old pasture") stretched south and east from Islais Creek to Hunters Point. The salt marsh that Bernal got the "corner" of was the brackish wetlands where Islais Creek mixed with the waters of the bay.

DAWN OF THE RANCHERO ERA

Though Spain had made land grants available to its soldiers and settlers, relatively few people took advantage of this. "Up to 1830," historian John Levinsohn tells us, "there had been only 50 ranchos claimed in California." This was partly the result of how closed the colonies were to outside society. Spain colonized Alta California to assert dominion, and, in order to maintain it, she forbade foreign trade. While this may have helped prevent invasion, it also the left the colonies isolated and impoverished. Few residents had the incentive or means to acquire land and make use of it.

Spain, too, was having troubles with the system she'd set up. Another of her colonies—Mexico was becoming increasingly insubordinate. Mexico achieved independence from Spain in 1821, and the political landscape in California shifted. The new government passed a series of laws to promote colonization and trade. "By 1846, as a result of the encouragement of Mexican laws, there were over 700" land grants in California, according to Levinsohn. Fellow historian Nancy Olmsted describes the same phenomenon: "From 1834 through 1845, 95 percent of the great California ranchos were created."

MEXICAN LAND GRANTS

In San Francisco, as elsewhere in California, the process of applying for a Mexican land grant was straightforward. "The petitioner asked the governor of Mexico for a specific tract of empty land," writes Olmsted. "This written request was frequently accompanied by a *diseño*, or map, prepared locally by a rough ground survey. If the petitioner had performed some service for the government, such as being part of the army, the claim was generally granted.

"Land grants were made to petitioners of foreign origin as well," she continues. To be eligible, applicants had to adopt the Catholic faith and become Mexican citizens. Levinsohn describes how settlers could become Mexican: "Foreigners could be considered naturalized citizens of Mexico if they exercised a useful profession, if at the end of three years they had the capital to support themselves 'with decency,' and if they were married." As a result of this last requirement, many petitioners married into Mexican families. William Richardson, for example, the first Yankee to set up shop at Yerba Buena Cove, was also known as Guillermo Richardson. His wife, Maria Martinez, was the daughter of a Presidio officer.

Many who began to take advantage of the new government's more liberal laws were already Mexicans, but they too forged a different identity, as Californios—colonists born in California. One of these was José Cornelio Bernal. His grandfather and father were born in Sinaloa, Mexico, but traveled to California in the Anza Expedition. His father was married at Mission Dolores and served at the Presidio. José Cornelio Bernal was born in San Francisco.

Bernal received his first land grant—a small one of a half-dozen acres or so—in 1834, at the midpoint of Mexican control over California. "The period when the Mexican flag flew over Alta California," to borrow the words of historian Robert Ryal Miller, was from 1822 to 1846. This was "the heyday of the ranchos," Miller says, and it coincided with "the era of the hide and tallow trade."



Aerial view of Bernal Hill, showing the floodplain of Islais Creek. This photo was taken in the 1930s, after the creek had been put underground.

CALIFORNIA RANCHOS

All the big land grants—the ranchos—were, in fact, cattle ranches. "There was no business in the country then," wrote José Ramon Pico in 1899, "but the raising of cattle." This remark, which appeared in the *San Francisco Call* newspaper, was part of a reminiscence about "Christmas Before the Americans Came" (see "For More Information," at the end of this section). Cattle had been raised for meat and milk for the missions, but in the days of the ranchos, it was their hides that had value—they were literally the currency of California. A hide was valued at two dollars, and was used to pay for all the goods brought by sea, such as fabrics, clothing and jewelry, tools, furniture, and food.

Another early-day commentator, Joseph Downey, described how transactions were made: "The articles brought for sale were retained on board the ships, which were fitted up expressly for trade and each had a large storeroom on the between decks, where the stocks were displayed." According to Downey, Californios bought goods using "bank notes... minted from the backs and bodies of the thousands of cattle which swarmed every valley of the country."

Whether cattle truly swarmed every valley is debatable, but there is no question there were plenty of cattle in Southern and Central California during the rancho era. They were the breed now known as the Texas Longhorn, and, according to Michael Casey, who has written their history (see "For More Information"), they "trace back to the estuarian marshes of Andalusia in Southern Spain as well as the more wooded region of Extramadura in western Spain."

When Spain began to send settlers to the new world, the majority of them came from Andalusia and western Spain. "The people who inhabited those regions comprised the largest block of settlers who came... with Columbus," Casey explains. When they came, they brought their cattle with them.

They settled first in the West Indies and Antilles, including on the islands of Jamaica, Cuba, and Puerto Rico. Some 25 years later, many of them moved to Mexico—and so did their cattle. Another 140 years after that, some of the descendants of those settlers moved up the coast. Their Andalusian cattle were herded with them and set loose near the first Alta California missions, in San Diego and Monterey Bay.

Estimates vary regarding how many cattle there were in California circa 1775. Casey says that "there were... approximately 350 head of horned cattle in all of Alta California"—an estimate that seems low if, as Nancy Olmsted suggests in her book, *Vanished Waters*, Moraga and his party alone brought 200 cows to San Francisco in 1776. Whatever the number, we can be sure that it grew considerably—from hundreds to hundreds of thousands—during the next 70 years.

HIDES AND TALLOW

At first the cattle were a part of the holdings of each mission. Allowed to roam far and wide, they initially grazed the bunchgrass prairie lands; then they grazed the annual grasses that soon became established once the bunchgrass was gone. The weather was mild enough to leave the cattle free year-round, and they became semiwild, easily expanding their range and numbers throughout Southern and Central California.

In the mission era, these cattle were used primarily for milk and meat. As many as were needed were caught and kept or slaughtered; those that evaded capture were left on their own. As the number of cattle increased, however, and as their use expanded to the hide and tallow trade, their management increased as well.

During the rancho period, cattle were rounded up once or twice a year to separate the stock of the different ranchos and brand them, and to slaughter the animals. Pico describes these old-time rodeos: "The vaqueros and Los Indios came many days' journey across the San Joaquin Valley, driving big herds of cattle to be killed for hides and tallow. There were no roads and the only way to get the products to market was to drive the animals themselves." Pico also tells us how, once the animals were brought in, the hides and tallow were processed:

For six weeks then there was plenty of work. All day long green hides were being hung over poles and dry hides were being packed away. Suet by the ton was dumped into the smoking cauldrons and far into the night the sweating Indians worked ladling out melted tallow with big wooden dippers into bags made of rawhide.

These bags were each as large as could be fashioned out of the skin of the animal and held from one to five hundred pounds of tallow. When filled and the tallow cooled they were stitched up with rawhide thongs and then piled with the hides in the adobe sheds in the courtyard to await the time when Los Gringos should come in their ships from Boston, bringing groceries, dry goods, and merchandise of every sort to trade for the hides and tallow.



The beginnings of Alemany Boulevard, 1926. This view looks east, toward the Islais Creek Watershed. It was taken from the Ocean Street Railroad station, which was on today's Ocean Avenue. The creek on the left flowed west, toward Lake Merced, along what is now Brotherhood Way.

The Californios used tallow—cow fat—to make soap and candles. They used hides—once it was made into leather—to make chairs and furniture. The unfinished hides were used to fasten timbers in buildings. "Everything then was fastened with rawhide," Pico explains, "as we had no nails.... The rawhide was put on wet, wrapped round and round whatever was to be united, and when it dried it contracted powerfully, drawing surfaces together as with clamps."

The traders from Boston, however, were shipping the leather back to the East Coast, where it was used to supply a growing industry in boots and shoes. And as shoe sales grew, so did the market for hides. In 1821, one trading company, according to Michael Casey, had "established a permanent agent in the [California] territory to begin the systematic collection of hides for the New England market." A year later, he says, "nine Hide and Tallow companies had opened offices in California, and business began to flourish."

BOOM TIME

With growth came change, of course. The barter economy when hides were used to buy other goods—was soon abandoned. "Once the hide and tallow companies established business offices, both the landowners and the newly independent Mexican Government... began demanding payment in the form of currency," Casey tells us. This shift, he says, "created the primary source of payment of the salaries of government workers and the Mexican military garrisons"; it also made it possible for individuals to amass and hold their wealth. The land- and livelihood-based system of exchange faded away.

The acceleration of trade also caused lasting change. Where the cattle had once been allowed to wander and live on their own, as demand for them increased, more were rounded up, and the round-ups were more frequent. More people worked to collect them and process the hides. What had been a way of life became an industry.

Greater demand also engendered greater waste. The Californios had systems for drying the hides and processing the tallow, and the hide and tallow companies, too, Casey tells us, "had developed sophisticated vats for rendering fat (be it whale blubber or cattle fat) off shore on their vessels." But there was no market for the meat. "The animal carcasses," Casey explains, "after being skinned and having the renderable fat removed, were left to rot. Tens of thousands of tons of beef simply went wasted in this way, much of it abandoned on beaches near where the longboats had loaded the usable portions."

BOOM OF A DIFFERENT KIND

All this was to change again, however, when another economic juggernaut hit California: the Gold Rush. With the arrival of thousands of miners and the merchants who catered to them, the basic necessities—shelter, clothing, food—were suddenly in great demand. Beef sold at a premium. Local supply was soon exhausted and the cattle industry shifted south. "The southern part of the state," Casey writes, "which had found itself cut off from any direct share of this newly discovered northern wealth, seemed to be the perfect supplier to this new and growing market" for beef. "The southern counties, and particularly those located along the coast, became increasingly invested in and dependent on the cattle business."



A wetland no more. May 1932. Bernal Hill is the second hill from the right. The gravel cars in the foreground are on the Southern Pacific Railroad track; this photo was probably taken near the corner of today's Rankin Street and Innes Avenue.

This too, was to be short-lived. In 1847, Mexico had turned California over to the United States, which, by 1851, embarked on extended arbitration over the rancho properties. While the rights of many of the land-grant holders were confirmed in court, the lands themselves frequently fell into other hands. The ranchos disintegrated, as did the cattle-based economy that was their mainstay.

The final death knell for the early cattle industry in California was rung by nature itself. "In 1856," Casey tells us, "a severe drought caused the loss of at least 100,000 head of cattle in Southern California. That calamity was followed by another drought in 1860, and, finally, by the great disastrous drought of 1864. In that latter year alone an estimated 50 to 75 percent of the entire cattle population of Los Angeles County died of thirst or starvation. Land values plummeted, mortgages were foreclosed, and the industry never recovered. After 1864, most of the remaining ranches were sold into smaller holdings, and landowners began diversifying out of cattle and into other more profitable and stable forms of agriculture."

HERE IN SAN FRANCISCO

In 1846, when Jose de Jesus Noe applied for the Rancho San Miguel land grant in San Francisco, he already had 2,000 head of cattle. It can be assumed that Jose Cornelio Bernal, too, had cattle and sought land for their increase when he applied for and was granted the Rincon de las Salinas y Potrero Viejo. Little is known of what became of these two ranchos—the details have been obscured by time. The outline is clear enough, though. For a short time, Californios such as Noe and Bernal enjoyed a land-based wealth and leisure. Their prosperity was built, to some extent, on the labor of Native Californians, who had worked at the missions and continued to work for the new landowners once the missions had been dissolved.

The rancheros' way of life was fleeting, overtaken by forces beyond their control—the increase in trade between the eastern and western sides of the continent, the acquisition of California by the United States, the mass migration triggered by the discovery of gold, and the litigation and land grabs that tore apart the rancheros' tenuous hold on their lands. One era ended and a new one—which much more closely resembles our own—began.

FOR MORE INFORMATION

The "SF Rocks" program has been mentioned elsewhere in this guide; it includes a lesson on Islais and Yosemite creeks, asking students to compare historic maps and photos of the creeks with contemporary ones, helping students understand how human activities can affect watersheds and their local environment. Find this exercise online at *sf-rocks.sfsu.edu/lessons/ thenandnow.htm.*

The "Shaping San Francisco" website has an amazing sequence of photos showing the development of Alemany Boulevard and Highway 280 over the course of eight decades. Go to *shapingsf.org*, do a search for "Islais Creek," then click on the "Islais Creek Covered" link. You'll also find links to other great historic photos of Islais Creek and its tidal marsh.

Artist and educator Bonnie Sherk has developed gardening and restoration programs at three schools in the Islais Creek Watershed (San Miguel Child Development Center, James Denman Middle School, and Balboa High School). For more information about her work, as well as historic maps of parts of the watershed, go to *www.alivinglibrary.org*.

"Christmas Before the Americans Came" by José Ramon Pico, can be found online at *northpolewest.com*, a site specializing in cowboy Christmas ornaments. To find the document, click the "Heritage" link, then select "Early California Christmas." A few errors were made in the transcription from the original; a cleaner version appears in *Christmas in California*, a small collector's book published by the California Historical Society (no date).

"History of Longhorns in California," by Michael Casey, appears on the website of the California Association of Texas Longhorn Breeders. Find it at *www.catl.com/ histCA.html.*

The Oakland Museum and the California Historical Society both offer excellent historic information online. The Oakland Museum's "Picture This" and Historical Society's "California History Online" emphasize visual literacy—each provides historic drawings, prints, paintings, and photos, as well as text—to help bring topics to life for students. Visit www.museumca.org/picturethis/index.html and www. californiahistoricalsociety.org/exhibits/online.html.



SOUTH BASIN WATERSHED

South Basin is both the name of a watershed and the name for a particular body of water the cove that lies between Hunters Point Naval Shipyard and Candlestick Point. The South Basin watershed is the drainage for Yosemite Creek. The creek's headwaters are in McLaren Park; the boundaries of the watershed are, to borrow words from the *Site Manual of the Lower Yosemite Watershed*, "the eastern tip of McLaren Park, Hunters Point ridgetop to the north, and the top of Bayview Hill to the south."

This manual, which was put together by the Yosemite Watershed Project, includes a nice characterization of Yosemite Creek and its outlet to the bay.

Yosemite Creek was one of four major year-round eastdraining creeks in San Francisco. Its headwaters were several tributaries on the north slope of the hill we now call McLaren Park. The creek flowed north and east in a gentle curve and met San Francisco Bay at about where Yosemite and Wallace Streets meet Ingalls Street today.

At the mouth of the creek was a tidal salt marsh of what is assumed to be a couple of hundred acres. No remnant of that wetland remains today.... South Basin, if a basin at all, was a gentle cove of San Francisco Bay between Point Avisadero (the eastern tip of what we now call Hunters Point Shipyard) and the foot of Bayview Hill.

Today, that cove is called South Basin. The mouth of Yosemite Creek is a human-made channel called Yosemite Slough, which is part of Candlestick Point Recreation Area. The shores of the slough are approximately 40 percent public parkland, but they are not currently managed for public use. There are no facilities or maintained trails, and access to the tidal marsh at the mouth of the slough is blocked by cyclone fences.

THE SITE MANUAL OF THE LOWER YOSEMITE WATERSHED

Cited numerous times in this text, the manual was developed by the Yosemite Watershed Project, a coalition of seven community-based organizations that came together in 2001 to look at the neighborhoods of the South Basin area from a watershed perspective and take steps to promote its restoration. The group defines restoration both in terms of ecosystems and, more broadly, in terms of "health, sustainability, and quality of life" for the community. As a result of their efforts, a Yosemite Watershed Council has been formed.

The manual builds on previous planning efforts to develop a picture of the watershed as a whole and the Yosemite Slough-South Basin area in particular. "A number of key conditions" are examined, including, to quote from the manual,

- Infrastructure, especially transportation and water and wastewater systems.
- Demographics, including economics, employment, ethnicity.
- Land use, including residential, industrial, and commercial uses, as well as parks and open space.
- Environmental factors such as geology and soils, water and sediment quality, and biological resources.

"The manual," its authors write, "is not intended to be a plan, but rather to identify opportunities and alternative Approaches... for a restored watershed."

The manual can be viewed online at *www.owenswater shedplanning.com.* Select the "Yosemite Watershed" link from the subsequent page.

Though humans currently have little access to the area, wild plants and animals have found it very welcoming. As a part of its work in the lower watershed, the Yosemite Watershed Project spent a year making counts of the wildlife that use the slough, the shoreline, and the basin's open waters:

169 different wildlife species were identified. There were five species of reptiles, including the colorful ringnecked snake, and many butterflies. The 119 species of birds included woodpeckers, meadowlarks, red-tailed hawks, great blue herons, pelicans, and oyster-catchers. Not only was there a large number of species, but also significant numbers of individuals—3,000 birds were seen on one day's census count. Mammals observed included harbor seals and jackrabbits.

The open spaces of South Basin, like those of Visitacion Valley, are a refuge for the wildlife of San Francisco.

PATTERNS OF DEVELOPMENT

In human history, South Basin has been both refuge and dumping ground. Since the Gold Rush, the whole eastern shoreline of San Francisco has been used for industry, as its creeks and marshes provided clean water for industrial processes and disposal sites for industrial waste.

As early as the 1850s, according to material adapted from the Bayview Hunters Point Community Concept Plan, "the City of San Francisco zoning rules began to relegate slaughterhouses, meat-packing plants, tanneries, fertilizer companies, soap and tallow works to the Islais Creek mudflats." Though geographically this area is part of the Islais Creek watershed, politically it is part of the Bayview Hunters Point community



Quesada Avenue west from Railroad Avenue, 1919.

today. The slaughterhouses, concentrated around 3rd Street and Evans Avenue, were collectively called "Butchertown."

In the early days, South Basin also provided fishing grounds. Chinese people fished for shrimp here, setting out nets in the shallow waters near shore. It was the deep water of Hunters Point, however, that was destined to have the greatest impact on the community in the long-term. Those depths made it possible for large ships, such as aircraft carriers, to come in and out. The US Navy moved into Hunters Point in the 1930s, first displacing the Chinese shrimpers and, after the bombing of Pearl Harbor in 1941, taking possession of other private

facilities on the point. It was also at this time that rapid bay filling began to occur here, which led to the current shoreline shape and conditions.

World War II was boom time. "The Bay Area," writes Charles Wollenberg, in the book *Photographing the Second Gold Rush*, "became the biggest shipbuilding center the world had ever seen." A drydock in Oakand where 600 people worked in 1939 had a work force of 30,000 five years later. A new shipyard in Rich-



Northern side of Hunter's Point, 1868. Note the serpentinite rock in the foreground.

mond—which didn't even exist in 1939—had 100,000 employees in 1944. No races or nationalities were excluded—the need for laborers was too great. Some gender barriers were dropped as well, as women entered the work force in large numbers. In San Francisco, this great shift took place at Hunters Point.

The boom was short-lived, however. With the end of the war came the end of accelerated production. The shipyards let most of their workers go just as quickly as they had taken them on. Hunters Point Shipyard continued to function, but at reduced levels, and was finally closed in 1986. in late 2005, the navy's financial commitment was ten times less than it had been before the war began.

PROSPECTS FOR THE FUTURE

In South Basin and the lands immediately north and south of it, Indian burial mounds dating to 3500 B.C. have been found. The city's first people made use of the Yosemite Creek watershed for more than five thousand years. On Innes Street, near the shipyard, 5,000 gallons of fresh water still burble up from the earth every day.

BAYVIEW HUNTERS POINT TODAY

The shipyard covers an area as big as Golden Gate Park, but this space was never a recreational resource and it is no longer a source of jobs. The war-time boom has been followed by decades of limited opportunity and a particularly intractable side effect of war operations: toxic waste.

For almost twenty years, the navy's obligation to observe some environmental regulations was waived. As a result, a stew of dangerous chemicals—volatile organic compounds, PCBs, and radioactive and other hazardous materials—has been left on-

> site. The shipyard has now been designated as one of the most polluted places in America.

According to the manual, "the US Navy is responsible for cleaning up the site, or providing adequate funding for the city to do so." However, the manual continues, "the process of characterizing and remediating the contamination has been slow and extremely frustrating for the community." The effort has been slowed even further by the war in Iraq;



Yosemite Cove, ca. 1930.

The State Parks Department, which owns Candlestick Point Recreation Area, is committed to restoring 34 acres of wetlands on Yosemite Slough.

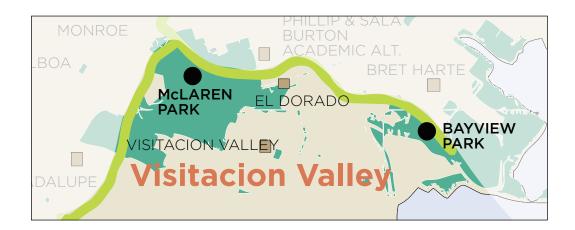
The authors of the *Site Manual to the Lower Yosemite Watershed* envision a "world class" park along the South Basin shoreline: "The new park concept includes the creation of a constructed wetland for stormwater treatment that will also provide freshwater habitat, the enhancement and expansion of tidal saltwater wetlands and associated habitats, public fishing areas, a segment of the Bay Trail, interpretive facilities, and a recreation-oriented business district serving area residents and regional visitors."

The Bay Trail, a 550-mile trail that will ultimately circle the entire bay, will pass through Bayview Hunters Point as documented on the current Bay Trail Map. Parts of it between Heron's Head and India Basin Shoreline—have already been built.

FOR MORE INFORMATION

Several of the organizations that participated in the development of the manual have ongoing programs in the South Basin and neighboring watersheds:

- •Literacy for Environmental Justice has a series of education and employment programs for youth. Find out more at *www.lejyouth.org.*
- •Bayview Hunters Point Community Advocates is now sponsoring a watershed council that will move forward with ideas developed in the manual. Contact them at (415) 671-2862, or 5021 Third Street.
- •Arc Ecology has been coordinating efforts to deal with toxics at the shipyard. They're located on the web at *www.arcecology.org.*



VISITACION VALLEY WATERSHED

If you go to the public library's online photo collection, you can find a black-and-white snapshot of a man and his son posing in front of the deer they've just shot. The place is Visitacion Valley; the date is 1951. A 1956 picture taken in Vis Valley shows a blacksmith in his shop, working metal by hand. Much of San Francisco was once the Wild West, and Visitacion Valley was its last outpost.

As far as plants and animals are concerned, Visitacion Valley and the rest of southeast San Francisco—is still a little more wild. The large, relatively unmanaged open spaces in this part of the city offer increasingly rare mammals, birds, and reptiles room enough to eke out a living.



Visitacion Valley, 1916. The exact location is uncertain; it could be the southeastern part of McLaren Park.

The southern end of Vis Valley lies beyond San Francisco city limits, at the foot of San Bruno Mountain. Proximity to the mountain, which is the largest chunk of wild space on the northern Peninsula, is important for wild animals, because it allows for connectivity—it may be possible for some animals to move between the mountain and other open spaces in Visitacion Valley. Those that can range this widely enlarge their overall territory and increase the likelihood they'll be able to find the food, water, shelter, and reproductive space they need.

The north end of Visitacion Valley is bounded by Candlestick Point on the east and by McLaren Park on the west. If you draw a line connecting McLaren to Bayview Hill, the area south of that line, all the way down to San Bruno Mountain, is the Visitacion Valley watershed.

BLACK HILLS AND RAINBOW PRARIES

Like so many of San Francisco's place names, that of Visitacion Valley has its roots in the Catholic calendar of holy days. The day this little valley was named by Spanish colonists was a feast day of the Virgin Mary, so its name commemorates the occasion when the Blessed Virgin was visited by the angel Gabriel, who descended from heaven to inform her that she was with child.

It was then a land of grasses and flowers. Few early settlers took the time to describe the California landscape in writing, but there are accounts of the grasslands—they were so exceptional it was impossible not to comment on them. The following account, which appeared in the March 2001 newsletter of the San Francisco chapter of the California Native Plant Society, was written in the mid-1800s and describes an area in northern San Mateo County:

Here they have flowers in May, not shy, but rampant, as if nothing else had the right to be: flowers by the acres, flowers by the square mile.... You can gather them in

clumps, a dozen varieties at one pull. You can fill a bushel basket in five minutes. And the colors are as charming as the numbers are profuse. Yellow, purple, violet, pink, and pied, are spread around you.... Imagine yourself looking across to a hundred acres of wild meadow....

A creek—records refer to it as both Visitacion Creek and Sunnydale Creek—flowed along a



Schwerin Ranch on the south side of McLaren Park, ca. 1910.

route that is now Geneva Avenue. Lake Geneva, which was located roughly where Balboa High School is, may have drained into it.

The creek probably emptied into the bay, and the waters of the bay reached farther inland then. The area between today's Bayshore Boulevard and the Bayshore Freeway may have had both riparian (streamside) and tidal wetlands. According to "A Concise History of Visitacion Valley" (see "For More Information," p. 97), "clam beds were staked out and worked in an area now occupied by a former building of the Schlage Lock Company....The land gradually dried out and filled in," the account says, when Southern Pacific Railroad laid track along what is now Tunnel Road.

In the mid-1800s, McLaren and Bayview parks were called the Black Hills. San Francisco historian Greg Gaar thinks this may be because the hills, when viewed from the north, would have been black at dawn. The sun rising behind them casts a shadow across their northern face.

A CURSORY ACCOUNT OF LAND USE IN VISITACION VALLEY

Shellmound sites near the bay tell us that the Ohlone once occupied Visitacion Valley. The Spanish used the land as

> pasture for Mission and Presidio livestock. Sheep and goats once grazed these lands, as did cattle and horses. When the missions were secularized, the land began to be divided, following a pattern that has been played out all over the Bay Area—large tracts were turned over to private hands and eventually broken into smaller parcels for commercial and residential development.

The first land transaction was made by a Mr. Jacob Lesse of Ohio. In 1839, he was granted almost all of Visitacion Valley— 9,500 acres. By 1850, he was subdividing the land. One of the buyers that year was Henry Schwerin, whose name remains on one of the valley's streets. Schwerin and his family kept dairy cows; their land was located at the site of today's Cow Palace.

Though residential development of the valley began in the early 1900s, its rural character persisted until after the Second World War.



Rutland Street northeast from Leland, probably looking west toward McLaren Park, 1916.

NEW CONNECTIONS: THE VISITACION VALLEY GREENWAY

Starting on Leland Avenue near Rutland Street, there was a string of connected lots that were used for Liberty Gardens during the Second World War. Fruits and vegetables flourished, but were forgotten when the war ended. The land lay dormant until 1996, when community members banded together to work with the Public Utilities Commission, which owns the parcels, to build a greenway. Today, six parcels have been converted to public open space; the most recent is a native plant garden.

In a July 2004 article about the Visitacion Valley Greenway, Louis Freedberg, a columnist for the *San Francisco Chronicle*, described it this way:

As soon as you pass through the decorative metal gates on Leland Avenue, you enter a verdant, meditative world. The mini-park has curving paths, lined with California native plants and trees. Cross the street and you reach a community garden, with a bounty of sprouting zucchini, carrots, and other vegetables. In the... children's park, a traditional play structure is set between an "enchanted forest" on one side, and a "magic meadow" on the other, a grassy area covered with flowering poppies and lupine. A curved cement bench is decorated with tile mosaics.... In one corner are waist-high planting beds so people in wheelchairs can participate....

A work in progress, the remaining lots still must be developed. Plans include opening an herb garden, along with a native-plant demonstration project.

The string of lots that make up the greenway cross Rutland Street at Campbell Avenue and curve toward McLaren Park. The native plant garden will connect to the wild meadows of McLaren.

FOR MORE INFORMATION

As mentioned in the opening paragraph, the San Francisco Public Library has a collection of historic photos online. There are thousands of pictures. To view them, go to *sfpl.lib.ca.us.* Select "History," then "San Francisco Historical Photograph Collection." You can search the collection by subject or neighborhood (or photo ID number—the photo of the two hunters is AAC-1679; the man in the blacksmith shop is AAC-1726).

The Visitacion Valley Community Center published the *Grapevine*, a free monthly newspaper of local news and events. A history of the area can be found at *www.visvalleygrapevine.com/vvvalleyhist.html*.

FINDING URBAN NATURE: WATERSHED/WESTSIDE



WESTSIDE WATERSHED

The Westside is San Francisco's largest watershed. It stretches from the Pacific Ocean in the west to Twin Peaks and Mount Sutro in the east. To the north, the watershed includes all of Golden Gate Park, ending more or less at the oak woodland in the park's northeastern corner. The southern end of the watershed lies past the city boundary in San Mateo County.

For many years, the Westside was outside city boundaries. Founded at the Presidio and the Mission, San Francisco's early growth was centered around Yerba Buena Cove, the protected harbor on the city's east side. The lands beyond Twin Peaks were "outside"—outside city limits. The dividing line between inside and outside was Divisadero Street. The boundary was also a natural one. The Outside Lands were mainly sand, a vast dune complex lying west of Twin Peaks and Mt. Sutro.

Because so much of the Westside was covered in deep sand, rainfall generally sank into the ground rather than running off. But water did flow through some channels in the sand, and it collected in some places. Dune hollows sometimes served as catchments—most of the lakes in Golden Gate Park, for example, were there before the park was built.

There were springs and creeks, as well, especially in the area around Lake Merced, where the sand gave way to grassy terraces and rich soil. But underlying the whole Westside is porous sandstone, where water has been collecting for hundreds of thousands of years. This underground network of pools, channels, and saturated rock is the Westside's biggest water body—the Westside Basin Aquifer. It is also the main

source for the two surface lakes in this watershed, Pine Lake and Lake Merced

WATER UNDERGROUND

An aquifer, according to the dictionary, is "a waterbearing rock [or] rock formation." The Westside Basin Aquifer occurs in the Merced Formation, poorly consolidated sandstone extending down hundreds of feet beneath western San Francisco and



Lake Merced

San Mateo County. It lies under 45 square miles of land on the peninsula, 14 of which are within the boundary of the City and County of San Francisco. Daly City, South San Francisco, and San Bruno rely on the aquifer for their entire municipal water supply, but San Francisco uses it too. The aquifer provides drinking and irrigation water to the big recreational landholders on the Westside—Harding, Olympic, and San Francisco golf courses; the San Francisco Zoo; and Golden Gate Park.

Some parts of Lake Merced and Pine Lake connect directly to the aquifer, and water being withdrawn from it has caused water levels at both lakes to drop. In response, the San Francisco Public Utilities Commission has worked with interested parties to develop a groundwater management plan for the Westside Basin Aquifer. It emphasizes, among other things, using recycled water for irrigation rather than the pure, potable water that has been stored underground for so many thousands of years. (For more about this issue, see the Lake Merced site description.)

HILLS AND VALLEYS

The Westside watershed is also a land of hills and bluffs. At the western edge, where land meets sea, there is broad Ocean Beach, but there are also the tall bluffs of Fort Funston. This wall of sandstone, part of the Merced Formation, bears the

> footprints of prehistoric animals and shows that sea level has risen and fallen many times along this coastline.

Along the eastern perimeter of the watershed, in the center of San Francisco, there's a cluster of bare hills that are now city open space. In the Avenues, Franciscan bedrock juts out of the ground in Sunset Heights, but the bigger peaks lie inland: Mt. Davidson, Mt. Sutro, Twin Peaks.

The southern flank of Twin Peaks used to be called the San Miguel hills. At one time, the whole mountain, and Mount Sutro, were part of Rancho San Miguel, an area given to Jose de Jesus Noe in the mid-1800s.

Portions of the Rancho San Miguel were some of the first Outside Lands to be developed. What we know as the Castro and Noe Valley were then called Horner's Addition— "Horner" for the man who bought the rancho from Noe and developed this part of it, and "Addition" for the addition of these lands to the city. The conversion of this land from open space to built environment was facilitated by the opening of San Francisco's first streetcar line in 1857. The Market Street Railway, a cable-car line, moved up and down Market Street from Ferry Plaza to 26th and Castro streets. If sand was a natural boundary between inside and outside lands, the hills were also natural barriers that defined neighborhoods and influenced development. People settled in the valleys. In Horner's Addition, for example, they moved into Eureka Valley (the Castro) and Noe Valley. As for the big hill between the two—they went around. Transporting people and materials over that hill was hard work on foot or with a horse and buggy.

Some development was taking place on the hills, however. In 1867, the eastern side of Twin Peaks was subdivided near Corbett Avenue. Rather than going straight up the slope, the new streets followed the

contours of the hillside. At that time, Corbett Road included Portola Drive. It sloped down to the west, meeting Ocean Avenue near Lake Merced. This was part of an old route to Ocean Beach. Though the Westside was outside the area where people lived and worked, they still traveled across it to take in views of the Pacific. For almost as long as there have been settlers in San Francisco,



Historic postcard depicting the wildflowers at Ingleside, 1908. The blue flowers may be lupine.

there have been sightseers making the trip to Lake Merced, Ocean Beach, and Lands End.

THE ROUTE WEST

In June 1859, *Hutchings' California Magazine* published an account of "a jaunt of recreation" that began downtown, then traveled beyond city limits through the Westside to Ocean Beach and then on to Lands End before returning to the city by way of Fort Point and the Presidio.

The trip originated at the plaza—Portsmouth Square—and was made by horse-drawn carriage. To get to the first destination, the mission, the Old Mission Road was the obvious route, but by 1859 it was no longer the only one. Hutchings shunned it because, though recently "macadamized," the Mission Road passed "through low sand hills and across little valleys by a very circuitous and laborious route." In other words, threading through the sand dunes was hard going. Hutchings preferred starting out on Folsom Street, which was "adorned with private residences, and well cultivated gardens and nurseries."

Even before reaching Mission Dolores, Hutchings had left the city behind, traveling through a semi-rural, semi-industrial landscape. He describes passing a sugar refinery and several hog ranches. The mission itself, once he reached it, was a pastoral site that lay in a "fertile and well watered valley."

Past there, however, Hutchings tells us "there are no objects of striking interest" until he reached Ocean Beach.

Hutchings did not spend much time describing the area near Ocean Beach, though he did mention seeing potato fields. He also waxed poetic about the beach surf— "this is sublimity"—and described the "architectural perfection and beauty" of "every shell, pebble, and

marine plant." But then he hastened on toward Seal Rock and Lands End.

Later writers had much more to say about the lands around Lake Merced.

FIELDS OF FLOWERS

In the early 1900s, it became popular to go to Ingleside and Lake Merced to see wildflowers, whose blooms covered square miles. Their profusion was a wonder. To walk amidst them or even throw yourself down upon them was, in the words of one botanist, "an exhilaration and a delight."



California poppies

In June 1906, just two months after the Great Earthquake, the Lake Merced wildflowers were described in detail. In the Sunday edition of the *San Francisco Chronicle*, Harold French extolled, in the effusive style of his era, the great beauty of the scene. Though less common now, many of the flowers he describes can still be found at Lake Merced in the spring and summer.

You will look over long, low ridges crowned with gold and purple hues and creased by gentle hollows. In the sunshine a wonderful play of colors flashes upon your eyes. These flowery mesas appear as though an artist had scattered broadcast all the tints of his paint box. So wonderfully do these rich shades blend together that they seem as though some subtle alchemy of the soil had transmuted them to all the rays of the spectrum. The varying finenesses of gold are displayed in infinite gradations from the superfine luster of the regal poppies to the silvery alloys of creamcups. All that has been sung of our California poppy seems inadequate fully to describe this scene.

The shades of yellow are of wonderful variation. Suncups, buttercups, and the delicate creamcups cover the ground during the earlier months.... In one locality... a carpet of yellow pansies spreads over many acres, and hither flock the most enthusiastic flower-gatherers from February to July.... The yellow pansy belongs to the violet family, and is described in the botany books as the *Viola pedunculata*. ...Here and there wallflowers cluster, resembling in the distance pools of yellow cream.

Later in the season, monkeyflowers grimace from their sticky stems while everywhere the tiny dandelion mimics the giant sunflower throughout the long summer days. Down near the lake, yellow lupines scent the air with their flower racemes, while their tenacious roots, twenty feet and more below the surface, check the encroaching sand drifting in from the Pacific.

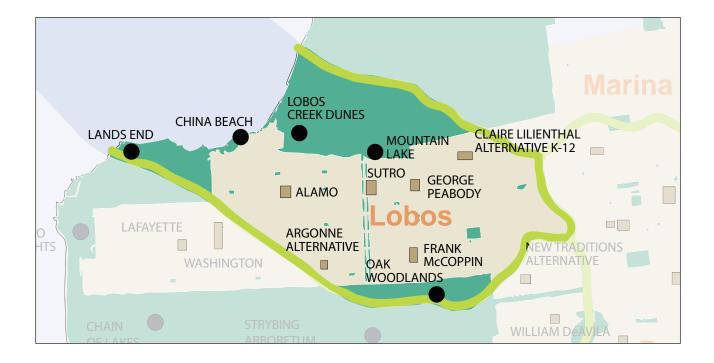
Bright shades of pink relieve the monotony of too much gold. Tiny filaria and buxom blossoms of wild hollyhock fleck the grass, while shooting stars spangle the sward, flaunting their raiment of royal purple and pink like gaily-poised insects. "Mad violet" is a well-chosen name for this eccentric little flower, although the more soberminded prefer to call it the dode-catheon. At this season, the crimson-blotched godetias are waving their farewell to spring. Blending blue with white, the dainty collinsias linger with the godetias well into summer....

FOR MORE INFORMATION

To view the PUC groundwater management plan for the Westside Basin (it contains some good natural history information), visit the PUC web site at *www.sfwater.org*, or type "westside groundwater management plan" into Google.

For an introduction to the history of Rancho San Miguel, read *Rancho San Miguel: A San Francisco Neighborhood History* by Mae Silver (Ord Street Press, 2001).

For more information about the wildflower fields of Lake Merced, go to *www.shapingsf.org*, type "wildflowers" in the search field, then select the documents named "Wildflower Gardens" and "Flowers of Lake Merced." Another online source of information about the historic vegetation of Lake Merced can be found on the website of Barbara Holzman, geography professor at San Francisco State University. Go to *bss.sfsu.edu/holzman* and click on the link to "Biogeography of Lake Merced."



LOBOS CREEK WATERSHED

The Lobos Creek Watershed is, more or less, the Richmond District. It drains approximately 3 square miles in the northwest corner of San Francisco.

The watershed's western boundary is the ocean; its eastern boundary is essentially in line with the eastern edge of the Presidio. The southern edge of the watershed parallels the boundary of Golden Gate Park and includes a bit of the park's oak woodland. The northern limit of the watershed runs through a portion of the Presidio (about a half square mile to the east and west of Mountain Lake) and includes all of Lincoln Park and Sutro Heights Park. If the watershed is viewed as an oval stretched east to west, Geary Boulevard and Park Presidio Boulevard cut it into quarters.

The watershed's defining water body is, of course, Lobos Creek; its other main water body is Mountain Lake. There is no surface connection between the two today, and it is unclear whether there has ever been. A 1776 map shows such a connection, but maps drawn by early explorers were approximations, based on limited experience of the land. An 1850 executive order (see the Mountain Lake site description) links the two, but latter-day engineers have determined that most of Lobos Creek's water comes from the southern part of the watershed, not Mountain Lake.

Geologists have suggested that an ancient stream channel established the above- and below-ground topography of the watershed, and that groundwater still flows along this prehistoric channel and emerges as surface flow in Lobos Creek. The creek is fed by a number of springs along its south bank, mainly between 19th and 21st Avenues. The headwaters of the creek are at about 15th Avenue.

The National Park Service, on whose lands both Mountain Lake and Lobos Creek are found, has designated the Lobos Creek corridor, from Mountain Lake to the ocean, as an Archaeologically Sensitive Area because it has the potential to yield prehistoric native remains. None have yet been found along the creek, but an obsidian point was recently found close by, at a restoration site near Battery Caulfield Road. In the words of NPS archaeologist Leo Barker, this arrowhead or spear tip is a "basal-notched serrated obsidian point which is generally diagnostic of the Late Horizon (maybe 500 to 1800 AD) in the San Francisco Bay Area."

The curve carved into the base of the point (hence "basalnotched") and the material the point is made from (obsidian)

give us clues to when it was made. Obsidian is not a naturally occurring rock in the Bay Area, so to get it, the Ohlone had to trade with other tribes. Dating of various artifacts suggests that they didn't begin to do this until the "Late Horizon," the thousand years or so prior to the time of contact with Europeans.

Thus we know that San Francisco's first people were present in the watershed. And because both Mountain Lake and Lobos Creek have water year-round, it seems very likely that the Ohlone made use of the watershed's resources year-round. People since then certainly have.

In about 1860, Lobos Creek served as the main water source for the city. According to a history of the city's water system put together by the Public Utilities Commission, the San Francisco City Water Works "dammed the mouth of Lobos Creek and brought two



Lobos Creek



Spring Valley Waterworks treatment plant, Lobos Creek, 1920s. A small patch of the brick floor of this building can still be seen today, upstream of the mouth of Lobos Creek. Note the man in the lower right-hand corner of this photo, who's painting the scene!

Francisco," to quote an educational poster put out by the PUC, "use 85 million gallons per day!" About two-thirds of this total goes to residences, where the average person uses about 70 gallons of water a day. Imagine if each person in your home had to carry in 70 one-gallon jugs in order to be

able to wash and flush and cook and drink each day.

In 1860, Lobos Creek water was stored in two reservoirs on the north side of Russian Hill. One of these, the Lombard Reservoir—located at the top of the switchback-dense, brick-paved block of Lombard Street—is still in use. The reservoir, under the city block defined by Lombard, Larkin, Greenwich, and Hyde, is one of thirteen serving the city, and is the oldest.

Water continues to be drawn from Lobos Creek today. It is collected at Baker Beach, where there's a treatment plant, and used in the Presidio. The creek still yields about 1.35 million gallons of water a day; the Presidio supplements this supply with water it purchases from the city. There are nine locations within the Presidio where the municipal system connects to the Presidio water lines.

The water treatment plant at Baker Beach is part of the

million gallons of water a day by flume and tunnel around Fort Point, through the Presidio, and under Fort Mason to the Black Point Pumping Station at the foot of Van Ness Avenue."

Two million gallons a day is a lot of water, but at today's rates of consumption, that only meets 2 percent of San Francisco's daily water needs. "The people who live and work in San Presidio's National Historic Landmark District. It is a blond brick building at the southern corner of the southernmost parking lot at the beach. Just south of it, in the sand, is the remnant of an earlier water-diversion facility, possibly part of the old dam and flume originally used to take water from the creek. Some of the flooring from that building can be found in the sand. Look for tiles set in a herringbone pattern.

PART FOUR Parks and Natural Areas



BAKER BEACH

Its scenic location just south of the Golden Gate Bridge makes Baker Beach a destination for visitors from all over the world. Locals find it no less alluring, perhaps because of the clothing-optional portion of the beach at the north end (which one should be aware of, and which can be avoided when in the company of your students). In addition to these attractions, the site is of interest to naturalists for its dune vegetation, rock formations, and serpentine bluffs.

LOCATION

Baker Beach is the western edge of the Presidio. It is paralleled on its eastern boundary by Lincoln Boulevard, which travels along the high bluffs above the beach and then slopes down, as the bluffs do, to the beach's southern end.

FACILITIES

The main entrance to Baker Beach is at the south end, on Bowley Street, off Lincoln Boulevard. If you come in this way, you'll see the hummocks of former dunes plainly visible beneath the forest of Monterey cypress along Bowley Street. There is also an entrance to Baker Beach on Lincoln Boulevard between Kobbe and Pershing streets. It's a trailhead, really, and the trail is a sand ladder that passes through a handsome patch of coastal dune scrub. It's a lovely bit of land, but since the route ends where the nude beach begins, this route is best avoided if you're with students. (Alternatively, you could go part way down, have a look at the area, read the signs, then hike back up.)

There are two parking areas at the main entrance. The one to the right gives direct access to a picnic area, bathrooms, and Battery Chamberlin. The other, to the left, is located near the Presidio water treatment plant and leads through restored dune fields.

BEST PLACE TO START

The best place to start is the main entrance; you can easily explore the dunes, the beach, and the bluffs from here.

WHAT YOU'LL FIND

Baker Beach lies in front of stabilized dunes and coastal bluffs. Graywacke can be seen at the north end of the beach; the cliffs and slopes beyond it, which lead to Fort Point and the Golden Gate Bridge, are mostly serpentine. The distinctive gray-green of the serpentinite is easy to spot. The south end of the beach is bounded by vertical graywacke walls and

picturesque tiers of Sea Cliff district houses.

In the area near the water treatment plant, the *foredunes* have been restored, and botanist Philip Munz assures us that a visit to them will almost always be rewarded with some new find. "Because of the weak seasonality of these coastal habitats," he writes, "plants can be found in flower nearly every month of the year."

Toward the south end of the beach, past the water treatment plant, you'll find the mouth of Lobos Creek. Though not exact-



A typical assemblage of dune plants.

ly picturesque, it is worth a look, especially if you have visited (or plan to visit) Lobos Creek Dunes across the street. Here, having been routed through the treatment plant first, Lobos Creek ends its journey to the sea in the mouth of a pipe.

To the north, past the bathrooms and picnic area, is the wellmaintained Battery Chamberlin. It lends a sculptural element to the back of the beach and is a fun place to scramble about. A disappearing rifle once used here has been rebuilt and reinstalled; demonstrations are given one Saturday each month. Beyond the battery, the bluffs are planted to cypress. Beyond them, the scrub and serpentinite begin.

The beach itself is endlessly beautiful; it never fails to soothe and delight.

PLANT ADAPTATIONS

Many beach and desert plants have gray leaves. There are gray sages in the Great Basin, for example, and at Baker Beach. They are not the same species, but they share a trait: Their light gray color reflects sunlight and deflects some of the

> glare off the sand. Beach sage is not only gray, but soft and furry. Its hairiness helps defend against drying winds.

Plants in beach and desert environments also grow low to the ground. Beach strawberry is an example of this. This plant also provides an example of another beach survival strategy— it reproduces vegetatively, putting out runners, called *stolons* or horizontal stems, that can set root.

Many beach plants are perennial. The strategy

here is to get established and hang on. One way perennials do this is by developing a long, thick, main root—a taproot that helps them tap into permanent sources of water and store nutrients. Beach-bur's taproot can grow to more than 9 feet; yellow bush lupine roots can grow 20 feet long or more. Yellow sand verbena also relies on this strategy; you can sometimes see its massive root—it can be as thick as a telephone pole— exposed in the wind-blown sand.



Serpentinite is easy to spot at Baker Beach.

Another trait that is common to both beach and desert plants is succulence. Instead of having thin, pliable leaves and stems, a plant will develop thick, fleshy ones. This enables it to store more water. Cacti are classic examples of this in the desert environment; at the beach, sea rocket, New Zealand spinach, and iceplant all have this characteristic.



The Golden Gate and Baker Beach with its first house (#1 25th Avenue), November 1908. Image from a 1983 postcard.

SPECIES FOCUS SEA ROCKET

Unlike many beach plants, sea rocket is an annual. Because it completes its life cycle in one growing season, its future depends on its offspring finding suitable habitat the following year. But in an environment as dynamic as the beach, where a storm can deposit



or withdraw tons of sand in a few hours, what is suitable one year may not be the next. To counteract this uncertainty, sea rocket disperses its seed in two different ways.

A sea rocket fruit looks like a two-stage rocket. The top half detaches, while the bottom half remains attached to the parent plant. The detached, cork-like "rocket," which carries a single seed, is dispersed by wind and wave to other beaches. The attached fruits, also with a single seed, are all deposited near the parent plant as it dies and breaks apart. If that spot remains hospitable, hundreds of seedlings will appear the following year.

Sea rocket seeds germinate a few weeks after the winter rains begin, grow quickly, and flower early. Even though it is an annual, sea rocket can put down a sizable taproot—one researcher excavated a plant that had a taproot more than 4 feet long. The root smells of mustard oils; sea rocket is in the mustard family.

Sea rocket's abundant lavender flowers grace nearly every beach on the west side of San Francisco, and it can be found along the coastal strand throughout California. Even though it is so widespread, sea rocket is a newcomer to this coast. It arrived, probably in ballast from a ship that began its journey on the East Coast, in the Bay Area in the late nineteenth century. Though it has flourished here, sea rocket has not done so at the expense of other plants. It is not invasive and so has not displaced any indigenous species.

Sea rocket grows in the area between high tide line and the first dunes. It can tolerate being closer to the pounding surf than almost any other plant.

—Pete Holloran

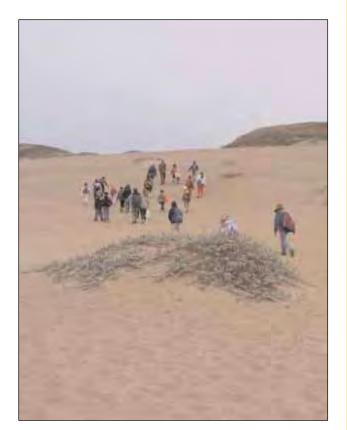
GOING DEEPER LIFE ON THE BEACH

Before they disappeared under housing and urban forests, the sands of San Francisco were often likened to the desert. The city's vast dune system was called the great sand waste, and it was popularly understood that its only value lay in its potential to be converted into something else. Though we now see more in the dunes than barren wilderness, we also have to acknowledge that there is some accuracy in the comparison between dunes and desert.

As every beachgoer knows, sand absorbs the sun's warmth. This is a welcome fact for the basking sunbather, but there can be too much of a good thing—as one researcher found on a hot and sunny day in 1952, when air temperature peaked at 82 degrees Fahrenheit and ground temperature on the sand reached 104 degrees.

If sand is hot like the desert, it is also dry like the desert. Sand is porous—it doesn't hold much water. If beach plants had to survive on the water stored there, they would last only four or five days. What's more, beaches and deserts can be windy places. The little water that sand does retain can quickly be dried by driving winds. Wind also takes moisture from a plant's leaves.

Because of these similarities between beach and desert, it's not surprising that there are similarities between dune and desert plants. In both environments, plants employ some of the same survival techniques.



FOR MORE INFORMATION

To learn more about the beach and dune environment and the plants that live there, see *Introduction to Shore Wildflowers of California, Oregon, and Washington* by Philip A. Munz (University of California Press, 2003).



HOW TO GET THERE

MUNI line 29 goes to Baker Beach. Also, if you and your group don't mind a healthy walk, MUNI line 1 will drop you several blocks away.



BAYVIEW HILL

Until recently, Bayview Hill could have been called Bay*side* Hill. When early San Francisco inhabitants lived and worked in its vicinity, the eastern side of the hill dropped down directly into the bay. Starting in the nineteenth century, however, parts of the hill began to be carved away. This trend continued, intermittently, well into the twentieth century, culminating in the north and east sides of the hill being used to create Candlestick Park.

Much of what remains is now park land. Bayview Hill is a lovely, desolate place of rocky outcrops and Islay cherry bushes, where rare birds take refuge and goldfields cast sheets of color come spring.

LOCATION

Bayview is the big hill on the east side of the freeway as you head south out of San Francisco on Highway 101. It is immediately west of Candlestick Park. The only access point is at the end of Key Avenue off Third Street in the Bayview Hunters Point District.

FACILITIES

Bayview Hill is a remote and rustic park. There are no bathrooms or picnic areas. One paved trail (approximately a mile long) loops around the hill, providing access to the park's fields, forests, and rocky perches.

BEST PLACE TO START

The trailhead at the end of Key Avenue is the best place to start.



WHAT YOU'LL FIND

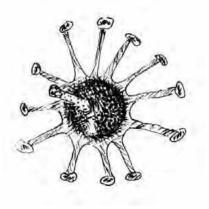
Bayview Hill has many features to recommend it, but it is especially important botanically. To quote the Natural Areas Program management plan, "of the 68 sensitive plant species discussed in this plan overall, 19 of those can be found on Bayview.... This is perhaps the most diverse assemblage of sensitive plants within the Natural Areas System." Many of these plants are annuals that appear in the spring, briefly littering the hillsides with pinks, purples, whites, and golds.

Not all of the notable plants are so ephemeral, however. Some are long-lived perennials that will reward a visit at any time of year. The Islay cherry is chief among these. Also called holly-leaved cherry, this rose family member has hard, prickly leaves that are indeed holly-like. "Islay" is the name given the plant by the Spanish. Islais Creek bears nearly the same name; the cherry must have once grown somewhere along its winding course.

Writing more than one hundred years ago, Mary Elizabeth Parsons recommended the Islay cherry for horticultural use and remarked that some of the finest specimens were to be found in the gardens of the old missions. She also tells us that the first people made use of the plant—the cherries were "made into an intoxicating drink by fermentation." The best place to see the Islay cherry is at the top of Bayview Hill. As you follow the paved path along the southern side of the hill, look on the right for a flight of red stone steps that lead up into a dense thicket of shrubs. That's your spot. This WPA stairway, made from chert collected on the hill, once led up and over the hill. The way is blocked now by poison oak and cherry trees, but even so, the steps make a good seating area for a group and, in addition to the cherry, there are other indigenous plants here to inspect, including California sage.

In following the loop around Bayview Hill, you'll pass through the most common environments of San Francisco's park lands—

planted forests, shrubby areas, and grasslands. The payoff is on the crest of the hill, where, besides getting to know the Islay cherry, you can get up close and personal with some beautiful rock formations, then walk out into the grasslands.



Flower of the Islay cherry

FOR MORE INFORMATION

The city's Natural Areas Program has published a brochure for Bayview Hill that highlights various features on the main trail. If you plan to visit this park, it is well worth picking up a copy, or downloading a PDF at www.parks.sfgov.org/wcm_recpark/Volunteer/Brochures/ BayviewHill.pdf



Near Bayview Hill and Bayshore Blvd., looking south, ca. 1905. A portion of the hill on the left remains today. San Bruno Mountain is visible in the background.



Hunters Point School, 1917. The street is being paved at Innes and Hunters Point Blvd.



Bayview Hill from Key Avenue, 1920. Today's Third Avenue is in the middle ground. The hill is now developed to about midpoint.



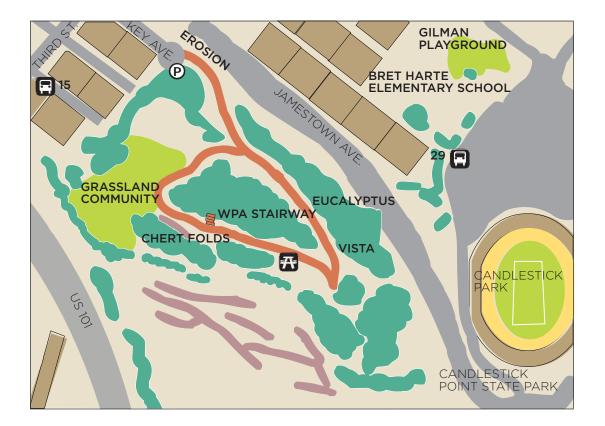
Looking east from San Bruno Blvd. and Bayshore Blvd., ca. 1930.



Rock outcrop on Bayview Hill in the area where the radio tower now stands, looking west-northwest, ca. 1930. Note the truck farms in the valley.



Closeup of same rock outcrop some time later. Notice the spread of homes and other buildings, and the height of the trees.



HOW TO GET THERE

MUNI line 15 stops at Third and Key. Bayview Hill is less than a half-mile from this intersection.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/BERNAL HILL



BERNAL HILL

At 24 acres, Bernal offers more hill than other parks of its kind. Its tall, rounded top is broad and open; its sides are steep. It is mostly grassland and, in the spring, shooting stars—an earlyblooming wildflower—sprinkle pink across its northwestern slopes. On most days, hawks can be seen overhead, riding updrafts, and ravens are ever-present. Those raucous parrots can sometimes be spotted flying across the Mission District; on the hill, it's possible to be higher than they are, looking down on them as they race through the sky above the city's buildings and streets. For getting out in the open and rising above it all, Bernal Hill can't be beat.

LOCATION

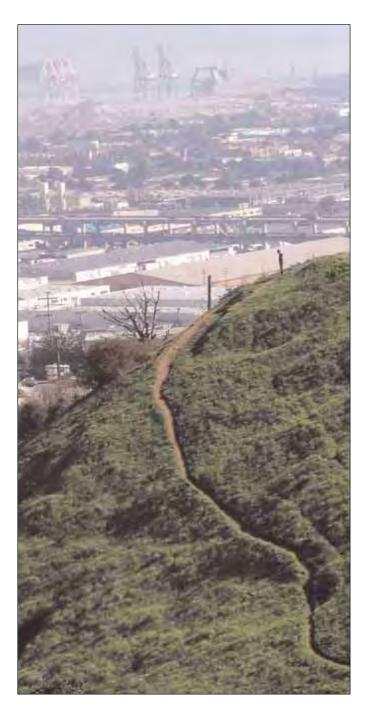
Bernal Hill is part of the Bernal Heights neighborhood. It is directly south of the Mission and east of Diamond Heights. To the east, on the other side of Highways 101 and 280, is Bayview Hunters Point.

FACILITIES

Bernal Heights Boulevard, which wraps around three-quarters of the hill, provides multiple access points. The main entrance is on the south side, where Bernal Height Boulevard ends. An old paved road leads nearly to the top of the hill; plenty of footpaths criss-cross the top and the slopes. There are no picnic tables, benches, or toilets on the hill.

BEST PLACE TO START

The best place to start is the side of the hill to which you're closest. Since you may access the hill from all sides, find the nearest path or stairway and walk up. The greatest concentration of wildflowers and bunchgrasses is on the northwestern side. If you're on the hill in March or April, be sure to stray that way.



WHAT YOU'LL FIND

Like grass-covered hills throughout the Bay Area, Bernal Hill is bright green in winter and spring and tawny brown during summer and fall. Many of the plants here are annuals, though there are also some perennial grasses and wildflowers. Either way, all of Bernal's grassland plants are adapted to going without water for that half of the year during which we have no rain.

The most common grass on Bernal Hill is wild oats, an introduced annual whose tall stalks are familiar to many. Though it originated in Eurasia, this grass has been in residence in California for a long time. In his 1952 master's thesis, William Carey Clarke cites a 1925 study "of the grass seeds found preserved in adobe bricks made during the Spanish period (1769–1824)." Wild oat seeds were among those found, demonstrating that perhaps even before 1800, this grass was widespread.

Though they are not as common as wild oats, at least ten perennial bunchgrasses also grow on Bernal Hill, including melica, June grass, and purple needlegrass. The latter has stalks that grow two to three feet tall; as they mature, a long, thin bristle extending from the seed covering develops several kinks, giving the plant a very distinct appearance, both from a distance and up close. The seeds themselves have a purple tinge, giving this grass its name.

Amidst the grasses, you can find wildflowers in February, March and April—the shooting stars mentioned previously, as well as a member of the Violet family called johnny-jump-up. This cheerful yellow flower is similar to the pansies and violets you see at nurseries. Its two upper petals are rich brown on the back and pure gold on the inner side, with delicate stripes that lead down to the flower's center. The three lower petals have dark purple lines, which direct pollinators to the nectar within.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/BERNAL HILL



Southern Pacific Railroad, looking toward Bernal Heights from the location of San Bruno Avenue and Gavin Street, 1916.



Same location, approximately ten years later. Though this shot is taken closer to the hill, the vantage point is the same. The buildings on the hill are little changed, but there's now a street where before there were only railroad tracks.



On the northwest side of Bernal Hill, looking west, ca. 1940. Mount Davidson and (undeveloped) Diamond Heights can be seen in the background.

SPECIES FOCUS STORK'S BILL (RED-STEMMED FILAREE)

Another spring annual that you are likely to see on Bernal Hill is stork's bill, or red-stemmed filaree. Named for its long, pointed seed pods, which resemble a stork or heron bill, its other common name, filaree, is related to the Spanish word *alfiler*, which means "pin." John C. Fremont made note of this plant in 1844 when he was exploring the American River. According to Charles Francis Saunders, an early garden writer, "an interesting entry in [Fremont's] journal is of meeting with the pretty rosettes of the filaree (*Erodium cicutarium*), which Indian

women were gathering into their conical burden baskets to be consumed as food."

Charlotte Bringle Clarke, author of *Edible and Useful Plants of California* (UC Press, 1977), tells us that not only native Californians, but other American



Indians—including the Blackfoot and Shoshone—"quickly learned to use this plant for food." She and other writers have also remarked upon the plant's appeal to livestock and wildlife, including many songbirds.

Given that Fremont found the plant "in an unfrequented part of Northern California," Saunders wonders whether the plant might not be indigenous. In his master's thesis, William Clarke characterizes red-stemmed filaree as an "aggressive species capable of penetrating and becoming established in remote localities independent of man." He suggests that it was introduced before the Spanish began to actively colonize California.

Regardless of when it was introduced, there's no question that red-stemmed filaree is effective at dispersal it's good at getting around—and at planting itself. Here is how Katherine Chandler, writing more than one hundred years ago in a book for children, described this plant's reporductive strategies (in *Habits of California Plants* [Educational Publishing Company, 1903]):

Some warm day in April or May the dried fruits give themselves a twist and fly off the stems. Some, as they fly, are caught by the wind by the long silky hairs that you see on the end.

Others fall to the ground. Now, if you notice the lower part of the seed-case you will find that it has on the end a little hook and on its sides little bristles that curve upward and outward. You know they often stick in your clothes as you pass and you carry them to new fields, or perhaps a sheep performs the same service.

When the seed-case falls to the ground, if it be warm weather, it curls its parts; when fog or dew falls, it straightens them out; with more sunshine it curls up again. By doing this over and over again, the seeds screw themselves down under the earth and are ready to spring up into new plants as soon as the early rains fall. You can see how the seedcase works if you put one in water and then in the sunshine.

Because of its tendency to curl and turn, children used to call this plant "clocks." Red-stemmed filaree has small, dark-pink, five-petaled flowers; its fruit—the long needle or stork's bill—is unmistakable.

FOR MORE INFORMATION

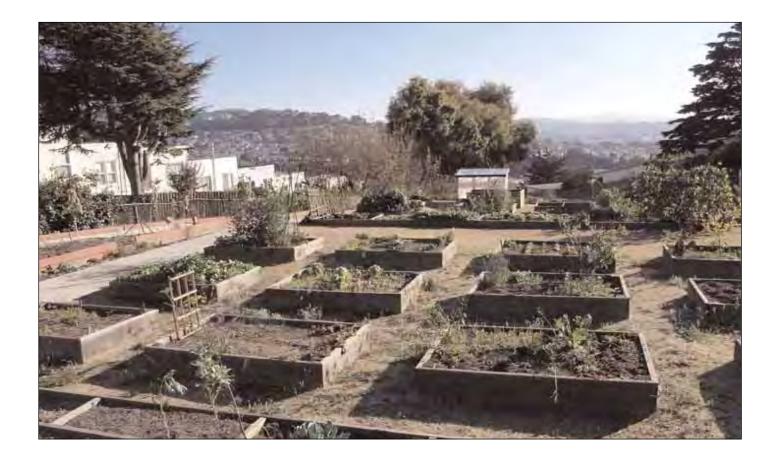
The city's Natural Areas Program has a brochure for Bernal Hill. In addition to information about the land use history and natural history of Bernal Hill, the brochure also includes a section on the American kestrel—our smallest falcon—which is frequently seen on the hill. This beautiful blue-winged, stripe-eyed bird is well-worth further investigation; look for and learn more about it.



HOW TO GET THERE

MUNI line 67 travels along the northeastern and eastern edges of Bernal Hill.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/BROOKS PARK



BROOKS PARK

Once a "scene of desecration," where the only park users were people packing guns, Brooks Park is now frequented by bright hummingbirds, painted lady butterflies, and neighborhood residents who have reclaimed this site for peaceful purposes.

LOCATION

Six-acre Brooks Park sits atop a small hilltop—"the south-westernmost hill in San Francisco"—in the Merced Heights neighborhood. The main entrance to the park is on Shields Street at Ramsell. There's also a park sign and footpath on Vernon Street.

FACILITIES

You'll find benches, picnic tables, and a barbecue in the wildlife garden and a small children's play area near the entrance. There are no toilets. The community and wildlife gardens are wheelchair-accessible.

WHAT YOU'LL FIND

The park is a sandstone knoll covered by a shallow layer of sand. At the edge of the park on the north and south sides are old quarry sites where the sandstone is exposed. On the north side, the old quarry walls face private homes; on the south side, you can see the stone more easily. The floor of the old quarry has been paved and is part of the play area for the adjacent school. This rock is described in the Natural Areas Resource Management Plan as typically yellowish-brown or yellowish-gray in color and with a rubbly surface. On the east side of the park is an orderly community garden shared by residents and school children at Jose Ortega Elementary School. The hilltop itself is a wildlife garden. The west side of park, on Vernon Street, is an open grassland that has been cleared of iceplant and replanted with indigenous species.

A FOCUS ON WILDLIFE GARDENING

The wildlife garden is enclosed by a low stone wall and tall cypress trees—remnants of the days when this land was homesteaded by the Brooks family. According to Jeanne Alexander's history of the park, Mrs. Brooks was "a woman ahead of her time" who "composted organic materials, kept beehives, and taught visitors about native plant gardening."

That tradition continues today. The hilltop has been intensively gardened over the last ten years and is filled with a variety of bird- and butterfly-friendly plants. There are many California native plants here; some are local and some come from other parts of the state.



You'll find sticky monkey flower, for example, which is a common sight on wild hillsides throughout the Bay Area. You'll also find a bigger, paler monkey flower with white speckles on it—though similar, this is a different species that grows in the wild in Big Sur. There are also many exotic plants that have been chosen because they attract butterflies, hummingbirds, and other creatures.



Brooks Park (the hill) taken from the west, 1913. What is now Ingleside is in the middle ground.

The garden at Brooks Park has succeeded in attracting a variety of birds and insects. On a summer day, one can hear tiny bushtits amidst the shrubs and see Allen's hummingbirds diving into the garden at dizzying speeds. Dragonflies hawk the site while skipper, west coast lady, cabbage white, and yellow swallowtail butterflies flutter by. Pygmy nuthatches have been recorded nesting in the cypress and lesser goldfinches have been seen in the grassland. An arboreal salamander has also been seen in the grassland.

IN THE GARDEN HUMMINGBIRD FEEDING HABITS

Hummingbirds are *nectivores*, using their long, slender bills to drink flower nectar. They eat insects as well, getting fats and proteins from them; most species also eat spiders.

The flowers that hummingbirds sip from have some features in common. Typically, they have thick walls and a tubular shape. Hummingbirds don't show a preference for a particular color of flower, but Sibley writes that they quickly learn to associate a vibrant color (such as red) with "a food reward."

Hummingbirds can be seen *traplining*—visiting the same flowers in the same order, sometimes even at the same time of day.

THE PEOPLE OF THIS PLACE

Shortly after the city bought the Brooks family property in 1978, a bad crowd moved in. They burned down the family house and established the park as a territory for drug use, dog fighting, and murder. Neighborhood residents avoided the place.

Fast-forward almost a decade. In 1987, community members formed the Friends of Brooks Park and began to pick up the broken glass, erase the graffiti, and reclaim the site. According to Jeanne Alexander, "the gangs, feeling the pressure, began to fight back. Neighborhood houses were shot at, but no one was hit. Slowly," she writes, "those responsible for the problems drifted away...." The look and feel of the park began to change. The group applied for and received a grant to expand the park to its current size. Working with the city, the California Native Plant Society, the League of Urban Gardeners, and others, the Friends of Brooks Park installed a community garden, enlarged and replanted the garden beds, and restored the park's natural grassland area; these projects are ongoing. The group also offers free Tai Chi classes on Saturdays. For more information, call Peter Vaernet at (415) 586-1451.

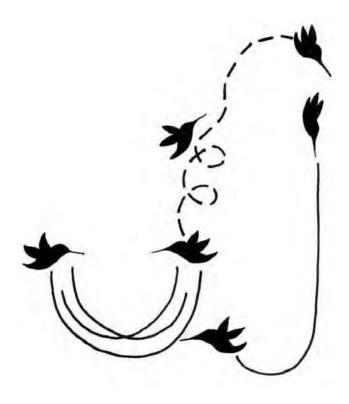
SPECIES FOCUS ALLEN'S HUMMINGBIRD

The Allen's hummingbird is a summer resident on the California coast in general and at Brooks Park in particular. Allen's breed in thickets, brushy slopes, and open pine forests, so the park—with its closely planted shrubs and ring of cypress trees—suits this species well.

This quick bird has a bright green back and wings. Females have an orange throat with a white band underneath and a buff-colored chest. Males are similar, but the color on their throat and chest is darker.

You can also identify a male Allen's by the aerial dives it makes. (Several species of hummingbirds, in fact, can be identified by their diving flights.) The Allen's makes a J-shaped swoop. Starting from the bottom, he hovers about 25 feet from the ground, flying back and forth a few times. This is called the shuttle display. He then climbs to a height of 75 feet, pauses for an instant, and flies straight down, dropping 50 feet in seconds. As he curves up, he makes a loud whistling noise.

This species starts arriving from Baja and central Mexico in January, and breeding pairs raise two broods. Each takes about six weeks, from egg-laying to the young being fully fledged. Their small nests (about three inches across) are hard to spot but worth looking for. They are made of moss and soft plant parts, bound together with spider silk and covered with lichen. Allen's hummingbirds begin to fly south again in July and August.



GOING DEEPER CREATING A WILDLIFE GARDEN

In the garden, the term "wildlife" includes not just butterflies and birds, but worms, pill bugs, and fungi. Small creatures, from soil microbes to Jerusalem crickets, are a vital part of any garden ecosystem. The food chain begins in the ground.

Because of this, every wildlife garden needs to be an insect garden. Most insects are a gardener's ally; far more garden

insects eat other insects than eat your favorite plants. And for the budding naturalist, insects are appealing because there are so many of them. They provide plenty of opportunities for observation and study, and learning about their needs is a natural springboard to developing a deeper understanding of other animals.

As for those other animals—lizards, birds, and the furry ones—their needs differ, so the kind of plants they'll be interested in differs. To get started, follow the general guidelines below. Over time, the garden itself will help you fine-tune your choices.

The most important thing is water. This alone will bring new creatures into the garden, and will help sustain the ones already there. Start with a shallow pan sunk into the soil at ground level, or buy a birdbath.

After adding water, build diversity. You have the best chance of appealing to a variety of animals if you create a varied environment. "The simplest, most obvious way to accomplish this," according to Eric Grissell, author of the entertaining and instructive *Insects and Gardens*, "is to grow plants that differ and to grow lots of them."

Choose plants that have different structures. Some plants grow from underground bulbs. Some have a long taproot.

Some plants have soft stems, others have hard ones. Each of a plant's features makes it more or less appealing to different creatures.

Chose plants that grow at different heights. Yerba buena, our indigenous mint, spreads over the ground, while a buckeye or madrone tree will tower 20 or more feet above it. Many different shrubs fill the air space in between. A slender salamander will never climb a tree, but it may live most of its life under a fallen branch, and it needs the

cover provided by low-growing plants.



Choose plants that flower and fruit at different times. Willow is a great wildlife plant and one of the earliest to flower. Coyote brush, on the other hand, blooms in the late summer. And food sources are not just flowers, but leaves, berries, and seeds. Don't cut off the flower heads. Don't always cut down the dry stems.

Choose indigenous plants over exotic ones. This does not mean you cannot use exotics. There are plenty of examples of animals that

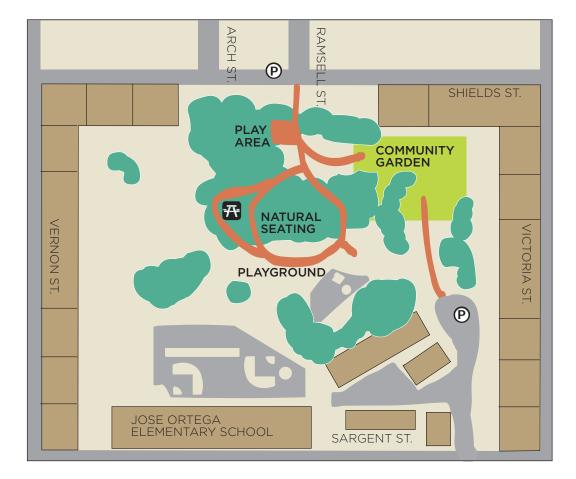
rely on introduced plant species, so it's okay to have a mix. But it's important to grow in digenous species as well. Since these plants evolved with our indigenous animals, we can be sure that they are giving these creatures the food and shelter they need.

Pay attention to specifics. The words "specific" and "species" are closely related. So in addition to paying attention to plants, take notice of the animals that already use the garden—you'll be amazed! Find out who they are and learn about their needs. What do they eat? Where do they like to live? How do they reproduce? To answer these questions, refer to field guides and natural history guides, and join walks offered by the Audubon Society, Native Plant Society, and many others.

FOR MORE INFORMATION

Neighborhood residents are still very active in the care and maintenance of Brooks Park. To get in touch with the local experts, go to the Neighborhood Parks Council website, *www.sfneighborhoodparks.org*. Select "Park Info," then click on "Park Groups Contact Info." The current contact person will be listed. You'll also find a history of Brooks Park, with an historic photo, on this site.

For guidance about how to use the environment around a school and create school gardens, one very good resource is *Greening School Grounds: Creating Habitats for Learning*, edited by Tim Grant and Gail Littlejohn (New Society Publishers, 2001).



HOW TO GET THERE

Brooks Park is one block from Muni line 29 and two blocks from Muni line M.



CHINA BEACH

Tucked below El Camino Del Mar in the Sea Cliff district, China Beach is an excellent place to take students when you want to get outside and relax. The beach is small and protected, making it easy to let kids explore without having to worry about keeping too close an eye on them.

Formerly a state park named for San Francisco mayor James Phelan, China Beach is now a part of the Golden Gate National Recreation Area. It was renamed in honor of the Chinese fishermen who once camped here at night—an engraved stone sign at the entrance to the site tells the story.

LOCATION

China Beach is between Lands End and Baker Beach in the Sea Cliff district. It is on Sea Cliff Avenue, off Camino Del Mar. For detailed driving directions, visit the National Park Service website (under "For More Information").

FACILITIES

Sturdy steps lead from a small parking lot on Sea Cliff Avenue down to picnic tables on a grassy area above the beach. Clean,

well-maintained bathrooms are nearby, inside an Art Deco bath house. Steps and a ramp take you past a retaining wall and on to the beach.

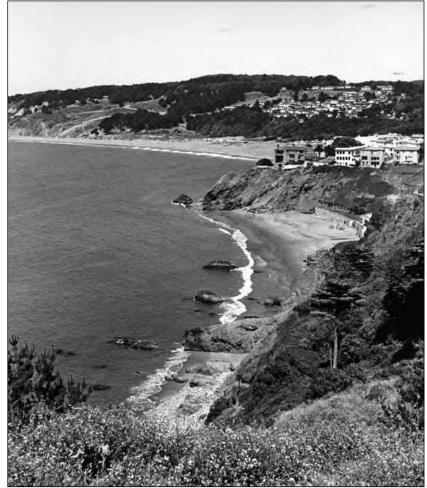
WHAT YOU'LL FIND

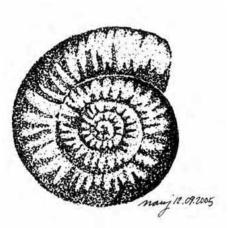
China Beach is a small, west-facing pocket beach at the foot of a steep slope that is the site of an old landslide. The beach is bordered on the north and south by walls of rock; it has views of the Lands End promontory and the Golden Gate Bridge. The beach is bare sand, without vegetation. There are no dunes here. Common seaweeds, as well as a few mussels and barnacles, can be seen on the rocks at either end of the beach. A small drainage has its outlet here, so there is usually a freshwater channel running through the beach. Pigeons frequent the picnic area; depending upon the time of year, Heermann's gulls, brown pelicans, and other shorebirds can be seen flying overhead or resting on the sand.

As at Baker Beach, this is a great place to get a close look at several kinds of Franciscan bedrock.

According to the late Clyde Wahrhaftig, a well-known San Francisco geologist, the "cliffs expose well-bedded graywacke... greenstone, and radiolarian chert. The beach marks a landslide in serpentine and sheared Franciscan rocks. The serpentine is now covered by the bath house."

In the 1950s, in the graywacke rocks west of the beach, two boys found a Cretaceous ammonite a large, spiral-shaped fossil (below). These ancient sea creatures became extinct at about the same time as dinosaurs.

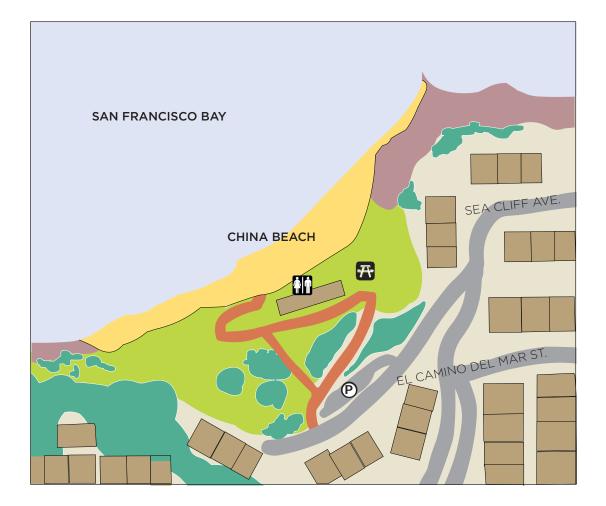




China Beach, ca. 1979.

FOR MORE INFORMATION

For an additional description and directions, visit the China Beach page on the Golden Gate National Parks Conservancy website: *www.parksconservancy.org/ visit* and select China Beach in the pull-down menu.



HOW TO GET THERE

China Beach is more difficult to access by public transportation than most other natural areas in the city. MUNI lines 1 and 29 will get you within four or five blocks of this beach.



CRISSY FIELD

Crissy Field is named for Dana H. Crissy, a military aviator who, in 1919, participated in the First Transcontinental Reliability and Endurance Test—a cross-country flying contest to promote the fledgling field of aviation to a somewhat skeptical public. Sixty-one aircraft participated, with 46 flying westbound from Long Island, New York, and 15 flying east-bound from a new military airfield in San Francisco.

Unfortunately, the test reassured no one. Crissy and his copilot were casualties of the event, and only nine of the men who began the flight completed the trip from one coast to the other. The airfield from which Crissy and his fellow fliers had taken off was named in Crissy's honor shortly after the contest.

Today, Crissy Field is the crown jewel of the Presidio. It includes Major Crissy's airfield and much more. From its bayshore beach, dunes, and marshland to its cafés, visitor centers, and grand promenade, this 100-acre shoreline offers visitors the experience of both unfettered nature and a fine day at the park.

LOCATION

Crissy Field is on the northern edge of the Presidio and the San Francisco Peninsula. It is bounded on the east by the St. Francis Yacht Club, the Palace of Fine Arts, and the Marina Green. At the west end lies Fort Point and the Golden Gate Bridge. Mason Street runs along the southern edge of Crissy Field.

FACILITIES

The Golden Gate Promenade—a wide, level walkway paved with crushed stone—runs the length of Crissy Field and links its many elements. Similar in intent to the pedestrian boulevards of Central Park in New York and the Jardin de Luxembourg in Paris, this esplanade also offers access to the wild open spaces of a large park at the edge of San Francisco Bay.

The promenade leads through dune hummocks beside the beach, crosses the mouth of Crissy Field Marsh and runs beside it and then alongside the historic airfield, past several buildings of note and numerous benches, picnic areas, and bathrooms. The Crissy Field Center looks out across the whole of this magnificent shoreline. The center offers shelter from the wind as well as food and drink, free newsletters and maps, and an interesting mix of programs for students and the general public. Food and information are also available at the Warming Hut, at the western end of Crissy Field.

BEST PLACE TO START

Start at the west end of East Beach. From here you have access to the whole beach, the promenade, and the marsh. Crissy Field Center is within easy walking distance of East Beach.

The edge of the Presidio, circa 1880. The tidal channel of the marsh can be seen in the upper right, and the planted trees of the Presidio are visible in the upper left.

WHAT YOU'LL FIND

Crissy Field puts you at bay level—and opens up the view. The Golden Gate Bridge frames the vista to the west, while the headlands and islands of Marin County lie to the north. The predominant theme here is wide open space.

Much of the shoreline is a clean and inviting beach. Dunes back the beach and also run nearly the length of the site. Marked off by low fences, these dunes are a symphony of both muted and startling color. In the spring especially, low-growing shrubs and matting plants are punctuated by the purples, pinks, yellows, reds, and whites of their own flowers. Inland from this sandy strand are the park's other main features: old glades of eucalyptus, cypress, and pine; grassy hillocks and broad lawns; salt- and freshwater wetlands; and an historic airfield. To assist you in discovering Crissy Field, we have broken it into three main parts—East End, Center Field, and West End. Each is described below.

EAST END

A grove of eucalyptus trees defines the eastern boundary of Crissy Field. Here you can smell both the salt off the ocean and the aromatic oils of the trees. Ravens can be seen in the blue gum branches, perhaps fiddling with scavenged treasures. At the right time of year, winter residents such as rubycrowned kinglets and golden-crowned sparrows can also be found amongst the eucalyptus.

Along the shoreline, there's plenty of riprap that can be explored for crabs and seaweed. Behind this rocky seawall are dunes planted with characteristic plants—beach sage, silver bush lupine, strawberry, and beach bur. Follow the dunes about 500 feet to the west, and the beach opens up in front of you. At the west end of East Beach, there are picnic tables and bathrooms. To find them from a distance, look for the big neon-orange windsock (and estimate how hard the wind is blowing). Outside the restrooms is a three-spout shower head for washing sand off beachcombers' feet and windsurfers' wet-suits. An interpretive sign at the west end of the parking lot provides history about the site as well as a general orientation to the Golden Gate National Recreation Area.

In the inland grassy areas throughout much of Crissy Field, the landscape architect built chevrons—narrow, raised hills that crest above shoulder height, meant, perhaps, to recall the undulating quality of the dunes nearby. You can see (and climb) quite a few of them here at the East End.



Visitors to Crissy Field enjoy the Golden Gate Promenade.

PLAYING THE TIDES

A bit beyond the park boundary, just east of the St. Francis Yacht Club, is a little-known work of art called the Wave Organ. Built by Peter Richards, an artist affiliated with the nearby Exploratorium, the Wave Organ is a thin strip of land that is also a large-scale musical instrument played by the fluctuating waters of San Francisco Bay. Here is a brief description of this special place, taken from the Exploratorium web site.

The jetty... was constructed with material taken from a demolished cemetery, providing a wonderful assortment of carved granite and marble, which was used in the construction of this piece. The installation includes 25 organ pipes made of PVC and concrete located at various elevations within the site, allowing for the rise and fall of the tides. Sound is created by the impact of waves against the pipe ends and the subsequent movement of the water in and out of the pipes. The sound heard at the site is subtle, requiring visitors to become sensitized to its music, and at the same time to the music of the environment.

CENTER FIELD

The center of Crissy Field encompasses both the recreated tidal marsh and the airfield. It is the heart of Crissy Field.

If built as it had been planned, the tidal marsh would have been larger. But when work began at the site, remains of a seasonal Ohlone village were discovered. Plans were altered, and the marsh was configured in a way that would allow the traces of the village to be covered over and remain where they had been found. Though their location is undisclosed, signs have been posted to notify visitors of the marsh's long history and to share knowledge of the first people's way of life here.

Other signs of the web of life can be witnessed at Crissy Field Marsh as well. Great egrets and great blue herons frequent the site year-round and can often be seen stalking the edges of the marsh, pulling worms out of the mud or poised to strike as soon as a fish happens by. It's equally common to find the great blue herons in the grasslands along Mason Street—they prey on gophers and other grassland inhabitants as well as aquatic species.

Gulls keeling and keening over the open water of the marsh are an almost constant presence. When you cross the foot-bridge, look for gulls hovering overhead—and watch out for broken shells underfoot. Over and over, the gulls drop clams and other shellfish on the bridge until they crack into pieces. When the tender mollusk is exposed, the gulls swoop down to eat it, leaving the pieces of shell behind.

West of the marsh is the 27-acre airfield. It is a mix of grasses and other meadow species now, but it was originally planted with Point Molate red fescue, an indigenous bunchgrass

RECALLING THE TIDES

Originally, all of Crissy Field was a tidal marsh. It covered 130 acres, from Fort Point on the west roughly to Divisadero Street on the east. The wetland was defined by a sand spit in the bay—called Strawberry Island for the wild fruit growing on it—that partially enclosed the marsh's shallow waters.

The marsh was long gone in 1994 when the Presidio was officially transferred to the National Park Service. By that time, the northern shoreline had become, in the words of one observer, an industrial backyard. Most of the field was paved, bordered with warehouses sheltering heavy equipment; piles of rubble and cracked asphalt marked the shoreline, which was blocked off by a cyclone fence.

As part of its agreement to transfer the base to the park service, the army had to do some remediation—several buildings were slated for removal and toxic areas needed to be cleaned up. The park service had additional goals for the site, having mainly to do with improved access and enhancement. Over the next few years, improvements began, and so did planning. With other restoration projects being undertaken elsewhere on the Presidio, the moment was ripe to transform Crissy Field.

Today, a portion of the original marsh has been restored; the old airfield has been rebuilt—"paved" in grass, as the first one was—and, along the beach, 30 acres of dunes have been reshaped and replanted. Crissy Field today is beautiful and compelling in its own right. For those who remember what it was less than ten years ago, the place is little short of a miracle. whose seed was collected near Point Richmond, in the East Bay. Point Richmond has much in common with San Francisco—both are, to quote from the management plan for the city's Significant Natural Resource Areas, "low, narrow peninsulas that are strongly shaped by maritime conditions."



The picnic and barbeque facilities at the west end of Crissy Field offer spectacular views of the bay and the Golden Gate Bridge.

WEST END

The west end of Crissy Field begins roughly where the historic airfield ends. Following the curve of the shore, the park bends to the north. The promenade is farther inland at this point; it continues west, terminating at the Warming Hut and Torpedo Wharf. Beyond these structures, a footpath and road lead to Fort Point and the base of the south tower of the Golden Gate Bridge.

At the end of the airfield, on the promenade, you'll see a historic two-story wood frame building accented by a row of palm trees. This is the Gulf of the Farallones National Marine

MEASURING THE TIDES

At the end of a long pier behind the Marine Sanctuary Visitor Center, one can see the Tide Gauge House. Inside, a computerized sensor records the twice-daily rise and fall of the tides. Though it is the most recent such gauge, it is by no means the only one that has operated at this location.

The first was installed at Fort Point more than 150 years ago. "Since that time," according to Albert Theberge, a retired officer with the National Oceanic and Atmospheric Association Corps, "this gauge and its successors have produced he longest-running unbroken series of tidal observations in the Americas." Theberge even goes so far as to suggest that "there is no longer a continuous record of any other geophysical phenomenon in the Western Hemisphere."

Though it is not open to the public, real-time records from the Tide Gauge House can be viewed online at *tidesonline.nos.noaa.gov/geographic.html.*

Sanctuary Visitor Center, which provides bathrooms, bottled water, and a few snack foods as well as plenty of hands-on materials to interest kids and adults alike.

Marine sanctuaries are essentially underwater parks, dedicated to conservation, education, and research. Three abut this part of the Northern California coastline: Cordell Bank, Farallones, and Monterey Bay. Sanctuary staff offer on-site, in-the-field, and at-your-school programs for a variety of grade levels.



Great egret

FOR MORE INFORMATION

For a basic introduction to the site's human and natural history, including a detailed map, pick up a copy of *Crissy Field*, at the Crissy Field Center (\$.99).

For more information about the Wave Organ, go to *www.exploratorium.edu/visit/wave_organ.html.* In addition to a description of the Wave Organ, you'll find a link to the Road Trip America website, which includes more pictures and postings from people who've visited the Wave Organ. Both of these sites—as well as the Wave Organ itself, of course—merit a visit.

To find out more about the programs offered by the Crissy Field Center, visit *www.crissyfield.org* or call (415) 561-7690.

To find out more about the Marine Sanctuary Visitor Center, go to *www.farallones.org* or call the visitor center manager at (415) 561-6625.



Snowy egret



HOW TO GET THERE

A free shuttle, which connects to MUNI lines 28 and 43, will take you to this area.



CORONA HEIGHTS

Corona Heights is the park surrounding the city's Randall Museum. Most of this twelve-acre site is a dramatic rocky hilltop; it offers great views, grassy slopes, and a few wooded areas as well as beautiful exposures of rock. There was a quarry and brick factory here in the nineteenth century; the spot where the Randall Museum now stands was once inside the hill.

The northeast side of the park features an unusual geologic formation—a slickenside. Thirty or forty feet tall and a hundred feet long, this wall of rock is as hard and as smooth as glass. It marks an old fault line where rocks once pushed past one another, polishing the slab to a high luster. The slickenside was exposed when the hill was mined in the late 1800s.

LOCATION

Corona Heights lies north of Market Street and west of Castro Street. The main entrance to the park is at the end of Museum Way. There is pedestrian access on all sides of the park—off Roosevelt Way, 15th Street, Beaver Street, Flint Street, and States Street.

FACILITIES

There are plenty of amenities at this site, including, of course, the museum itself. There is a parking lot beside the museum and nice bathrooms inside. The grounds, which were recently redone, have been dubbed an "Outdoor Learning Environment" in which the museum conducts programs. Seating areas can be found around the building and there are picnic tables nearby. A paved path leads to a playground just south of the museum; another playground on the northeast side of the park can be reached by way of steps and a short walk on Beaver Street.



View of Corona Heights with windmill on the left, ca. 1870.

Clearly marked trails go up to the top of the hill as well as around it. There are benches at some of the vista points. The terrain is steep and rocky in a few spots. The north side of the park has a groomed lawn and fenced-in dog run.

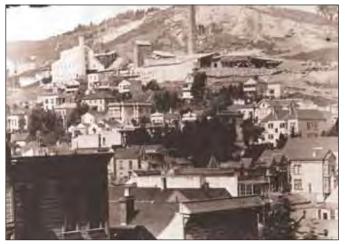
BEST PLACE TO START

Start at the museum. There are great views of red chert from the parking lot. It is easy to explore both the museum and the park from here.

WHAT YOU'LL FIND

This is an area of grasslands and Franciscan bedrock. Most of the rock you'll see is chert, but you can also find a bit of sandstone and basalt—Corona Heights is one of the few places in San Francisco where you can see pillow basalt. Look for it on the paved path between the museum parking lot and the States Street tennis courts. An outcropping of graywacke sand-stone can be found alongside the footpath on the north side of the hill, not far from the dog run. The slickenside is at the playground off Beaver Street (see "Facilities," p. 133).

Because the museum is located here, lots of attention has been focused on the park. Margaret Goodale, longtime staff member at the museum, keeps lists of the park's flora and fauna, and UC professor Gordon Frankie and his students are



Quarrying of Corona Heights, ca. 1885. This northwest-facing view shows the future site of the Randall Museum.



Sign for the Randall Museum in front of Corona Heights, taken at the corner of Roosevelt and Museum Way, ca. 1950.

conducting a three-year study on the native bees that inhabit Corona Heights. So far they've found about 25 species, many of which use the open ground of the hilltop to build nests for their young.

GOING DEEPER THE POWERFUL BUMBLER

Honeybees are big bees, but bumblebees are even bigger. In addition to their size, which makes them easier for us to see and recognize, bumblebees are remarkable because they can maintain their body temperature despite variations in air temperature, a feat few other insects are capable of. Like fish, reptiles, and amphibians, insects are cold-blooded: hey regulate their body temperature according to ambient temperatures. Bumble-bees, however, are an exception to this rule. As Randy Zebell, a gardener with the city's Natural Areas Program, explains, "bumblebees can maintain a steady, high body temperature, essential for their flight muscles to work, over a very broad range of ambient temperatures, from near freezing to well into the 90s. This is an incredible feat of biomechanical engineering for such a small creature. That's one reason you'll see bumblebees, and not honeybees, foraging for nectar or pollen on cold days."



BEES ARE HAIRY

One trait that bumblebees share with honey— and all other bees is hairiness. This above all is what makes a bee a bee. Most have stiff hairs on their back legs and, to borrow a phrase from the *Columbia Desk Encyclopedia*, "they usually have a dense coat of feathery hairs on the head and thorax." Their hairy legs and bodies led Gordon Frankie's researchers to call bees "the world's star pollinators." A bee's hairs pick up pollen at each flower it visits and, as it moves from flower to flower, the bee transports the pollen, becoming an agent in the sexual reproduction of plants.

Bees help plants reproduce, but they are also helping themselves to a flower's resources. Honeybees, bumblebees, and solitary bees rely on flower nectar and pollen to live. Bees suck nectar from flowers, deriving energy from it the way we would from a glass of fruit juice. They also collect pollen and nectar in order to provision their nests—that is, in order to lay away a food store for their young.

HOW SOLITARY BEES NEST

Most solitary bees build nests in the ground. They excavate tiny tunnels, using their front legs to dig out the soil. Depending upon the species, the tunnel may be a single line, or it may be a network of chambers. It may be vertical or horizontal. Either way, the mother bee smoothes the surface of the tunnel and, in many cases, lines it with a particular material—leaves, for example, or wood shavings or secretions from her own body that are comparable to the wax that honeybees secrete and from which they build their combs.

As she builds her tunnels, the mother bee creates separate rooms, or brood cells. She provisions each with a pea-sized mixture of pollen and nectar. She lays a single egg on this little loaf of food and seals the cell in the same way that she lined it. When it hatches, each larva has its own "room" and the nourishment it needs to grow and then to pupate. About a year after the mother bee lays her eggs, a new generation of mature bees emerges to begin the process again. Males frequent the places— nests and preferred flowers—where females go about their business.

About 85 percent of solitary bees nest underground. The other 15 percent are cavity nesters—they go through the same process using the wood of old trees, the stems of plants, and some human-made structures and materials such as wood, masonry, and even metal.

GETTING TO KNOW LOCAL BEES

As with other kinds of insects, it is hard to identify particular bee species without learning the intimate details of their anatomy. Fortunately, because local entomologists have recently developed research methods that can be applied to urban species, more is being learned about our local bees, and this information is available online.

At the Urban Bee Gardens website (*www.nature. berkeley.edu/urbanbeegardens*), you will find pages entitled "Bees and Your Garden," "Urban Bee Garden Research," and the "Bee-Friendly Garden Builder." (As of the writing of this guide, the latter page was still under construction.) The first two pages contain text and pictures; each of the text headers is a link to more information on that particular topic. "Common Bee Groups in the San Francisco Bay Area" is a featured link that provides an excellent introduction to common families and species; another link, "Flowering Season vs. Bee Season," describes which bees you're likely to see in spring, summer, and fall, and the flowers at which you're

continued on next page

continued from previous page

likely to see them. Also worth checking is the Guide to Closer Bee Observation, where two techniques for catching bees in a butterfly net-the tennis swing vs. the drop technique-are described.

Once you've caught a bee, you can observe it without harming it, the website explains, by chilling it for 30 minutes in the fridge or an ice chest. To find out more, visit the website.

HONEYBEES. **BUMBLEBEES, AND** SOLITARY BEES-WHO'S WHO AND WHAT DO THEY DO?

When we think of bees, we think of hives and honey. But the honeybee—and its hive—are fairly uncommon in the bee world.

Honeybees are social insects; they form colonies where all work toward the collective goal of raising offspring.

The majority of the world's bees, on the other hand, are solitary. Each female builds a nest alone.

California has about 1,500 indigenous, mostly solitary, bee species; nationwide, there are almost 4,000

> indigenous bees. Recent research led by entomology professor Gordon Frankie at UC Berkeley has revealed more than 80 species in the Bay Area, and new species continue to be identified. As Frankie's research continues, it is expected that well over 100 species will be found.

> All bees are members of the Order Hymenoptera and the superfamily Apoidea. Within that superfamily are numerous smaller families, five of which are common in the Bay Area. One of these, the Apids, includes the European honeybee (Apis *mellifera*) and the bumble-bees

(genus Bombus). Both are social, living and raising their young in colonies.

THE IMPORTANCE OF LOCAL POLLINATORS

Some solitary bee species have a preference for a particular genus or species of flower. In the April-June 2004 issue of the California Native Plant Society Bul*letin*. Zebell describes what he has observed in his own garden: "I see... one medium-sized solitary bee that is inordinately fond of checkerbloom (Sidalcea malvaeflora). I frequently find several bees curled up, seemingly lounging, in its blossoms." In Sunset magazine (May 2005), Sharon Cohoon tells readers that "some native bees and native plants, including penstemon and salvia, are literally made for each other."

This specialization, and our indigenous bees' solitary habits, make them difficult for farmers to "manage" as pollinators. This is why the honeybee was introducedfor its pollination services. However, because of predation by the vampire mite, a parasite that was inadvertently imported from Southeast Asia about twenty years ago, honeybee numbers have plummeted in recent years. The honeybee's decline has highlighted our need to better understand the activities of local pollinators.

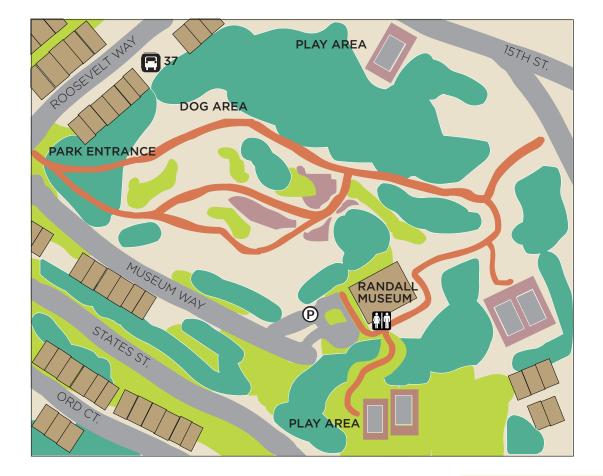
FOR MORE INFORMATION

The city's Natural Areas Program has a brochure on Corona Heights that includes a map of the site.

The Randall Museum offers cultural and natural history programs for K-8 students. Sign-ups take place in the spring and fall. For more information, see the listing in the Resources for Teachers section of this guide or visit www.randallmuseum.org.

In addition to the UC Berkeley website described earlier, the Xerces Society has also posted some great resources online. Named for the Xerces Blue, a San Francisco butterfly that is now extinct, this nonprofit organization is dedicated to "protecting biological diversity through invertebrate conservation." Go to the "Pollinator Conser-vation Program" page and select links to "Native Bee Biology." The "Gardening for Bees and Butterflies" link will lead to instructions for how to build nests for solitary bees. Find this and more at www.xerces.org.





HOW TO GET THERE

MUNI Line 24 runs within a block or two of the east side of Corona Heights. Muni Line 37 travels one block from the northwestern edge of the park.



EL POLIN SPRING & INSPIRATION POINT

El Polin Spring has been described by one educator as a very sweet part of the Presidio, and it is. As a year-round spring, it is also an historic site that has been in use for hundreds, if not thousands, of years. At the top of the slope above the spring is Inspiration Point, named for its view over the Presidio and the north bay. The point is the crest of a block of serpentinite, a rock type known for its fractured structure and tendency to have seeps and springs. Though very different, El Polin Spring and Inspiration Point are connected spatially and ecologically; together, they offer excellent opportunities for nature study.

LOCATION

Both sites are in the southeastern corner of the Presidio. Direct access to El Polin is by way of MacArthur Avenue, which ends in a cul-de-sac around the spring. It can also be reached by trails from Paul Goode Field, Julius Kahn Play-ground, and Inspiration Point (which is just inside the Presidio's Arguello Boulevard entrance).

FACILITIES

There are picnic tables, barbecue grills, and a Port-O-Let at El Polin Spring. Flush toilets are a short walk away at Paul

Goode Field and Julius Kahn Playground. Inspiration Point has a nicely paved overlook with sandstone benches. There are several well-marked trails in this small area, including the Ecology Trail (see "For More Information," p. 139).

BEST PLACE TO START

Start at El Polin Spring, which, because it is a small bowl with a water body in the middle, is an ideal place to talk about watersheds. Then, point out the interconnections between land and water on a hike up to Inspiration Point.



El Polin Spring area, 1951.

WHAT YOU'LL FIND

El Polin Spring is a pocket of riparian habitat; Inspiration Point is a serpentine grassland. Each is described below.

EL POLIN SPRING

The spring is roped off but easy to see; two small walls have been built to catch the water that emerges from the earth here. The stream passes under the street and then flows through a small channel to the center of the site, marked by a knee-high stone circle. Another small channel drains to this point from the top of the bowl, due south. The area around the cul-de-sac is wooded; the vegetation immediately beside the spring is typically riparian—willow, California blackberry, and rushes. Birds abound here, and you can also find animals in the streambed (see "Going Deeper," p. 140).

INSPIRATION POINT

A trailhead to the right of El Polin Spring leads uphill toward Inspiration Point. The first part of the trail passes through an area that has recently been cleared—it and the area above it are part of a grassland restoration project. The soils here, derived from the serpentine bedrock beneath them, are an unusual substrate, lacking some minerals that most plants need and containing a surplus of others they don't. As a result, the area supports an unusual flora: a serpentine grassland. It is one of the few places in San Francisco where some plants, such as tidy tips and the endangered Presidio Clarkia, now occur. The best time to visit is in spring, when the wildflowers are blooming.

The hike from El Polin Spring to Inspiration Point is about a quarter-mile; it is uphill, but the trail is well graded. En route, ask students to look for signs of moisture and for moistureloving vegetation, such as willows. Why might there be shrubby vegetation on this otherwise grassy hillside? How do the grassland and shrubby areas compare?

The route also includes a portion of the Ecology Trail, for which an educational guide has been published (see "For More Information," below).



The soils at Inspiration Point are derived from serpentinite rock.

FOR MORE INFORMATION

Designed for young park visitors, *Kids on Trails: A Guide to the Ecology Trail* is available free at the Crissy Field Center and the Presidio Visitor Center. It includes a variety of activities that will open students' eyes and minds to the plants and animals of this part of the park.

The National Park Service offers free programs on the human and natural history of El Polin, in both Spanish and English. Attend one or two and you'll come away with lots of good ideas for how to share this site with your students. For a listing of upcoming programs, pick up a copy of *ParkNews*, available free at visitor centers and cafés throughout the Presidio, or view it online at *www.nps.gov/goga/parknews*.

GOING DEEPER: STREAM ANIMALS

Just as there are benthic, or bottom-dwelling, organisms in a pond, biologists recognize a community of benthic macroinvertebrates in streams. The term "macroinverte-

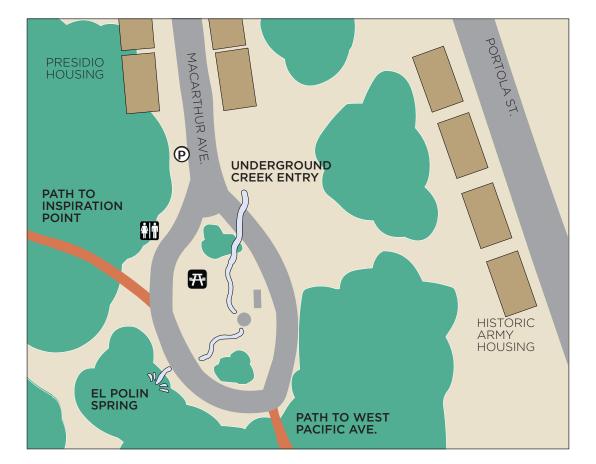
brate" is a catch-all meant to describe creatures without a backbone that are big enough to see without magnification. (In other words, they are invertebrates that are not microscopic.) They include insects, worms, clams, limpets, snails, crayfish, and the like. Some of these have been found at El Polin Spring.

Tracking macroinvertebrates is a way to determine the health of a stream. Some species, such as stoneflies and mayflies, need clean, cold water with a high quantity of oxygen to survive. When you find these insects in a stream, it is an indication that water quality is good. Other organisms are more tolerant of poor conditions and can be found in streams where conditions are variable or water quality is fair to poor. Pouch snail shell

These more pollution-tolerant organisms can be a blessing for educators, because they are easy to come by. Two—the pouch snail and the leech—can always be

found at El Polin. Other more sensitive organisms have also been seen here, including stoneflies, dragonflies, caddisflies, and scuds.

Finding snails and leeches is as simple as picking up a leaf that's fallen in the stream and turning it over. You'll find small creatures on its underside. The snail's shell makes it easily recognizable; the leech is shaped like a long, thin, brown leaf, but its body expands and contracts when it moves. (Remember that it is not appropriate to remove any organisms from a park or other natural area.)



HOW TO GET THERE

A free shuttle—the PresidiGo connects with MUNI lines 28, 29, and 43 and runs to Inspiration Point. The PresidiGo Shuttle and MUNI line 43 stops within a half-mile of El Polin.



FISHERMAN'S WHARF AREA

Though better known as a tourist attraction than as a natural area, Fisherman's Wharf is an important part of San Francisco's natural history. While ultimately, everyone depends upon the natural world, San Francisco's fishing industry relies upon it in a very direct and obvious way.

The stories of those who make their living from the bay and ocean are told at numerous venues in the wharf area. Not far from the wooden piers, working boats, and seafood restaurants that every tourist sees, two parks—Aquatic Park and the San Francisco Maritime National Historical Park provide a complex of sites where the lore of sea and shore can be explored.

LOCATION

Fisherman's Wharf extends along the bayshore from the Municipal Pier and Aquatic Park at the foot of Van Ness Avenue, to Pier 39 on the Embarcadero.

FACILITIES

As one of the top tourist destinations in San Francisco, this area has no shortage of toilets, seating areas, or paved walkways.

BEST PLACE TO START

Pick up a map of the area at the SF Maritime NHP visitor center at the corner of Jefferson and Hyde streets. This puts you between the wharf and Aquatic Park. A two- or threeblock walk in either direction will get you where you want to go.

WHAT YOU'LL FIND

There are multiple sites to consider visiting in this area. Each is briefly described below, starting from the west and moving east.



Fisherman's Wharf, looking toward Russian Hill, ca. 1950.



Fisherman's Wharf, date unknown. A crab fisherman drops his catch into a cook pot.



A typical scene at Fisherman's Wharf, ca. 1930. Note the cook pots to the right of each fisherman's stand.



AQUATIC PARK

Aquatic Park runs from Hyde Street to Van Ness Avenue. The Hyde Street side is where the cable cars turn around; this part of the park is nicely landscaped and lined with benches. Street performers and tourists converge here year-round. Just north of this area, at the water's edge, is a sweet little sliver of beach. Here you can watch members of the Dolphin Club swimming between buoys in the protected waters. At the west end of the beach, behind the Maritime Museum, is a patch of riprap; when the tide goes out, you're likely to find rough limpets, dogwinkles, and purple shore crabs clinging to the rocks. Sea lettuce and Gigartina (red marine alga) are common here.

MUNICIPAL PIER

This long concrete pier at the foot of Van Ness Avenue keeps the near-shore water slack. It's a good spot for fishing, and on any given day you can see a handful of men and women tending lines or traps they have cast from the pier. Walk by with your students to see what folks are catching. This is also a site for the state Department of Fish and Game's "Fishing in the City" program (for more about this program, see the "Teacher Resources" section of this guide).



Surf scoter



Aquatic Park was dedicated on January 22, 1939.



Facilities at Aquatic Park under construction, ca. 1930s. Note the WPA sign in the foreground.

MARITIME MUSEUM

All of Aquatic Park, which was built by WPA workers in the late 1930s, follows the Art Deco style. The bathrooms at either end of the beach, for example, have the style's characteristic round windows and curved walls. The Maritime Museum, which looks like a ship and is located at the intersection of Polk and Beach streets, also has these features. Inside, there are beautiful, highly stylized sea murals.

The building alone is worth the trip, and the museum's collection also merits attention. On the ground floor, look for the display about the shipwreck of the *Frolic*. The upstairs rooms are arranged chronologically, from the Gold Rush to steamboat days. The Gold Rush room has great old photos, maps, and lithographs. *The Fisheries of San Francisco* exhibit at the western end of the second floor tells the story of the rise and fall of the city's salmon, sardine, and shrimp industries. Both the Maritime Museum and the Hyde Street Pier are part of the San Francisco Maritime National Historical Park.

HYDE STREET PIER

There are a half-dozen sea vessels moored at the Hyde Street Pier, located at the foot of Hyde Street. Ranging from small craft to a 250-foot square-rigger, all the boats are open to the public, waiting to be boarded and explored. Interpretive rangers offer programs for students and the general public.



Fisherman's Wharf, date unknown.

FOR MORE INFORMATION

The San Francisco Maritime National Historical Park offers educational programs for all ages, and has several programs geared to school groups. For a description of the park's many offerings, go to *www.nps.gov/safr/ local/sgroup.html*. A more general introduction to the park and its features can be found on the park's home page at *www.nps.gov/safr*.

A good guide to the plants and animals you'll see in the riprap is *Seashore of Northern and Central California* by lan Sheldon (Lone Pine Publishing, 1999). Like the other Lone Pine field guides, it features large color illustrations and clear, accessible text.



HOW TO GET THERE

Not surprisingly, this area is well served by public transportation. MUNI lines 10 and 47 will take you within a block or two of the entire stretch of Fisherman's Wharf. MUNI lines 19, 30, and 49 travel to the west end of Fisherman's Wharf, Aquatic Park, the Maritime Museum, and the Hyde Street Pier. Take MUNI lines F or 39 to get to the east end of Fisherman's Wharf. To experience a bit of San Francisco's cultural history, take the Hyde Street cable car to Aquatic Park.



FORT FUNSTON

Part of Golden Gate National Recreation Area, Fort Funston is more than 200 acres of beach, bluffs, and dunes. Hang gliders launch from the bluff and can be seen aloft almost every day. Other human uses are evident as well, from abandoned gun emplacements to the many dog-walkers who use the bluff-top trails near the parking lot.

The park's main attractions from a naturalist's point of view are the exposed layers of sediment on the bluffs, which tell the story of millions of years of sea level rise and fall; the restored dunes, where one can wander amidst a landscape that once defined much of western San Francisco; and the bank swallows that nest in the bluffs each spring, one of the few remaining populations to breed on the California coast.

LOCATION

Fort Funston is in the southwestern corner of San Francisco, between the Pacific Ocean and Skyline Boulevard (Highway 35). It is bordered on the south by the Olympic Country Club and on the north by Ocean Beach. Lake Merced lies just to the east.

FACILITIES

The main access to Fort Funston is from the parking area at the south end of the park, off Skyline Boulevard. The lot is a former Nike missile pad. There are Port-O-Lets here as well as a wooden viewing platform beside the hang-glider launch site. Well-marked and well-traveled trails lead down to the beach and through the dunes. The sand ladder to the beach from the parking lot is steep, but should be manageable for students of all ages.

BEST PLACE TO START

Start at the main parking lot—from there you can focus a visit on either the geology of the bluffs (see "Going Deeper") or on



the plants and animals of the coastal dune scrub plant community. To emphasize geology, take the sand ladder down to the beach, then walk north—different layers of geologic history are exposed as you walk up the beach. The other approach is to stay up on the bluffs and walk directly north from the parking lot, past the iceplant, through the batteries, into the restored areas of coastal dune scrub. There is also access to the beach in the middle and at the end of this route. The bank swallows nest at the north end of the beach. The distance from the parking lot to the north end is about a mile.

The bluffs are most exposed in the winter, when the sea has scoured the beach and removed the load of sand that builds up over the summer. Exploration of the beach is also easier at low tide; access to some areas is blocked at high tide. The swallows arrive at the beginning of April and nest through July.

WHAT YOU'LL FIND

Coastal dune scrub can be seen on your left (south) as you drive into the park. There is a greenhouse and native plant nursery here, and the area around it offers an example of the subtle beauty of this plant community. The dunes immediately to the north of the parking lot are covered with iceplant. The military planted it to cover the sand; it also planted the area's trees to cover the batteries. The most common trees here are Australian tea tree and acacia. There are also eucalyptus and Monterey cypress. These groves of trees are prized by birders because migratory vagrants—migrating birds who have veered off their normal, more easterly, flyway and ended up on the Pacific flyway can sometimes be found in them.

North of the batteries are beautiful stretches of coastal dune scrub, much of it restored by volunteers. These areas were cleared of invasive weeds and replanted using indigenous plants and seeds collected at Fort Funston. These are now the largest stands of coastal dune scrub in San Francisco.

Dune plants can be easier to reestablish than some other species because they are adapted to disturbance. They can withstand winds and survive being buried in or stripped of sand. Several of the restoration projects at Fort Funston are the oldest in the city, having been done more than ten years ago. The US Geological Survey did a pre- and post-restoration diversity study at some of the older sites; results indicated that there was greater plant and animal diversity after the restoration projects were completed.



Gun being transported into Fort Funston, 1937. Note the rows of newly planted iceplant on the hillside.



Fort Funston is the last refuge for a number of dune scrub specialists, birds and mammals most comfortable living in the thick, low growth of dune shrubs. In the early days, as the city inexorably expanded, these animals were pushed into remnant

WHAT CAUSED THESE CHANGES IN SEA LEVEL?

Sea level—the amount of water in our oceans—is tied to the glaciers that cluster around the Earth's North and South Poles. These glaciers, in turn, are influenced by global temperatures. During cooler periods, the glaciers grow. They get bigger and spread farther by taking up more water from the sea, and sea level drops. When temperatures rise, the process is reversed. The glaciers recede, releasing water back into the oceans, and sea level rises.

The temperature changes that trigger glacial advance and retreat are thought to result from slight variations in the Earth's orbit. In the 1920s and 1930s, Milutin Milankovitch proposed that the interaction of three orbital variables could cause small but significant changes in global temperature. He predicted that changes in these parameters would create oscillations in climate with a basic period of 100,000 years, and shorter-term cycles of 20,000 and 40,000 years. Though this explanation is still in some dispute, there is evidence that the Earth's temperature has varied according to the cycles that Milankovitch predicted. open spaces—undeveloped land, vacant lots, parks, military lands. Over time, the number of open spaces has dwindled. The character of those that remain has been changed by the introduction of trees and invasive plants (such as the ubiquitous iceplant).

The Bewick's wren, a mid-size perching bird with a mellifluous song, is holding on at Fort Funston; it still breeds here (and at McLaren Park). Brush rabbits also breed here. San Francisco birder Dan Murphy recalls a time not that long ago when families took drives through Golden Gate Park to see quail and brush rabbits; now it's not possible to do so. There are two pairs of quail at Golden Gate Park. Funston is the last place in the city where brush rabbits can be found.

During episodes of sea retreat, a broad plain developed west of the Golden Gate. Sea waves broke on the sandy beach that lay beyond the Farallones. As sea level rose, the shoreline came closer, and it changed form. According to geologists Ed Clifton and Ralph Hunter, the periods of sea level rise "seem consistently to have produced a barrier coastline with extensive back-barrier lagoons or estuaries."We are in a period of high sea level today, and our "back-barrier lagoon or estuary" is San Francisco Bay.



Fort Funston opened to the public in 1961.

FOOTPRINTS FROM THE PAST

Throughout the eons in which this slow ebb and flow has taken place, plants and animals have continued to live along the shoreline, wherever it might be. Geologists have found depressions in the Funston bluffs that were probably made by elk or deer; they have found "excellently preserved pawprints probably made by canids," and large "structures" that were once the tracks of mammoths. The sandstone beds at Fort Funston were, to use Clifton and Hunter's words, "intensely trampled by large mammals."

We know that some two million years ago, many big animals lived in Northern California. The best record of them locally is also one of the best in North America, according to geologist Deborah Harden. She writes that the Irvington gravels, in Fremont, have yielded "deer, camels, horses, saber-toothed tigers, a wolf, and the oldest mammoth elephant discovered in the western hemisphere." Remains of these animals have also been found at the site of the Shoreline Amphitheater, on the peninsula. Before being converted to a concert venue, the site was a landfill. In the deep pits dug for San Francisco's garbage, excavators found big animal fossils.

The shoreline fossils are about 20,000 years old. This was a period of low temperatures and high glaciation, so sea levels were low. The ocean shore lay about 20 miles west of its present location, and there was no bay. In the valley that is now our bay, camels and horses grazed on grasses, sunflowers, and sage; tigers and wolves walked through woods of cypress, Douglas fir, and incense cedar. This was the last major glaciation. Since then sea level has slowly crept back, reaching current levels about 5,000 years ago. The Native Americans, who have lived here for as long as 10,000 years, moved up the shore as the shoreline shifted; it is likely that their early village sites were drowned.

Today, because of global warming, sea levels are again on the rise. World temperatures have gone up by one degree Fahrenheit in the last hundred years, and land-bound snow and ice (not just glaciers) are yielding their frozen waters at an unprecedented pace. In as little as fifty years, another 10 inches of San Francisco may be underwater.

FOR MORE INFORMATION

Ted Konigsmark has included a very user-friendly account of the bluffs at Fort Funston in his book *Geologic Trips: San Francisco and the Bay Area* (GeoPress, 1988).

Golden Gate National Recreation Area holds volunteer workdays at its native plant nursery and elsewhere in the park. Golden Gate Audubon has been active in working to protect the swallows at this site. Both groups offer walks and interpretive programs throughout the year. For more information, call the GGNRA volunteer hotline at (415) 561-3034, x3444, or the Audubon office manager at (510) 843-2222. For listings of interpretive programs at Funston and many other locations in the GGNRA, pick up a copy of the quarterly *ParkNews*, available free at many park locations.

An interesting and critical look at Funston appears in the article "Little Colonel Funston," by Mark C. Carnes, in *American Heritage* magazine (September 1998). A more conventional account of Funston's life, from which some of the text above was taken, can be found on the Presidio web site at *www.nps.gov/prsf*. Select the "History and Culture" link and then select "People."

WHO WAS FUNSTON?

Frederick Funston, whose name has been given not only to this park but to streets at Fort Mason and in the Presidio, was stationed at the Presidio on April 18, 1906, when the Great Earthquake struck. His superior, the Major General Adolphus Greely, was out of town at the time, so Brigadier General Funston was in command.

Funston immediately ordered the mobilization of troops in surrounding military installations. He took command of local relief and law enforcement. Funston also directed the dynamiting of buildings to create firebreaks. Acting without state or national authority, Funston was later criticized for many of his actions: Colonel Morris, Post Commander of the Presidio, said of Funston's actions, "He'd better look up his Army Regulations... nobody but the President of

the United States in person can order regular troops into any city." Nonetheless, Funston played a role in reestablishing communications, sanitation, medical facilities, and housing in the destroyed city, and the media of the time called him "the man who saved San Francisco."

All of Funston's exploits carry this kind of ambivalence. His was a double-edged sword.

Funston's father, Edward Funston, had served in the Civil War and subsequently was elected to Congress. He was a tall and imposing figure, nicknamed "Foghorn" because he had a deep voice and penetrat-

ing delivery. As a child, Frederick Funston had dreamed of also having a military career, but he was denied entrance to West Point military academy because of middling grades and because of his height. Funston was 5 feet, 4 inches tall.

After going to college in Lawrence, Kansas, he worked as a botanist for the US Department of Agriculture in the Dakota Badlands, then took similar assignments in Death Valley, Yosemite, and Alaska. He went to New York City, writes historian Mark Carnes, "to sell accounts of his adventures to the newspapers and magazines," but above all, Carnes tells us, "Funston came back from his solo explorations with a renewed desire to make his mark as a fighting man." Funston chanced upon a rally held by supporters of rebels fighting to remove the Spanish from Cuba. He joined them and participated in twenty-two battles.

Having thus gained some experience and recognition, Funston was appointed colonel of the volunteer 20th Kansas Infantry Regiment, which trained at the Presidio. Their tent camp was located in the Camp Miller area (now called Tennessee Hollow because the 1st Tennessee volunteers also occupied the area). Funston called the 20th Kansas Infantry Regiment "Kansas scarecrows" because they lacked uniforms and sophistication, which made them a local joke. Funston's regiment was sent to the Philippines, where the United States had taken control at the end of the Spanish-American War. Funston and his men were to fight Filipino nationalists engaged in an "insurrection" against the US.

The 20th gained distinction under Funston's leadership after engaging in nineteen battles in less than a year, earning the title "Fighting Twentieth." Funston and two privates earned Medals of Honor. The newly promoted Brigadier General Funston and his 20th Kansas volunteers returned home as national heroes.

Funston soon returned to the Philippines, where he devised and led a controversial covert operation. He and a small team of soldiers posed as prisoners with ninety Filipinos disguised as rebels and marched to the

headquarters of rebel leader and elected President Emilio Aguinaldo. They then entered and fired upon the guards. As Aguinaldo was captured, he said, "Is this not some joke?" Funston had violated international law in apprehending Aguinaldo, but the episode was no joke. Some weeks after having been captured, Aguinaldo capitulated. Funston had ended the Philippine-American conflict.

Funston's exploits made national headlines. He was lauded and promoted. Back in the US, he went on the lecture circuit—and soon was silenced by President Theodore Roosevelt, who objected to his strident, imperialistic rhetoric. Roosevelt, who had

once been an admirer of Funston, wrote in an April 1902 letter, "I think that General Funston will have to be requested not to make any more public speeches... he expresses himself at times in a way that is very unfortunate." Mark Twain, who opposed US occupation of the Philippines, found Funston's tactics particularly deceitful, and penned a sarcastic piece entitled "In Defense of General Funston."

Much of what Funston had done in the Philippines was also called into question, and there was a Senate investigation. According to historian Mark Carnes, "one of his captains told the Senate committee that Funston had routinely administered the water torture and had ordered his men to 'take no prisoners."

Funston died of a heart attack in a San Antonio hotel near his headquarters at Fort Sam Houston, Texas, at age fifty-one. He lay in state at the Alamo and under the San Francisco City Hall rotunda. Presidio cannons fired thirteen times, and city activity stopped for two respectful minutes. He was buried in full dress uniform at the Presidio cemetery.



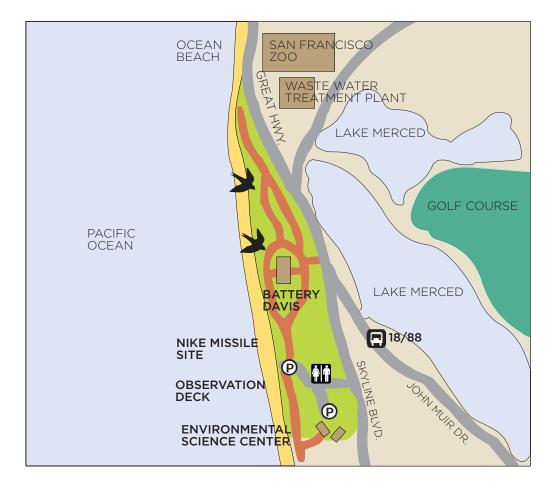
GOING DEEPER GEOLOGY OF THE BLUFFS

The bluffs at Fort Funston are part of the Merced Formation, a mass of sedimentary rocks over a mile thick. Though it is recognized as a single geological unit, the Merced consists of multiple layers. At Funston, where the bluffs are about 150 feet tall, geologists have counted more than forty separate rock sequences formed near the ocean shore over the past three million years. These sequences are made up of beds deposited in different environments. Geologists read the beds from oldest to youngest—from the bottom of the bluff to the top.

Some of the sequences show a repeating pattern of three. The sands in the stone of the bottom bed suggest ocean shelf deposits. They contain sediment laid down in the ocean, but in shallow waters not far from shore. The middle bed shows shore deposits, i.e., sand and mud that collected at the water's edge. The youngest of the three beds shows beach deposits, or sediment that settled above the shore. So at the same location, what was once underwater eventually became dry land. When these sequences formed, the sea was receding.

This pattern appears in the bluffs above Fort Funston more than a dozen times. Other sequences show evidence of sea level rise. Taken together, the layers of sandstone now fronting the ocean show sea level rising and falling at least thirty times.

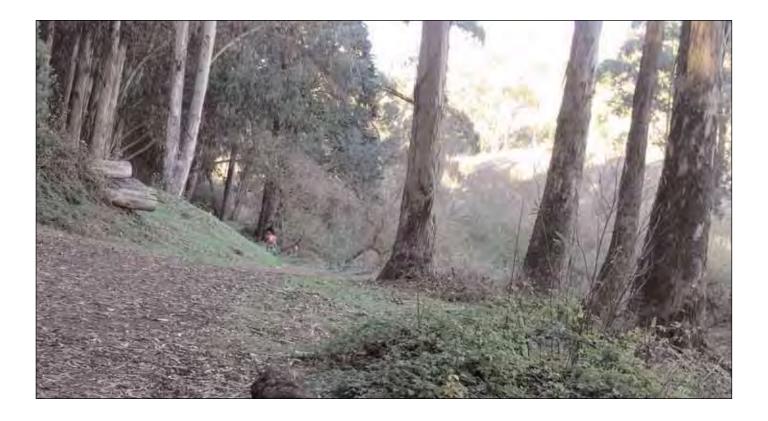




HOW TO GET THERE

MUNI line 18 will take you along Skyline Blvd. to the northeastern portion of Fort Funston.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/GLEN CANYON



GLEN CANYON

In Appendix C of San Francisco's Significant Natural Resource Areas Management Plan, you can find a chart showing the plants and animals that live in each of the city's natural areas. Even at a glance, it's easy to see that Glen Canyon has more animals than other parks—only Lake Merced and McLaren rival it for number of species.

Great horned owls and red-tailed hawks nest in the canyon's blue gum forest; more than 30 different butterflies have been counted in its grasslands. Plant life abounds too. There's a little bit of everything, from the low-growing to the tall-standing, and there are rarities as well—for example, the yellow-eyed grass that grows here, beside Islais Creek.

Islais Creek once originated on the southern shoulder of Twin Peaks, flowed through the canyon, then meandered south and east, ultimately emptying into the bay about where Highway 280 meets Highway 101 today. Now, according to the management plan, "the watershed of Islais Creek has been reduced by as much as 80 percent from its historical extent and is... limited to Glen Canyon Park." Some might disagree with this assessment—the contours of the larger watershed still exist, after all—but it is true that one of the few places where you can now find Islais Creek above-ground is in Glen Canyon.

LOCATION

Glen Canyon is a part of the Glen Park neighborhood. It is bordered by O'Shaughnessy Boulevard on the west and Diamond Heights Boulevard on the southeast. The main access to the park is from Elk Street.

FACILITIES

The entrance at Elk Street passes by a baseball field, tennis courts, and a recreation center where there are bathrooms, picnic tables, and a play area. On the wall of the rec center facing the picnic area is a new mural that features larger-thanlife representations of many indigenous plants and animals with labels! Contrast this mural with the one on the other side of the building, which presents a patchy, worn-out vision of the park. Together, they demonstrate that maintenance of our parks is an ongoing effort.

One main trail runs through the base of the canyon, following the path of the creek. It starts out wide and then narrows, leading to a wooden boardwalk through willows. A round-trip along this route is about a mile or so, with little elevation gain.

Deeper in the canyon, beyond the rec center, the Silver Tree Day Camp offers programs every summer. Its many picnic tables and benches provide an easy staging area for schoolyear groups.



Glen Canyon, 1909. Though there are no well-dressed women pointing at cows in Glen Canyon today, the rest of the scene is familiar enough, right down to the Douglas iris among which the cow is grazing. This shot was probably taken downstream of today's Silver Tree Day Camp.



Glen Canyon, taken from the west side of the canyon, looking east, date unknown. Notice the windbreak of eucalyptus on the left-hand side.

BEST PLACE TO START

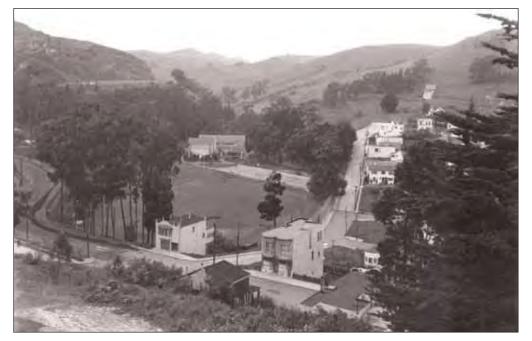
Start at the southern end of the canyon, at Elk Street. The wilder part of Glen Canyon—past the ball fields and tennis courts—begins just up-canyon from the Recreation Center.

WHAT YOU'LL FIND

This 70-acre park is like no other. It is a real canyon—a deep one, with steep walls. Walking into it feels a bit like lifting a curtain and stepping into another world.

The eastern side is mostly grasslands and rocky outcrops. To the west are woods. Once you get past the recreation center, you'll see the creek. Work has been done here to open it up and revegetate its banks—to give the creek a nice send-off, if you will, before it is consigned to a long network of pipes.

Follow the stream and you will eventually reach a riparian corridor, a place where willows throng the creek banks and rushes and other water-loving plants may be found underfoot. From various points on the trail, you'll also have access to the park's other plant communities: grassland, woodland, and scrub.



Corner of Bosworth and Elk streets, 1942. Islais Creek lies under the recreation center, tennis courts, and playing field. Twin Peaks is in the background, and none of the upper hills have been developed. O'Shaughnessy Boulevard is under construction on the left.

FOR MORE INFORMATION

The city's Natural Areas Program has a brochure for Glen Canyon Park, which includes a walking tour that follows the main trail along the canyon bottom.

See the park's history online at www.sfnpc.org.

Thousands of teachers, students, and volunteers across the United States (and around the world) are involved in water-quality monitoring. One of the best sources of information about this movement is The Volunteer Monitor, a free newsletter published twice a year. Have it mailed to you, or read it online. To find out more, visit www.epa. gov/owow/monitoring/volunteer/issues.htm.

The LaMotte Company is one of the best sources for water-quality-monitoring equipment. The company also offers background information, lesson plans, and other free resources online. Find out more at *www.lamotte.com*.

GOING DEEPER THE CONTENTS OF WATER

Glen Canyon is one of the few places in San Francisco where children have access to a free-flowing stream. It is a small one now—no more than a trickle in some places but it invites investigation all the same. The best place for direct access is beyond the boardwalk, where the trail curves back to the south and takes you directly across the stream.

At this spot, you can look for aquatic insects, as has been discussed elsewhere (see the El Polin site description), or you can test the water quality. One of the most common tests is for oxygen.

Water's chemical formula, H₂O, tells us that it contains oxygen. This itself is wondrous enough, that these two gases, when joined, make a liquid. But water also contains free oxygen—that is, oxygen molecules that are not bonded to another chemical element. Free oxygen is available for uptake by plants and animals. It is also called "dissolved" oxygen, or DO, because it is held in solution (dissolved in water).

As in our atmosphere, the main source of free oxygen in water is plants. The fundamental process upon which all terrestrial life relies photosynthesis—is the foundation for all aquatic life as well. On land and in water, plants convert the sun's energy into sugars and release oxygen.

Through mixing, water also receives some oxygen from the air. Waterfalls provide an example of how air and water can mix; even a shallow stream riffling across a rocky bottom

will pick up a fair amount of oxygen. Wind blowing across the surface of a lake will cause the water to move, incorporating oxygen as it does so.

Compared to air, though, water doesn't hold a lot of oxygen. One example, provided by Robert Coker (see note), demonstrates this fact: "A liter of pure water... will hold around seven cubic centimeters of gaseous oxygen; a liter of air has about 210 cubic centimeters of the same gas.



Obviously, it takes nearly 30 liters of oxygen-saturated surface water to supply to a fish the same quantity of oxygen that one liter of air offers to a rabbit." The reasons for this difference have to do with the laws governing the behavior of gases, which are beyond the scope of this short essay. Suffice it to say that water simply holds less gas than air.

We do know, however, that one of the factors that influences the amount of oxygen in water is temperature. The colder the water, the more oxygen it can hold.

That's why, when you heat water on the stove, you see bubbles of air form and rise to the surface.

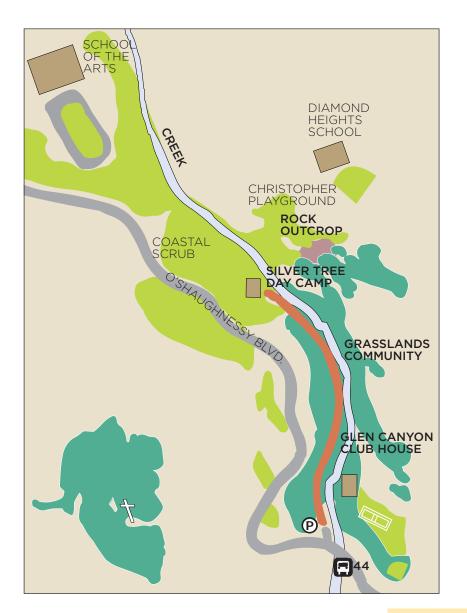
TESTING WATER QUALITY

Temperature, of course, is one of the easiest parameters to measure. (In mathematics, a parameter is a variable that influences an equation's result. In this context, we use the word to describe the different ways we measure the condition of water. Temperature, oxygen levels, and pH, for example, are water-quality parameters— each one is a variable that helps us understand overall water quality.)



To test the temperature of a creek, put a thermometer in it. To test its pH, take a small sample of creek water in a paper cup and dip a pH strip into it for 30 seconds or so. To measure oxygen levels, you'll need a kit (to get started, see the "For More Information" box).

Note: The title and much of the content of this "Going Deeper" comes from Part One of a book by Robert Coker, *Streams, Lakes, Ponds* (Harper Torchbooks, 1968). Though originally published in the 1950s, Coker's work remains a thoughtful introduction to many of the concepts, processes, and organisms one encounters when exploring any freshwater environment. Keep an eye out for it at your local usedbook store.



HOW TO GET THERE

MUNI line 44 runs along the western and southern edge of Glen Canyon. MUNI line 52 runs near the eastern side of the park. Also, MUNI lines J, 23, and 26 and BART all stop within a half-mile of the southern tip of the park.



GOLDEN GATE PARK

San Francisco's largest park needs no introduction—it is known and loved by many city residents. Three miles long and a half-mile wide, Golden Gate Park offers sheltered path-ways and broad avenues, deep woods, shaded glens, open meadows, and bright ponds and streams. There are garden beds of every variety.

It was not always so, however. Much of the park was originally dunes. William Hammond Hall, who designed and built the new park, described the site in 1870: "Golden Gate Park contains about 1,000 acres, of which 270 acres at the eastern end is good arable land covered in many places with trees and shrubbery; this portion may at once be converted into an attractive resort. The remaining 730 acres, stretching down to the ocean beach, is a waste of drifting sand."

THE MAKING OF AN URBAN OASIS

Hall first developed the Panhandle and the eastern end of the park, where there was already some vegetation. His goal for this area, he noted, was to create "a finished modern pleasure ground... fashioned after those of Eastern Parks." According to Russell A. Beatty (see note), Hall saw to it that "66,000 trees had been planted,... 22 entry gates erected, and most of the roads and paths completed" in the eastern park. Hall's "pleasure ground" was, Beatty writes, "largely established by 1876, to a point west of where the conservatory now stands."

Hall also began to tackle the other two-thirds of the park. Having studied dune reclamation projects in Europe and North Africa, Hall planted European beach grass at Ocean Beach to slow the drifting sand at its source. To stabilize the inland dunes, he planted native lupine and trees that, within the shelter of the dune vegetation, could withstand the wind, salt spray, and sandy soil. To assist these plants in getting established, Hall had tons of horse manure, which at that time was regularly collected from city streets, dumped onto the sand. For water, he drew from naturally occurring lakes and ponds in the park, and sank wells, tapping into the Westside Basin aquifer. Within three years, about 800 acres had been converted from dunes to a young forest that held the sand in place.



The land that would become Golden Gate Park viewed from just south of the Cliff House, ca. 1870.

Hall envisioned a park in which dense plantings of trees, meant to block the wind and condense some of the fog, alternated with open areas where one could enjoy the protection the trees provided. Under the guidance of John McLaren, who followed some years after Hall as park superintendent, that vision was realized. Though the park has continued to develop in many ways since its inception, its overall shape continues to reflect Hall's original vision.

NATURE-WATCHING IN GOLDEN GATE PARK TODAY

Though the park is by no means wild, it is nonetheless one of the best places in San Francisco to engage your students in the world of nature. Its size, accessibility, and amenities make it easy to study plants, watch birds, hunt for insects, or just take a few deep breaths and enjoy being outside.

Though the park's size prohibits a complete description here, the following three sites are offered as good starting places for your explorations. It is also recommended that you purchase a copy of the *Map* & *Guide to Golden Gate Park*, available at McLaren Lodge, Stow Lake, and other well-trafficked sites.



NOTE

All the historical information presented here comes from Russell A. Beatty's essay, "The Planting of Golden Gate Park: A Metamorphosis in Sand," which appears in *The Trees of Golden Gate Park and San Francisco*, a field guide written Elizabeth McClintock, edited and arranged by Richard G. Turner (Heyday Books, in collaboration with the Pacific Horticultural Foundation, Strybing Arboretum Society, Friends of Recreation and Parks, Friends of the Urban Forest, and San Francisco Tree Advisory Board, 2001).

OAK WOODLAND

Though William Hammond Hall felt that the indigenous oaks in Golden Gate Park were "not sufficiently in keeping with the class of vegetation desirable in the more finished portions of the park," he did leave some in place. Today, we cherish this grove of coast live oaks, the largest such patch in San Francisco.

LOCATION

Though oaks run across the whole eastern edge of the park along Stanyan Street, the best groves are in the northeastern corner, running parallel to Fulton from Stanyan to Third Avenue. There are access points at Hayes Street and at every avenue that meets Fulton on the north side.

FACILITIES

The oak groves themselves are relatively undeveloped, but given that this is Golden Gate Park, picnic tables and other facilities are never too far away. Ghirardelli Rustic Shelter a paved, shaded picnic area—is not far from the intersection of Fulton and Third, across from the Conservatory of Flowers. Restrooms are nearby, and there are formal and informal trails throughout the grove.

BEST PLACE TO START

Start at a spot called Coon Hollow or Raccoon Hollow, depending upon which map you're using. This is at the western end of the grove, at the intersection of Fulton Street and Third Avenue. This open grassy area enclosed by former sand dunes is an easy staging ground for whatever activities you want to do with students. It is also close to picnic areas and the conservatory.

WHAT YOU'LL FIND

Here you'll find that special place known as an oak woodland (it's not a forest, as the tree cover is not dense enough for that designation), a place where you can glimpse the sky between the crowns of the trees.

The presence of the oaks makes this site special but, like every urban park, it is not pristine. There are many informal trails and, because the ground is so sandy, foot traffic has caused erosion in some places. In addition, the understory (all the plants growing under the trees) is a motley mix made up largely of exotics. One native plant is fairly prevalent, however: poison oak. It is easy to avoid, but nonetheless, be on the lookout for it. Despite these warnings, this site is still one of the best—and few—places in the city where you can walk amidst our indigenous oaks.

A remnant of this same grove of oaks can also be found on the north side of Buena Vista Park, off Haight Street.

FOR MORE INFORMATION

The city's Natural Areas Program has a brochure on the Oak Woodlands. It includes a walking tour that starts at the intersection of Hayes Street and Stanyan Street and ends at the intersection of Fulton Street and Third Avenue. Even if you don't do the whole tour, the brochure contains a lot of useful material.

Cachuma Press published an excellent and accessible book, *Oaks of California*(1991), written by Bruce Pavlik and three other botanists. It has plenty of color photos and illustrations as well as solid information about all the oaks that grow in California, including chapters on wildlife and human interactions with oaks.

The California Oak Foundation has published *Investigating the Oak Community*, a grade 4 to 8 curriculum on the role of oaks in the California landscape. It can be ordered at the Oak Foundation website, *www.californiaoaks.org*.

GOING DEEPER ABOUT OAKS

Sturdy and handsome are but two of the many words of praise that might be applied to California oaks. *Diverse* is another appropriate descriptor: Oaks take the form of both trees and shrubs; they congregate in forests, woodlands, and grassy savannahs; and they mix with other plants in habitats ranging from moist stream canyons to dry chaparral. There are some twenty different oaks in California. Within the nine-county Bay Area, one can find oaks named black, blue, valley, canyon, interior, and coast. In San Francisco, there's just one: the coast live oak.

The coast live oak is so called because it keeps its leaves year-round—it's evergreen. It doesn't always have the same leaves, however. A coast live oak retains its old leaves until new ones emerge in early spring. These early leaves are beautiful small, delicate, and tinged with red. Once they've been replaced, the older leaves brown and drop, covering the ground below with a stiff, papery duff that may crackle when you walk through it.

Coast live oak leaves are hard and bristly. Leaves from the same tree may be an inch to three inches long, depending upon whether they're growing in sun or shade. One thing that is consistent about coast live oak leaves, however, is that they're convex. When looking at the upper side of

the leaf, you'll see that it is curved, and its edges curl under. On the underside of the leaves, you'll sometimes find little clusters of hairs where the veins meet the midrib. Under a lens, those hairs appear to be arranged in the shape of stars.

All oaks have acorns—that's what defines them as oaks and each one is different. The coast live oak's acorn is slender and long and ends in a point. It ripens within a single year, while many acorns take up to two years to mature. It starts out green, but by late fall, when it falls to the ground, it's plain brown. Like all acorns, it has a cap with scales like a fish skin. The cap separates from the acorn when the acorn is ripe.

Whether from a coast live or another oak, the meat of the acorn was food to many of California's first people. It has been estimated that acorns were the dietary staple for 75 percent of native Californians. Each tribe had its own way of collecting and preparing acorns. The nuts could not be eaten raw, because they contain bitter tannins. Generally, the acorns were pounded into flour that was soaked in water to remove the tannins, then cooked with water in a basket or shaped into patties and baked. Acorns are super-nutritious; they provide protein, carbohydrates, and fat, as well as vitamins and essential amino acids.

Acorns were and still are an important food source for wild animals. In days past, grizzly bears helped themselves to acorns every spring and fall, depending upon the type of oak and its location. Rather than wait for the nuts to fall, grizzlies broke off acorn-bearing branches and whole limbs. Today, one can watch scrub jays make use of oak trees. This big blue bird with a dashing gray

> eyebrow stripe collects acorns all fall and caches them—stores them, that is, for later consumption—by burying them in the ground. Each jay buries many more than he or she eventually recovers, thereby helping many a young oak tree get started.

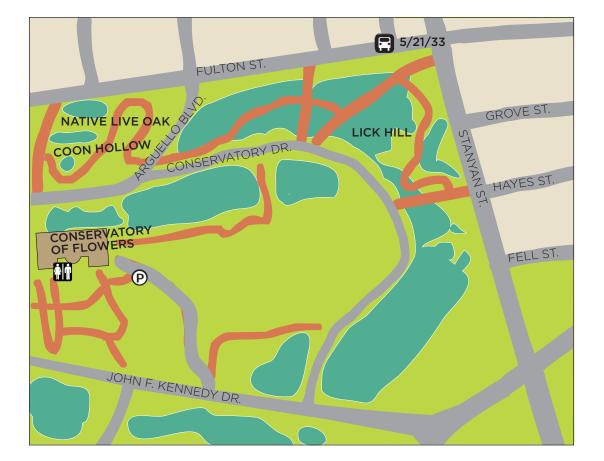
It's not just acorns that provide food, however. Every part of an oak tree is sustenance to someone. The California Oak Disease and Arthropod (CODA) database lists 853 species of insects and mites associated with California oaks. A much smaller list, which focuses on just 28 insects that make use of California oaks, includes four leaf consumers, eight borers, two girdlers, and six sucking insects. The number and variety of animals that use oaks, and the ways in which they use them, results in a complex set of rela-

tionships that the words "food web" can only begin to convey.

In fact, these relationships extend well beyond the matter of food altogether. "Of greater overall significance," to quote from the authors of *Oaks of California*, "is the fact that oak communities contain the nooks, crannies, perches, and passages where animals live, breed, or rest." They go on to explain this in greater detail:

The physical structure of those [oak] communities, especially the way different plant species are arranged in time and space, determines the availability of shelter, nesting sites, and corridors for travel. An oak woodland with complex structure—an overstory of old, middleaged, and young trees, along with unders tory canopies of shrubs and herbs—forms a wealth of micro-habitats for animals to occupy. Such an oak woodland can support far more wildlife species than simpler communities with few plant species and canopy layers.





HOW TO GET THERE

The Oak Woodland is accessible by MUNI lines 5, 21, and 33.



SAN FRANCISCO BOTANICAL GARDEN AT STRYBING ARBORETUM

If you want to learn about plants, this is a good place to start! You will find a seemingly endless variety of plants here; it is a wonderful place to appeal to students' senses of touch, smell, and sight. You can also use some of the arboretum's more than 7,000 varieties of plants to engage students on a more analytical level, studying taxonomy, morphology, evolution, and more.

LOCATION

The arboretum runs along Lincoln Way between 9th Avenue and 19th Avenue. The main entrance is next to the County Fair Building at the corner of Lincoln and 9th; a second entrance the Friend Gate—lies northwest of the main entrance, on Martin Luther King, Jr. Drive, not far from the Japanese Tea Garden.

FACILITIES

As a part of Golden Gate Park, the botanical garden and arboretum is owned and operated by the city. The nonprofit San Francisco Botanical Garden Society provides additional staff and funding. The society operates a library and bookstore near the main entrance and offers year-round education programs, including guided theme walks for school children. The garden is open every day of the year. Paved paths wind throughout the 55-acre site; benches abound and there are plenty of open grassy areas. Bathrooms are located near both entrances. There is a fence all the way around the arboretum, so entrance and exit are only through the main gate or the Friend Gate.

BEST PLACE TO START

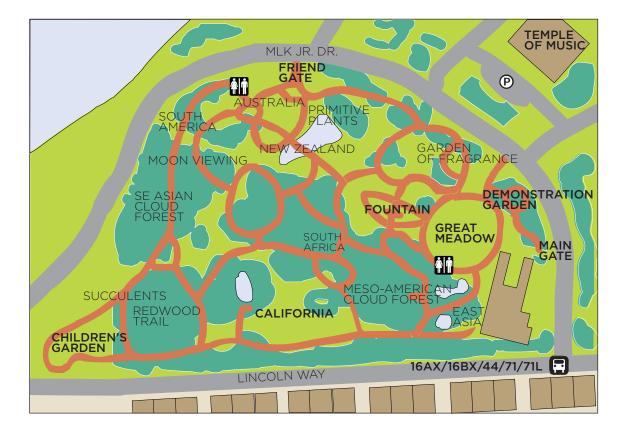
For your first visit, begin at the main entrance. You can pick up a free black-and-white map at the Garden Bookstore just inside the gate. From there, you can make your way to any of the individual gardens.

WHAT YOU'LL FIND

This is a botanical garden and arboretum—a living museum of plants ranging from groundcovers to the world's tallest trees. There is an emphasis on plants native to Mediterranean climates, so you'll find gardens of plants that originate in Australia, New Zealand, Chile and South America, South Africa, and California. In addition to the geographical collections, visitors can explore a primitive plant garden, a moon-viewing garden, or a cloud forest, among others; the Redwood Trail and Nature Trail are also popular spots. Almost all the plants are identified by small signs, and there is good interpretive signage throughout the garden.

FOR MORE INFORMATION

To find out more about the Garden Society's education programs, call (415) 661-1316 or visit *www.sfbotanicalgarden.org*.



HOW TO GET THERE

Buses on MUNI lines 44 and 71 stop at the intersection of Lincoln and 9th. The N-Judah stops two blocks away.

Four-hour street parking is permitted on Martin Luther King, Jr. Drive and on Middle Drive East. There is an underground parking garage near the de Young Museum and the California Academy of Sciences.



BEST PLACE TO START

The grassy area with picnic tables just off the parking lot at Middle Lake is a nice starting location. The other lakes are within walking distance from here if your students are older. If proximity to bathrooms is important, start at the south end of North Lake.

WHAT YOU'LL FIND

Here you'll find pond and riparian ecosystems. Where there's water, there's wildlife, so this is a good spot for birdwatching, especially at Middle Lake. This is also a good place to look for aquatic organisms—according to Emil Fogarino, a teacher at Washington High School, North and Middle lakes are "guaranteed-to-find-something" places. South Lake is the smallest and, by most accounts, the least interesting of the three.

CHAIN OF LAKES

Located at the western end of the park, Chain of Lakes is a string of three lakes—North, Middle, and South—that are good spots for birding as well as for exploring lake ecosystems.

LOCATION AND FACILITIES

North Lake is the biggest of the three; its tip is at the intersection of 43rd Avenue and Fulton Street. South Lake is near the intersection of 41st Avenue and Lincoln Way. Chain of Lakes Drive winds around both sides of North Lake, then passes along the western edge of Middle Lake and eastern edge of South Lake. There are trails around all three lakes. The nearest restrooms are at the corner of John F. Kennedy Drive and Chain of Lakes Drive West.

FOR MORE INFORMATION

The water strider is just one of many animals profiled in *The View from the Oak: The Private Worlds of Other Creatures,* by Judith and Herbert Kohl. This wonderful book describes the world as seen (felt, smelled, and heard) by many different organisms, relates animal sensing to our own experiences, and explains how our own senses work. The book also tells stories about the naturalists who figured out the intricacies of these animals' lives and asks questions of readers that will awaken their own curiosities. Written clearly and simply, students from fifth grade through high school will find facts and ideas of interest in *The View from the Oak*.

Herbert Kohl was a classroom teacher for four decades and has written several well-regarded books about education. *The View from the Oak* was originally published in 1977, when it won a National Book Award. It was rereleased in 2000 by New Press and can be ordered from online booksellers.

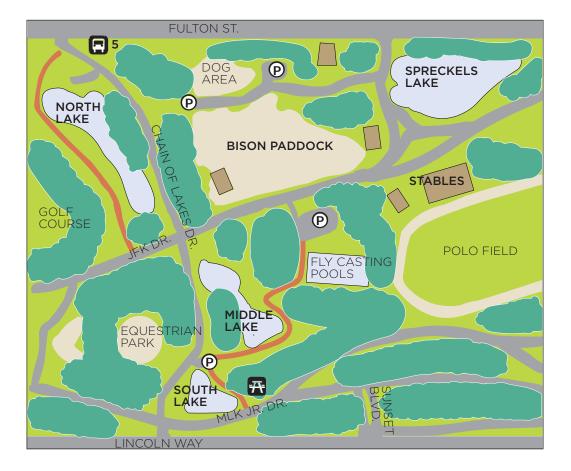
GOING DEEPER LIFESTYLES OF AQUATIC ORGANISMS

Though they live in water, a large number of aquatic organisms need solid footing of some kind in order to survive. They are called *benthic* organisms, from the Greek word *benthos*, meaning "bottom." That "bottom" may be a plant stalk or a log or a rock, or it may be the bottom of the pond. Snails, crayfish, and many insects fall into this category.

In their dependence upon a substrate—something to be anchored in or hold on to—benthic animals have much in common with terrestrial creatures. Water offers other lifestyles, however, that are not available on land: swimming and drifting. Organisms that swim, according to biologist Robert Coker, "are independent of the bottom and have capacities for locomotion which enable them to move against ordinary currents and so to go from place to place at will. Drifters... are independent of the bottom but not of water movements." There are, of course, some animals whose habits blur the lines. The western pond turtle, for example, lives in the water and swims but also hauls out onto logs and rocks, which makes it a benthic creature as well. In freshwater systems, fish are really the only true swimmers. Everyone else is either dependent on the bottom or is a drifter.

Drifters are the most common organisms in lakes and ponds, the plankton and microscopic plants and animals that are the base of the aquatic food chain. You'll find them in great numbers at Chain of Lakes, especially in the spring and fall.

There is one more group of animals that is, in some ways, the most interesting of all—the animals who live at the surface of the water. Water striders and spiders skitter across the surface, sometimes even leaving tracks. Some creatures—flatworms, small snails, and waterfleas— exploit the underside of the film created by surface tension, traveling across it upside down (at least from our point of view). Mosquito larvae suspend themselves from it. Look for all these animals on your next visit.



HOW TO GET THERE

MUNI Line 5 runs on Fulton past 43rd Avenue; North Lake is a short walk from this intersection. Line 29 will bring you to Lincoln and Sunset Boulevard, near South Lake. The N-Judah runs about two and a half blocks south of South Lake.



HERON'S HEAD PARK & INDIA BASIN SHORELINE

The creation of Heron's Head Park began—unintentionally—in the early 1970s, when the Port of San Francisco started to dump dirt and concrete at the site in order to develop a new pier. The ground was laid for commercial development, but the port changed its plans and the newly formed spit was abandoned.

Over the next couple of decades, the rubble subsided. The tides reshaped its edges. Marsh plants began to colonize this forgotten bit of land, and shorebirds began to forage amidst its sediment and rocks. Time and benign neglect combined to recreate what has been almost entirely eliminated from the San Francisco shoreline: a salt marsh.

In the early 1990s, people stepped back in. After being lobbied by the Audubon Society to protect the natural area it had inadvertently created, the port spent millions removing some of the fill and millions more shaping new tidal channels. School children and community volunteers began planting indigenous species and pulling invasive ones, actively working to augment changes begun by the natural world. Community involvement at the site is ongoing and remains high. Heron's Head Park was officially opened in October 1999. Two months earlier, India Basin Shoreline Park, which lies directly south of Heron's Head, had also received an extra infusion of love and money. The city, the port, and other local agencies had already made some improvements to the park, installing new lawns, picnic tables, and parking. In 1999 the shoreline received a "Renaissance Park" designation, and goals were set to expand green spaces, add a playground and basketball court, and build a segment of the Bay Trail through the park, connecting it to Heron's Head. All of this has now been done, and an extension of the eastern shoreline has been designated an open space preserve. The new-and-improved India Basin Shoreline Park was officially reopened in October 2003.



BEST PLACE TO START

Since Heron's Head is the more wild and natural of the two parks, start there and then walk to the shoreline park to have lunch.

WHAT YOU'LL FIND

Heron's Head and India Basin Shoreline sit in the lee of a PG&E power plant which ceased operation in 2006. One journalist compared the plant's looming presence to that of a mountain towering over an alpine meadow—a generous but rather stretched metaphor. Even so, like all the area's residents —be they feathered, finned, or human—one can ignore this hulking mass of machinery and go about one's business.

As explained in A *Field Guide to Heron's Head Park*, "Heron's Head can be described as having two principal habitats: upland and tidal marsh." Upland areas are those not subject to the daily action of the tides. They are higher and drier and include plants you may recognize from other plant communities, such as coyote brush and coffeeberry. The tidal

LOCATION

Both parks are located at the eastern edge of the Bayview Hunters Point District. The entrance to Heron's Head is at the end of Cargo Way, off Third Street. The entrance to the India Basin Shoreline is on Hunters Point Boulevard, which can be reached from Evans Street, off Third Street.

FACILITIES

India Basin Shoreline is the larger and more developed of the two parks; as described previously, it has picnic areas and a playground and terraces of green lawns. Toilets consist of a Port-O-Let in the parking lot. There is no running water.

A Port-O-Let has also been installed in the parking area at Heron's Head. A wide trail leads into the park and then splits in two. The right-hand trail leads into the marsh; the left-hand trail continues upland, leading out to the tip of the point.

As the crow flies, Heron's Head and India Basin Shoreline lie within a quarter mile of one another. By way of the Bay Trail, which connects the two, they are about a third of a mile apart.

LIVING WITH SALT

Salt is a chemically reactive substance: It draws water to it. In our bodies as well as those of plants, it can break down cell walls and disrupt normal functioning. To make a go of it in the salt marsh, many plants have had to develop ways to manage salt's harmful effects.

Pickleweed deals with the problem by making itself saltier than the water around it so that water is drawn into the plant. Pickleweed stores salt in its succulent outer branches, which turn red, die, and eventually fall off, leaving the plant free to grow and repeat the process.

Saltbush, like other plants in the genus *Atriplex*, has become a specialist in living in salty environments by developing special glands that concentrate the salt in pockets (called bladders) on the leaf surface. The expandable bladders eventually burst and the salt is washed away. Salt grass, likewise, sends the salt to its surface simply by secreting it. If you look at a blade closely, you'll see salt grains. Look through a hand lens and you'll see the characteristic square shape of those grains.



Great blue heron

marsh is a very specialized place, with an association of plants and animals adapted to the rigors of life on a saltwater shore. (See "Going Deeper.")

In the riprap along the northern side of the Heron's Head spit, one can find big specimens of San Francisco's main rock types: chert, graywacke, and serpentinite. On the walk from Heron's Head over to India Basin Shoreline, more serpentinite is exposed along the banks. The Hunters Point melange, which stretches across the city from Hunters Point to Fort Point, has large chunks of serpentinite embedded in clay. Because the clay is soft, it erodes, while the relatively harder serpentinite remains. Potrero Hill, which is part of this melange, is primarily serpentinite.

Across the street from India Basin Park, in a vacant lot owned by PG&E, is another indicator of serpentinite: a grassland with a large number of natives. Serpentine soils are low in some nutrients and high in others, creating conditions that most plants find intolerable. Some of our local plants, however, have adapted to these circumstances, making serpentinite areas some of the richest for indigenous flora. San Francisco artist Margo Bors discovered this area in 2002, when she happened upon more than a thousand golden nuggets—also known as mariposa tulips (*Calochortus luteus*)—in bloom.

GOING DEEPER LIFE IN A TIDAL SALT MARSH

There are a few rocky spots along the shoreline of San Francisco Bay, but for the most part, the bayshore is a land of mud. This is where, over great spans of time, creeks and rivers have dropped their finest sediments. For the last 10,000 years or so, the in-and-out of the tides has further sorted and abraded this ground, scouring channels and smoothing great mudflats.

According to biologist Andy Cohen, marshlands once covered "about 850 square miles, or nearly two-thirds" of the San Francisco Bay and Estuary. Today, they make up a tiny fraction of the bay shoreline. The marsh at Heron's Head is one of the few examples of marshland remaining in San Francisco.

Like the ground itself, the plants that inhabit this landscape have been sorted by the tides into distinct zones. The plant that grows farthest out in the water is cordgrass, whose name describes its appearance quite well. Extending as far as the low-tide line, it can tolerate being wet most of the time because it has special channels in its stem that conduct air to its water-saturated roots. Inland from the cordgrass, you'll see patches of pickleweed, a succulent plant with a branching growth habit. You can eat pickleweed, which does taste like a salty pickle. It often covers large areas of a salt marsh near the high-tide line. You'll sometimes see a bright orange netlike plant growing on top of it; this is dodder, a parasitic vine.

Sometimes associated with pickleweed and sometime occurring farther inland, you'll find salt grass and alkali heath. Even farther ashore, beyond the reach of the tides, are upland species such as salt bush and other, more familiar plants. A hardy plant of the marsh upland that does well in most gardens is gumplant, named for the sticky "glue" its flower buds exude; it has bright yellow, sunflower-type blossoms. Gum plant also grows along channels in the salt marsh, marking passageways that would otherwise be hidden by pickleweed.



Pickleweed

The park itself is as described under "Facilities." In the small cove near the parking lot, where the trail from Heron's Head comes in, there's a nice example of the typical gradation of marsh plants, from cordgrass to pickleweed.

The animals that colonize the salt marsh are as many and varied as any other place on Earth. "Its bottom dwellers," to quote Andy Cohen, author of *An Introduction to the San Francisco Estuary*, "have muddy lifestyles.... The bottom is primarily a place of diggers and burrowers, of worms and clams and tube-building amphipods, and all the things that feed on them." Buried beneath the surface of the ground, these animals are less affected by the fluctuating tides. The activities of other wildlife, writes Cohen, "shift in rhythm with the rise and fall of the tides." He paints this picture of a typical salt marsh:

At high tide, small fish... forage in the smaller channels and in among the cordgrass... in the lower portions of the marsh. The ebbing tide concentrates these fish in the larger sloughs.... Along the channel banks and slough edges, night herons and great egrets wait patiently for fish to come to them, while the smaller and more excitable snowy egrets stalk and pounce nearby, or plow their yellow-gloved feet through the mud, scouring up shrimp and other morsels. As the water drains from the marsh, saltmarsh song sparrows peck in the damp mud beneath the pickleweed canopy for small worms and snails to augment their diet of seeds, while red foxes search for the nests of rails, egrets, and other birds.

As the tide returns, sandpipers, dowitchers, and other shorebirds are driven up from the mudflats where they feed at low tide. Sometimes the taller shorebirds such as willets and greater yellowlegs venture into the marsh to hunt for insects and other invertebrates. But most shorebirds huddle in open, unvegetated areas, where they can watch for approaching predators while waiting for the water to drop.



Bufflehead

FOR MORE INFORMATION

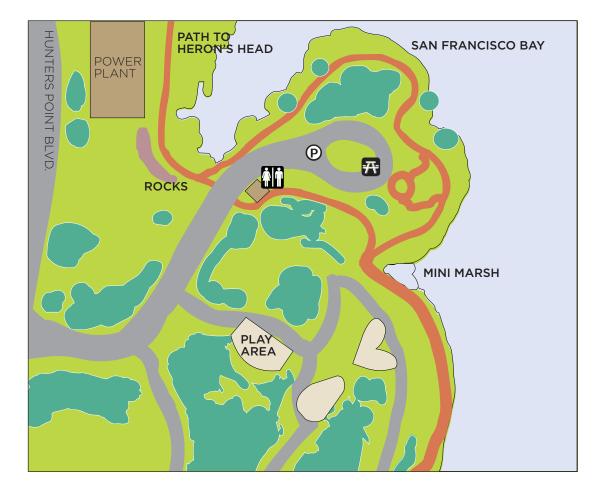
The city's Natural Areas Program has a brochure on India Basin, which includes a description of Heron's Head and a map.

Working through City College in collaboration with a variety of community-based organizations, editor Mark Chambers put together *A Field Guide to Heron's Head Park*. It provides an introduction to the site and a plant species identification guide. Copies are available from Literacy for Environmental Justice.

Literacy for Environmental Justice is a nonprofit urban environmental education and youth empowerment organization that holds programs at Heron's Head. In the next few years, LEJ (say "ledge") will be building the Living Classroom, an environmental education center, at the park. To find out more, call (415) 282-6840 or email *heronshead@lejyouth.org.*

As is demonstrated in the quotation at left, *An Introduction to the San Francisco Estuary*, by Andrew Cohen, provides a knowledgeable and easy-to-grasp account of the bay and its life. The excellent text is accompanied by appealing illustrations and accessible charts and graphs. The book is suitable for distribution to high school students and easily adaptable for lower grades.

You'll find everything you need in this one 40-page book, and it's free. To get a copy, call the San Francisco Estuary Institute at (510) 746-7334 or download a PDF at*www.sfei.org/staffpubs_pages/pubs_cohen.htm*. The book is also available from the San Francisco Estuary Project at (510) 622-2465.



HOW TO GET THERE

MUNI lines 19 and 44 run on Middle Point Road approximately a quarter of a mile from both Heron's Head Park and India Basin Shoreline. MUNI line 54 will take you within a half-mile of both locations.



HILLTOP PARK

All of San Francisco's eastern shoreline has been altered. This includes Hunters Point, a once-narrow point of land that was expanded on all sides to accommodate development of the now-inactive naval shipyards. But because all of the land added to Hunters Point is flat, the shape of the original landscape can still be seen on a topographic map. The contour lines trace the old point, which was hilly. The map also suggests that the patch of land we call Hilltop Park was the last tall hill on the old point.

LOCATION

Hilltop Park lies southwest of India Basin. As its name suggests, it sits atop a steep hill that is now mostly residential. The park can be entered off Whitney Young Circle, Newcomb Avenue, and La Salle Avenue. It is adjacent to Gloria Davis Middle School.

FACILITIES

Hilltop is a recreational park, not a natural area, so it has all the amenities you'd expect. Round concrete picnic tables ring the park—twenty-one in all. At the east end there are bathrooms (locked on weekdays) and a small skateboard arena. At the west end is a tall play structure, swings, and a pair of concrete slides. A paved path rings the park and leads to the play area.

BEST PLACE TO START

The park is small enough that it doesn't matter where you start. Every point within the park is easily accessible from every other.

CROWS AND RAVENS: WHAT'S THE DIFFERENCE?

Crows and ravens are in the same family and the same genus. They're both big black birds with loud voices. Both live in San Francisco, and both have had big population booms in the last fifteen years. So which one's which?

To begin with, ravens are bigger and shaggier. If you see some scruff about the neck, you're looking at a raven. Crows cut a smaller, cleaner profile. The exception to this is when the two birds are in flight—crows have broad wings in proportion to their bodies, while ravens' wings are long and narrow. Also, when you see one or the other aloft, look at the tail; the raven's tail is wedge-shaped, the crow's is not.

While ravens sometimes congregate, they don't tend to mass in flocks the way crows do. Crows often gather in large numbers and can often be seen flying together at twilight.

WHAT YOU'LL FIND

The most prominent feature at this park is an enormous sculptural sundial. Made from steel and angling dozens of feet into the air, the sundial does indeed tell time—the hours are marked in concrete on its north side. When you visit, have a look at where the dial's thin shadow is cast.

The sundial occupies the highest point, on the western side of the park. It is set in a mini-amphitheater, and the paving around it has been etched with very sweet children's drawings.

The center of the park is another amphitheater of sorts, a grassy bowl that begs to be walked across or laid down in.



Planted around its edges are cypress and pines. Several broadleaf trees have also been planted in arcs on the lawn. Near the playground there are plantings of pyrecantha, acacia, and Russian olive, which scrub jays and bushtits make use of. Ravens are a vocal presence in all parts of the park.



Today, Hilltop Park sits on the highest hill seen here in this undated photograph. The original Hunters Point is in the background. Taken from Bayview.

FOR MORE INFORMATION

A few years ago, Joe Eaton wrote a good article about ravens for *Bay Nature* magazine. It can still be found online at *www.baynature.com*. Select "Back Issues," then click the link to the July-September 2002 issue. At the end of the article is a list of additional print and web resources.

The natural world provides an excellent extension for language arts studies that are required in the classroom. Lorraine Ferra's book, *A Crow Doesn't Need a Shadow: A Guide to Writing Poetry from Nature* (Gibbs Smith, 1994) is geared to the needs of educators and will help you and your students put words to your perceptions of and feelings about nature.

GOING DEEPER BRAINY, BRAWNY, AND BOLD-THE RAVENS OF SAN FRANCISCO

Though never an endangered or threatened species in wild habitats, ravens used to be scarce in urban environments. Not so anymore. According to data reviewed by writer Joe Eaton, 14 ravens were counted in San Francisco at the end of 1983; just 16 years later, the city's raven population was one bird short of 240.

It's not just San Francisco that's booming with ravens. Since the early 1980s, raven numbers have shown a sharp increase in most Bay Area cities, and birdwatchers are

seeing the same growth on the East Coast. According to The Sibley Guide to Bird Life and Behavior, common ravens "became much more numerous in eastern North America in the 1990s than at any other time in the twentieth century."

Ravens are very smart birds. They come from a clever family (Corvidae) that features collectors, scavengers, and cachers (hiders). The crow is a corvid, as is the magpie, that infamous collector of shiny objects. Corvids such as the scrub jay, which caches food for later use, rely on visual cues-the configuration of rocks and a broken log, for example-to remember where they've hidden their meals.

Ravens also cache food, so we know they have a good memory for places. There is evidence that they watch and remember be-

haviors as well. Young ravens watch what other birds do, both their own and other species, and they remember what they've seen, sometimes altering where they forage, or the way in which they do so, based on their observations. Well-known raven researcher Bernd Heinrich credits ravens with insight-the ability to solve problems by thinking about them. He has written two books about

ravens-Mind of the Raven (Harper, 2000) and Ravens in Winter (Vintage, 1991), which of which are both enjoyable and information-dense.

Given these talents, ravens were perhaps well-primed to move into urban territory and begin to exploit a variety of new food sources. The Sibley Guide to Bird Life and Behavior characterizes ravens as "opportunistic scavengers" who "typically glean food from plants and ground surfaces, but can learn to get food from many unique situations." In cities, this means ravens have learned to help themselves to our cast-offs. They frequent landfills, dumpsters, trash cans, streets, and parking lots.

> As scavengers, ravens are carnivores, but they don't always restrict themselves to eating what somebody else has killed. Ravens are big birds—they have a body length of about 2 feet and a wingspan of more than 4 feet—but they are not raptors. (In fact, they're passerines. They have a straight, stout bill and a songbird's perching feet.) Though not equipped to hunt and kill on a regular basis, they will prey on the eggs and chicks of other birds, most notably in our area, great egrets and snowy plovers.

Some ecologists consider the raven a subsidized predator an animal that, because of its access to human food sources, fares better than it would otherwise and so becomes a dominant force in the ecosystem in which it lives. From this point of view, ravens are, to borrow a phrase

from San Francisco ecologist Josiah Clark, "out of sync with the pulse of nature."

The raven, however, is just doing what comes naturally. The problem may not be ravens, per se, but people-or the environment that humans have created, which favors some species at the expense of others. In nature, there is no right or wrong, but there are certainly consequences.





HOW TO GET THERE

MUNI line 44 will take you along the northern edge of Hilltop Park and line 54 will take you along the western edge.



LAFAYETTE PARK

Wherever you set foot in San Francisco, there's a story. Though some are told aloud, many are captured in pictures and words on a page. The pictures show Lafayette Park as a refugee camp after the Great Earthquake and Fire of 1906; written stories tell of the quiet activities of a scientist who watched the planets and stars from this hilltop.

Lafayette Park today is a grassy, open area punctuated with well-tended groves of tall eucalyptus, palms, cypress, and pine. The park is flanked by several historic buildings, the largest being the Spreckels mansion on its north side. Next to that house is Octavia Street, which, in the block leading up to the park, is paved in brick. The park bespeaks a quiet gentility and suggests a storied past.

LOCATION

Lafayette Park is on the eastern edge of Pacific Heights. It occupies a four-block area defined by Washington, Sacramento, Gough, and Laguna streets.

FACILITIES

This eleven-acre park has a fenced-in play area for tots as well as "old-fashioned" play structures—a wooden jungle gym, a metal slide, and a concrete tunnel to crawl through. There is a playground area with four-square and hopscotch grids painted on the asphalt. Benches have been placed in numerous locations; bathrooms and picnic tables are also available at the play area.

BEST PLACE TO START

Access to this broad, open park can be had on all sides, and no one is better than another. Choose the entrance most convenient for you.



Lafayette Park, ca. 1880. The typescript notation below this photo reads: "The view from Davidson's observatory, Clay Street. Showing corner of Sacramento and Gough Streets."

WHAT YOU'LL FIND

Lafayette is a recreational park characteristic of this part of town—its lawn-covered hilltop with beds of ornamental flowers and plantings of trees is similar to the open spaces of Alamo Square and Alta Plaza.

It offers opportunities common to many San Francisco parks. You can scan the trees and bushes for signs of movement and, when you find it, lift your binoculars to see who's responsible. The birds you're likely to see include the American robin, Anna's hummingbird, California towhee, northern mockingbird, mourning dove, and house finch. In most seasons, the flower beds will offer opportunity for botanical exploration—look at leaf shapes and growth patterns or examine



flowers or seed pods. At any time of year, the park's trees are excellent subjects of study.

Consider the trees from three perspectives. First, look from a distance: What is the tree's height? Its shape? Its overall color? The look of its trunk? Consider the same tree when standing next to it: What does the trunk look like now? How does the tree's shape seem now? What other sensory information can be picked up—for example, does the tree have a scent? What does the wind sound like blowing through its leaves? Finally, consider the tree "in hand": Touch the bark and pick up and examine leaves and cones or seeds. Seen from these three vantage points, a tree begins to show itself and can become a good friend.

FOR MORE INFORMATION

The National Oceanic and Atmospheric Administration, latter-day successor to the US Coast Survey (which was later the Coast and Geodetic Survey), has posted several interesting documents pertaining to the life of George Davidson on the web. For a short biography of Davidson, go to www.history.noaa.gov/giants/davidson.html. To download a copy of The Frontier Coast, a well-written and interesting account of the work of the US Coast Survey on the shores of the Pacific, go to www.lib.noaa. gov/noaainfo/heritage/coastsurveyvol1/ BACHE6.html. For a copy of The Autobiography of James S. Lawson (Lawson worked with Davidson for many years and ably chronicles their lives and times), go to www.history.noaa.gov/stories_tales/jlawson.html.

The Coast Mappers by Taylor Morrison (Houghton Mifflin, 2004) is mainly about the work of George Davidson on the Pacific Coast. While the format is for a younger audience (it is a large picture book), much of the content is suitable for high school students; it explains how latitude and longitude measurements were taken as well as depicting, in words and images, the surveying techniques and printing processes of the day. Illustrated with excellent oil paintings, this book can be used by teachers at all grade levels. The writing is a bit disjointed and is best supplemented with information from additional sources, such as those cited above.

To delve further into the challenges of ship navigation in the nineteenth century and how they were solved, read *Longitude* by Dava Sobel (Fourth Estate, 1996). This short and very readable book describes the development of a movable timepiece, which made it possible to measure longitude as George Davidson did.

GOING DEEPER GEORGE DAVIDSON AND THE HEAVENS ABOVE

Though San Francisco's highest peak is named for him, George Davidson spent more time atop Clay Street Hill, which is better known today as Lafayette Park.



In 1879, Davidson built an observatory on this hill. From this site, he "timed the moons of Jupiter as they orbited their planet, observed our Moon's passage in front of distant stars, and carefully recorded the appearance of Saturn's rings," writes Kirsten Vanstone in the Spring 2003 issue of *California Wild* magazine. Though he made no major discoveries, "his meticulous observations helped motivate others and began California's impressive astronomical tradition."

In 1850, as an employee of the US Coast Survey, Mr. Davidson was assigned the task of mapping the Pacific Coast. With his colleagues James Lawson and John Rockwell, Davidson traveled from the East Coast by steamer to the Caribbean side of Panama, then crossed the isthmus in canoes and by mule. They took another steamer up the West Coast, arriving in San Francisco in mid-June.

SAN FRANCISCO, 1850

They found a city in the throes of Gold Rush fever. In his autobiography, Lawson described the scene at Yerba Buena Cove:

Our landing was made in boats at the end of "Howison's" pier, a small wharf, the only one San F. could then boast of, at the foot of Sacramento St. On this wharf was a wooden tramway on which was pushed a small car for carrying trunks etc. to terra firma. Our luggage, however, did not get taken quite so far. The fire of June 14th had laid waste all that vicinity, burning the connection of the wharf with the land, hence all our "traps" had to be carried from the pier across a plank to the shore. My first astonishment (after that they were innumerable) was seeing a man digging a trench among hot ashes and burning embers to lay the sills of a new structure. By noon of the next day the house, a skeleton frame with cotton-cloth and sides, was finished, stocked with goods, and stood conspicuously as a first class store.

At that time, more people came to California by sea than by land. But this did not mean that the routes—and their perils—were well known. "There wasn't a single lighthouse, buoy, or beacon to guide ships from the Canadian border to Mexico," writes Taylor Morrison in the children's book, *The Coast Mappers*. "The few available charts were untrustworthy. They often placed headlands and bays up to forty miles away from their true positions." It was to be the job of Davidson and his colleagues to correctly map the West Coast.

WHERE ON EARTH

To do so, however, they first had to put the coast on the map—that is, they had to accurately determine its main features and their locations. To do this, Davidson took measurements of the stars.

The constellations and their apparent movement across the heavens had long ago been charted onto a celestial sphere, a grid of latitude and longitude laid out across the heavens. By taking readings of the stars, Davidson was able to determine the distance between the Earth's equator and his site on the coast of California—that is, his latitude. To measure longitude, he used a chronometer a traveling clock synchronized to a clock in Greenwich, England—and the moon. By comparing the time when he saw the moon overhead to the time it was seen in Greenwich, he could calculate his distance from Greenwich and



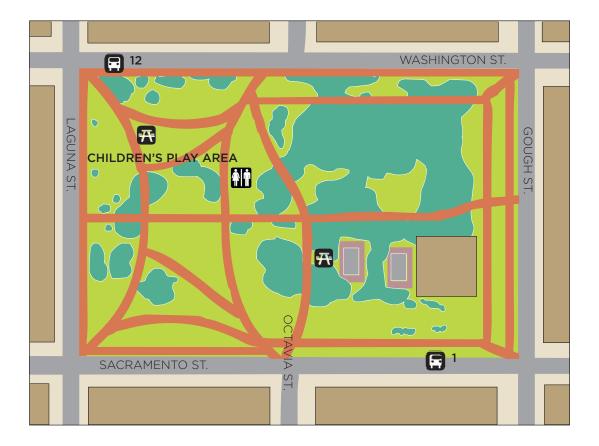
thus ascertain his longitude.

He, Lawson, and Rockwell began their work at Point Conception, just north of Santa Barbara. They worked night after night, using a zenith telescope to take measurements for latitude and a transit telescope for

longitude. A fourth man, A. M. Harrison, joined the team, and they began to work in pairs. Davidson and Rockwell took the astronomical measurements while Harrison and Lawson made topographic surveys. In less than 90 days, they had mapped Point Conception and pinpointed its location.

Over the next 18 months, Davidson and his colleagues would do the same thing in Alaska, at the mouth of the Columbia River, and at many other points along the coast of California. "By the end of 1852," to quote from *The Frontier Coast*, a history of the US Coast Survey, "George Davidson had virtually completed the critical work of observing astronomically determined geographic positions of the major headlands and port locations on the western coast."

Davidson continued to survey lands in the West for almost 60 years. He was president of the Academy of Sciences for more than 15 years, a professor at UC Berkeley for more than 40 years, and the founding president of the Pacific Seismological Society, which formed four months after the Great Earthquake in 1906. He died in 1911. Though he traveled often, his place of residence was San Francisco. After he set up his observatory in Lafayette Square, he built a home on Washington Street.



HOW TO GET THERE

MUNI line 12 runs along the northern edge of the park. MUNI line 1 travels along the southern edge.



LAKE MERCED

Lake Merced Park is about 600 acres in size, and the lake itself covers almost half that area. This immense water body is naturally occurring and has been here for thousands of years. Grizzly bears once drank from the shores of Lake Merced, as did their prey, the tule elk, who also grazed the prairies nearby.

Today's wild animals still rely on the land and water of the lake; it is now one of the best places in the city to watch birds. According to San Francisco ecologist Josiah Clark, more bird species have been seen at Lake Merced than at any other place in the city.

Lake Merced was originally a big V-shaped body of water that intermittently drained to the sea in the area where the zoo is today. According to San Francisco writer Harold Gilliam, this outlet was blocked in "the 1890s... when the lake was dammed and its surface raised for reservoir purposes." The lake has been further divided and dammed since then and is now four smaller lakes—East, North, South, and Impound—that are collectively referred to as Lake Merced and together retain the lake's original shape.

LOCATION

Lake Merced is located in the southwest corner of San Francisco, just inland from Fort Funston. Skyline Boulevard passes along the lake's western edge; Lake Merced Boulevard defines its northern and eastern sides. John Muir Boulevard completes the circle on the south.

FACILITIES

There is a wide, well-maintained foot- and bike-path all the way around Lake Merced; it can be accessed at many points. There are Port-O-Lets at the south end of the bridge at Impound Lake; there's a permanent bathroom facility at Harding Park. Picnic tables are located at Harding Park and Impound Lake. There are piers out onto the lake from all three sites.



Cormorant

BEST PLACE TO START

The parking lot at Sunset Circle is a good place to start, as it provides access to a variety of habitats, from lakeshore to tall woods. The willows and the fishing pier near Impound Lake are prime birding spots, as are the banks and depressions on the sides of the Mesa, near Sunset Circle.

Any time of year is good for a visit. In the winter, you'll find ducks and waterfowl; spring will offer more bird song and nesting. Summer has the fewest birds, though the swallows can be a wonderful presence in June and July.

WHAT YOU'LL FIND

Lake Merced is a freshwater wetland. California bulrush or tule (too-lee), a wetland specialist, grows along its entire perimeter. This tall, blue-green-colored reed with a puff of small brown flowers at the top is spongy when you squeeze it,

THE BIRDS OF LAKE MERCED

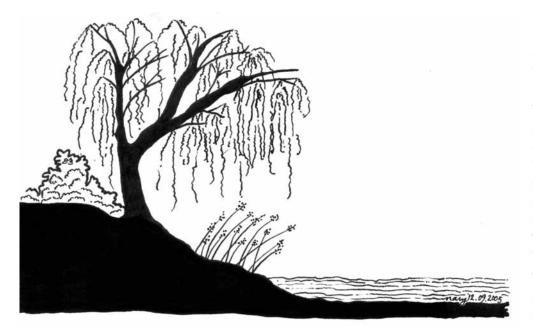
Lake Merced is home to most of the birds that are common throughout San Francisco. Also present are birds that may not be widespread in the city but are commonly found near water, such as the marsh wren.

The lake is a stopping-off point for many songbirds during spring and fall migrations. In the fall and winter, look for cedar waxwings, ruby-crowned kinglets, Townsend's warblers, and yellow-rumped warblers. In the springtime, be on the lookout for Wilson's warblers, common yellowthroats, and five species of swallows bank, cliff, barn, tree, and violet-green swallows all rely on the rich insect resources of Lake Merced. They are a delight to watch as they swoop and careen at high speed, catching food on the wing.

There are bigger birds—herons, egrets, cormorants that either live on the lake year-round or can be found here in the winter. The great blue heron can be seen any time of year; in the spring and early summer you can watch them flying in and out of a rookery, or nesting area, in some of the eucalyptus on the north side of the lake. Great egrets are also Lake Merced residents, though they're not common in the summer. A big black bird, the double-crested cormorant, has two colonies at Lake Merced and can be seen most days on boats moored in the lake or the several abandoned piers.

Seasonal waterfowl making use of the lake include plenty of ducks. Besides the ever-present mallards, you may see ring-necked ducks, lesser scaup, canvasback ducks, and eared grebes. Less common species that have stayed to breed in the tules include Western grebe, Clark's grebe, and ruddy ducks.

Finally, several birds of prey are present for all or some of the year, including red-shouldered and red-tailed hawks, and that very specialized raptor, the osprey, which always lives near water and relies on fish for food. Though it may roost as far away as in Marin County at night, this eagle can be seen at Lake Merced during the day, perched above the lake, scanning the water, then swooping down to pluck fish from it before flying away.



indigenous plants. The slopes at the southern end of the bridge off Sunset Circle have been planted with bee plant, yarrow, sticky monkey flower, and other hardy species common to many restoration projects. This is a good spot to pause and watch for Anna's hummingbirds, song sparrows, bushtits, and chestnut-backed chickadees. The Mesa, east of Sunset Circle, has been restored to coastal scrub you'll find lupine, sagewort, and more; white-crowned sparrows nest there now.

Plants often grow in distinct zones along shorelines.

but surprisingly tough. For the Ohlone, it provided material for housing, boat-making, and mat- or carpet-making. Tule is lightweight, like a Nerf ball, and has a foam-like interior.

Willow trees grow just a little farther up the bank from the tules. Willows like wet environments such as lake shores and stream banks but, unlike tule, cannot tolerate having their roots and the base of their stems perpetually submerged. As a riparian, or water-loving, tree, willows are part of the most productive plant community in San Francisco. The presence of year-round water makes it possible for willows to grow quickly and profusely. Their lush growth, in turn, supports high populations of many insects—which attract birds and other animals.

Farther up the banks of the lake, most of the vegetation has been planted by humans. It ranges from the cypress and lawns of Harding Park to the tall eucalyptus trees along the northern side of the lake.

There are also areas where, more recently, Natural Areas Program staff members, Friends of Lake Merced, and California Native Plant Society volunteers have been re-establishing

FOR MORE INFORMATION

The Natural Areas Program has a brochure on Lake Merced that includes a map and provides good background on many of the lake's main natural and cultural resources.

A wealth of information about Lake Merced is available online. Visit the Friends of Lake Merced website at *www.lmtf.org* and the SFSU Biogeography of Lake Merced website (*bss.sfsu.edu/holzman/LakeMerced/ Default.htm*).

The Friends of Lake Merced and the California Native Plant Society have involved school groups in some of their projects and outreach efforts; for more information, visit the Friends' web site or go to *www.cnps-yerbabuena.org.*

Some folks are so enthusiastic about reducing impervious surfaces in San Francisco that they've formed a group—Permeable Landscaping As Neighborhood Treasure—to promote the idea. With the proper city permits, they're taking jackhammers to sidewalks and converting stretches of concrete into pockets of open space. To find out more, visit *www.plantsf.org*.

GOING DEEPER HUMAN INTERACTION WITH THE LAKE

Wild animals need water to live, and so do we. Because of this, humans have a long history of interaction with Lake Merced. Ohlone artifacts have been found on the shores of the lake, and there is evidence that the first people had seasonal villages here. Spanish explorers gave the lake its name—*Laguna de Nuestra Senora de la Merced* (the Lake of Our Lady of Mercy). European settlement began closer to the bay, but after the Gold Rush, earlyday entrepreneurs turned their sights toward Lake Merced and saw in it a potentially profitable source of water for the burgeoning city. In recent years, the Friends and other interested parties watched as the level of the lake decreased, threatening the very values they want to protect. Studies were done and plans developed; the PUC determined that lake levels were dropping because less surface water is flowing into the lake. It may also be the case that less water is seeping into the lake from underground—Lake Merced sits atop and is partly fed by the Westside Basin aquifer, from which San Francisco, Daly City, and San Mateo all pump water. To remedy the situation, the PUC started adding water to the lake in late 2002, and has negotiated with aquifer water users to irrigate golf courses and parks with recycled water rather than groundwater. With these changes, the water level at Lake Merced has risen by 3 feet.

In 1870 or so, the Spring Valley Water Company began to build wooden flumes along the shores of Lake Merced and was soon drawing water from it as well as other sources in and around San Francisco. In 1908, partly in response to the water shortage the city experienced after the earthquake, water suppliers began to look farther afield, eventually deciding to collect water in the High Sierra and transport it across the state.

Lake Merced ceased to be used for regular water supply in the 1930s, but has remained a backup



Lake Merced taken from the north side of the lake near the area now called the Mesa, 1904. The wooden flume was used to transport water. Fort Funston is visible in the background.

its way into the lake because little rainfall remains where it lands. In an urban environment that is predominantly pavement and buildings, rainwater is directed away from where it falls, transported to the sea and the bay by gutters and storm drains. This leaves our neighborhood environments drier.

Less water was finding

We can help reverse this trend simply by reducing the amount of impervious surface, such as concrete and asphalt, in the places we live and work. If you're building a deck or walk-

site in the event of another large-scale emergency such as an interruption of the water supply from Hetch Hetchy reservoir in the Sierra Nevada, which is the city's main water source. Managed today by the San Francisco Public Utilities Commission (PUC), which is also responsible for Hetch Hetchy, the lake also has a dedicated support group. The Friends of Lake Merced is a community-based volunteer group that advocates for preserving the natural and recreational values of the lake. way, use permeable surfaces—wood, rocks, or stones with openings that will allow rain to sink into the ground. Also, rather than have your downspout feed directly onto the street, consider redirecting water to open ground such as an unpaved area where it can be absorbed. Alternatively, residents can connect their downspouts to cisterns and save rainwater for use in the garden, thus reducing overall water use and eventually returning water to the ground on which it fell.



HOW TO GET THERE

MUNI Line 29 runs along the northern end of Lake Merced. Line 18 loops around the eastern, southern and western areas of the lake. There are three main parking lots: Sunset Circle is at the intersection of Sunset and Lake Merced boulevards; the Impound lot is at the intersection of Brotherhood Way and Lake Merced Boulevard; and the Harding Park lot can be reached from a turnoff at the south end of Lake Merced Boulevard.



LANDS END & SUTRO DISTRICT

Explorers and early settlers all remarked upon the scarcity of trees on the San Francisco peninsula. The wind, the sand, and annual drought favored other kinds of plants lower-growing ones. In a pattern that is still visible on hills throughout the Bay Area today, trees could be found clustered around drainages and sheltered spots where conditions supported their establishment and growth.

This pattern has been changing, of course, with every wave of immigration to San Francisco since the mid-eighteenth century. The few original stands of trees were cut mainly for firewood, and new residents began to plant new trees. In the late 1800s and early 1900s, especially, whole forests were created from the few species able to withstand the winds and set root amidst the shifting sands. These forests are present in many of San Francisco's parks and open spaces today, including the headlands of the Sutro District and Lands End.

LOCATION

Lands End is the name of a promontory, a park, and a part of the city. It is part of the Golden Gate National Recreation Area, as is the adjacent Sutro District. This complex of parks follows the curve of the shoreline, starting in the Sea Cliff District just west of China Beach and extending west to Point Lobos, then south to Ocean Beach. The area is bounded, roughly, by Clement Street on the south and 48th Avenue on the east. The main entrance is more or less the intersection of Point Lobos Avenue and 48th Avenue. There are bus stops at that point, and just west of the intersection, at Merrie Way, is a big parking lot on the right-hand side (as you're looking toward the Pacific Ocean). There is also a smaller lot to the left. Just a few paces farther on, where the road curves south, is the Cliff House.

FACILITIES

This is a relatively undeveloped part of the GGNRA. The National Park Service is putting together a plan for the area; at some point in the future there is likely to be a visitor center in part of the space currently occupied by the acre of asphalt at Merrie Way. For now, the main facility is the Cliff House—one of San Francisco's primary tourist attractions for more than a century—and an adjacent gift shop. There are toilets there; there is also a Port-O-Let in the parking lot. A map of the area is posted on a four-sided kiosk in the same lot. Trails and trail-heads are for the most part easy to come upon and will be described in greater detail in the site descriptions that follow.

The best place to start is in the 48th Avenue–Point Lobos Avenue–Merrie Way zone. From here, you can walk to Sutro Heights, Sutro Baths, and the main trail through Lands End.

WHAT YOU'LL FIND

Moving from north to south, you have the parks of Lands End, Fort Miley, and Sutro Heights on the forested headlands; along the shore are the wetlands of Sutro Baths and the rocky land of Point Lobos; just offshore are Seal Rocks. South from there, below Sutro Heights and at the northern terminus of Ocean Beach, is a pocket of restored dunes called the Balboa Natural Area. All of these lands are open to the public and accessible either on foot or with binoculars.

LANDS END

Lands End is the large area of green space in the northwestern corner of San Francisco that includes the Lincoln Golf Course, the Palace of the Legion of Honor, and part of the Coastal Trail, which runs through 9 miles of GGNRA land from Fort Funston to the Golden Gate Bridge. In Lands End, the trail skirts the edge of the rocky bluffs above the sea from Ocean Beach to China Beach and is the main way visitors experience this natural area. To reach it, walk to the northern end of the Merrie Way parking lot—the trailhead (a wide dirt road) will be easily visible from there.

Much of the Coastal Trail in Lands End follows the bed of an old train track. In the late nineteenth century, starting from a roundhouse at the intersection of California Street and Presidio



A postcard depicting the rail line at Lands End.

Avenue, a steam train chugged its way around Lands End. The forests had yet to be planted, so the views were breathtaking.

In one of her "Leaflets of Western Botany," Alice Eastwood, who was curator of botany at the California Academy of Sciences for the first half of the twentieth century, recalled the "attractive excursion along the railroad track that once went to Sutro Heights via Lands End. Except for the wild currant which was abundant in the spring," she writes, "this area was better for summer and fall. The pink and yellow sand verbenas, the San Francisco willow herb (*Angelica hendersonii*), cow parsnip (*Heracleum lanatum*), golden rod, lizard tail (*Eriophyllum*), coyote brush (*Baccharis*), and the heather-leaved Ericameria, all were common."

As close as it was to the cliffs' edges, the route must also have been a bit hair-raising, particularly since the track sometimes gave out. After a severe washout in 1925, the line—which by then had been converted to a two-way electric trolley similar to today's F Line in Market Street—was abandoned. The route became what it remains to this day: a footpath.

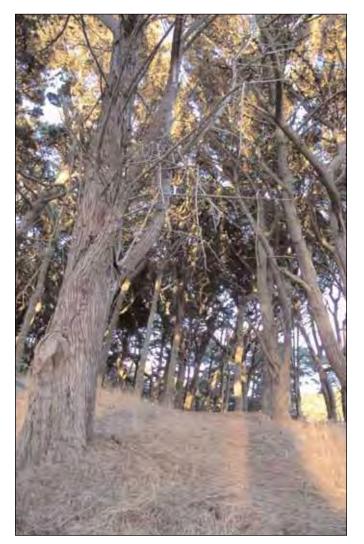
The trail now passes through forests of Monterey cypress and eucalyptus, across streams and through corridors of willow. The willows signal water—recent surveys have revealed seventeen natural springs in the Lands End area. The steep hillsides above and below the trail are shot through with seeps and rivulets, a fact that contributes, no doubt, to the area's popularity not only with people, but with birds. The bluffs provide good spots to see ocean- and shorebirds but, because of its location and varied habitats, Lands End is a "trap" for vagrant birds. As an important landfall along the Pacific Flyway, Lands End provides excellent birdwatching opportunities in the spring and fall. Also, keep your eyes open for handsome outcrops of graywacke and greenstone as you walk.

FORT MILEY

Where 48th Avenue meets Point Lobos Avenue, its name changes to Camino Del Mar. The entrance to Fort Miley is off Camino del Mar—it's another huge parking lot with a Port-O-Let at the northwest end. On the western side of the lot is a memorial to the USS *San Francisco*, which includes a small portion of the ship's battle-damaged bridge.

Fort Miley is a high spot that faces northwest over sea rocks that have meant habitat for sea birds but doom for some unlucky sailors and ship passengers. From the viewing platform at the west end of the parking lot, you can see five navigation lights and fog signals, all installed to prevent shipwrecks. For more than a century, there was a lookout station here that tracked the progress of incoming ships. Though the building still stands, the lookout was closed in 1967, after ship-to-shore telephones came into use. The several gun batteries that were installed here are now also obsolete.

Today, Fort Miley is public park land, part of GGNRA. A short uphill hike from the parking lot leads through a dense cypress forest to one of the abandoned batteries. (When hiking up to the battery, stay to the right. The left-hand fork leads to the old lookout, which is locked up.) At the battery, you'll find groomed lawns, picnic tables, garbage cans, and—on a clear day—excellent views. Common suburban birds such as house finches and California towhees can be seen here any time of year; less common woodland species can also sometimes be glimpsed. Just to the north is the larger Battery Chester, also abandoned and a bit derelict. (While these structures beg to be climbed, it would be best to keep an eye on children who do so.)



Fort Miley

In a clearing at the western edge of Battery Chester is a nice little stand of remnant coastal scrub, which contains some of the plants Alice Eastwood described (see "Lands End"). To find it in the springtime, look for the tall stalks of cow parsnip, an annual plant that sprouts from seed and reaches heights of 6 feet or more in a single growing season. You'll also see two other scrub stalwarts, coyote brush and California blackberry. In summer, keep your eye out for big grasshoppers that can also be found here.



Sutro Heights, ca. 1900. Fort Miley (the peak) is visible through the circle. Note the Ghirardelli's Chocolate sign on the left and the grasslands on the right.

SUTRO HEIGHTS

Sutro Heights is part of the Sutro District—the amalgam of lands that Sutro once owned in this area. The main entrance to the park, at the corner of 48th and Point Lobos avenues, is flanked by two concrete lions—vestiges of a grand portal to a once-grand garden.

WHO WAS SUTRO?

Millionaire, philanthropist, engineer: Adolph Heinrich Joseph Sutro was born in 1830 in Prussia; he died in 1898 in San Francisco. He came to California at age 20, after having worked in his family's cloth manufacturing business, and studied mining engineering.

For his first nine years in California, Sutro sold cigars and tobacco. In 1859, he moved into the silver mining industry in Nevada, where he is remembered for the Sutro Tunnel, which bored 7 miles into the stone of Sun Mountain. It was a mammoth undertaking, from the standpoint both of engineering and political persuasion, and a lengthy one. By the time it was completed, in 1878, the Comstock was spent. Within a year, Sutro had sold all his mining interests.

SPECIES FOCUS: HOUSE FINCH

House finches are ubiquitous. The distribution map in the Sibley guide shows them as year-round residents through the whole of the United States. To some this makes them uninteresting—you see them all the time. For the beginning naturalist, however, common species can be the most welcome. As we observe the living things around us, we develop observation skills and levels of understanding that can then be applied to countless other animals, whether they're common or not.

One of the reasons house finches are so widespread may be that they prefer, according to Sibley, "open forests in which the trees are rather widely spaced." As this description fits many urban and suburban landscapes, house finches are well-adapted to the kinds of environments humans create. Another reason for the house finch's success may be that it is a seedeater. It can make use of bird feeders as well as of plenty of other food sources in yards and vacant lots.

The house finch's coneshaped bill helps him eat seeds—you can watch him bite off seed pods and hold them in his beak as he chews through them, using his tongue to move the pod



around and extract the seeds. The husk falls, the bird swallows, then he is immediately looking for the next tidbit.

Another characteristic that makes house finches worthy of study is their variation in coloring. The plumage of many birds differs according to age, season, and location, and getting to know these variations can sometimes be the key to knowing the bird. In the case of the house finch, the male normally has a red head and shoulders (the females are plain brown). Sometimes, though, you might see a yellow house finch. This variation in color is the result of what the bird eats—a house finch that is red is getting enough carotene in his diet. Back in San Francisco, Sutro turned his attention to other great works. Though they were undertaken by a private individual with an interest in financial gain, Sutro's projects were, to some extent, also public works. Sutro Heights was not only the location of his home but of large, elaborate gardens that were open to the public. He built a public walkway around the west side of the promontory on which his home stood, calling it *Dolce Far Niente*, which can be loosely translated as "Sweet to Do Nothing."At the crest of the same headland, he constructed parapets that can still be climbed today. In his day, each of the rising crenellations was topped by a reproduction of a classical statue. It was Sutro's intention to provide aesthetic education and inspiration to all the residents of San Francisco.

In our times, Sutro's biggest legacy may be trees. Like Jones at the Presidio, like Hall and McLaren at Golden Gate Park, Sutro planted trees. He favored Monterey cypress, Monterey pine, and eucalyptus, and he employed laborers and school children to plant thousands of them. In doing so, he completely transformed the lands throughout western San Francisco that still bear his name. What had once been grassland, sand hills, and scrub became planted forests of very limited diversity.



Parapet at Sutro Heights, ca. 1894-1907.

SUTRO HEIGHTS TODAY

The house on Sutro Heights is gone; the ornate garden beds have been replaced by lawns, but something of the site's early grandeur lingers in the broad walkways, the remaining statuary, and, of course, the park's location at the high edge of the land.

The *Nature in the City* map identifies Sutro Heights as a "naturalistic" park, one that consists of "landscaped areas



"Sutro Pleasure Grounds," ca. 1896-1907. Note the second Cliff House—often referred to as the Victorian Cliff House—in the background on the left.

and urban forests." This is a good description for Sutro Heights. The park is fringed by Mr. Sutro's signature trees and has broad lawns and big garden beds. In the area where a glass conservatory once stood is a long row of proteas—plants that originated in South Africa and have a beautiful flower structure. They're also called "sugar bush," because of their sweet nectar, which you can easily dip into and lick off your fingers. The lawns are dotted with old palms and a few other specimen trees; on the north side of the garden is a small white gazebo that appears in some photos of the garden in its heyday.

Typical urban wildlife species can be found here year round —mourning doves, robins, and Brewer's blackbirds. There are gopher mounds on the ground. In the summer, barn swallows can be seen swooping in and out. During fall and spring migration, woodland species such as Townsend's warblers can be sighted here.

One very interesting bird species, the hooded oriole, nests nearby in the spring, and visits the eucalyptus and palms at Sutro Heights. Many native California birds have moved in to colonize San Francisco's planted landscapes but, according to San Francisco ecologist Josiah Clark, "none have moved farther than the hooded oriole. Dependent on palm and yucca fibers to make their hanging nests," he explains, "hooded orioles were rarely recorded north of Southern California until recent decades." According to the Presidio's Draft Forest Management Plan, "Along the coastline, the Presidio defines the northern breeding limits of… the hooded oriole, which nests in palm trees near Letterman Army Hospital."

POINT LOBOS, SUTRO BATHS, AND SEAL ROCKS

Point Lobos, Sutro Baths, and Seal Rocks form a shoreline complex that is easily accessible and always enjoyable to explore. From **Point Lobos** you can look onto the rocky shoreline and offshore, where, according to San Francisco birder Alan Hopkins, bay and ocean waters meet. This rip line churns up nutrients and thus is a good place to see seabirds, and even the occasional porpoise. Hopkins also says that gray whales have passed within 100 yards of the point. John Martini, retired National Park Service cultural historian, says that Point Lobos is named for the gray sea "wolves"—or harbor seals—that sometimes haul out on the rocks.

Although they are too high and too close to the water to safely climb on, the rocks immediately below Point Lobos offer the marine naturalist views of tidepools and the life associated with them. They are close enough to be seen quite clearly through binoculars.

Sutro Baths are the ruins of another one of Adolph Sutro's grand projects. The saltwater baths operated, in one form or another, from the late nineteenth century to the 1960s; a skating rink also occupied part of the building beginning in the late 1930s. Finally, it was shut down, and in 1966, as its fate was being debated, it burned, leaving only a few jutting pillars and the drowned foundations that can be seen today.



Sutro Baths today.



From Point Lobos, visitors can enjoy spectacular vistas of the Golden Gate and Marin Headlands.

The Sutro Baths are a remarkable mixture of natural and human forces. Within the foundations, brackish ponds—a mixture of fresh and salt water—have formed. The fresh water comes mainly from two springs in the hillside. The salt water, of course, comes from high tides and sea spray. The surface of the ponds often has many strands of Enteromorpha, a common bright-green algae, as well as bird feathers and other biological detritus floating in it. On the east side of the ponds, at the foot of the hillside, is a patch of tules where great blue herons can often be seen; other wading birds such as the pure white great egret also use this site. Even double-crested cormorants, which normally flock on the offshore rocks, can be seen swimming and surfacing in the ponds. At low tide, a small beach is exposed at the west end of the old baths. Several big rocks comparable to those farther out rise up out of the sand.

The area around the baths has been invaded by several tenacious exotic plants. Feather acacia and mattress wire weed dominate the slope behind the baths, though the occasional dune tansy can still be seen poking through.

Immediately north of the baths, there's a tunnel under the Point Lobos platform. It's usually moist in there and the ground is sticky—the soil in this area is a powdery clay that gets very tacky when wet. The stones around the tunnel and at Point Lobos are fun to look at and touch—they're sandstone that has weathered in patterns like honeycomb. This distinctive rock is called *tafoni*.

COMMON PLANTS OF THE FOREDUNE

The foredune is the back of the beach; it lies above high tide line. Wind blows sand up the beach, and the foredunes are the first place it begins to collect. The sturdy plants listed below are able to get a root-hold in this environment and, as they grow, catch some of the blowing sand, helping form the first dunes.

Beach bur (*Ambrosia chamissonis*) Beach sage (*Artemisia pycnocephela*) Beach strawberry (*Fragaria chiloensis*) Yellow sand verbena (*Abronia latifolia*) Coast buckwheat (*Eriogonum latifolium*) Sea rocket (*Cakile maritima*)

Just west of the Cliff House is a well-known cluster of offshore rocks called **Seal Rocks**. The best place to look at them is from the observation platforms behind the Cliff House. Stained with guano, wave-splashed, and steep, these outcrops may seem inhospitable; nonetheless, cormorants, pelicans, and gulls can be seen resting, roosting, and foraging here. One bird species, the black oystercatcher, won't be found in any other habitat. Such rocky edges are the only place it lives and breeds. Ecologist Josiah Clark says that offshore rocks are an important resource for some shorebirds because they are one of the few habitats that has remained essentially unchanged. The animals that made use of them 300 years ago can still do so today.

The Lands End shoreline is littered with such rocks, and all of them are good spots upon which to train binoculars. Harder to see but even more significant in terms of marine life are the **Farallon Islands**, which lie 27 miles west of Lands End. On a clear day you can see them from the city; from June through November each year, the Oceanic Society makes boat trips out to them. Great white sharks also spend their summers in the vicinity of this cluster of bare, granitic islands.

The sharks come in response to the elephant seals, harbor seals, and sea lions that also swim the waters of Central California. The Farallones are a draw for these and many other marine animals because the islands mark the edge of the continental shelf—a sea-floor cliff that looms over an abyss more than 2 miles deep. This pronounced change in topography causes deep-sea currents to well up, which carry with them extra quantities of microorganisms at the base of the food chain. This in turn attracts the fish, birds, and mammals that can be found in such great number around the Farallones.

The rocks themselves host the biggest breeding populations of Cassin's auklets and ashy storm petrels. Western gulls breed there; so do common murres. According to Susan Casey, who learned about the Farallones while writing a book about great whites, "every patch of land [on the islands] is claimed by nesting seabirds."



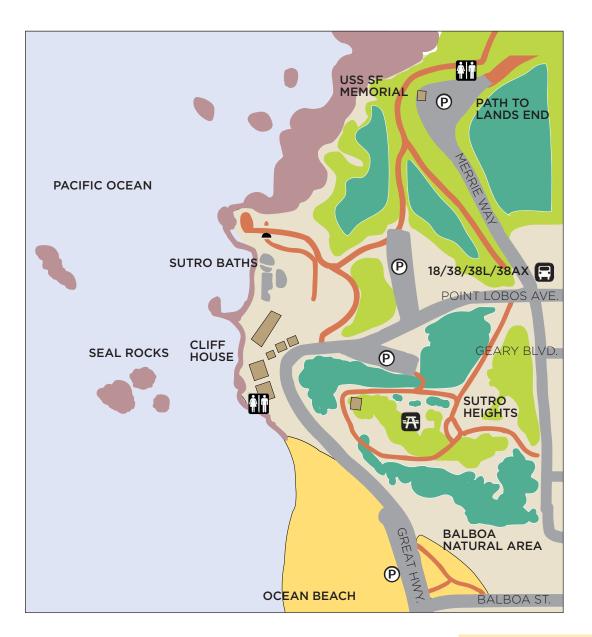
Balboa Natural Area

BALBOA NATURAL AREA (PARCEL 4)

At the foot of Sutro Heights, immediately inland from the northern end of Ocean Beach, is a city-owned property known as Parcel 4 (on the *Nature in the City* map, it is identified as the Balboa Natural Area). It is a single lot that has been restored to dunes. The site is a bit scruffy—a small parcel such as this does not have the advantages of a larger open space like Fort Funston, where natural processes have much greater play. But this is a good place to get to know foredune plants. They're all here and, since there's a boardwalk through the site, it's easy to view them. Access to the site is also easy, at the corner of Balboa and the Great Highway, across from Ocean Beach parking lot.

FOR MORE INFORMATION

A Day at the Seaside by Ariel Rubissow Okamoto (Golden Gate National Parks Conservancy, 1998) documents the popularity of Sutro Heights, the Cliff House, and Sutro Baths.



HOW TO GET THERE

MUNI lines 18 and 38 will bring you in close proximity to all areas of the Sutro District. Lines 5 and 31 end approximately one block from the Balboa Natural Area.



LOBOS CREEK DUNES

If conditions across the street at Baker Beach are tough for plants, they are also fairly consistent. The ceaseless movement of wind and waves creates a certain uniformity and sparseness. According to botanist Philip Munz, less than 20 percent of a beach may have plant cover. What's more, he writes, "species diversity... may be low; sometimes only a half dozen species occur over large areas." The dunes behind the beach, near Lobos Creek, have a different story to tell.

LOCATION

Lobos Creek Dunes are in the southwestern corner of the Presidio, off Lincoln Boulevard. The main entrance is from a parking lot off Lincoln near 25th Avenue. There is also a parking lot and trailhead off 15th Avenue, just north of Lake Street. This area is run down and unsightly, but worth visiting because it offers an overlook into the Lobos Creek valley.

FACILITIES

A boardwalk furnished with benches and interpretive signs loops through the dunes. At the start of the boardwalk, you'll find copies of an interpretive guide to numbered sites along the walk, which is level and covers a short distance. There is also a quarter-mile trail on the north side of the park that climbs gently uphill through a cypress forest and connects the dunes with the overlook off 15th Avenue. A picnic and play area is located on the north side of the valley, in the trees. There are toilets across Lincoln Boulevard at Baker Beach.

BEST PLACE TO START

The main entrance off Lincoln Boulevard is the best place to start. The park is small, and if your students are willing and you have time, you can walk the boardwalk and hike up to 15th Avenue.

WHAT YOU'LL FIND

Lobos Creek Dunes occupy a small valley. On the north side is a forest of Monterey cypress and Monterey pine that was planted in the late 1880s. On the southern edge is Lobos Creek, which flows through a woodland of coast live oaks. At the east end of the valley, near the creek's headwaters, is a lush thicket of willows. The valley itself is a beautiful dune complex filled with bright and varied wildflowers and subtle perennial shrubs.

More than fifty species of plants can be found at Lobos Creek Dunes. What's more, because of the creek that runs

through this small valley, this site has a *riparian*, or creekside, plant assemblage that can be found in few other places in the city. There is no direct access to the creek, but a great deal of plant- and birdwatching can be done through the fence.

The presence of fresh water and the variety of environments in such close proximity supports a great diversity of wildlife, from burrowing mammals and hovering raptors to woodpeckers, songbirds, and coyotes. According to the Lobos Creek Water Quality Man-



Lobos Creek, 1917. Note that the creek is visible in the foreground. Lobos Creek Dunes are on the right. Lincoln Avenue would be built roughly where the fence posts are.

by lining a depression in the creek bottom with algae fragments. He also builds a top for it from the same materials, creating a tunnel that he cements together with a secretion from his kidneys. He then woos the female into the nest, where she lays the eggs and he fertilizes them.

A LAND OF EDGES

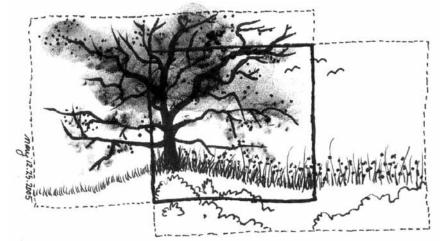
Lobos Creek Dunes also provides a nice example of an *ecotone*, or boundary between one plant community and another. There are several such boundaries here, between forest and three

after they've hatched. He makes the nest dune and between dune and creek corridor. Their variety makes edges like these very fertile ground. Here the hawk can perch in a tall pine while surveying the open area of the dunes below. Song-birds attracted to the water of the creek can glean insects from the nearby trees and the dune shrubs just a little farther away. Insect life is certainly more diverse, with species such as caddisflies and mayflies, which specialize in aquatic habitats, in close proximity to a host of

agement Plan, written by Mark Youngkin and Douglas Kern, "Lobos Creek provides several habitat features for mammals, including perennial water, cover, forage, roosting sites, breeding sites, and denning sites. Trees provide roosting habitat for bats. Perennial water in Lobos Creek provides a habitat for flying insects, which in turn provide a food source for bats. Several amphibians and reptiles may occur in streamside habitats of Lobos Creek," including the coast garter snake. A single fish species—the three-spine stickleback—is found in Lobos Creek. The male of this small species, which does have spines on its back, is the one who builds a nest and guards the eggs until terrestrial insects. In the dunes themselves, insect types and numbers have increased since the restoration project began.

ONE WHOLE WATERSHED

The meaning of the word *watershed* also becomes apparent at Lobos Creek Dunes; this little valley illustrates the concept nicely. The waters from the surrounding uplands drain into the creek, which in turn drains into the sea. From the overlook at the 15th Avenue Gate you can see the ocean, and it doesn't take a great stretch of the imagination to realize that Lobos Creek empties into it.



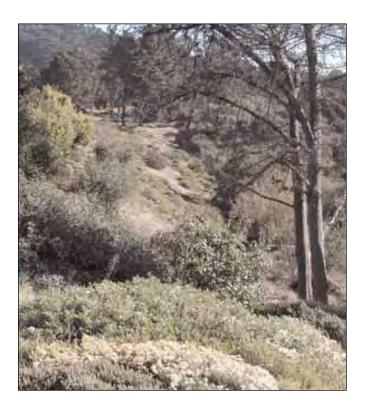
Ecotones, the areas where two or more plant communities intersect, often contain a particularly large diversity of species.

Just before it reaches the ocean, however, the water from Lobos Creek is diverted into the Presidio Water Treatment Plant, from which the water is distributed to homes and offices throughout the Presidio. Lobos Creek provides most of the Presidio's drinking water. What is left is released on Baker Beach; the mouth of the creek is a pipe buried in the sand.

THE PEOPLE OF THIS PLACE

Famed photographer Ansel Adams grew up near Lobos Creek, and his father enjoyed walking along the creek and over to Mountain Lake. Adams explored the length of the creek and remembers it this way:

It was bordered, at times covered, with watercress and alive with minnows, tadpoles, and a variety of larvae. Water bugs skimmed the open surfaces and dragonflies darted above the stream bed. In spring, flowers were rampant and fragrant. In heavy fog the creek was eerie, rippling out of nowhere and vanishing into nothingness.



FOR MORE INFORMATION

The National Park Service's website for the Presidio of San Francisco contains information about Lobos Creek Dunes, as well as many other sites in the Presidio. Go to www.nps.gov/prsf.

GOING DEEPER THE RESTORATION OF LOBOS CREEK DUNES

Fifteen years ago, this site was, in the words of one observer, a weedy, trashy back lot. It had been, most recently, an abandoned baseball field. Before that, it was the site of a balloon hanger; long, long ago, in the 1870s, it had been an army vegetable garden. Prior to this miscellany of human uses, the area was dunes and scrub—it looked something like it does today.

Then and now, a diminutive annual sunflower grew at the site. In 1985, however, very few of the San Francisco lessingia remained, and its potential demise focused attention on the Lobos Creek Dunes. To save this plant as well as meet a variety of other goals, the National Park Service and the City of San Francisco decided to restore the 13-acre site.

Garbage and weeds were removed, a few trees were felled, sand was added, and the land was recontoured. A boardwalk was built. Seed was collected from nearby sites and cultivated by hand. (To do this, an entire nursery was built, wholly by volunteers.) Over the last eight years, dozens of species of plants have been reintroduced to these new dunes, and the little lessingia has spread throughout the site. Where once there were only nineteen individual plants, now there are more than 100,000.

Restoration is not complete, however. Maintenance—that is, weeding and planting—continues as the new system becomes established. In a few years, the balance may be tipped in the favor of the dune plants. The weed seed bank will have been exhausted and the influx of new weeds brought in on the wind, deposited in bird droppings, or carried by mammals (including humans) will be relatively small and can be regularly removed.



Many hours of weeding and planting are represented in the restored scrub habitat at Lobos Creek Dunes.

SUCCESSION OF DUNE PLANTS

Change will continue to take place, however. A gradual process of plant succession is expected at Lobos Creek Dunes. Today there are patches of shrubs such as lupine, coyote brush, and sage, but there are also broad swaths of open ground where annuals sprout and grow. As time passes, more shrubs will establish. There will still be room for the lessingia, but eventually, shrubs will dominate. And given that there are oak trees growing so close by along the creek, it's possible that by the time our children have grandchildren, the dunes may be evolving into an oak woodland.



HOW TO GET THERE

You can take MUNI line 29 to Lobos Creek Dunes. Also, MUNI line 1 will take your class within a few blocks of the site.



MCLAREN PARK

Originally called Mission Park, McLaren Park was renamed in 1927, when it was officially dedicated by John McLaren himself. As superintendent of Golden Gate Park for more than fifty years, McLaren's influence looms large in parks throughout San Francisco, but the one that's named for him probably falls short of what he would have wanted. This may be the best thing about it.

McLaren Park is big, rambling, and a bit unkempt. The groomed gardens so common in Golden Gate Park can be found in some places here, but it could be argued that the park's broad grassy hills are even more compelling. At McLaren, there's space to roam, to search for ground squirrels and raptors, wander amongst wildflowers, and find snake skins. According to Natural Areas Program gardener Jon Campo, McLaren has the largest area of grasslands left in San Francisco. It also has several riparian areas where songbirds can be glimpsed amongst leaves and branches or ducks and coots can be watched at length on open water.

LOCATION

McLaren Park occupies a high ridge overlooking Visitacion Valley to the east. West of the park is the Excelsior District. Crocker Amazon Playground is adjacent to McLaren Park on its southwestern side. The Portola neighborhood lies to the north of the park; Silver Avenue is the main thoroughfare on the north side, and Geneva Avenue is the main road to the south. Three streets run through McLaren Park: Shelley Drive, Mansell Avenue, and Sunnydale Avenue. University Street runs along a portion of the eastern edge of the park and provides access to one of the most popular areas of the park, at McNab Pond.

FACILITIES

At just under 320 acres, McLaren Park is second only to Golden Gate Park in size, and offers all the usual amenities in a variety of locations. One unusual feature is the park's amphitheater, which can be found off Shelley Drive.



McLaren Park, 1926. Note the cow grazing on the hillside and the truck farms in the middle ground.



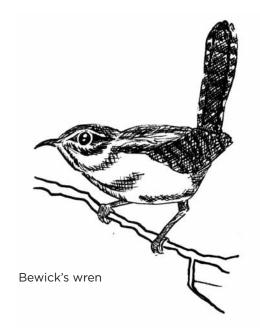
Planting cypress, ca. 1927. The hill in background is now Gleneagles Golf Course. The street in middle ground is probably Sunnydale.

BEST PLACE TO START

The best place to start is at McNab Lake. Not only is it an easy area to stage a group—it is close to parking and bus stops and has bathrooms, picnic tables, and a playground—but the riparian area surrounding the pond offers the best birdwatching in the park. For flowers in the springtime, the best places to visit are the Sunnydale Meadow near John McLaren School, the western intersection (as opposed to the eastern—there are two intersections) of Shelley Drive and Mansell Avenue, and the southern grasslands near Visitacion Valley Middle School.

WHAT YOU'LL FIND

Tree-planting began at McLaren Park before it received its current name and, like many San Francisco parks, this one has woods of eucalyptus, Monterey cypress, Monterey pine, and coast live oak scattered across it. Near the amphitheater, there is a grove of planted redwoods. One of the nicer grassland areas is relatively close to the amphitheater. Others are located in the southern half of the park, which has the larger grassland areas. McLaren Park straddles the divide between two watersheds. The Visitacion Valley watershed lies to the southeast and the Yosemite Creek watershed (also called South Basin) lies to the northeast. The line between them is more or less marked by Mansell Avenue. The headwaters of Yosemite Creek are at the northern end of the park, and this is one of McLaren's riparian areas. Unfortunately, as was the fate of so many wetlands, it



was filled in and is now degraded. Restoration of the site is currently being overseen by the city's Natural Areas Program. The area around McNab Lake is a better place to walk amongst willows and listen to the sound of slow-moving water. You might also see a Bewick's wren flitting through the shrubs in the area; McLaren is one of the few places left in San Francisco where this handsome bird nests. As a species most at home in the scrub, the Bewick's wren can sometimes be seen perched on an outermost branch, surveying its territory and singing melodiously.

SPECIES FOCUS CALIFORNIA GROUND SQUIRREL

The California ground squirrel's way of life has put it in direct conflict with humans, and there are few places left for it to live. Viewed as "a serious pest in agricultural areas," another concern is that "its digging and burrowing destroys irrigation channels and results in a loss of water." Another source frames the impact of the animal's activities a little more sympathetically, saying that in the past, ground squirrels have been "viewed as a hindrance to agriculture and ranching. They ate cattle and sheep forage, and their burrows could trip a horse or weaken a levee." Because of this, ground squirrels have been trapped and poisoned in many parts of California. In San Francisco, their habitat has mostly been paved.

Ground squirrels are the prairie dogs of the West Coast. They live in networks of underground burrows, but pop up outside regularly to survey their surroundings and sally forth in search of food—seeds, green grasses, and herbs. They tuck their findings in their cheeks, then run back to their burrows, where they can eat in safety.

Ground squirrels are diurnal (daytime animals) and can still be found at the Visitacion Valley meadow in McLaren Park.



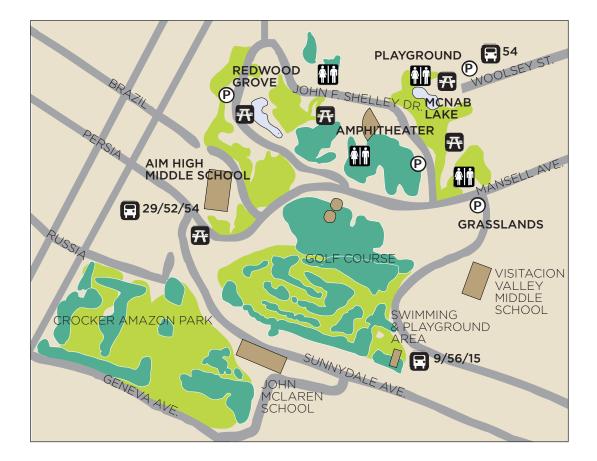
FOR MORE INFORMATION

The city's Natural Areas Program has published a brochure for McLaren Park that includes a thorough map as well as snippets about the inhabitants of McLaren's trees, grasslands, scrub, and wetland areas.

Friends of McLaren Park has a web site (*www.jennalex. com/projects/fomp/homepage/index.html*) that includes plant and bird lists for the park. Select "Features" and then look for links to the species lists.

Kids in Parks, a nonprofit organization that helps San Francisco public school students explore urban parks, runs programs at McLaren. Specifically, they take middle school science classes on bi-weekly field trips to the park, providing students and teachers with a year-long sequential program. For more information, go to *www. kidsinparks.org.* Kids in Parks is sponsored by the San Francisco Parks Trust.

The Wilderness and Arts Literacy Collaborative, an environment-based academic program at Balboa and Downtown Continuation high schools, does habitat restoration work at McLaren. They say: "To truly feel a connection to nature, we must learn how to care for a specific place. For us, McLaren Park is that place." To find out more about what they're doing, go to *www. walcsf.net.*



HOW TO GET THERE

MUNI line 29 runs through John McLaren Park on Mansell Street. Line 54 will take you to the northeastern corner of the park and also travels along Felton Street one to three blocks from the northern edge of the park. MUNI line 52 will take you within a block or two of the western edge of the park. If you are headed for the southernmost portion of the park, try lines 9 or 15.



MOUNTAIN LAKE PARK

Lake Street is almost certainly named for Mountain Lake, one of San Francisco's few remaining natural bodies of fresh water.

LOCATION

Mountain Lake Park stretches from 8th Avenue to Funston Avenue, stopping just short of Park Presidio Boulevard where it heads into the tunnel. The lake itself is wedged into the corner created by the intersection of Lake Street and Park Presidio Boulevard. The park lies along the southern boundary of the Presidio and is managed jointly by the National Park Service and the San Francisco Recreation and Park Department.

FACILITIES

In the last five years, the National Park Service has undertaken an enhancement program at the lake—contractors, staff, and volunteers have replaced exotics with indigenous plants, improved trails, and installed new benches and signage. The city maintains the southern edge of the park, where most of the recreational facilities can be found. At the west end, there's a newer playground with sculpted concrete slides, swings, and a big play structure, as well as tennis courts, picnic tables, and a bathroom. The east end of the park is a popular dog play area; in between is a wide trail, tree-studded lawns, and the occasional bench or cluster of tables. A trail runs around the lake and connects to other trails in the Presidio. Another broad trail runs along the south side of the park, parallel to Lake Street, from Funston to Arguello.

BEST PLACE TO START

Start at the main entrance, on Lake Street at 12th Avenue. This is where the picnic tables, play structures, and bathrooms are. There's direct access to the water here, and there are usually a few shorebirds hanging about.

WHAT YOU'LL FIND

Mountain Lake is a small freshwater lake. It has both wetland and riparian woodland vegetation. Much of the lake is edged with tule and cattail. There are thickets of riparian shrubs, many of them planted by the park service within the last five years as a part of the Mountain Lake Enhancement Project. There's a willow grove on the east side and an overstory of exotic trees ringing the lake.

Red-winged blackbirds, Brewer's blackbirds, and house sparrows are frequently near the lake shore, as are big waterfowl such as great blue herons and double-crested cormorants. Raptors, including the red-shouldered hawk, use the big trees around the lake. On the water, you'll see American coots and mallards. In the water are fish, turtles, and frogs bullfrogs, to wit—and red-eared slider turtles, carp, catfish, mosquito fish, and spotted bass.



Many generations of San Franciscans have enjoyed Mountain Lake Park. This group took in spectacular views of the lake during a 1973 outing.

There are, of course, countless smaller organisms living in the waters of Mountain Lake. The California Academy of Sciences worked with students and adult volunteers to monitor, among other things, the zoo-plankton in the lake; according to one volunteer who posted their findings on his blog, water fleas and copepods are the most numerous. The Mountain Lake Monitoring project was designed to "monitor and document water quality and various biological parameters at the lake prior to, during, and after the completion of the Enhancement Plan." Participants measured the water quality of the lake as well as counted the park's reptiles, amphibians, and birds.

ISSUE: SHOULD MOUNTAIN LAKE BE DEEPER?

At only 10 feet deep, Mountain Lake could very likely be filled in by sediments and plants within the next few decades. This process is a natural one, but it has been accelerated in the case of Mountain Lake by the dumping that took place when the Presidio Tunnel was being built.

The park service's Mountain Lake Enhancement Plan calls for the lake to be deepened. This will be done by dredging; the lake bottom will be scraped and dug out, and the material that is removed will be hauled away.

In choosing to deepen the lake, the park service is selecting some natural resource values over others, an inevitable aspect of any land-management action. The gardener who plants vegetables is choosing some plant species over others. When we pave a path, we are choosing some values—ease of maintenance, ease of passage—over others, such as leaving the soil open so more water can soak into the ground.



Eutrophication

The rationale for deepening Mountain Lake is to keep the lake as a lake, to restore certain fish species, and to increase the lake's visual appeal. Deeper lakes are cooler, which makes them more hospitable to fish such as trout. Cooler water also favors some of the insects that trout feed on. Deeper, cooler lakes are clearer. Their water is more blue, as opposed to the green color one often sees in ponds and shallow lakes.

On the other hand, a shallow lake is generally considered to be more fertile. That greenish color comes from algae and phytoplankton, organisms at the bottom of the food chain. As they thrive, they support other organisms. While some species may not be able to survive in the warmer waters of a shallow lake, it nonetheless favors a great deal of life. Depending on their productivity, lakes are often classified as *oligotrophic* ("few foods") or *eutrophic* ("good foods"). Mountain Lake is a eutrophic lake.

All lakes tend toward eutrophication. The accumulation of sediment and nutrients over time—the shallowing of the lake—is a natural and inevitable process. At Mountain Lake, that process was altered by humans more than fifty years ago, and we are now preparing to alter it again.

There is no right or wrong in this case, but there are different approaches. Which one would you choose?

FOR MORE INFORMATION

The Shaping San Francisco website has several very interesting pieces about Mountain Lake and the moment of contact. To view them, go to *www.shapingsf.org.* Search for text that contains all the words "Mountain Lake," then select the links to the documents entitled "First Contact" and "Indigenous People and the Land."

As part of its monitoring program at Mountain Lake, Cal Academy has posted a short bibliography of resources related to the site. Find it online at www.calacademy.org/research/library/biodiv/biblio/ mtlake.htm.

GOING DEEPER MOUNTAIN LAKE AS BOUNDARY— AND MEETING PLACE

Mountain Lake has long marked the southern boundary of the Presidio. When President Millard Fillmore signed an executive order reserving the Presidio for military uses in 1850, the Presidio's boundary was defined as "passing by the southern extremity of a pond (presently known as Mountain Lake) that has its outlet into the channel between Fort Point and Point Lobos." That channel was Lobos Creek, though now the lake and creek are

separated by Funston Avenue and Park Presidio Boulevard.

The lake was also the ending point of Juan Bautista de Anza's 900-mile walk from Arizona to California to found a northern outpost for Spain. His party camped at the lake in March 1776, having decided that the area just to the north would be a good site for the establishment of a military settlement—the Presidio. A sign beside the lake and a brass plaque set in stone nearby commemorate the event.

As the site where European settlement of San Francisco began, Mountain Lake has become a focal point for speculation and commentary regarding contact between the land's first people, the Oblone, and the settlers who c

Ohlone, and the settlers who came after them.

CULTURE CONFLICT

Many accounts of Ohlone/European contact tell a dire story of coercion and dissipation: the indigenous culture

and peoples were decimated by settlers who carried disease and forced foreign beliefs and technologies on an innocent people. While this is true, it is not the whole story. The Ohlone must certainly have felt threatened by the arrival of Europeans, but they may also have been fascinated. Who were these strange people who came on horses, with squeaking leather boots and saddles, the metal on their gear and clothing glinting in the sun? Many Ohlone were forced to abandon their way of life, but some may have chosen to leave it willingly. And there were probably many for whom the path lay



cultures that Anza and the Ohlone experienced. Perhaps now, though, there is a greater possibility for peaceful coexistence.

somewhere in between. The moment of contact

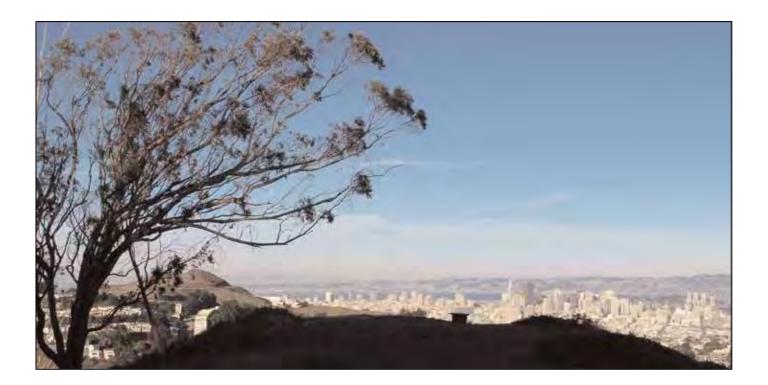
between Anza's party and the local indigenous people provides an opportunity to consider the meeting of two cultures-the sort of meeting that can now take place a hundred times a day in San Francisco. People from different cultures encounter one another all the time in the city. But we also have ways of staying apart, by living in different parts of town, by associating with friends and family members who are like us. It is hard to cross boundaries of class and color and experience. It is hard to understand people who are different than we are. We still experience the clash of



HOW TO GET THERE

MUNI lines 1 and 28 will drop you off a few blocks from Mountain Lake. MUNI lines 2, 38, and 44 will get you within walking distance of the lake.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/MOUNT DAVIDSON



MOUNT DAVIDSON

San Francisco historian Greg Gaar has suggested that Mount Davidson, which was originally called Blue Mountain, was first named for the many blue-flowering herbs and shrubs that once bloomed on its slopes. This includes Douglas iris, which is still prevalent on the mountain.

It might have also included a shrub called blue-blossom (*Ceanothus thyrsiflorus*), which, according to the authors of the 1958 *Flora of San Francisco California*, "once crowned [most of] the hilly summits in the western part of the city." The mountain's present name honors George Davidson, an early surveyor of the California coast and one of the founders of the California Academy of Sciences.

LOCATION

Mount Davidson is the high heart of the Miraloma district, defining all the streets that surround it. (A stretch of Dalewood Way, which abuts the park, is said to be one of the steepest streets in a city known for steep streets!) The park lies directly west of Glen Canyon and O'Shaughnessy Boulevard and just south of Portola Drive.

FACILITIES

To borrow a description from the Natural Areas Program management plan, facilities at Mount Davidson include "trails, access roads,... Work Projects Administration (WPA) stairs and retaining walls,... and the cement cross (owned by the Council of Armenian-American organizations of Northern California)." There are benches and a grassy open area at the summit, where it would be easy to stage activities with students or sit down for lunch. There are no toilet facilities in the park.

BEST PLACE TO START

Start at the trailhead on Dalewood Way just west of the intersection of Dalewood and Molimo. From here you can do an easy three-quarter-mile loop that goes over the summit and passes through all the different plant communities on the mountain.



pre-Spanish settlement landscape. Here, a variety of plants grow in the nooks and crannies-indigenous species outnumber the exotics by almost two to one. Especially notable among them is the Nootka reed grass, a big bunchgrass that grows along the Pacific Coast from Alaska to Northern California. San Francisco is near the southern end of its range, which ends in the Monterey Bay area. Another special plant here is the huckleberry. It can only be found in a few places in San Francisco. Mount Davidson is one of them.

View of Twin Peaks from Mt. Davidson, 1903; Nootka reed grass in the foreground.

WHAT YOU'LL FIND

At approximately 930 feet tall, Mount Davidson is the highest peak in San Francisco, but it is best known for the great white cross that surmounts its summit and adds another 100-plus feet to its height.

Mount Davidson Park is a study in contrasts—or a study in two ecosystems. Two-thirds of the park is a eucalyptus forest that Adolph Sutro had planted by workers and schoolchildren. The understory is predominantly Himalayan blackberry. There's also English ivy and Cape ivy in these woods. While more than 40 indigenous species persist on this side of the park, much of this urban forest is what ecologists call a *depauperate* environment—an impoverished one. In many places, only a few species take up most of the space. There is little diversity.

The eastern side of the mountain, on the other hand, is treeless and incredibly diverse. It marks the edge of Mr. Sutro's plantings and is a sizeable remnant of San Francisco's earlier,

FOR MORE INFORMATION

The website of the San Francisco chapter of the California Native Plant Society has great information on a variety of plants, including Pacific reed grass. Go to *www.cnps-yerbabuena.org*. Select the "Rarities" link and scan the list for Pacific reedgrass.

Restoration gardener Judith Larner Lowry sells a lovely grasses poster through her seed business. It can be viewed online at *www.larnerseeds.com/_pages/tools.html.*



View of Twin Peaks from Mt. Davidson. 1923. Twin Peaks Boulevard and Portola are plainly visible, as well as Market Street and downtown San Francisco.



Mt. Davidson, taken from the eventual site of Lincoln High School, 1937. Dune tansy and dune scrub are visible in the foreground.



Mt. Davidson, 1940s. This is the slope near the Dalewood and Landsdale bus turnaround. Note the girls picking mustard.



Mt. Davidson seen from Glen Canyon across O'Shaughessy Boulevard, ca. 1940.

GOING DEEPER GRASSES AND GRASSLAND

If you had to choose one family of plants that stands out above others for versatility, utility, and general success in the world, it would likely be the grasses. They are the most widespread plants, growing from the arctic tundra to the equator and many places in between. They are the most important foods in the world, providing humans and our livestock with wheat, oats, corn, rice, millet, and other grains. And, in the form of lawns, grasses are the most beloved plants of many a homeowner and recreational facility operator.

Grasses have the uncommon ability to resprout when cut or torn. We take this for granted—mow the lawn and it grows again—but there are few other plants that can survive such treatment repeatedly. Before lawnmowers, there were herbivores—elk, antelope, deer, caribou, rabbits, and the like—who grazed the world's pre-historic grasses; it is very likely that grass's ability to grow after having been cut is an evolutionary response to having been nibbled upon in the past.

Of the grasses in California today, a line can be drawn between annuals and perennials. This is really a line between pre- and post-Spanish settlement. Eighty percent of California's native grasses are perennials—they live for many years—but most of the grasses growing wild in California today

are annuals; they flower, set seed, and die in a single year.

A great conversion took place in the early 1800s when the Spanish imported farm animals and began to graze cattle. At the same time that land was being put to a variety of new uses—gardening, farming, and grazing—a variety of new grass species were being introduced. As botanist Richard Beidleman describes it, "the seeds of exotic grasses arrived with hay, ballast, mattress fillers, and clothing, as well as in the hair of farm animals. Some species, moreover, were planted intentionally, either as crop plants or for landscaping...." Almost in the blink of an eye, California's perennial grasslands were turned to fields and pastures of exotic annual grasses. Their look stayed somewhat the same, but their composition was radically changed.

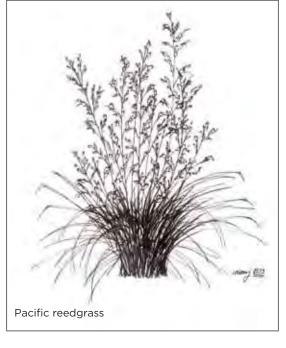
Our wildflowers, which are mostly annuals, fared a bit better. They can be found in some places where the perennial grasses have gone over. In a few spots, the perennial grasses are still holding on. A knowing eye can find them in many of San Francisco's natural areas, including Glen Canyon, Twin Peaks, Bernal Hill, Bayview Hill, and—Mount Davidson.

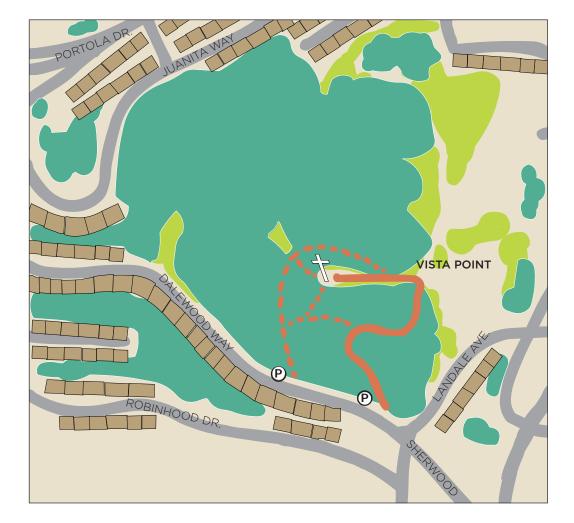
> The signature perennial grass on Mount Davidson is Pacific reedgrass, and it's not hard to spot. It's a big grass, growing up to 4 feet tall. Like most of California's perennial grasses, Pacific reedgrass is a *bunchgrass*—it grows in clumps or bunches.

Most bunchgrass stems and blades grow vertically, then arch gracefully as they get longer and gravity bears upon them. The blades form the characteristic tufts or clumps. The stems stay erect longer, for they are holding small flowers up to the wind to be pollinated. Once seeds have formed, their weight or shape changes the look of the flowering stem. Eventually, it will dry out and break off,

but the blades—the bunched-up body of the plant—will live for many years. After setting seed, bunchgrasses go dormant, waiting out the driest part of the year. When the rains come, they slowly awaken, putting on new growth and sending out flower stalks once again.

Other perennial bunchgrasses that can be found in San Francisco are California oat grass, purple needlegrass, and red fescue.





HOW TO GET THERE

Access to the park is off Juanita Way, La Bica Way, Molimo Way, and Dalewood Way. MUNI Line 36 will bring you to the southern tip of Mount Davidson and near its eastern edge. Lines 43 and 48 run near the park's northern boundary.



OCEAN BEACH

For as long as there have been tourists in San Francisco, Ocean Beach has been a destination. It has the allure of any beach—the lull of rolling waves and breaking surf, the unimpeded view to the western horizon—but its extent is a wonder in itself. Eight miles long, Ocean Beach defines almost the whole western edge of the city.

As part of Golden Gate National Recreation Area, Ocean Beach is enjoyed by beachgoers, surfers, and countless shorebirds. Two words of caution, though: rip tides. Waders and swimmers have been swept out to sea and drowned by the powerful currents flowing away from the beach back to the ocean.

LOCATION

Ocean Beach stretches from Land's End to Fort Funston. The street that intersects its northern end is Balboa Avenue; its southern end is marked by Sloat Boulevard (though the beach itself continues unbroken beyond the city and county line). It is bordered immediately to the east by the Great Highway.

FACILITIES

The main entrances to the beach are at either end. There is a paved walkway paralleling the beach beside the Great Highway, so on foot, access to the beach can be had almost anywhere. There are bathrooms at the Sloat Avenue entrance.

BEST PLACE TO START

Depending upon where you're coming from, start at either the north or south end. Plan to visit more than once a year because the look of the place changes with the seasons. Winter storms can remove two or three feet of sand from the beach, revealing old pilings, buried slabs of stone, and so on. During summer, sand builds up, again changing the profile of the beach and its inhabitants.



This historic postcard portrays Ocean Beach as a popular destination for San Franciscans.

Digging in the sand is another way to explore beach life—a host of burrowing animals find security in the sand beneath the pounding waves. Bristle worms are a likely find, as are various clams. Many of the burrowing bivalves, such as the razor clam, feed by means of a siphon tube that they extend up to the surface.

Depending upon the time of year, you may see shorebirds digging in the sand or quickly running across it, following the edge of the surf. Sanderlings feed at the foamy edge of the water; the larger willets, whimbrels, and godwits probe the sand with their long bills.

WHAT YOU'LL FIND

Ocean Beach is broad, flat, open—and empty? Not exactly. Here is an ever-changing scene shaped by wind and tides. The sandy expanse invites bare feet and beachcombing—all sorts of shells, pebbles, and bits of this-and-that can be found lying about. "Crab remains are common," says Elna Bakker in the seashore chapter of her wonderful book, *An Island Called California* (University of California Press, 1984). You're likely to find sand dollars, too, she reminds us. Each one, when, alive, "was bristly, much like its cousin the sea urchin whose globelike casing is also part of beach debris."

The piles of seaweed that one often finds after storms enclose whole worlds, particularly if they have just been washed up. Newer piles may include animals that live offshore amidst kelp and other seaweeds, or that normally cling to rocky shorelines. Sea stars and kelp crabs, even baby octopus can be found from time to time. As the piles dry and the stranded creatures die, the decomposers move in. You'll certainly see sand hoppers, small crustaceans that look like pinched pill bugs and have a penchant for jumping. Also present amidst the sea wrack is another similar group of crustaceans, the isopods. They are closely related to—and even more closely resemble—our terrestrial pill bug.



Today, Ocean Beach is still popular, but automobiles have replaced the horse-drawn carriages.

GOING DEEPER SAND, SAND, AND MORE SAND

The word beach refers to the part of the shore that stays dry most of the time, the zone between the high tide line and the first dune. You might also hear the beach called coastal strand—technically, a term that refers to both the beach and the near dunes.

In all these locations, sand is the main motif. Sand is a category of size rather than a type of rock; the dictionary defines it as "finer than gravel and coarser than dust." Any kind of rock can become sand, but some are ground to this size more easily than others.

Most Ocean Beach sand is white, bleached by the sun and polished in the surf. The grains are primarily quartz and feldspar, two abundant minerals. The rest, perhaps 20 to 30 percent, are heavy minerals; these are concentrated in the black sands that accumulate just above the swash zone—that area where waves charge up and down the shoreline. Hold a magnet to these sands and the grains snap into alignment. They contain iron.

Wind, too, influences how sand grains line up. Waves deposit sand on the beach, but wind carries it overland and sorts it according to size. Heavier grains drop out sooner. Smaller, lighter grains are carried farther. Over the last 3,000 to 5,000 years, the sands of Ocean Beach were carried all the way across the San Francisco peninsula, and Ocean Beach once stretched miles inland.

SAN FRANCISCO'S GREAT DUNES

Unlike Sutro Heights to the north and Funston to the south, where the beach is backed by cliffs and bluffs, Ocean Beach is open to the east. Because of this, and because of the strong winds that come in off the ocean, a huge dune system built up beyond the beach, eventually covering more than 20 square miles of the San Francisco peninsula. The entire western flank of the city—the Marina, Presidio, Sunset, Richmond, and Haight districts—is built on sand dunes.

In his 1967 book *The Natural World of San Francisco* (Doubleday), Harold Gilliam eloquently describes the movement and historic extent of the city's dunes:

As the sand moved up from the ocean, filling canyons and leveling valleys, it created the smooth slopes of



the Richmond and Sunset districts. The high area in the Richmond now occupied by George Washington High School, for example, is a volcanic outcrop surrounded by drifted sand. Farther south the sand flow encountered the long north-south ridge known as Sunset Heights, or Golden Gate Heights—consisting mainly of chert. So powerful and persistent was the sea wind that it carried the sands up the ridge several hundred feet. At some points, the flow rose entirely over the ridge at the extraordinary height of six hundred feet and spilled down the leeward slope toward Laguna Honda canyon, creating drifts that sometimes still give trouble to residents of houses

built in that area.

Protected from the flow by this barrier, Mount Sutro and most of Twin Peaks are relatively free of sand. But in the unprotected low-lying valleys to the north now occupied by Golden Gate Park and California Street, the flow was abundant. The moving sand hit a volcanic outcrop at Buena Vista Peak, rose five hundred feet to the peak's top, and spilled down the lee side toward the valley of the Mission District. Most of the Mis-

sion, sheltered by the Twin Peaks-Mount Davidson Ridge, escaped the sand flood. Farther north the sand drifted through Hayes Valley to the Civic Center area in tremendous quantities. The City Hall is built on sand eighty feet deep.

In the eastward or leeward part of the city, where the wind is less powerful, the sand flowed around, rather than over, the higher areas of Russian, Nob, and Telegraph hills, but in such low areas as Polk Gulch and the valley now occupied by Market Street, the flow was unobstructed. Near the site of the Palace Hotel, it created a large dune that impeded travel in Gold Rush times, forcing traffic for Mission Dolores to detour to the south. The dune had to be leveled when Market Street was built.

To the can-do immigrants who became San Franciscans, the dunes were obstacles to be overcome. The city was growing and the sand would just have to be dealt with. This was nowhere more true than at Golden Gate Park and Ocean Beach.

continues next page

continued from previous page

THE INTRODUCTION OF EUROPEAN BEACH GRASS

To still the moving sands that perpetually threatened his new park, William Hammond Hall studied how dune reclamation had been undertaken

in other parts of the world. Based on this research and the advice of a man who had grown up in the dune lands of southwestern France but now owned land near the boundary of Golden Gate Park, Hall decided to plant European beach grass at the back of Ocean Beach, along what is now the Great Highway. Using brush and existing walls, he created a high sand bank into which he planted European beach grass. This reduced the inflow of new sand across the rest of the park. It worked wellperhaps too well, given what we know today.

Before the introduction of European beach grass, the foredunes—the area just before the dunes, where storm waves rarely reach—were dominated by open stands of Pacific beachgrass. Like its European relative, Pacific beach grass spreads by means of an underground stem called a rhizome. The rhizomes of both species can grow up to almost 6 feet a year, but the rhizomes of European beach grass grow vertically while those of Pacific beach grass grow horizontally. This enables the European beach

grass to survive in deeper drifts of sand. It can withstand burial of more than three feet annually, while Pacific beach grass can only tolerate being under about a foot of sand.

This single detail has resulted in multiple changes in the look and shape of Ocean Beach and its dunes. To begin

with, sand collects around European beachgrass in taller, steeper mounds than it does around Pacific beachgrass. Also, European beachgrass grows more thickly. In the areas where Pacific beachgrass grows, the hummocks where the sand collects around the plants—are lower and more rounded, and there's more open space between the plants.



Pacific beachgrass. Note the open space between plants.



European beachgrass tends to grow thickly and sand forms steep mounds around it.

This change in architecture has, in turn, had an impact on wildlife. It has been documented that there are fewer insects in foredunes dominated by European beachgrass. In addition, the decline of western snowy plover has been linked to this plant. This small, pale-colored sandpiper nests on the ground. Previously, it made its nests in the sparsely vegetated foredunes of Pacific beachgrass. Where European beachgrass has taken over, the plover must roost in front of the foredunes, where it is more exposed and vulnerable.

Last but not least, European beachgrass does what William Hammond Hall wanted it to do—it keeps sand in place. Because it creates taller foredunes, and because it can tolerate deep burial, European beachgrass prevents sand from being blown off the beach. For the neighborhoods just east of Ocean Beach, this may be a good thing. But for the natural areas where one set of processes has been replaced by another, it is perhaps a loss. At Point Reyes, for example, sand dunes

several miles inland have stabilized—they've stopped changing and moving—because of the European beachgrass growing to the west.

FOR MORE INFORMATION

The city's Department of the Environment has a web page about Ocean Beach. The beach's history, geology, and ecology are covered at *www.oceanbeachsf.org*.



HOW TO GET THERE

There are parking spaces and bus stops at the intersection of Balboa Avenue and the Great Highway, and likewise at Sloat Boulevard and the Great Highway. A great many MUNI lines will take you to various parts of Ocean Beach, including Lines 5, 18, 23, 31, 38, 48, 71, and the N. The L line will get you quite close to the southern portion of Ocean Beach.



SOMA RECREATION CENTER

This site goes by two names. The older one is "Gene Friend Recreation Center"; you'll see this on the green city park sign posted outside. A newer plaque inside the building, and recent maps, call the site "SOMA Recreation Center." Either way, this is a popular, recently renovated community center with a bright, pleasant park at its side. A short walk from the park, you can see the effects of what geologists call *subsidence*. Bit by bit, the ground beneath many buildings in this neighborhood is slowly shifting and sinking.

LOCATION

SOMA Rec Center is located between 6th and Harriet streets, along Folsom Avenue. The address is 270 6th Street.

FACILITIES

Near the rec center there are two play structures, swings for tots, and a sand lot bordered with large mosaic sculptures kids and adults can relax and play among cactus, an alligator, a big purple fish with yellow lips, and other fanciful creatures.

Opposite the play area is a basketball court; there's another one indoors, in the rec center. There are also Ping Pong tables inside, as well as a weight room and a community meeting room with a small stage. Toilets are, of course, available indoors.

BEST PLACE TO START

The front door of the rec center is on 6th Street, but the entrance most people use—both for the park and the rec center—is a wide gate on Harriet Street.

WHAT YOU'LL FIND

Palm trees line the Harriet Street entrance and accent the lawn on the Folsom Street side of the property. A paved walkway frames the lawn, leading to benches set in flower beds. The street-side edges of the yard are lined with familiar sturdy



Folsom between 6th and 7th, 1926.

plants such as lily-of-the-Nile, but some beds have been planted with less common bushes whose bright flowers, pleasant fragrance, and varied textures are pleasing to all the senses. Rub a lavender leaf between your fingers to release its soothing scent. Feel the fuzzy leaves of licorice plant. You are also likely to see chestnut-backed chickadees and house sparrows in these bushes, or perched in the trees along Folsom Street.

Opposite the entrance to the rec center on 6th Street is Clementina Street, a narrow alley that intersects 6th. The next street to the left (north) is Tehama, which runs parallel to Clementina. Take a walk down Tehama Street to see one example of how the natural world can influence our built environment.

It is well known that during the 1989 Loma Prieta earthquake, buildings in the Marina District were badly shaken, but the area that suffered the most damage was from 5th to 8th streets between Mission and Townsend. The same was true in the 1906 earthquake when, according to the late Clyde Wahrhaftig, a San Francisco geologist, "permanent waves as much as five feet high were left in the streets and sidewalks" of the SOMA District. The surface shook and rolled so much because it consists of loose rock—or mud, to be more exact. The old tidal marshes that extended inland from much of Mission Bay were not rock at all, but soft, water-soaked soil that is subject to much greater shaking during an earthquake. As is explained in the geology section of this guide, such unconsolidated ground can amplify shaking by as much as ten times.

An earthquake provides quick, cataclysmic evidence of the consequences of building on soft ground, but the slow passage of time can also demonstrate its effects. Walk to the house at 481 Tehama Street. It has what Wahrhaftig called a "photogenic tilt"—it's tipping

back, away from the street, as the ground beneath it slowly gives way under its weight. At number 473, a light blue building with yellow doors, compare the level of the window and doors to the sidewalk—they're the same. In the building





Folsom Street, looking east from 6th, 1925.

at numbers 451–453, the side doors are easily 3 feet below the sidewalk. Windows that once looked out over the street are below it, and are now boarded up, an ad-hoc retrofit in plywood and cast iron.

EXPANDING YOUR FIELD OF KNOWLEDGE

Inevitably, as you make observations, questions will arise. Finding answers requires follow-up. Talk about what you've observed outside—you might be surprised by how many people are interested. Track down other naturalists and pose your questions to them. Look for books, magazine articles, films, and TV shows on topics that pertain to your experience. Formulate your questions in ways that you can answer through further observation or simple experimentation. Your field experience will be greatly enriched by maintaining your curiosity once you come inside.

DOING NATURAL HISTORY: AN EXAMPLE

John Alcock, entomologist and author of *In a Desert Garden: Love and Death Among the Insects* (Norton and Company, 1997), models the process of making observations, asking questions, and finding answers as he investigates the activities of native bees in his garden.

A flurry of movements in and around the dried flower stalks of the big brittlebush in the middle of the yard catch my eye, and I wander over to see what's up. There I find a mob of small native bees flying from flower stalk to flower stalk. Individuals drop out of the "swarm" to settle on the outer parts of stems, often where other bees have already perched....

I am delighted because what I have here is a sleeping cluster of male bees, which I later learn from bee biologist Wallace LaBerge belong to the species *Idiomelissodes duplocincta*. Males of these bees can be identified by their unusually long and supple antennae. When I come out again in the dusk, all the bees have settled down and rest immobile in the growing darkness. They will spend the night together....

I feel privileged to have acquired a sleeping bee aggregation in the front yard. It is an odd phenomenon that cries out for investigation, and what closer laboratory for behavioral research than my own front yard? I have three questions I'd like answered. First, why are the sleeping bees a males-only club?...

The question... takes me first to the library to hunt for published information on the genus *Idiomelissodes*. My search yields a single paper in the *Pan-Pacific Entomologist* written in 1975 by T. J. Zavortink, who reported that females collect pollen from barrel cacti, an interesting observation but not entirely pertinent to my quest.... Fortunately, bug watchers working in many places and seasons have over the decades accumulated a good deal of information on bee species closely related *Idiomelissodes duplocincta*.

To answer his second question—"Do the same males return to the same brittlebush, perhaps the same dead flower stalks, from night to night?"—Alcock marks some of the sleeping bees with dabs of paint and then makes note of how many bees return and where they settle. After that, he fiddles with the flower stalks, switching them with scissors and masking tape. To find out what Alcock's third question was, and what he learned, you'll have to read the book.



A young naturalist examines a pill bug she found in a parking lot.

FOR MORE INFORMATION

Nature journaling is almost a genre; you'll find both new and used books on this topic. Its leading lights are Hannah Hinchman and Clare Walker Leslie. Both are artists who emphasize the value of drawing as a tool for observation, learning, and self-awareness.

Most of the older UC Press field guides include an "Activities" section that offers tips for how to make and record field observations. See, for example, *Reptiles and Amphibians of California* (Stebbins, 1972) and *Natural History the San Francisco Bay Region* (Smith, 1981).

Almost 100 years ago, Joseph Grinnell, first director of the Museum of Vertebrate Zoology at UC Berkeley, developed a note-taking system that naturalists still use today. Its rigorous approach does not appeal to everyone, but it is worth knowing about. One account of the Grinnell method appears in an article written by ornithologist Van Remsen, in the journal *American Birds*. Here's the citation: Remsen, J. V., Jr. 1977. On taking field notes. *Amer. Birds* 31: 946-953.

The Sierra Nevada Field Campus of San Francisco State University, located near Downieville, offers summertime classes for the general public and usually includes a three-day course on keeping a naturalist's notebook. This course provides an excellent introduction to the many ways of recording your observations of the natural world. To find out more, go to *www.sfsu.edu/~sierra/*.

GOING DEEPER DOING NATURAL HISTORY ANYWHERE

The focus of this guide is San Francisco's parks and natural areas—the places where some bit of nature has been preserved or cultivated—but it's possible to "do" natural history anywhere. Though it may be less obvious on a city street than in a park, something of the natural world is always available to us, no matter where we are.

Simply put, the practice of natural history is one of observing and learning about the world around us.

The goal is discovery. The means is independent observation. There is a wonderful sense of relaxation and release that comes from paying attention to goings-on in the natural world.

Getting restless minds and bodies to settle down and focus, however, can sometimes be a challenge. What's more, according to Clare Walker Leslie, who has published several books about sketching from nature, when students are just starting out, they can be "overwhelmed by all there is to see."

"To help them begin," she writes, "I will often

set a structure: Find four things that live here and help describe this habitat; four things that characterize this season...." Leslie also asks students to draw these things in a notebook.

MAKING MEANING

Keeping a field notebook is one of the best ways to begin to tune in to the natural world. Not only does the act of recording what you see—in words or pictures or bothsharpen your perceptions, but, in Leslie's words, each "moment of watching, examining, and recording adds significance to our own lives."

A field notebook provides a framework for making regular observations over time. "Children seem to love particularly to keep journals describing different things from week to week," Leslie writes. She recommends paying attention to details. "Did you ever record the stages of tree buds unfolding and wonder about plant growth?" she asks. Small events such as these, Leslie says, "are exciting for the doors they open to learning more about

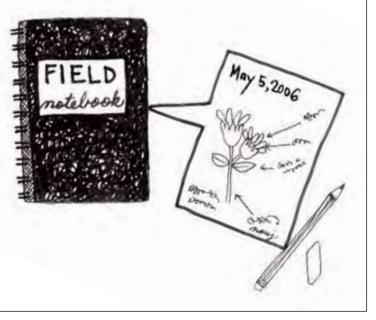
> nature. Your learning can be enlarged not only by watching, but also by questioning... what is happening."

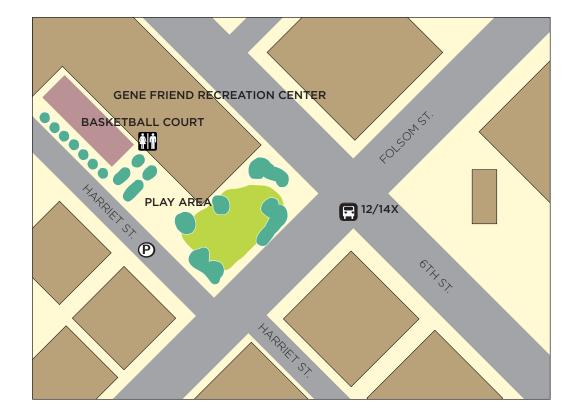
> Each entry in your notebook should include certain information. Make note of the date, time, and location. Describe the weather. It often helps to look at the sky—the act of looking up, into the infinite, can subtly shift moods and open minds.

Drawing is also an excellent way to become more engaged. The act of drawing helps you notice more and notice differently.

It doesn't matter if the drawings are good or even much of a likeness—it's about the process. And don't forget maps. Encourage (or require) your students to draw a map of the site or the route you've taken.

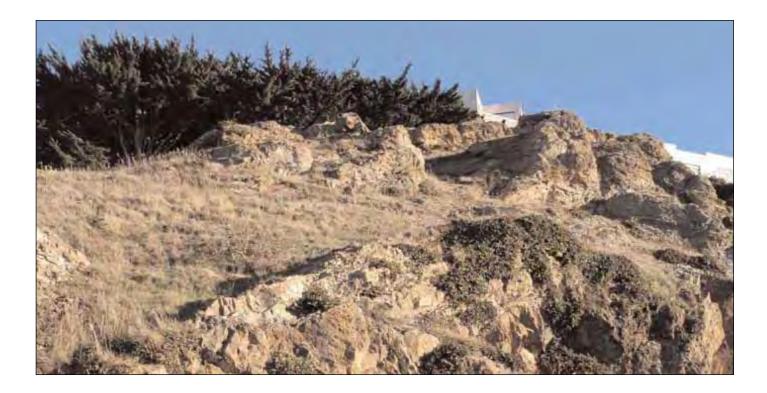
While paper and pencil are your primary field tools, binoculars and a hand lens can also be very helpful. They expand your field of vision and open up worlds at scales that humans don't normally experience.





HOW TO GET THERE

MUNI line 12 runs past the SOMA Recreation Center on Folsom Street. MUNI lines 14, 19, 26, 27 and 47 all come within a quarter-mile of the site.



SUNSET HEIGHTS

Just east of 19th Avenue in the Sunset District, the streets go funny. The orderly grid is disrupted by a line of tall hills and bare rocks. This is the western edge of a swath of chert that runs through the center of San Francisco. But there's more than just outcrops along this ridge. Sand from the ocean's edge, carried inland by strong winds for thousands of years, has overtopped these hills. Here, 2 miles from the ocean, you can climb 700 feet above sea level and still be walking on sand.

LOCATION

This western ridge shows up in a series of parks and natural areas—15th Avenue Steps, Grandview, Rock Outcrop, Golden Gate Heights, and Hawk Hill—that follow a north-south line in the Sunset Heights neighborhood, starting at 15th Avenue and extending almost to Taraval Street. Precise locations and access points are given in each site description under "What You'll Find."

FACILITIES

Most of these sites are natural areas—lands preserved for their value as wild places rather than for recreational use. Golden Gate Heights is the exception; it is a developed park with paved paths, picnic tables, and toilets.

BEST PLACE TO START

Where to start depends on how much time you have. Each site can be visited individually, or, if you have more time, you can walk through several of them. The 15th Avenue Steps, Grandview, and the Rock Outcrop are in close proximity; Golden Gate Heights and Hawk Hill are more distant and each is probably best visited on its own.

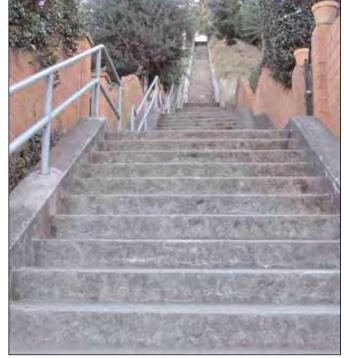
WHAT YOU'LL FIND

Notable features for the sites as a whole include sandy soils and rocky outcrops, a small oak woodland, a bit of coastal prairie, and beautiful examples of the dune scrub that once covered much of western San Francisco. Hawks circle the hills, songbirds forage in the scrub, and lizards can sometimes be seen skittering across the sand. Things to notice in each park are described below, starting from the north and moving south.

15TH AVENUE STEPS

The steps connect Kirkham and Lawton streets at 15th Avenue. Your best bet is to begin at Kirkham and climb up the

steps. On either side, you'll find a brushy hillside—a bit of dune scrub in which California blackberry predominates. Here, it twines with poison oak and wild cucumber, while the tall stems of California bee plant reach out over all of them. While it would be hard for humans to walk through this brushy growth, many birds find it an easy place to move about, hopping from branch to branch within its shelter. Whether they are looking for fruits and seeds or insects, the birds can find what they need in this brush. The low grove of coast live oak on the left side of the steps tells us that at one time, these hilly backdunes supported not only shrubs and herbs but trees,



15th Avenue Steps

which were uncommon on the west side. (For more about oaks and oak woodland, see the description of Golden Gate Park's oak woodland.) Note: It should also be mentioned that another set of steps, at 16th Avenue and Moraga, will lead you up to the foot of Grandview Hill. Though the land on either side of these steps is no longer covered by indigenous plants, the steps themselves are the site of a new mosaic that presents a beautiful vision of the natural world.

GRANDVIEW PARK

Two stairways lead to the top of Grandview Hill, which does indeed reward one with a 360-degree view. One staircase is on the east, at Moraga and 14th; it is an extension of a public staircase on Moraga Avenue (see historic photos). The other is on the southwest, where 15th Avenue meets Noriega. It cuts

> through an area that was once quarried. Both climb through grassy areas and low scrub.

Several flowering plants are worth a springtime visit. There are two species of the pretty phacelia, as well as the Franciscan wallflower, which is federally listed as a species of concern. This wallflower is a cream-colored version of the more common yellow type, and it grows only in Marin and San Francisco counties. In the city, Franciscan wallflower can only be found at a few hilltop sites such as this one. It grows in all the natural areas along this ridge.

Though not as rare as the wall-

flower, an equally interesting plant is the dune tansy. As its name suggests, this is a sand-loving plant that is common in northern California dunes and coastal scrub, but only grows as far south as San Francisco. These sandy hilltops mark the southern edge of its range.



Grandview Hill is on the left and the hill where the 15th Avenue Steps are now is on the right; 1921.



Grandview Hill from the south, ca. 1926. The steps at 14th and Moraga are visible on the right-hand side. The retaining wall and steps were completed in late 1927.



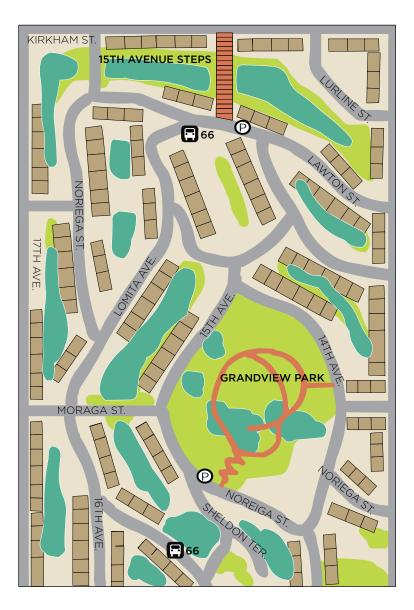
Close-up of the steps at 14th Avenue and Moraga, 1926 or 1927.



Rock outcrop, 1926.



Rock outcrop two years later, 1928. Steps have been put in .



HOW TO GET THERE

MUNI line 66 will take you near all five of these sites. Line 6 will take you close to Hawk Hill.

ROCK OUTCROP

There are no formal trails through the rock outcrop, but there is plenty to see just by walking on 14th Avenue south of Ortega. The rocks themselves are handsome examples of Franciscan chert, a sedimentary rock that can be found throughout central San Francisco. Mount Sutro, Mount Davidson, and Twin Peaks are a part of this formation; so are the bluffs on the other side of the Golden Gate Bridge, in the Marin Headlands. (For more on chert, see the Geology chapter of this guide.)

From the base of the north end of the outcrop, it is easy to see plants that make a living along vertical walls of rock. Gold-backed ferns and succulent live-forevers set root in the crevices. In the springtime, miner's lettuce grows in the damp seam at the foot of the rocks. At top of the rocks, buckwheat puts forth its tough, crinkly leaves and long stems of rounded flower heads. If you venture up onto the level ground between the rocks of the outcrop—step carefully—you'll find tiny patches of coastal prairie, one of our natural grasslands. Here are native grasses such as red fescue, blue wild rye, and California oat grass.



Dune scrub near Hawk Hill, 1926.



Blocky and colorful, chert is relatively easy to identify.

GOLDEN GATE HEIGHTS PARK

Though the same rock and soil underlie Golden Gate Heights Park, it's harder to find dune scrub here. Trees have been planted on this hill, and it has become an urban forest. Tall cypress loom over Veldt grass and English ivy. On the western slope is a grassy area where a few indigenous plants persist. Though this park has the least to offer in terms of natural vegetation, it has other amenities—toilets; picnic tables; and wide, well-used trails. There can also be some good birdwatching here; red-shouldered hawks and Wilson's warblers have both been sighted in this park. The main entrance is on Rockridge Drive, where Funston and 12th Avenue meet.

HAWK HILL PARK

At the south end of the ridge, Hawk Hill Park is the least accessible of the five natural areas. The entrance is at the end of Funston Avenue off Quintara, but there are no formal trails or stairways, and poison oak abounds. Perhaps because of this, Hawk Hill also has the ridge's most dense and varied dune scrub. It really gives you an idea of what much of western San Francisco used to look like. Shrub lupine, coyote brush, mock heather, and coffeeberry share space with deer weed, dune sage, and Indian paintbrush. The fleeting dune gilia quickly flowers and then goes to seed. With its mixed architecture of shrubs and soft-wood plants, Hawk Hill provides high-quality habitat—food, shelter, and places to raise young—for insects, reptiles, birds, and furry animals.

THE ANIMALS OF SUNSET HEIGHTS

In April 1967, Harold Gilliam, a San Francisco journalist, wrote a piece about Grandview Hill for the *Sunday Examiner and Chronicle*. He described the wildlife he found there:

Often in early morning you can see intricate tracings on the damp sand, indicating the presence of small animals. The mellifluous meadowlarks, almost unknown elsewhere in the city, can be heard here. There are quail, red-shafted flickers, wood-peckers, and white-crowned sparrows. Doves and a pair of red-tailed hawks roost in the Monterey cypresses at the summit.

Not all these animals will still be found on Grandview and the other natural areas of Sunset Heights, but some can. Alligator lizards have been spotted searching for prey beneath the plants and on the open sand on Hawk Hill; mouse burrows and gopher mounds at Hawk Hill, Grandview, and the Rock Outcrop tell us where these animals are still making a home. And raptors still nest in the trees: Red-tailed and red-shouldered hawks and an American kestrel have all been seen at one or several of these open spaces.

A VISION FOR THE PRESERVATION OF GRANDVIEW

According to a 1952 letter written by the secretary of the Sunset Heights Improvement Club, the top of Grandview Hill "was initially set aside for park use by the late M. M. O'Shaughnessy, City Engineer, when the area was replatted as a part of Golden Gate Heights." According to Harold Gilliam, John McLaren, long-time superintendent of the Recreation and Park Department in San Francisco, planted the Monterey cypress and eucalyptus trees on the hill's summit.

The Golden Gate and Sunset Heights neighborhoods were not developed until the 1940s. In 1952, the secretary of the Sunset Heights Improvement Club was urging the Recreation and Park Commission to set aside lots adjoining the top of



Grandview Hill from the rock outcrop, c. 1927.

Grandview Hill because they were for sale. At that point, "the surrounding blocks" had "not yet developed residentially." And if quail could be seen there in 1967, the hill and the surrounding area must still have been relatively open.

At that time, Gilliam sketched out his vision for the kind of park Grandview might be. It was, he wrote, "an ideal location for a natural park. The city's other parks are all man-made, and there is now no place in the park system set aside as an example of the native landscape. It is possible to envision here a nature preserve where schoolchildren could be brought to see what the tip of this peninsula looked like in the days of the first settlers, to learn about the native plant and animal life, to hear the story of the creation of this peninsula with all the elements in plain view—the ocean, the islands, the bay, [and] the central ridge of the city, from Mount Davidson to the Presidio."

FOR MORE INFORMATION

To see pictures of the mosaic steps on Moraga between 15th and 16th, go to *www.tiledsteps.org.* It provides an account of the making of the mosaic and shows pictures of a similar project in South America.

GOING DEEPER WHAT IS DUNE SCRUB?

The dunes of San Francisco were not only bare hills of sand. They were often covered with vegetation. Close to the shore, you can see the plants of the coastal strand, and on some coastal bluffs and pockets farther inland, you still find dune scrub.

Scrub is a vegetation type. It is a landscape that is dominated by short, brushy plants. On the eastern side of the Sierra, there's sage-brush scrub; along the coast in Northern California. there's northern coastal scrub. In San Francisco, there's dune scrub—an association of plants that eventually grows up and matures on older dunes. Dune scrub is not permanent, but it is stable and can persist for many years. Dune scrub once covered thousands of acres in western San Francisco.

The composition of San Francisco dune scrub is different in different places—the 15th Avenue Steps are different from Hawk Hill,



Grandview Hill, taken from the west; 1936.

for example. But there are some signature plants, such as Chamisso's lupine and mock heather. Mixed with the shrubs are semi-woody species such as dune tansy. And in between all of these, in the spring, herbaceous plants such as dune gilia and Indian paintbrush make a showing.

Commonly accepted definitions of the word *scrub* come nowhere near conveying what San Francisco's dunes have to offer. The *American Heritage* dictionary gives us this: "a straggly, *stunted* tree or shrub; a growth or tract

> of stunted vegetation." The emphasis is on stunted. When it comes to San Francisco's dunes, however, the meaning of scrub is largely a question of perception. You could say "low-growing" instead of stunted, and add that such stature is a predictable response to a windy environment.

Anyone who stops to take a look at dune scrub will begin to see, if not its majesty, at least its com-plexity and variety. At first glance, you may take in a few plants. But a slightly closer look and an offhand count—can easily reveal two dozen species in just a few minutes. A closer, longer look could reveal as many as 50 or 60 different plants. What appears from a distance to be a uniform mat of low

plants is actually a mix of many different shrubs and less woody species, which are home to hundreds of insects, birds, mammals, and reptiles.



HOW TO GET THERE

MUNI line 66 will take you near all five of these sites. Line 6 will take you close to Hawk Hill.

FINDING URBAN NATURE: PARKS AND NATURAL AREAS/TELEGRAPH HILL



TELEGRAPH HILL

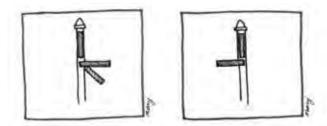
Any system used to signal messages across a distance can be called a telegraph. Though there were others, the first such system to appear atop Telegraph Hill was a tall post with two movable arms. The position of the arms told townspeople what kind of ship was entering the bay.

In 1849, when the post was erected, this was vital information. Almost all goods came to San Francisco by way of the ocean. The post could be seen from downtown, and nearly every resident knew the signals. Though effective, this simple system was short-lived; just four years later, in 1853, the post-and-arm telegraph was replaced by an electric telegraph station.

Some 20 years later, the hilltop was purchased by early preservationists, who named it Pioneer Park and deeded it to the city. Though preserved, the hill was neglected, and history has little more to say about the site until 1929, when a bequest from Lillie Hitchcock Coit resulted in construction of the tower that has secured lasting recognition for Telegraph Hill.

LOCATION

Telegraph Hill is in North Beach. It sits between Grant Avenue and Sansome Street and can best be reached from Filbert and Kearny streets on the west and Filbert Street on the east. (See "Best Place to Start" on the following page.)



In 1850, most San Franciscans would have recognized these two arm positions on the post on Telegraph Hill. The left one indicated a Brig of War was entering the bay; the right, a vessel in distress.

FACILITIES

Coit Tower is one of San Francisco's tourist attractions, and on sunny days you'll find plenty of visitors milling around the parking lot on the north side of the hill. The tower is open daily; entrance is free but the elevator ride to the top costs \$3.75.

There are informal seating areas around the parking lot. There is a paved path along the west side of the hill, and a semicircle of grass at the foot of the tower on the south side. One of those free-standing green toilet facilities has been installed in the parking lot; the bathrooms on the ground floor of the tower are open to the public.





View of Telegraph Hill from downtown, ca. 1851. The first telegraph—the signal post—can be seen on top of the hill.

BEST PLACE TO START

Start at the foot of the hill and walk to the top. From Sansome Street on the east side, you can walk up the famed Filbert Steps, which are truly lovely; from the west, you can start in Washington Square and follow Filbert Street up that side. There is also an approach from the north—take Lombard Street to the corner of Lombard and Kearny. Here, you'll see the green sign for Pioneer Park and find a path that leads through a cypress forest to the top of the hill.

WHAT YOU'LL FIND

Pioneer Park plays second fiddle to Coit Tower, serving mainly as the grounds surrounding it. The park is landscaped and much of the northern hillside is planted with cypress. Telegraph Hill as a whole, with its many gardens and few streets, is a haven for all kinds of wildlife—red foxes have been seen on the Filbert Steps and many of San Francisco's birds use the various plantings. Though *The Wild Parrots of Telegraph Hill* focuses on one particular kind of bird, author Mark Bittner also reports having seen house finches, scrub jays, mourning doves, Anna's hummingbirds, Townsend's warblers, kestrels, mockingbirds, northern flickers, towhees, hooded orioles, and white-crowned sparrows on Telegraph Hill.

The hill was not always as steep and rocky as it is today. Its eastern and northern faces were quarried for more than sixty years, leaving vertical walls of stone exposed, which you'll see



East side of Telegraph Hill, 1860. Note the ice house, "Cobble Stone Depot," the horse-drawn cart, and the water in the foreground. A note has been made on the photo that this site was east of Battery Street.

if you walk the Filbert Steps. The rock was used for ballast in departing ships, as street paving, and for bayshore fill. Along the paved footpath on the northern side of the hill there are a few outcrops of graywacke sandstone. Rub the rock with your fingers and you can feel its graininess.

Atop the hill is a tower made from smooth concrete. The simplicity of Coit Tower's materials and design, like the murals on the walls inside, reflect the era in which they were made.

When she died in 1929, just months before the stock market crash that ushered in the Great Depression, Lillie Hitchcock Coit left almost \$120,000 to the city "for adding to the beauty" of San Francisco. Having determined that Telegraph Hill would be a suitable site for a memorial to Coit (she was particularly attached to the Number 5 volunteer fire company, which was based in North Beach), the Parks Commission held a competition for designs. Though it was not a unanimous decision—the vote was split between genders, with the men in favor and the women against—the tower was selected. It opened in 1933. At about that time, in Washington, D. C., several influential figures with an interest in art were promoting the idea of employing artists to paint murals in public buildings. In San Francisco, a group of artists came together to advocate for government support of their work—including murals. The first federal Public Works of Art project began at Coit Tower in January 1934. It was completed six months later.

The murals cover the inside walls and reach from floor to ceiling. Though larger than life, their theme is everyday life in California, in 1934. The murals are frescoes—dry pigment applied directly onto wet plaster—painted by 25 artists and 15 assistants. They feature scenes from industry and agriculture, from city and country, and include a wealth of interesting (and sometimes amusing) detail. The style of the images is Social Realism, which features clear, simple representations of people and places, but with a critical edge. The murals show us Depression-era dissatisfaction, but also its optimism. A brochure titled *The Story of Coit Tower*, which can be purchased in the souvenir shop, provides a brief introduction to each panel as well as its meaning.



Top of Telegraph Hill, 1923. Visitors and their car in the parking lot still in use today.

GOING DEEPER FOG WATCHING

San Francisco is famed for its fog, and Telegraph Hill is a good place to watch it, particularly in the spring and summer, when you can often see it flowing through the Golden Gate, wheeling over Alcatraz, and traveling in a long, unbroken line across the bay into the East Bay hills.

WHAT MAKES FOG?

Fog equals clouds, and the conditions that form fog are the same as for other clouds: Moisture in the air is cooled enough to condense, forming droplets. In other, higher clouds, this might result in rain. Along the California coast, this process often

results in fog.

As is explained in the weather chapter, much of our air—our wind—comes off the Pacific Ocean. As this air travels over the ocean, it picks up moisture from the water's surface. When it reaches shore, it comes into contact with colder water—especially in the spring and summer, when cir-



KINDS OF FOG

In the preceding passage, Gilliam refers to fog as "stratus formations." Stratus is one of the three main kinds of clouds. The word means layer, and that is how stratus clouds form—in layers that are typically low to the ground. This is often the only type of cloud we have during fog season in San Francisco, a time of year also known as summer.

This fog-cum-stratus cloud has another name, which also refers to how it is formed: advection fog. The opposite of advection is convection, a term and a process with which more people may be familiar. Convection describes the upward movement of warm air, a process that is visible in a pot of boiling water. Advection refers

to air's horizontal movement.

Advection is an important component of San Francisco fog, because it implies wind. Our fog would be less interesting if it were simply formed at the coast and stayed there. But winds and that mile-wide strait known as the Golden Gate—

ensure that San Francisco fogs often provide a spectacle.

THE AIR RUSHES IN

We know that hot air rises. When it does, cool air rushes in. This can happen on a small scale, as in a heated room where a door or window is left open—one can feel warm air overhead, while at ground level there may be a cool draft. In central California, this happens at a landscape level, especially during the summer, when inland air temperatures are so much higher than those along the coast. The Pacific Ocean is responsible for this difference in temperatures; the ocean is cool, and so the air that is near it stays cool too. To a lesser extent, the same is true of San Francisco Bay.

continues on next page

cumstances are such that cold deep water comes welling to the surface along the coast in Central California. The water-laden air is chilled by the extra-cold water, and it condenses. Presto: fog.

This process can also be observed on a smaller scale. As Harold Gilliam, author of *Weather of the San Francisco Bay Region* (UC Press, 2002) describes it, "nearly saturated air moving across a small body of water, such as Stow Lake in Golden Gate Park, will drop in temperature sufficiently on contacting the slightly cooler water to form small wisps of fog that drift across the lake, duplicating in miniature the stratus formations over the ocean." Taking notice of such smaller-scale events is a good way to connect to the larger processes taking place in the air around us all the time.

continued from previous page

But east of the bay, where there is no such mitigating factor, the longer days and higher sun of summer quickly heat up the earth and air—and the hot inland air rises. The coast's cool air rushes in through the only opening available: the Golden Gate.

The Coast Range—our westernmost mountains, which run almost the length of California—stand as an obstacle to the eastward movement of air. At the Golden Gate, however, there's a break, and the wind and fog come streaming in. "The Golden Gate is the largest and lowest of the gaps in the Coast Range," Gilliam tells us, "and [it] has the greatest influence on Bay Region weather." But it is not the only gap. The varied topography of the city allows for other pathways as well.

The biggest of these is the Alemany Gap. The cool air finds an opening in the vicinity of Lake Merced and follows it east along a line more or less defined by Alemany Boulevard. A portion of Highway 280 follows this same line. When drivers headed south on 280 turn west at Highway 101, they often run smack into the cold moist air of the Alemany Gap.

Gilliam describes other, smaller, gaps. One "extends eastward from the beach along the line of Geary Boulevard, making that stretch of the Richmond District particularly breezy. Golden Gate Park," he continues, "lies in another gap; its streamline extends inland between Lone Mountain and Buena Vista Peak to the downtown area and blows the hats off pedestrians on Market Street."

Along with the gaps, there are the hills, of course, and these too have a role in dictating the passage and play of our airborne waters. Who can fail to admire the sight of fog cresting one of our mid-city peaks and sliding in tendrils down the inland side? How could one not pause atop Telegraph Hill, standing higher than the clouds, to watch as they slip in upon the bay?

FOR MORE INFORMATION

The Neighborhood Parks Council has a history of Pioneer Park posted online. Go to *www.sfneighborhoodparks.org* and click on the "Park Histories" link. You'll see Pioneer Park (and many other parks) listed there.

If you're interested in learning more about the murals at Coit Tower, keep an eye out in used bookstores for *Coit Tower San Francisco: Its History and Art* (Volcano Press, 1983). Written by Masha Zakheim Jewett, the daughter of one of the muralists, it tells the whole story of the creation of the tower and its murals and includes reproductions and interpretations of the artwork.

When Harold Gilliam's book on local weather came out a few years ago, *Bay Nature* magazine published an excerpt from it that focuses on fog. Find it online at *www.baynature.com*. Select the "Back Issues" link and look for the July 2002 issue.



HOW TO GET THERE

MUNI line 39 will take you to Telegraph Hill and Coit Tower. Line 39 is a short bus line but it connects to many other MUNI buses, including lines F, 10, 15, 30, 41, 45 and 47.



TWIN PEAKS

A hundred years ago, when a well-known architect was invited to develop a beautification plan for San Francisco, he agreed, on the condition that he be given a place to stay on Twin Peaks. When Daniel Burnham presented his plan, he recommended leaving the crest of the peaks untouched.

Their simple symmetry and smooth aspect were already so important a part of San Francisco that he did not think they should be changed. (He did, however, suggest putting a statue at the summit, and he envisioned elaborate gardens, terraces, staircases, cascades, and more on the slopes of the mountain. His recommendations, made in 1905, were forgotten in the wake of the Great Earthquake.)

Twin Peaks remains a landmark today. It stands more or less at the center of the city and is visible from many parts of town. From its summit, it provides a 360-degree panorama. Twin Peaks is a great place for getting to know the topography of San Francisco; it is also a designated open space that includes, according to the Natural Areas Management Plan, some of the largest patches of coastal scrub and coastal prairie in San Francisco.

LOCATION

Twin Peaks lies west of upper Market Street and east of Clarendon Avenue. It can be accessed from the north or south, by way of Twin Peaks Boulevard. In the park, the boulevard becomes one-way and snakes around the peaks in a figure eight.

FACILITIES

There is a parking lot, viewing area, and pay toilet at Christmas Tree Point, on the north side of the north peak. A well-marked trail leads over each hilltop; its length is less than half a mile. It's also possible (with a little caution) to walk along the road, looking at road cuts and vegetation from that vantage point.



Cows grazing at the north end of Twin Peaks in an area where the parking lot is now, 1903.



Daniel Burnham's cottage on the north end of Twin Peaks, where the parking lot is now, ca. 1904. This cottage was built by Willis Polk.



Building Twin Peaks Boulevard, 1915. Look at the extent to which the place was altered!



Twin Peaks road, ca. 1922. The grass has come back. Today, this area is covered with coastal scrub.



Twin Peaks photo, from an old postcard, ca. 1930. Market Street runs horizontally though the middle of the photo. The vertical street is Alvarado near 22nd.

BEST PLACE TO START

Start at Christmas Tree Point because it's the simplest logistically. But don't stay there. Walk the trail, read the signs, have a look at the view from the peaks rather than from the sidewalk, where the tour buses are parked.

WHAT YOU'LL FIND

These are high, rocky hills of chert and basalt. The North Peak is chert; the South Peak is basalt. The chert changes colors—in some places it's dark red, in others it's orange and green. But whatever its color, chert always breaks into squarish, sharpedged chunks and is hard enough to scratch glass. Both it and the basalt are part of the Marin Headlands terrane, a great unit of rocks scraped off the oceanic crust like icing off a cake.

In general, the slopes of Twin Peaks are scrub-covered, while the tops of the peaks are grassland. Compare this site with Mount Sutro to the west. That mountain is covered in trees, a planted forest that is now senescent. The grasslands here have, of course, changed since the arrival of the first Spanish colonists and settlers, but they are still much as they would have been when only the area's indigenous people lived here. In the spring, clarkias bloom in great sheets below Christmas Tree Point. Nootka reed grass, a tall, broad-bladed perennial, continues to grow here, as it has for centuries, along with buckwheat, yarrow, and many other hardy native plants.

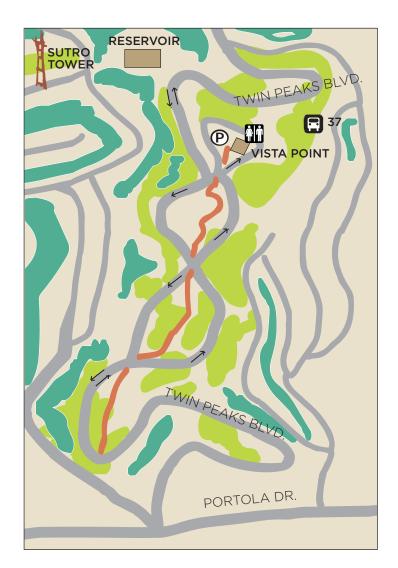
The scrub—those shrubby plants that are accustomed to fog and strong winds—still prospers here and gives us a feel for what so many of the city's hillsides must have once been like. We get another glimpse of old San Francisco at nearby Laguna Honda reservoir, on the south-facing slope visible from 7th Avenue just before Clarendon. Here and on Twin Peaks, we see the brushy hills that are dark green in winter and spring, rusty brown by fall. Amidst the foliage, bright flowers shine out—the orange of sticky monkey flower, the white-pink of California blackberry. Gray-greens are abundant too, in California sagebrush and silver bush lupine. This lupine is the host plant for a rare butterfly, the mission blue, which is listed as a federally endangered species. The only place it is still found in San Francisco is on Twin Peaks.



Another nearby natural area that offers a mix of dramatic rock outcrops, grassland, and scrub is Tank Hill, named for the water tank that once stood on its crest. All that's left of the tank today is a big concrete pad. The hilltop is encircled, more or less, by eucalyptus, and its interior has been lovingly re-planted with sage, monkey flower, and other indigenous plants. Tank Hill lies directly north of Twin Peaks on Clarendon Avenue. There are stairs into the park from Clarendon and from the eastern end of Belgrave Avenue.

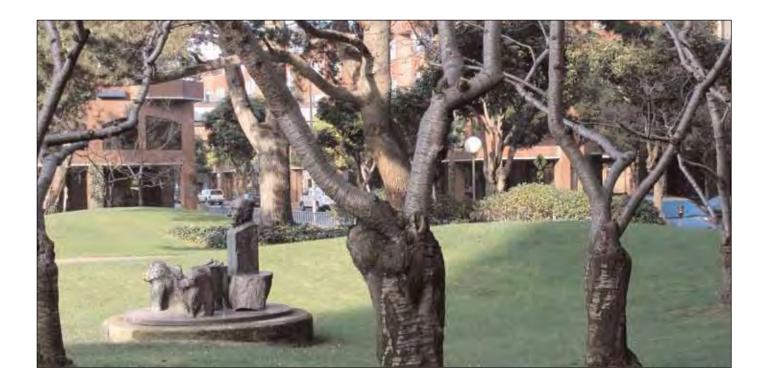
FOR MORE INFORMATION

A Google search for "San Francisco Mission Blue Butterfly" yields a good list of local resources. Among these are the website of San Bruno Mountain Watch (the mission blue can also be found on San Bruno Mountain) and SFSU geography professor Barbara Holzman's website, where she posts her students' biogeography projects.



HOW TO GET THERE

MUNI line 36 takes you to the western edge of Twin Peaks. Line 37 travels along the eastern and southern edges. Lines 33 and 37 will take you close to Tank Hill.



WALTON SQUARE

Set in an historic part of town, this small park has the feel of a cloistered garden. A fountain fills the square with the sound of falling water and the park is bounded on two sides by brick arcades.

Mark Bittner, author of *The Wild Parrots of Telegraph Hill*, describes Walton Square this way: "Covering a whole city block and enclosed by tall pines, the interior feels pastoral with its grassy hillocks, cherry trees, and weeping willows." Walton Square offers respite to everyone who visits.

LOCATION

The park occupies one square block between Jackson and Pacific streets and Front and Davis streets, not far from the Embarcadero shopping center and just a block east of Battery Street.

FACILITIES

There is a paved walkway through the park, with a few benches. There are also plenty of informal seating areas, such as grassy knolls and low concrete walls.

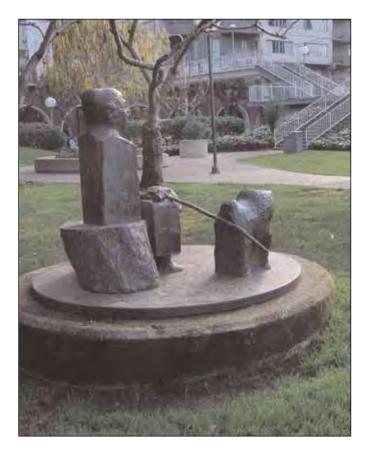
BEST PLACE TO START

There is a concrete arch on Front Street that creates a formal entrance to the park, but you can enter from any of the streets that surround the square.

WHAT YOU'LL FIND

Named for a member of the San Francisco Redevelopment Agency, Walton Square appears to have been built with private funds as part of the development of the highrise apartment buildings immediately to the south. Its makers clearly wanted to create a park that was not just a recreation area, but also a quiet oasis set apart. They have succeeded in doing so through the use of art.

There are at least five sculptures in the park. The centerpiece (though it is set off-center, on the eastern side of the park) is the "Fountain of the Four Seasons," a modern piece set in bronze. Four abstract columns rise out of randomly placed



concrete stepping stones. Water spouts from the columns and falls on the stones, which are set at ground level.

Nearby is another bronze, a sculpture of Georgia O'Keeffe, flanked by two squat dogs, her beloved Chows, Jingo and Inca. Though cast in metal, the dogs and O'Keeffe are made to look as if they're hewn from wood. Her body is two blocks of wood, which rest on a stump. Her face and feet are roughly chiseled. Her hands, which are resting on top of one of the blocks, are precise and pure—as if cast from her very hands. One holds a walking stick. The piece was made just four years before O'Keeffe's death at age 98 and reflects both the toughness of her personality and the clarity of her work.

In the southwestern corner of the park, set amongst the pines, is a tile obelisk—a column that comes to a point, like the Washington Monument—that celebrates a few well-known features of the natural world. Bittner has written about the park because the wild parrots that are the subjects of his book once roosted (slept each night) in the pine trees here. They have since "expanded their range slightly, moving south past Walton Square to a waterfront park," but they can often still be seen, and heard, at Walton Square.



FOR MORE INFORMATION

There is both a book and a film titled *The Wild Parrots Telegraph Hill.* The book is by Mark Bittner (Three Rivers Press, 2004) and chronicles his experiences with the parrots. The film is by Judy Irving and focuses both on the birds and on Bittner himself. It can be ordered at *www.pelicanmedia.org.*

GOING DEEPER PARROTS IN THE CITY

San Francisco is home to a large flock of wild parrots. It began to form in the late 1980s, when a single pair was able to raise young; today, the flock numbers about 85 birds.

HOW DID THEY GET HERE?

The majority of San Francisco's parrots are cherry-headed conures, beautiful, foot-long green birds with bright red heads. They are wild animals that were captured in their native lands (the coast of southern Ecuador and northern Peru) and sold to the pet trade. They did not take well to being pets. In Bittner's words, "the birds feared and hated captivity. Some screamed endlessly, and they bit their owners. Angry and frustrated themselves, some pet owners

tossed the birds out the windows." Others escaped, either from their owners or during what Bittner calls "handling accidents at pet stores and airports."

San Francisco isn't the only place where parrots have naturalized. According to Bittner, there are flocks "in Connecticut, Florida, Hawaii, Illinois, Louisiana, New York, Texas, Oregon, Southern California, Utah, and Washington State.... One of America's largest wild parrot flocks," Bittner writes, "lives year-round in Chicago."

WHAT THEY'RE LIKE

The cherry-headed conure is a highly

voluble species— the birds are very vocal, and they're inveterate fighters and biters. They can also be very affectionate with one another. Bittner calls them "compulsive noisemakers and has named their most intense screams psycho-gobble "because it sounds like turkeys who have completely lost their minds." The chattering of the parrots is the best way to begin to notice them in the city. Once you learn to recognize their voices—and it's not hard you'll be able to spot them in many parts of town.

When Bittner first saw the parrots in 1990, he was trying to get interested in birdwatching and not having much success. But the parrots caught his attention. "They were always good for a laugh," he writes. "They would fly into the garden with their nutty urgency, a united, harmonious group. Then, the instant they landed, fights would break out. Sometimes while fighting they'd get tangled up in each other's feet and fall from the lines, struggling to disengage before both crashed to the ground.... It was like watching the Three Stooges, only much funnier."

HOW THEY'VE MANAGED TO GET BY

Bittner says that the parrots have been able to make a go of it in San Francisco "for at least two reasons. First, along with corvids, owls, and woodpeckers, parrots are considered to be among the smartest birds. Second, there is a large amount of food available to them." He goes on to explain that:

"American cities and suburbs are large, human-built ecologies in which parrots are able to thrive. Gardens and parks are usually designed to have something growing in

> them at all times of the year. Sometimes the plants are even exotics that are native to the parrot's home territory. That so many different species [of parrots] can thrive outside their native habitat indicates adaptability with regard to diet. They've also learned to use bird feeders. So far, none of the wild parrot flocks have left urban or suburban areas. If they were to venture out of urban areas, they would more than likely starve to death."

The conure eats berries and flowers. Bittner says he had "seen or heard of them eating cotoneaster berries, toyon berries, black-berries, pyracantha, magnolia blossoms, cherry blossoms, coral tree blossoms, flowering eucalyp-

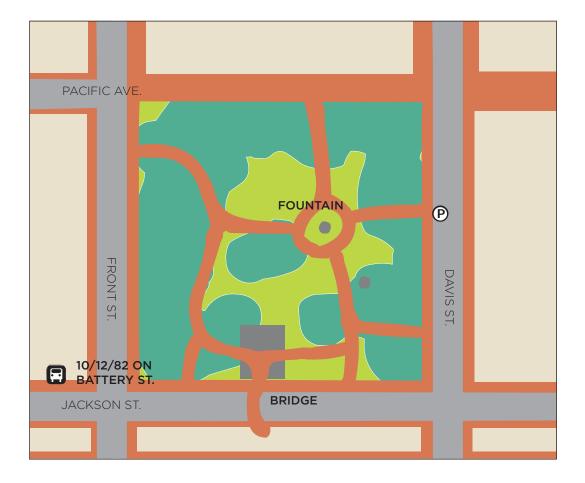
tus, pine nuts, juniper berries, hawthorn berries, loquats, strawberry guavas, plums, apples, and pears."

NESTING AND RANGE

The cherry heads have also been able to make use of a variety of city trees for nesting. They are cavity nesters—they nest in holes in tree trunks, typically where a branch has fallen and left an opening in the trunk. Bittner has seen them in palm trees and eucalyptus.

The parrots nest as a flock, in a park that Bittner has chosen not to reveal. The territory of Bittner's birds is the northern waterfront: the Embarcadero, North Beach, Telegraph Hill, Russian Hill, Fisherman's Wharf, Fort Mason, and the Presidio.





HOW TO GET THERE

Although no MUNI buses travel on any of the streets directly bordering Walton Square, its downtown location puts it in close proximity to a great number of bus lines. MUNI lines F, 1, 10, 12, 15 and 41 are among those that will bring you within a quarter-mile of the park.

PART FIVE Species Cards





Scientific Name: Salix lasiolepis Family: Willow (Salicaceae)

Leaves: Arroyo willow is a deciduous shrub or tree (meaning it loses its leaves in the winter). The thin oval leaves are dark green and arranged alternately on the stem.

Flowers: Many yellow flowers bloom on catkins, a string of small, clustered flowers. Willow is *dioecious*, meaning that male and female catkins develop on separate trees.

Fruit: The wind disperses the small cottony seeds from the catkins.

Habitat: Arroyo willow prefers riverside, or *riparian*, areas or places with high ground water. It tolerates full to partial sun and seasonal flooding.

Cultural Uses: Willow branches have been used in basketry and in the framework for thatched shelters. The bark is known for its pain-relieving effects (the original aspirin was made from the same chemical that is in willow bark).

Interesting Information: The Latin species name, *lasiolepis,* meaning "shaggy scales," refers to the flowering parts.





Scientific Name: *Fragaria chiloensis* **Family:** Rose (Rosaceae)

Leaves: Beach strawberry, also called coast and dune strawberry, has shiny, leathery, dark green leaves, arranged in groups of three. Each leaf is deeply veined and serrated.

Flowers: The flowers are white with yellow stamens and resemble miniature white roses.

Fruit: Although smaller than the strawberries you find at the grocery store, the bright red berries of beach strawberry have a similarly delicious flavor. Beach strawberry usually ripens April through June.

Habitat: This plant grows in a wide range of habitats. It can take full sun and is never far from the sea. **Cultural Uses:** California Native Americans, including the Salinan, Maidu, and Sinkyones, gathered and ate these strawberries, though this fruit was not a large part of their diet. The fruit is generally eaten raw, but also can be dried. The leaves, both dried and fresh, can be brewed to make a clear tea rich in vitamin C, thiamin, riboflavin, and niacin.

Interesting Information: In the wild, strawberry colonizes new areas by sending out long shoots or runners (stolons) that carry clusters of new leaves on their tips. These satellite clusters settle on the sand and begin to send out their own roots, eventually becoming independent plants.





Scientific Name: Rubus ursinus Family: Rose (Rosaceae)

Leaves: California blackberry is an evergreen shrub that trails along the ground or climbs to produce mounds of prickly stems. The leaves are alternate and have jagged edges.

Flowers: White flowers develop in clusters near the ends of the branches.

Fruit: The berries start out red but turn black when they are ripe. The small seeds have a hard coat and are dispersed by the many small birds and mammals that eat the berries. Habitat: California blackberry is found in a wide range of habitats, from warm, open areas to dense woodlands. It is particularly common in disturbed soils and on river terraces dominated by red alders.

Cultural Uses: Some indigenous people used the roots of California blackberry to treat skin infections and to help cure dysentery.

Interesting Information: The ripe berries are also the favorite of grizzly bears, hence the species name *"ursinus"* from the Latin *ursa*, meaning "bear."





Scientific Name: Lupinus chamissonis Family: Pea (Fabaceae)

Leaves: Chamisso lupine has palmately compound leaves divided into seven to ten leaflets. The leaves are graygreen and covered in small silverywhite hairs.

Flowers: Violet-colored spikes of pea flowers bloom March through July.

Fruit: Lupines produce seeds in pods that look much like pea pods. However, lupine pods and seeds contain alkaloids that are extremely poisonous.

Habitat: This medium-sized bush only grows in sand.

Cultural Uses: Native Americans used lupine in a variety of ways. The Coast Miwok have used chamisso lupine roots to make cords and ropes. The Maidu leached the poison from chamisso leaves in a running stream overnight to make them edible. Some indigenous people steamed chamisso leaves and flowers in an earth oven and then ate them with acorn soup.

Interesting Information: As a member of the pea (or legume) family, lupine is a nitrogen-fixing plant that actually helps to enrich the soil in which it grows. Lupine is also an important source of food for the larvae of the endangered mission blue butterfly.

COAST BUCKWHEAT



Scientific Name: Eriogonum latifolia Family: Buckwheat (Polygonaceae)

Leaves: Coast buckwheat has paddleshaped, gray-green leaves that turn pink, orange, and red with fuzzy white undersides. They form a rosette at the base of the plant, with fewer leaves growing up the stem.

Flowers: Coast buckwheat has tiny flowers arranged like pom-poms; they start out white, gradually become pink, and finally turn to the color of rust.

Fruit: Small seeds evolve inside each tiny flower after the flowers are pollinated and turn to a rust color. The seeds have an almost triangular shape. Habitat: Buckwheat grows in the foredune plant community, up through the transitional zone community, and into the backdune plant community. It is also found in serpentine grasslands.

Cultural Uses: Indigenous people discovered a variety of medicinal and culinary uses for coast buckwheat. Coastanoans, Maidu, and Round Valley tribes have used it to relieve colds and coughs. Roots have been used to make a wash for sore eyes and to treat stomachaches. The young leaves, which have a sour taste, can be eaten.

Interesting Information: Members of this family are not related to the true wheats, which belong to the grass family.



COAST LIVE OAK



Scientific Name: Quercus agrifolia Family: Oak (Fagaceae)

Leaves: The leaves of the coast live oak are dark green and resemble holly. They form a thick evergreen canopy on the large, wide-spread, crooked branches, which spread out horizontally.

Flowers: Tiny yellowish-brown flowers appear in spring.

Fruit: Acorns are fully developed in November and December and provide food for scrub jays.

Habitat: This large majestic tree, which can live over 250 years, may be found on protected slopes and in valleys in mixed evergreen forests and woodlands. **Cultural Uses:** Coast live oaks have historically been one of the most important resources for humans within California. At least twelve indigenous tribes used the coast live oak's acorns for food. The wood has also been popular as fuel. The Mission builders made the oak wood into charcoal for firing the kilns that made adobe mortar.

Interesting Information: Coast live oaks are fire-tolerant and can grow up to 80 feet tall.



COYOTE BRUSH



Scientific Name: Baccharis pilularis Family: Sunflower (Asteraceae)

Leaves: Coyote brush has bright, yellowish-green, slightly toothed, round leaves. The leaves are arranged alternately on the stem.

Flowers: Coyote brush is *dioecious*, which means it produces male and female flowers on separate plants. The flowers are small and creamy white, forming in clusters.

Fruit: The fruit is a tiny seed that hangs off a tuft of hair called a *pappus*. The pappus catches the wind and flies, which allows the plant to spread its seeds. Habitat: Coyote brush is common all over California, from coastal bluffs to oak woodlands to disturbed roadside areas.

Cultural Uses: The Coast Miwok heated coyote brush leaves and applied them to swellings. Some indigenous tribes used limbs of coyote brush for building houses and making arrows.

Interesting Information: Coyote brush becomes resinous (sticky) and fragrant on hot summer days. The fragrant oils are distasteful to herbivores and may serve to protect the plant from being eaten.

INDIAN PAINTBRUSH



Scientific Name: Castilleja latifolia Family: Figwort (Scrophulariaceae)

Leaves: Paintbrush has long, narrow leaves that range from simple to broad and very dissected.

Flowers: The brilliant red of Indian paintbrush is not in fact the flower, but rather, its sepals and bracts. The actual flowers, which have green petals, are partially hidden inside the bracts and appear in late spring through summer.

Fruit: There are many foam-like seeds in each pod. The pods gradually dry out and split; the seeds fall out when the pods split entirely. Habitat: These plants are found throughout the western United States, from coastal dunes and scrub to alpine woodlands.

Cultural Uses: Indian paintbrush root has been used to cure earaches, and the flower can make a soothing wash for bites or rashes. The Maidu used it for food, as a diuretic, and to cure bronchial problems.

Interesting Information: Paintbrush species are semi-parasitic plants whose roots hook into the roots of host plants for nutrients otherwise unavailable in the soil. Hummingbirds pollinate Indian paintbrush.



LIVE FOREVER



Scientific Name: Dudleya farinosa Family: Stonecrop (Crassulaceae)

Leaves: Live forever has rosettes of fleshy leaves that range in shape from broad to thin, and in color from bright green to chalky white, often with red tips.

Flowers: This plant has candelabra-like clusters of small, pale-yellow flowers that are pollinated by bees.

Fruit: The flowers turn into fruit with tiny brown seeds inside. The petals fall off and the fruit left on the spike dries.

Habitat: Live forever grows in rock crevices on bluffs, cliffs, and sandy slopes. It can be found holding tight on steep slopes of rocky outcrops, near the coast and farther inland.

Cultural Uses: The stems and leaves of live forever have been eaten by several groups of indigenous peoples.

Interesting Information: Plants in this family are often cultivated for rock gardens and flowerbed borders. Live forever can regrow from just single leaf or part of a root.



POISON OAK



Scientific Name: Toxicodendron diversilobum Family: Sumac (Anacardiaceae)

Leaves: Poison oak is a deciduous shrub with leaves that grow in groups of three. Each leaf is oval or eggshaped and lobed. The size and color of the leaves can change with the season and the environment. They are commonly 2 to 5 inches long, and are orange-red when they first emerge, turning glossy green in summer, then scarlet in the fall.

Flowers: The flowers are short and whitish-green, blooming on small spikes that appear in mid-spring.

Fruit: The flowers become small, whitish berries in summer, and are eaten by birds.

Habitat: Poison oak can be found in most plant communities. In sunny chaparral or coastal scrub, it tends to be a dense shrub that grows 8 to 10 feet tall. In shady woodland environments, it commonly appears to be a woody, vinelike plant that climbs tree trunks toward the light.

Cultural Uses: The slender stems of poison oak have been used in basket-making. The berry juice has been used as a black dye for baskets and tattoos.

Interesting Information: Poison oak is not an oak at all—it belongs to the sumac family, and is related to the mango—but its leaves are thought to resemble the leaves of certain oak trees. The leaves and twigs of poison oak contain an oil (urushiol) that causes an itchy rash in some people, even when the shrub is bare in winter.

STICKY MONKEY FLOWER



Scientific Name: *Mimulus aurantiacus* Family: Figwort (Scrophulariaceae)

Leaves: Sticky monkey flower has long, thin, dark-green leaves arranged oppositely. The undersides of the leaves are slightly sticky to the touch.

Flowers: This plant has trumpetshaped, yellow-orange flowers. Some people think the flowers, which bloom from March through August, resemble a monkey's face.

Fruit: The flowers bear tiny, blackishbrown seeds.

Habitat: This shrub grows abundantly in the coastal dune community and on coastal bluffs.

Cultural Uses: The roots have been used to treat fever, dysentery, and

diarrhea, and to stop hemorrhages. The Pomo, who often lived in smoky, poorly ventilated homes, used a decoction made from sticky monkey flower to treat sore bloodshot eyes. The flowers were also used to decorate Miwok wreaths and children's hair.

Interesting Information: Sticky monkey flower has a method to prevent self-pollination. As an insect crawls deep inside the flower, where two pairs of stamens are located, the petals close around the stigma. The closed petals prevent the insect from depositing pollen on the stigma as the insect leaves. To see for yourself, gently touch the middle of the petals with your finger or a small twig.



YARROW



Scientific Name: Achillea millefolium **Family:** Sunflower family (Asteraceae)

Leaves: Yarrow has feathery, fern-like leaves arranged alternately on stems that may reach several feet in height.

Flowers: Yarrow has tiny, white, daisylike flowers arranged in large clusters.

Fruit: Seeds form inside each flower after the flowers are pollinated and turn brown.

Habitat: Yarrow is found in a wide variety of plant communities, including serpentine outcrops, the transition zone community, and the backdune plant community. **Cultural Uses:** Yarrow has been used by many groups, including indigenous tribes and the Spanish, to heal health problems ranging from indigestion to toothaches. Fresh leaves placed on wounds help stop the flow of blood. A tea made from the leaves and flowers has been used to treat consumption (tuberculosis), stomachaches, headaches, and sore eyes.

Interesting Information: Yarrow's genus name honors Achilles, the hero of the Trojan War, who was supposed to have been the first to discover its many virtues.



CABBAGE WHITE BUTTERFLY



Scientific Name: Pieris rapae Family: Pieridae

Description: The uppersides of the wings are milky white with charcoal tips; adult females have two black spots on the front wings and one on the hind wings, while males have a single black spot on each wing. The undersides of the wings are pale yellowish with similar black spots.

Diet: Cabbage white larvae like to feed on plants in the mustard family, such as cabbage and broccoli, but will eat other leafy crops as well. Habitat: Cabbage whites live in a range of habitats across California, but are most often associated with gardens, agricultural fields, and weed lots.

Interesting Information: The cabbage white butterfly was accidentally introduced to North America through Quebec, Canada, in 1860. It is now a common garden pest.



MISSION BLUE BUTTERFLY



Scientific Name: Icaricia icarioides

missionenses **Family:** Lycaenidae (Gossamerwinged butterflies)

Size: Adults are about the size of a quarter, while larvae are very small and rarely seen.

Description: On the upper side of the wings, the adult female is brown with some blue, and the male is light blue. Both have blackish wing edges. The underside of the wings is off-white with two rows of irregularly shaped black spots.

Diet: Mission blue larvae will feed only on the leaves of the three host lupines in their habitat: chamisso lupine, varicolor lupine, and silver-leaf lupine. Adults drink the nectar of certain flowers in the sunflower family using a long feeding tube called a *proboscis*.

Habitat: The mission blue requires a coastal grassland habitat where its specific host plants and nectar plants are growing. In GGNRA, the mission blue has been seen at Milagra Ridge and in the Marin Headlands.

Interesting Information: The mission blue butterfly is a federally endangered species found in only a few locations around the San Francisco Bay Area, including the Marin Headlands, the coastal ridges in San Mateo County, San Bruno Mountain, and possibly Twin Peaks in San Francisco. At one time, these butterflies probably lived in much more of the coastal scrub/grassland habitat of the northern San Francisco peninsula and Marin County.



PAINTED LADY BUTTERFLY



Scientific Name: Vanessa cardui Family: Nymphalidae (Brush-footed butterflies)

Size: Adults are about 2 inches across.

Description: The painted lady and monarch butterflies are easily confused, as both have orange-and-black coloring. Painted ladies can be distinguished by their front wing tips, which are black with white spots, and slightly extended and rounded. The upper side of the hind wing has several pale blue spots along the edge. Underneath, the wings are mostly a rosy pink, with brown, black, and white markings. **Diet:** The larvae primarily feed on thistle, nettle, and plants in the Mallow family.

Habitat: Painted ladies prefer flowery meadows and parks, but are also found in the desert and in a variety of other ecosystems.

Interesting Information: Although they are one of the most widespread butterflies in the world, the painted lady cannot survive a cold winter. For this reason, in California they are found in the southern deserts yearround, but in the northern part of the state only during the warmer months. They are called "brush-footed butterflies" because of their short and hairy front legs.



DRAGONFLY



Scientific Name: Multiple Family: There are 7 dragonfly families in California, comprising 64 species.

Description: Dragonflies are generally large and brightly colored insects with huge compound eyes, a long thin body, and two pairs of membranous wings. The larvae, called nymphs or naiads, have thick bodies and no wings and live in water.

Diet: Dragonflies are predators, eating mosquitoes and other small insects. The nymphs have a long lower lip called a labium that extends to help them catch their food.

Habitat: Though these insects live near water, in which they lay their eggs, they are strong fliers and may be seen as far as several miles from streams or ponds.

Interesting Information: Male dragonflies are very territorial, and will fight with other large insects, especially other dragonflies. Their flying agility makes them very difficult to catch.



WATER STRIDER



Scientific Name: Gerris remigis Family: Gerridae

Size: Body length is generally around 1/2 to 3/4 of an inch; the leg span may be as much as 1.18 inches.

Description: Water striders have elongate bodies and long thin legs with feet adapted for skating across the surface of water. They may or may not have wings, and are generally a black, gray, or silvery color.

Diet: Water striders prey on smaller insects and other organisms that fall onto the water or swim to the surface.

Habitat: These insects live in a variety of aquatic habitats, from moving streams to lakes and ponds.

Interesting Information: Water striders use their middle legs, which are longer than the others, as oars to push themselves across the water. The shape of their legs and their light weight allow them to move on top of the water without breaking the surface. When the sun is out, you can see the beautiful, symmetrical shadows these insects make on the bottom of the pool or stream.





Scientific Name: Aneides lugubris Family: Plethodontidae

Size: Up to 4 inches, not counting the tail.

Description: The Arboreal salamander is plain brown with yellow spots and a white underside. Its head is triangular, its toe-tips are squarish, and its tail is often coiled when it is resting.

Diet: Salamanders eat small bugs and worms.

Habitat: The Arboreal salamander lives in annual grasslands, coastal

scrub, and forested areas. It is most common in moist areas near permanent water, and can be found under logs, rocks, and leaf litter, and occasionally in trees.

Interesting Information: These salamanders are nocturnal. Large adults can bite, but rarely do so. They may, however, squeak when caught. These salamanders do not have lungs, but rather, breathe through their moist skin. For this reason, it is important that they do not dry out.





Scientific Name: Sceloporus occidentalis Family: Phrysonomatidae

Size: The Western fence lizard's body, not including its tail, is about 2 to 3 inches long.

Description: The Western fence lizard displays a blotched pattern on its black, gray, or brown body. It has blue on the sides of its belly, and the males have a blue throat. The undersides of its limbs are a yellowish-orange.

Diet: The Western fence lizard feeds on insects and spiders.

Habitat: This reptile is most commonly found in annual and serpentine grassland areas, forests, streams, and coastal scrub and developed areas. It is primarily diurnal (active during the day), seeking out basking and perching spots to regulate its body temperature.

Interesting Information: The Western fence lizard is the most common reptile in California. It occasionally climbs trees, but is more likely to be found on the ground or on low rocks.



WESTERN POND TURTLE



Scientific Name: Clemmys marmorata Family: Emydidae

Size: 4.7 to 7.2 inches long.

Description: The upper part of the shell (carapace) is smooth and has a brown, black, and olive-green pattern The legs, head, and neck are usually olive green or yellow with brown or black lines or spots.

Diet: Western pond turtles eat small insects, aquatic invertebrates, fish, frogs, snakes, birds, and mammals.

Habitat: Western pond turtles live in ponds, streams, lakes, ditches, and marshes.

Interesting Information: The Western pond turtle, like other California turtles, hibernates in winter. It is listed by the government as a Federal Species of Concern.





Scientific Name: Selasphorus sasin Family: Trochilidae (Hummingbird)

Size: About 4 inches long, with a wingspan of 4 inches.

Description: Allen's hummingbirds are tiny birds with long bills and short tails. They have bright green heads and backs, and orange flanks. The male has a shiny red throat patch called a gorget (pronounced "gore-jet").

Diet: Hummingbirds use their long beaks to suck nectar from flowers. Allen's hummingbirds also eat small insects. Habitat: In the Bay Area, Allen's hummingbirds can be found in coastal and dune scrub, groves of eucalyptus or cypress trees, parks, and gardens.

Interesting Information: Hummingbirds build tiny cup-shaped nests out of spiderwebs and lichen. They are the only bird that can fly backward as well as forward. Allen's hummingbirds are migratory, and begin arriving in the Bay Area during late winter and spring, when the flowering shrubs are blooming.





Scientific Name: Euphagus cyanocephalus Family: Icteridae

Size: About 9 inches in length, with a wingspan of roughly 12 inches.

Description: Males are iridescent black with yellow eyes. Females are a duller black or brown, and have darker eyes.

Diet: This species of blackbird feeds on insects and other invertebrates, as well as seeds and grains. **Habitat:** Brewer's blackbirds can be found in areas of upland sand, annual grasslands, all forested areas, and all developed areas.

Interesting Information: These blackbirds nest in dense foliage, on the ground, or in low shrubs. They have easily adapted to living in and around urban areas.



BROWN PELICAN



Scientific Name: Pelecanus occidentalis Family: Pelecanidae

Size: The brown pelican has a wingspan of about 7 feet and a length of about 4 feet.

Description: The brown pelican has different coloring in winter and summer. In the winter, it is mostly white. In the summer (as shown here), the brown pelican has a gray- to browncolored body and wings with a whiteand-yellow head and a dark-brown neck. The bill is long and flat and may have more pronounced red coloring in the summer. The brown pelican has a long neck, a characteristic which is most easily seen when the neck is extended. **Diet:** In this area, the northern anchovy is the main food source for the brown pelican. They also eat other fish and crustaceans.

Habitat: The brown pelican is found in lagoons, such as Rodeo Lagoon and Bolinas Lagoon, and other waters along the California coast. Colonies of brown pelicans nest on small islands.

Interesting Information: The brown pelican is both state and federally listed as an endangered species. Their reproduction in California was close to zero in the years 1969 to 1971, mainly due to banned pesticides such as DDT, which is still present in the food chain. They are also threatened by other disturbances such as human activity, off-leash dogs, and small fishing boats.

CALIFORNIA QUAIL



Scientific Name: Callipepla californica Family: Odontophoridae

Size: About 10 inches tall, with a roughly 2-foot wingspan.

Description: This species looks a little bit like a small, gray-brown chicken. Its body is mostly gray, with a brown speckled belly and sides and a short, black plume curving forward on its head.

Diet: The California quail feeds on vegetation, seeds, and fruits.

Habitat: This species is mostly found in coastal scrub areas, and in forests, lawns, and areas with ornamental plantings. It takes cover in brushy vegetation and trees.

Interesting Information: Quail are fairly rare in San Francisco, but the Presidio is an important refuge for them. They are generally seen in tight flocks called coveys, and when feeding, an adult male may perch on a nearby shrub or post to stand guard. Their song has been described as "Chi-CA-Go! Chi-CA-Go!", or "Where ARE you? Where ARE you?" The California quail is our state bird.



GREAT BLUE HERON



Scientific Name: Ardea herodias Family: Ardeidae

Size: About 4 feet long, with a 6-foot wingspan.

Description: This large, stately bird is gray-blue in color, with a black stripe above its eye and a yellow bill. The biggest of the herons, inflight, it tucks its long neck close to its body.

Diet: Great blue herons feed on small fish, frogs, small mammals, and birds, as well as invertebrates caught by stalking.

Habitat: This species can be found near fresh water, saltwater bays, marshes, and tidal areas.

Habitat: Great blue herons feed on small fish, frogs, small mammals, and birds, as well as invertebrates caught by stalking.

Interesting Information: Great blue herons typically feed alone, but often roost with other herons, building large platform nests. They are sometimes mistaken for cranes.



HOUSE FINCH



Scientific Name: Carpodacus mexicanus Family: Fringillidae

Size: Around 6 inches long, with a 9-inch wingspan.

Description: The male house finch is brownish in color, with a red breast and forehead and a stripe over its eye and lower back. The female is brown with white streaks. Both have thick short beaks, which they use for cracking seeds.

Diet: House finches forage for seeds and other plant parts in areas that provide nearby escape perches. Habitat: This species is ubiquitous; it can be found in annual grassland areas, coastal and dune scrub, forested areas, and developed areas. It selects protected sites for roosting and nesting.

Interesting Information: House finches are monogamous, meaning they only take one mate. When they are not nesting, these finches are often seen foraging or perching in large flocks.





Scientific Name: Buteo jamaicensis Family: Accipitridae

Size: About 2 feet long, with a 4-foot wingspan. Males are usually slightly smaller than females.

Description: Seen in flight from below, a red-tailed hawk has broad, light-colored wings with dark shoulders and wingtips. Its tail is fan-shaped and lightly striped; adults have dark reddish-brown tails. From above, the bird's back is a mottled brown. **Diet:** Red-tailed hawks eat small mammals, birds, amphibians, and reptiles. They are primarily "sit-and-wait" hunters, diving for prey from a perch.

Habitat: These hawks typically hunt in grasslands and roost in trees, where they build large stick nests. They are often seen perching on fence posts along highways, or soaring over fields.

Interesting Information: The red-tailed hawk is one of the best-known raptors in America. Its shrill voice, a long "keee-eerrrr," is the hawk sound most commonly used in movies.

ROCK DOVE (PIGEON)



Scientific Name: Columba livia Family: Columbidae

Size: About 1 foot in length, with a 2-foot wingspan.

Description: The rock dove (known as a pigeon in the US) is gray with a white rump, two black bands on the wings, and a dark band on its tail.

Diet: This bird eats seeds as well as scraps from trash cans.

Habitat: Comfortable in urban and suburban areas, this species can be found in eucalyptus forests as well as on buildings, lawns, and roads.

Interesting Information: The rock dove was introduced to the US from Europe; for centuries, humans used them as message carriers (even Napoleon and Caesar used them!). Scientists have also studied rock doves extensively to learn about bird behavior.



SNOWY EGRET



Scientific Name: Egretta thula Family: Ardeidae

Size: About 2 feet long, with a wing-span of approximately 3 feet.

Description: This all-white species has a medium-long neck, which it holds in an S-shape when in flight; a black bill; yellow around the eyes; and long dark legs with yellow feet. It is smaller than the great egret.

Diet: This bird feeds on small fish and other small vertebrates and invertebrates, which it catches by stalking. It stirs up the mud with its feet to flush out prey. Habitat: The snowy egret can be found in fresh- or saltwater bays, lagoons, and tidal areas.

Interesting Information: In the 1800s, snowy egrets were almost hunted to extinction for their showy feathers. They are now legally protected from hunting.





Scientific Name: Charadrius alexandrinus Family: Charadriidae

Size: About 6 inches long, with a 13-inch wingspan.

Description: The snowy plover is a small shorebird with a short bicolor beak (except in winter, when it is uniformly dark), pale gray back, and white belly, with a dark band on the sides of the neck.

Diet: The snowy plover forages in sand-beach wash zones, running and pecking to scare up small insects and fish.

Habitat: This species, which is listed by the U.S. Fish and Wildlife Service as threatened, can be found in tidal areas.

Interesting Information: Snowy plovers breed in summer. Parents are easily scared away from their nests by humans, so it is best to look for them during the seasons when they are not breeding. Also, their nests, made on the open ground out of shells, pebbles, and debris, are notorious for being difficult to see, so be careful!

SONG SPARROW



Scientific Name: *Melospiza melodia* Family: Emberizidae

Size: Generally 5 to 7 inches in length, with a wingspan of about 8 inches.

Description: The song sparrow has a streaked breast with a dark central spot. Its body color varies from a pale to dark brown. Its beak is short and cone-shaped, good for cracking seeds.

Diet: The song sparrow feeds mostly on seeds, but it also occasionally forages for small invertebrates and berries. Habitat: These small birds can be found along streams, springs, and marshes; in coastal scrub and forests with willow and blackberries; and around ornamentals. It seeks out low, dense vegetation, usually near water.

Interesting Information: Song sparrows have a very complex and sweet song. As with all birds, only the males sing, and they learn from their fathers or other rival males. Their songs are used for courting and establishing territory.



WESTERN GULL



Scientific Name: Larus occidentalis Family: Laridae

Size: Generally about 2 feet long, with a 4-foot wingspan.

Description: This gull is primarily white with a dark gray back and wings. It has a thick yellow bill and pink legs and feet.

Diet: Western gulls feed on fish, insects, shellfish, food scraps, and just about anything else even remotely edible.

Habitat: This species can be found in the ocean, bays, tidal areas, or ponds, and around piers, pilings, and lawns. They nest on cliffs and offshore islands

Interesting Information: Western gulls breed along the California coast, particularly in the Farallon Islands. They are bold, vocal, and pushy, often scaring smaller gulls away.



COYOTE



Scientific Name: Canis latrans Family: Canidae (canine)

Size: Coyotes are approximately 23 to 26 inches tall and 3 to 4 feet in length.

Description: Coyotes have a coarse, gray-colored coat streaked with yellowish-brown and black, and a bushy tail with a black tip.

Diet: The coyote is an omnivore it eats mice, rats, ground squirrels, gophers, and other small mammals as well as some insects, reptiles, amphibians, fruits, and occasionally, birds and bird eggs. Habitat: Coyotes occur in a variety of habitats, from open grasslands to urban areas. Coyotes prefer open areas of vegetation, including farmland, where they are more likely to capture prey.

Interesting Information: Coyotes, highly adaptable predators, are found throughout the United States. They are often found close to urban areas because they adapt well to human activities. In Native American mythology, the coyote is often a "trickster."



RACCOON



Scientific Name: Procyon lotor Family: Procyonidae

Size: Raccoons measure about 2 feet long and are heavily built, generally weighing 10 to 20 pounds.

Description: Mostly dark gray with a black "mask" across the eyes and black-striped rings around a thick tail.

Diet: Raccoons are omnivores, and will eat just about anything! Their diet includes fish, frogs, insects, birds, eggs, fruits, pet food, and kitchen scraps.

Habitat: Raccoons are very adaptable and can survive in many different environments. They can be found in annual grasslands, coastal and dune scrub, forests, buildings, lawns, and rocky tidal areas.

Interesting Information: Raccoons are very curious and clever, and can do a lot with their sensitive hands. They are able to open latches, lids, and drawers, and are known for washing their food before eating. Raccoons are nocturnal.



RED FOX



Scientific Name: Vulpes vulpes Family: Canidae

Size: Red foxes are about 3 feet long, and resemble small dogs.

Description: Red foxes may be colored rusty-red, grayish-black, or somewhere in between. All of them have bushy, white-tipped tails and white bibs. **Diet:** This fox eats mice, rabbits, and other small animals.

Habitat: Red foxes live in mixed field and scrub areas, sometimes near human development.

Interesting Information: Foxes, like all members of the canine family, have non-retractable claws. This is one way to identify their footprints.



VALLEY POCKET GOPHER



Scientific Name: Thomomys bottae Family: Geomyidae

Size: About 9 to 11 inches, not including the short tail.

Description: Pocket gophers are brown rodents with little eyes and ears, a short hairless tail, large incisor teeth, and large front claws for digging. They carry food in the furlined pouches of their big cheeks.

Diet: These gophers mainly eat the roots, stems, and leaves of plants growing within reach of their burrows.

Habitat: Pocket gophers burrow underground, forming extensive networks of tunnels. They live in areas of annual and serpentine grassland, coastal and dune scrub, forests, and lawns, and are a common pest on farms.

Interesting Information: Pocket gophers use their front teeth to help break through hard soil or roots. These teeth may grow as much as 12 inches a year, but are kept worn down by the gopher's industrious digging. Gophers do the important work of plowing the land, bringing soil to the surface and allowing water to filter down through the burrows.

ACKNOWLEDGMENTS

Many people shared their time and expertise during the making of this guide. Josiah Clark, Will Elder, Greg Gaar, Pete Holloran, and Tim Hyland provided conversation, inspiration, and guidance as well as books, articles, and photographs.

Staff members of the city's Natural Areas Program reviewed text for the sites that are under their care as well as making themselves available in the office and in the field. Thank you to Kristin Bowman, Jon Campo, Christopher Campbell, Collette Todorov, and Randy Zebell.

John Dillon of the Randall Museum; Mark Hylkema of the Santa Cruz District of State Parks; Dan Murphy of the Audubon Society; and John Martini, Mary Petrilli, and Asha Setty of the National Park Service led walks or gave lectures pertinent to the guide.

Katie Clower worked cheerfully and tirelessly on the species cards.

Many people answered emails or phone calls, provided resources, or reviewed portions of the text. They include: Leo Barker, National Park Service; Bob Besso, Sunset Scavenger; Peter Brastow, Nature in the City; Jennifer Clary, Alliance for a Clean Waterfront; Barbara Corff, National Park Service Docent; Paul Fresina, SF Recycling and Disposal; Suzanne Gautier, San Francisco Public Utilities Commission; Margaret Goodale, Randall Museum; Ruth Gravanis, Treasure Island Wetlands Project; Bob Holloway, National Park Service; Doug Kern, Urban Watershed Project; Al Keuter, Santa Cruz County Entomologist-at-Large; Bradley Owens, Owens Watershed Planning; John Plummer, Friends of Lake Merced; Damian Raffa, Presidio Trust; Paul Scolari, National Park Service; Aleutia Scott, National Park Service; Jake Sigg, California Native Plant Society; Lisa White, Geosciences Dept., San Francisco State University; and Becky Wike, SF Dept of the Environment.

Thank you to the following educators who helped create a vision for this guide through their participation in project focus groups: Margaret Ames, Ralph Baum, Kristin Bowman, Fatima Colindres, Rachel Elliott, Emil Fogarino, Elaine Gee, Kalyca Green, Ursula Guise, Doug Kern, Michael Leahy, Anne Lewenhaupt, Carol Little, Tami McDaniel, Bill Milestone, Yvette Nash, Debra Netkin, Nicki Phelps, Kim Probst, Jim Reed, Tessa Rohde, Carmelo Sgarlato, Rae Ann Sines, Carla Vasquez, Cidney Webster, Ryan Yee, and Betty Young. Mari Azuras, Katie Clower, Fatima Colindres, Michele Gee, Nicole Jung, Charity Maybury, Jonathan Muller, Ernesto Pepito, and Aleutia Scott lent us their expertise in compiling our tips for teaching outdoors. Thank you to May Lee of Alamo Elementary School for graciously allowing us to use her idea for attaching a pencil to a clipboard in this same section.

The work of archaeologist Barbara Voss provided the basis for the portion of the guide focused on Juana Briones. The translation of Juana's divorce petition is excerpted from *The Archaeology of Ethnogenesis: Race and Sexuality in Colonial San Francisco*, by Barbara L. Voss (University of California Press, 2008).

PHOTO CREDITS

Except as listed below (alphabetically by photographer), all contemporary photos are by Tung Chee, Golden Gate National Parks Conservancy, and all historic photos are courtesy of Greg Gaar. For information regarding reproduction of any of these images, please contact the source.

Abbreviations: GGNRA Golden Gate National Recreation Area, NPS National Park Service

Margo Bors: 110, 147

Chris Campbell: 261

Nancy Caplan/NPS: 72

Gerald and Buff Corsi © California Academy of Sciences: 267 Crissy Field Center: 29, 31, 32, 33, 35, 53, 71 (lower right), 103 (upper middle), 127, 129, 130, 157 (center/upper, lower)

Division of Interpretation/GGNRA: 18 (center)

Division of Natural Resources/GGNRA: 55, 57, 60,

Steve Dowlan/Oregon Birds: 51, 176

Will Elder/NPS: 16, 17 (middle right), 18 (bottom left), 20, 42, 43, 48, 50, 80, 107 (upper left), 136, 152, 248, 250–260, 262–266, 268–269, 271–279, 281–283

Cheri Garamendi: 111

GGNRA/US Department of the Interior/NPS: 103 (lower middle), 107 (lower left), 125, 139 (upper left), 144 (lower right), 145 (upper left), 148 (lower right), 149, 188, 191 (upper right, lower left), 205, 215 (upper left)

Debbie Harton: 59

Alan Hopkins: 47, 270

Darren McNally/NPS: 280

Damien Raffa/Presidio Trust: 46

US Army: 151

APPENDIX A: PARKS AND NATURAL AREAS AT A GLANCE

Sites	Geology and Soils	Weather	Watersheds	Insects	Reptiles/Amphibians	Birds Mammals	Marine Life	Human History	Art	Going Deeper Topic	Species Focus	Agency Responsible for the Site
Baker Beach	•			,						Life on the beach	Sea rocket	National Park Service
Bayview Hill	٠				•							S.F. Recreation & Park Dept.
Bernal Hill				,							Stork's bill	S.F. Recreation & Park Dept.
Brooks Park	•			•		•				Creating a wildlife garden	Allen's hummer	S.F. Recreation & Park Dept.
China Beach	•						•			0		National Park Service
Crissy Field		•				•		•	•			National Park Service
Corona Heights	•	-		•		-	-		-	Bees		S.F. Recreation & Park Dept.
El Polin Spring/Inspiration Point	•			•				•		Stream animals		National Park Service
Fisherman's Wharf	-		+	-								Trational I dix oct vice
Aquatic Park, Maritime												National Park Service
-									•			National Fark Service
Museum, Municipal Pier Fisherman's Wharf Area							•					Commercial
							-	•				National Park Service
Hyde Street Pier Fort Funston							+-					
						• •	-			Geology of the bluffs Contents of water		National Park Service
Glen Canyon								-		Contents of water		S.F. Recreation & Park Dept.
Golden Gate Park				-		_		•				
Chain of Lakes				•		•				Aquatic organisms		S.F. Recreation & Park Dept.
Oak Woodland			•	•		•				Oaks		S.F. Recreation & Park Dept.**
S.F. Botanical Garden												S.F. Botanical Garden Society/ S.F. Rec. & Park
Heron's Head/India Basin	•			•			•			Life in a tidal salt marsh		
Hilltop Park						•		•		Ravens		S.F. Recreation & Park Dept.
Lafayette Park				•		•		•		Early surveying and astronomy		S.F. Recreation & Park Dept.
Lake Merced						•				Human interaction with the lake		S.F. Recreation & Park Dept.
Lands End & Sutro District												
Balboa Natural Area											Foredune plants	NPS/S.F. Rec. & Park Dept.
Fort Miley						•					House finch	National Park Service
Lands End						•		•				National Park Service
Point Lobos, Sutro Baths,	•	•	•				•					National Park Service
Seal Rocks, Farallones												
Sutro Heights						•			•			National Park Service
Lobos Creek Dunes				•		•				Restoration		National Park Service
McLaren Park						• •	•	•			Ground squirrel	S.F. Recreation & Park Dept.
Mountain Lake						•				Historic meeting place		NPS/S.F. Rec. & Park Dept.
Mt. Davidson										Grasses and grassland		S.F. Recreation & Park Dept.
Ocean Beach	•						•			Sand		National Park Service
SOMA Rec Center	•			•						Doing natural history anywhere		S.F. Recreation & Park Dept.
Sunset Heights										Dune scrub		
15th Avenue Steps												S.F. Recreation & Park Dept.
Golden Gate Heights Park						•						S.F. Recreation & Park Dept.
Grandview Park	•					•	•					S.F. Recreation & Park Dept.
Hawk Hill					•	+						S.F. Recreation & Park Dept.
Rock Outcrop	•				-			•				S.F. Recreation & Park Dept.
Telegraph Hill	•	•	+	+		•		•	•	Fog		S.F. Recreation & Park Dept.
Twin Peaks	•	+		•		-			-	- vb		S.F. Recreation & Park Dept.
Walton Square	-		-			•				Feral parrots		o.i. increation of raik Dept.

**Heron's Head programming is managed by Literacy for Environmental Justice; the land is managed by the Port of San Francisco. India Basin is managed by S.F. Recreation & Park Department.

APPENDIX B: PLANTS

Sites	Coastal Strand	Rocky Shore	Freshwater Wetland	Salt Marsh	Coastal Dune	Dune Scrub	Northern Coastal Scrub	Coastal Prairie	Grassland	Oak Woodland	Riparian Woodland	Urban Forest	Urban Park
Baker Beach	٠				٠	٠	٠						
Bayview Hill								٠	٠	٠		٠	
Bernal Hill								٠	٠				
Brooks Park (Community and wildlife gardens)									٠			٠	٠
China Beach	٠												
Crissy Field	٠			٠	٠								
Corona Heights	٠												
El Polin Spring/Inspiration Point			٠						٠		٠		
Fisherman's Wharf Area													
Aquatic Park, Maritime Museum, Municipal Pier		•											
Fisherman's Wharf		٠											
Hyde Street Pier		٠											
Fort Funston	٠						٠						
Glen Canyon							٠	٠	٠		٠	٠	
Golden Gate Park													•
Chain of Lakes	٠										٠		
Oak Woodland										٠			
S.F. Botanical Garden													•
Heron's Head/India Basin				٠									
Hilltop Park													•
Lafayette Park													•
Lake Merced			•				•				•	•	
Lands End & Sutro District													
Balboa Natural Area					•								
Fort Miley							•					•	
Lands End Point Lobos, Sutro Baths,							•					•	
Seal Rocks, Farallones		•	•	•								•	
Sutro Heights												•	
Lobos Creek Dunes					•	•						-	-
McLaren Park			•		-	-		•	•			•	
Mountain Lake			•					-	-		•	-	
Mt. Davidson							٠	٠	٠			٠	
Ocean Beach	٠				٠								
SOMA Rec Center													٠
Sunset Heights													
15th Avenue Steps						٠							
Golden Gate Heights Park								٠				٠	٠
Grandview Park						٠							
Hawk Hill						٠							
Rock Outcrop							٠						
Telegraph Hill													٠
Twin Peaks							٠		٠				
Walton Square													٠