



Sweetwater Safari Backpack



Acknowledgements

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Introduction

Welcome to the Sweetwater Marsh National Wildlife Refuge which was established to protect, restore and enhance rare and endangered habitat, fish and wildlife and is the largest remaining salt marsh on San Diego Bay. Rare eel grass beds are nurseries for fish. Rare and endangered species such as the Light-footed Clapper Rail, California Least Tern, Western Snowy Plover and a state-listed bird, the Belding's Savannah Sparrow, all make their homes and raise their young here. Salt Marsh Bird's Beak, an endangered plant, grows at Sweetwater Marsh. Hundreds of thousands of birds migrating along the Pacific Flyway twice each year use the Refuge as a place to rest and feed before continuing on their long journeys north to Alaska and down to South America. Sweetwater Marsh is home to over 270 species of birds, hundreds of thousands of invertebrates and fast-diminishing marsh plants which support much of the wildlife.

This curriculum opportunity was created through a joint venture of the San Diego Zoological Society, the U.S. Fish and Wildlife Service San Diego Refuges and the Chula Vista Nature Center to provide an educational adventure for local students to learn about science and the local environment in a hands-on manner. The curriculum program was designed for fourth grade students and matches the state educational science standards for fourth grade.

The program includes step-by-step information on how to arrange for your field trip, pre-visit teaching lessons, on-site curriculum and equipment, and a post-visit curriculum to further the learning process. The on-site curriculum is taught by the teacher and chosen chaperones. The Chula Vista Nature Center will coordinate your visit and greet you upon your arrival. The Chula Vista Nature Center is not able, however, to provide on-site teaching or supervision of students. Please note that this unique field trip is only available to a teacher and his/her class once the teacher has attended a mandatory workshop, provided quarterly and free of charge at the Chula Vista Nature Center.

The Refuge's first priority is to conserve the wildlife and wildlife habitats of the Sweetwater Marsh National Wildlife Refuge. Therefore, this field trip opportunity is only open to one classroom of approximately 32 students per day. While ensuring that the reserve is not overly impacted, this also provides each visiting class the opportunity to enjoy this experience in a quiet natural setting. The refuge trails are flat, wide and wheelchair accessible. The hiking distance is about a mile maximum and would be considered an easy trail. Comfortable, sturdy shoes are recommended, however.

Before visiting, students should be divided into four research teams: Clapper Rail, Least Tern, Savannah Sparrow and Peregrine Falcon.

Each bird group will rotate among four 45-minute research stations:



Plankton



Plants



Animals



Birds

During each station, students will learn about the living and nonliving components of the Refuge ecosystems and how these components interact. The field curriculum consists of an interactive activity designed to promote exploration and learning and a data collection worksheet to be completed and saved for the post-visit curriculum in the classroom. Each station is conducted in a different area of the refuge. See Refuge map for the location of each research area.

Pre-lessons were organized to prepare the students with necessary background knowledge to enhance their learning experience once on-site. A post-visit curriculum is provided to guide students as they review, organize and publish their field data. This real-life experience provides authentic assessment of gained science knowledge.

For further information about this unique educational experience, please contact the Chula Vista Nature Center at 619-409-5903.

Habitats

The Sweetwater Marsh National Wildlife Refuge has several distinct wildlife habitats.

The salt marsh is characterized by salt-tolerant vegetation such as Salt Marsh Rosemary, Alkali Heath, Pickleweed, Cordgrass, Arrowweed and Batis. All of these plants have developed strategies for dealing with the daily inundation by tides and the salinity of the water. The soil is always wet and permeated with burrows of fiddler crabs, clams and other burrowing creatures. On the surface you can see California Horn Snails and Channeled Basket Shells. Many large shorebirds like willets, curlews and godwits take advantage of the rising and falling tides to feed on these invertebrates. The endangered Clapper Rail constructs its floating nests in the cordgrass and the endangered Savannah Sparrow needs to nest in the pickleweed.

Tidal channels meander through the salt marsh bringing the life-giving salt water. In the channels live the long-jawed mudsuckers and yellow-finned gobies that make up the food of the Great Blue Heron and the white Snowy and Great Egrets. Round stingrays and halibut can be seen swimming in the channels and terns, Black Skimmers and Osprey can be seen hovering over them in search of fish.

Mudflats are exposed at low tides. They are riddled with the burrows of ghost shrimp, worms, clams and other invertebrates. Then thousands of shorebirds of all sizes can be seen intently probing into the mud for food. The birds have different leg and bill lengths and each species searches for different foods.

The beach here is often covered with dead eelgrass and human items (such as trash, chemicals) that wash down from the watershed. At high tide it is used as a roost by the larger shorebirds. As the tide recedes, hundreds of tiny sandpipers scurry along the edge of the water looking for isopods and other morsels on the surface.

The Coastal Sage Scrub habitat of the uplands of Gunpowder Point has been degraded over the past century by human activities. When the Kumeyaay people were living here, they were able to utilize the plants and animals that lived here to make a decent life. With the coming of the kelp processing factory that employed 1500 people to make the components of gunpowder, the creation of two levees to impound water, the cottonseed oil storage facility and then the farming, most of the native mammals, birds, reptiles and plants disappeared. The Nature Center and the U.S. Fish and Wildlife Service are now working together to restore the uplands.

Plants of the Coastal Sage Scrub community such as lemonadeberry, toyon, sagebrush, black, white and Cleveland sages and bush sunflower are among those being planted by volunteers. In time it is hoped the plants will mature enough to provide shelter and food for displaced native mammals, birds and reptiles such as the San Diego Coast Horned Lizard, Gray Foxes and California Gnatcatcher.

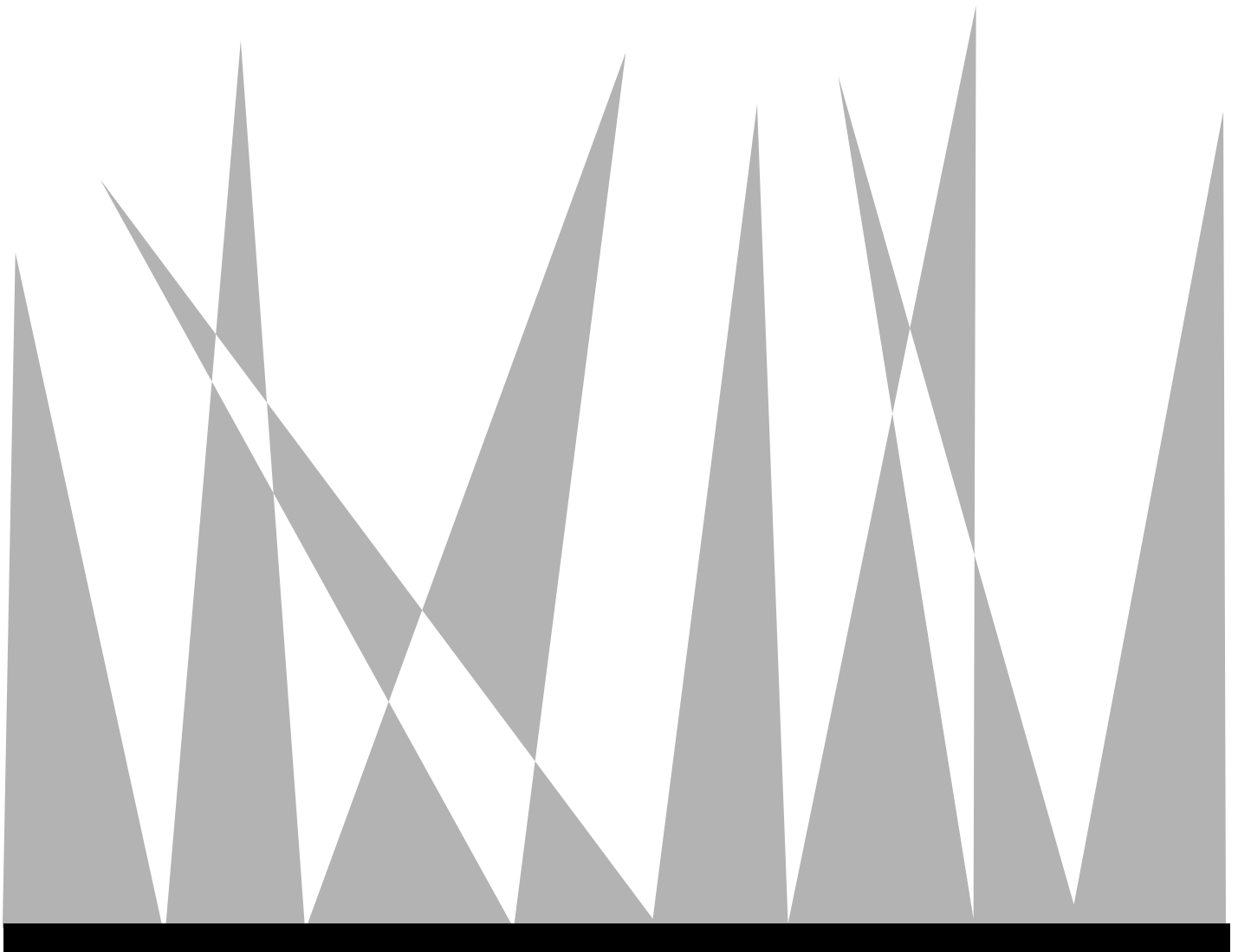




Section One

Pre- & Post-Lessons

(for the classroom)





Pre-Lesson 1: Vocabulary Study

Objective

Students will learn the definitions of vocabulary words pertaining to the Sweetwater Marsh Safari Backpack curriculum program.

Materials

Copy of vocabulary list and definitions

"Vocabulary Bingo" gameboard

Bingo markers- approximately ten per student

Procedures

1. Provide each student with a vocabulary list. Practice the pronunciation of each word as a class.
2. Review the definitions of the words. If preferred, provide students with the vocabulary words and direct them to research the definitions themselves in a dictionary.
3. Once the students are familiar with the vocabulary words and their meanings, play "Vocabulary Bingo." Write the vocabulary words on the board or make sure each child has a list of the words. Direct students to neatly write one vocabulary word in each square of the blank bingo page. It does not matter which words they use or in which squares the words are placed. Each word may be used only once. Give each student markers (beans, plastic disks, squares of paper, etc.) to use when they have a match.
4. When the students are ready, read a definition. The students look at their bingo boards and, if they have the word that matches the definition, a marker is put on the word to indicate a match. The first student to fill one row yells "Bingo" and wins the game. Bingo can be played several times. Encourage students to exchange boards with each other when a new game begins.

Vocabulary List

algae - simple, aquatic plants with chlorophyll, but without roots, stems, and leaves

aquatic - pertaining to water

brackish - containing a moderate amount of salt

bay - an inlet of the sea

beach - the shore of a body of water that is covered with sand, gravel or rocks

crustacean - ocean animals with outer coverings that are shed periodically as the animal grows, like crabs, shrimp and lobsters

decompose - to break down into more basic elements (decay)

decomposer - an organism (such as bacteria) that breaks down dead plants and animals into more basic elements, releasing nutrients

development - the construction of buildings, roads and houses in a once natural and wild area

ecosystem - a system made up of a community of living things and the physical environment with which they interact

endangered - a species in danger of extinction

extinction - a species that no longer exists

food chain - a sequence of organisms in which each member of the chain feeds on the member below it

habitat - the arrangement of food, water, shelter and space suitable to an organism's needs

halophyte - a salt-loving plant; a plant that grows in saline soil

herbivore - an animal that feeds only on plants

kelp - a large seaweed that is harvested for many projects

larvae - juvenile forms of many invertebrates and fishes

marsh - an area of soft, wet lands

metate - a stone used for grinding grains

microscopic - visible only with a microscope

Vocabulary List, con't.

migration - the act of moving (usually seasonally) from one place to another
for feeding or breeding purposes

mudflats - muddy areas of a wetland that are exposed at low tide, providing foraging for
shorebirds

native - a plant or animal belonging to a locality, not brought to the locality by humans

nutrients - any substance that provides energy for growth (such as food, vitamin, minerals)
when materials decompose, their nutrients are released

oxygen - a gas that animals breathe to stay alive

phytoplankton - small plants that drift in the water

plankton - small plants and animals that drift in the water

predator - an animal that hunts, catches and eats other animals

refuge - a place that provides shelter and protection

salinity - amount of dissolved salts in the water

sanctuary - a place of refuge and protection

scat - the droppings left behind by an animal

shorebird - wading birds that frequent shores of oceans, rivers and marshes

shrub - a large woody plant, not a tree

slough - a creek in a marsh

stomata - an opening on the leaf of a plant to allow gases to pass through

tide - the alternate rising and falling of the ocean caused by the gravitational attraction of the
moon and sun occurring unequally on different parts of the earth

upland - an area near a body of water that never is covered by water

watershed - a region that drains into a creek, river, ocean or other body of water

zooplankton - small animals that drift in the water

 **Bingo Board** 



Pre-Lesson 2: Journal Introduction

Objective

Students will read the fictional journal of L.D. Hernandez and create drawings to illustrate each journal entry.

Materials

One copy of journal entries per student

Drawing materials: paper, colored pencils, markers, crayons, etc.

12" x 18" piece of construction paper — one per student

Background Information

Science is the process of exploring our world. This exploration occurs in many ways. . . by hiking the outdoors, conducting research on the internet, reading published materials, dialoguing with others, and often by exploring our thoughts about our world through journal writing.

This curriculum program includes a fictional journal written by L. D. Hernandez. Through L. D.'s journal, we learn that this young scientist is exploring the Sweetwater Marsh National Wildlife Refuge for the first time, just as your students will, and is excited by all that will be learned.

L.D.'s journal entries provide an example of a typical field journal kept by scientists. Journals provide a place for thoughts, for questions for further research, for drawings of plants, animals and objects seen, and for specific data collected.

Procedure

1. Teach the vocabulary pre-lesson before reading the journals. Vocabulary words are used throughout the journals.
2. Introduce the concept of journals to students. Ask if they have ever kept a journal. Discussion questions include:
 - Did you enjoy keeping a journal? Why or why not?
 - Why might field scientists keep journals?
 - How would the journal of a scientist be useful in the future?
3. Further expand on students' answers to the above discussion questions. Explain that it is very important that field scientists keep notes or a journal. It would be impossible to remember everything seen in the field and then to record it when returning to base camp. Explain that scientists write down what they see, take samples for further research (when granted permission), make drawings of things that can not be brought back as samples, and record questions needing further research.
4. Read the journal entries as a class, further expanding on information provided in the text and answering questions. Note: Consider reading one journal entry each day over the course of a week. At the end of each journal entry, ask students to visualize what they read and to create a drawing which represents what L.D. was describing.
5. After reading the journal entries, attach the drawings next to the corresponding journal entries and staple inside a folded piece of 12" x 18" construction paper to create a book which can be sent home to share with parents before the field trip.



Journal Entry
5:30 a.m. No wind; no clouds visible
Research Focus: History of Sweetwater Marsh

I am so excited today has finally arrived! My university has assigned me to the research team that will be studying the Sweetwater Marsh National Wildlife Refuge area found along south San Diego Bay. I had to go through three interviews before being accepted to study this marsh ecosystem. Soon I'll be able to share our research with others who work at wetlands throughout the state. This is the first time I'll be a part of a field research team. I'm very excited to put my years of learning to use and help preserve this fragile area. . .and to get my feet wet and muddy!

I arrived before the sun this morning, so I'll use this quiet time to review what I know about the area:

- For hundreds of years before the coming of Europeans, native people called Kumeyaay lived here. They ate shellfish and seeds from the area in the summer months and in the Fall they traveled to the mountains to collect acorns. Metates, arrowheads, and pieces of pottery have all been found here in the marsh. Kumeyaay continue to live in San Diego and Baja California.
- During World War I, the Hercules Powder Company used kelp, an important ocean plant for all living things, to make explosives for the war. Bricks from the factory still litter the shoreline.
- After the war, the area was taken over by an oil company to store cottonseed oil. Their buildings burned down in 1929.
- Farmers cleared the land and planted tomatoes and other crops.
- After farming was discontinued, the area was used as a trash dump!
- The Chula Vista Nature Center opened in 1987.
- The U.S. Fish and Wildlife Service established a national wildlife refuge here in 1989.





Journal Entry
6:30 a.m. Rain clouds blowing in from the ocean
Research Focus: Plants

Today we returned to observe plants of the marsh. Throughout my botany classes at the university, I remember being amazed about the plants of the marsh environment. Many of them, such as cordgrass and pickleweed, live in the salty soils of the marsh. They must pull salty water up through their roots. I remember swimming in the ocean as a child and accidentally swallowing salt water. I hated the taste and felt ill afterwards. However, some of these plants always have many salt crystals on their leaves. They excrete the salt through many tiny holes in their leaves called stomata. I wish I had this adaptation as a child!

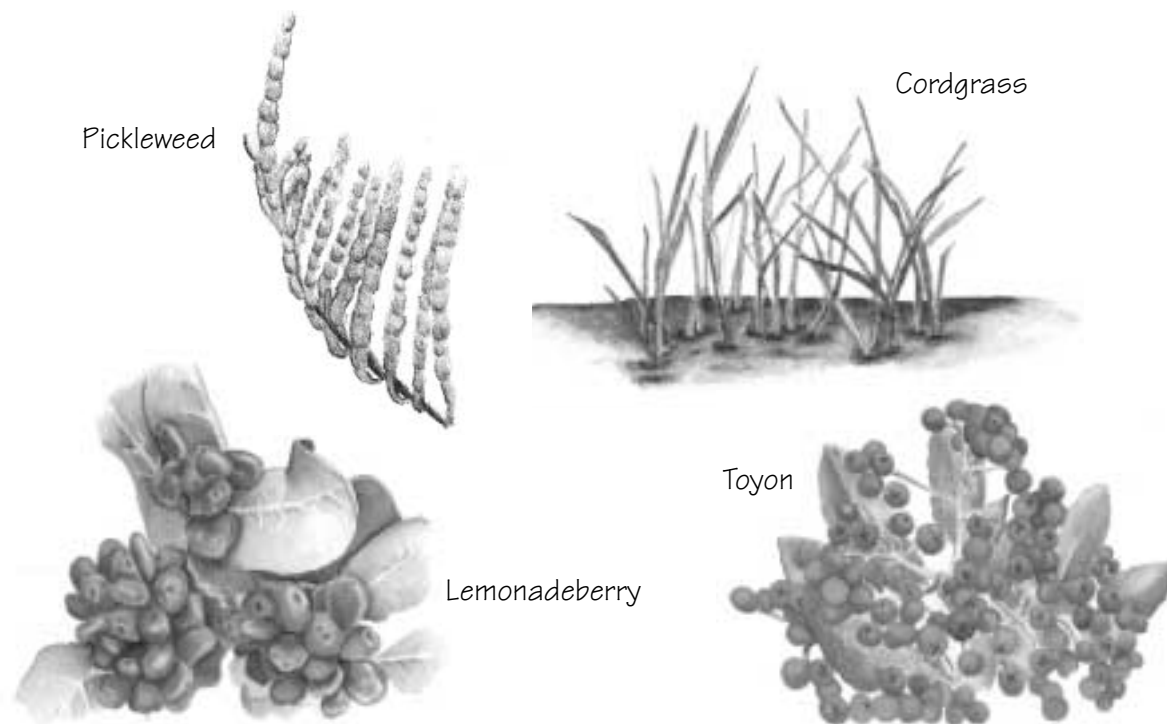
I must gather data on how long cordgrass can live underwater, and observe what animals eat cordgrass. Cordgrass is an important plant in the lower marsh because it provides shelter and nesting for the endangered Light-footed Clapper Rail.

Middle Marsh. . .

In the middle zone of the marsh is the pickleweed plant. This plant starts growing where the cordgrass stops. When I was a freshman and in my first botany class, I could always recognize this plant because its leaves looked like a bunch of slender pickles attached to one another. Pickleweed, like cordgrass, can also live in salty water. It gets rid of salt by bringing it to the tip of its branches. In the fall, the branch tips turn red and fall off. I want to discover if the salt causes them to turn red and fall off or if something else causes the change.

Uplands. . .

I'll look for the toyon and lemonadeberry plants. Coyotes often eat the berries and I might find evidence of coyotes by searching for tracks and scat around these plants.





Journal Entry
6:00 a.m. Heavy Fog
Research Focus: Animals

Many animals are crepuscular—most active at dawn and dusk. My goal today is to collect data on the wildlife living in the Refuge. I've learned from experience that I'll be most successful if I can become "a part of" the environment and almost invisible to the animals living here. I have worn clothes that mimic the colors of the marsh and will move slowly and quietly during my mini-safari.

8:00 a.m.

My morning was very exciting and successful! The morning fog left water droplets hanging from rows of tiny silk thread—a spider's web—found between two bush sunflower plants. If the spider had been there, I might have seen it hanging from its "safety line" as it spun its silk from one bush to another.

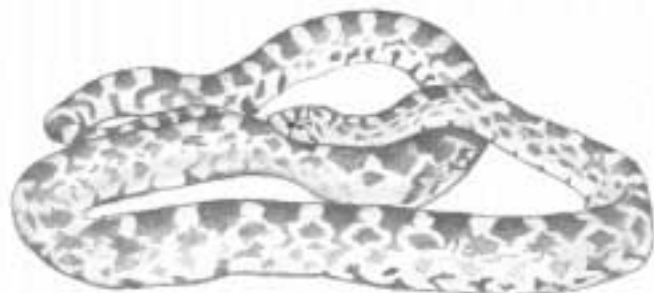
There was a log lying alongside the Cottonseed Trail. Around the log appeared lots of tracks. I can identify them with my field guide. They are rabbit tracks! When I look beyond the log, I can see a rabbit trail heading toward the sagebrush. Many rabbits live in the uplands of the Refuge.

While watching shorebirds at the bay shoreline, I noticed a curvy track going into the grass. It was a snake of some kind. I followed its track and found shed skin left behind by a gopher snake. A gopher snake looks much like a rattlesnake, but is not harmful to humans. I took pictures of the skin and a few scales for testing and placed the rest back in the grass. Although I looked for some time, I could find no other clues of the snake.

Cottontail Rabbit



Gopher Snake





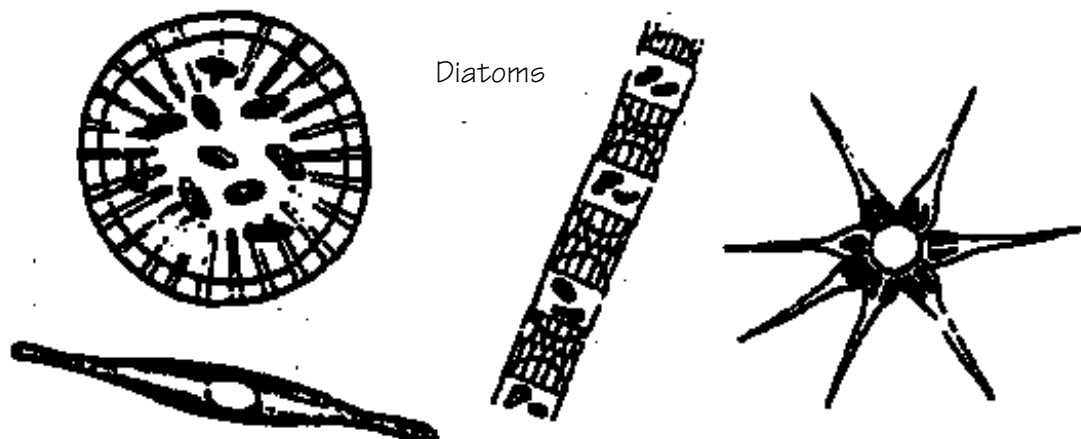
Journal Entry
7:00 a.m. Clear Skies, Cool Temperatures
Research Focus: Plankton

I find plants and animals fascinating and could spend each and every day researching their lives. Many plants and animals in this Refuge depend on the water that flows in and out of the area twice daily. If I don't understand the water sources and what lives within the water, I won't understand the marsh ecosystem.

A marsh is an amazing area because the salt water of the bay, brought in twice a day with the tide, mixes with the fresh water of the streams and rivers. The fresh water of the Sweetwater Marsh starts in the mountains of Cuyamaca State Park and finds its way downstream and finally to the ocean. Unfortunately, trash and chemicals also find their way into the streams that carry water to the marsh. The polluted stream water then pollutes the marsh and affects the marsh animals. I hope that my research will help people understand the damage that polluted water can do to the plants and animals of the marsh ecosystem.

As I begin to collect water, bubbles form on the surface of the water. The bubbles are coming from several kinds of fish living in the waters of the marsh. Many of them feed on the algae and other small plants and animals in the water. I watch one fish as it grazes like a cow on the algae. Nearby a great blue heron has a different meal in mind for lunch. The heron is hiding in the tall grass near the slough looking for an opportunity to grab one of the surfacing fish. It patiently waits for the right moment to plunge its bill into the water to snatch a fish. Then it flips the fish around in order to swallow it head first.

Plankton is one the most important food sources for marine animals. The word plankton means "drifting" which describes how planktonic organisms move through the water with the help of the current. Plankton are either animals or plants, and can be as large as a jellyfish or so small that you can only see them under a microscope. Phytoplankton (plant plankton) are important to the animals of the marsh because they are a major source of food throughout fresh and salty bodies of water. Phytoplankton produce oxygen in the water and in the air we breathe. Zooplankton are marsh invertebrates; they can be eggs, larvae, juveniles, or adults. Part of my research today will be to see what kinds of plankton live in the marsh.





Journal Entry

5:30 a.m. Clear Skies

Research Focus: Birds

The birds of the Refuge, as in many habitats, play a very important role in keeping the habitat alive and healthy. Many seeds, such as those of the lemonadeberry, need to pass through the digestive system of an animal in order to grow. Finches help the bush sunflower by spreading seeds that would otherwise die and never reach the ground to germinate.

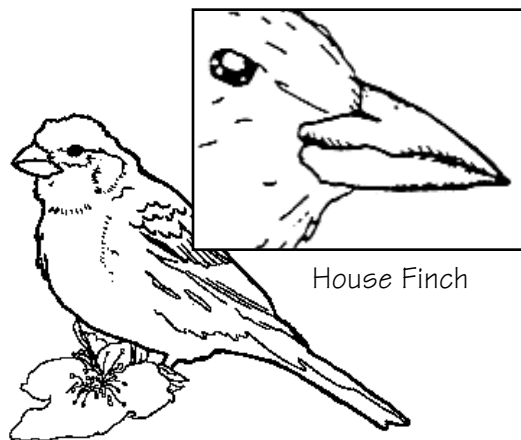
Beaks are varied and unique to each bird. The beak is the "utensil" the bird uses to pick, catch, or eat its food. When I look around the marsh boardwalk, I spot a sandpiper with a probing beak, a red-tailed hawk with a tearing beak, and a house finch with a seed-eating beak. Each of these birds feeds on a different plant or animal. They each have a different beak or "utensil" to help them.

A bird's feet are used to help it move and catch its prey. The hawk I am observing has grasping feet with long talons to help it catch rabbits and rodents. The sandpiper has feet with long toes which keep it from sinking in the soft mud of the mudflats, allowing the sandpiper to use its long beak to dig crabs and other crustaceans from the mud. Finches are seed-eating birds usually found perched on branches of plants. Their flexible toes are easily wrapped around branches, helping them to stay balanced as they pick seeds.

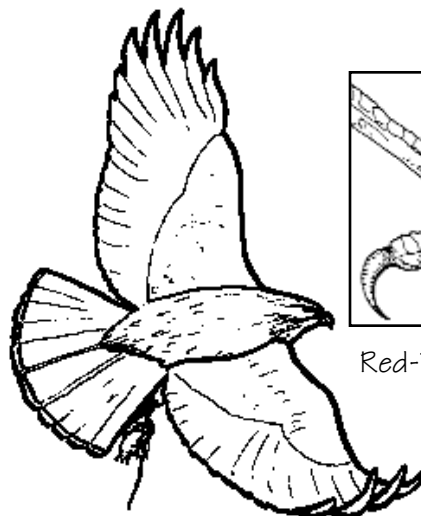
Many of us think all birds are the same, but the more you learn about them, the more you understand that each has its own look, walk, flying style, song and job in helping to keep the environment healthy. I must observe their physical features, behaviors and sound to learn how to protect them. Then I will compare what I observed in the field with the information in my bird field guides before recording which bird it is.

When identifying birds, there are three main steps:

- Use the field guide to look for key markings, characteristics and behaviors.
- Find a drawing in the field guide that matches the bird seen.
- Read the information about the bird in the field guide to make sure you are identifying the bird you see.



House Finch



Red-Tailed Hawk



Pre-Lesson 3: What is a Refuge?

Objective

Students will learn the definition of a Wildlife Refuge, the history of refuge development in the United States, and the four main components of refuge management.

Materials

Overhead projector

Overhead transparency of map of the Sweetwater National Wildlife Marsh Refuge

Chart or overhead transparency of the "Mission of the National Wildlife Refuge System"

One set of "Refuge History Cards" and "President Cards" for each pair of students

One set of "Refuge Management Cards" for each pair of students

Overhead transparency or copies of handout "Refuge Fact Sheet"

Procedure

1. Tell students that the class will be taking a field trip to the Sweetwater Marsh National Wildlife Refuge in Chula Vista. To familiarize the students with the area, show the map of the Refuge on an overhead projector. Discuss the area by pointing out the bay, beach, uplands and marsh areas (see vocabulary lesson for definitions of the areas). Then show the boundaries of the Refuge on the map. Explain that land within the boundary lines are federally protected (protected by the United States government). Land outside of the boundary lines is either held privately or owned by the city or county. This lesson explores why the United States government finds it important to create refuge land.
2. Read the refuge mission statement with the students. Ask the students why an organization such as the U.S. Fish and Wildlife Service would write a mission statement. (*Mission statements allow all individuals in an organization to clearly understand the goal of the organization and therefore work toward the goal.*)
3. Provide pairs of students with the History of the Refuge System Cards and the President Cards. Explain to students that land preservation is an ongoing process, often spanning decades. The National Wildlife Refuge System can be traced back to 1903 when President Theodore Roosevelt established Pelican Island (Florida) as the first bird sanctuary in the United States.
4. Ask students to create a timeline by laying out the names of the presidents in chronological order. Under each president's name, put each History of the Refuge System card that fell under his administration. When the timeline is complete, ask student volunteers to read the cards to the class. Compare United States current events at the time with decisions made concerning protected lands. For example, from 1939-1945 the Interior Secretary allowed bombing on refuge lands. Ask the students why. (*These were the years of WWII and winning the war was the main goal of the country. Land preservation was not a main priority.*)

5. Explain to students that once a refuge is established, there are four main areas involved in the management of the land:
 - Refuge objectives: The refuge objectives guide decisions and are the same for all refuges.
 - Current Issues of Concern: Each refuge identifies its most urgent environmental concerns and develops programs designed to improve the environmental problems.
 - Significant Species Protection: Species that have been identified as threatened or endangered are closely monitored and protected.
 - Public Use: Community visitation is encouraged to increase awareness and understanding of the need for protected land and wildlife.

6. Provide each pair of students with a set of Refuge Management Cards. Ask students to first lay out the four management area cards (Master A) across the tops of their desks or tables. Ask the students to read each card (Master B & C) and decide if it is an objective, a current issue of concern for the Sweetwater Marsh, a significant species of the Sweetwater Marsh, or a public use component. Using either an overhead transparency or copied handouts of the Refuge Fact Sheet, ask students to check their work.

7. Discussion Question: How can the refuge manager promote public use and at the same time protect endangered habitat and species? *(Accept all possible answers as a means to promote discussion. There are many ways to meet the above objective.)* Encourage students to look for ways the Sweetwater Marsh Wildlife Refuge has encouraged public use while protecting land and species.



Sweetwater Marsh National Wildlife Refuge Map



U.S. Fish & Wildlife Service

Mission of the National Wildlife Refuge System

“To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.”

National Wildlife Refuge System Improvement Act of 1997
(Public Law 105-57, October 9, 1997)

(President Cards—Master A)

Directions: Cut apart to create a time line.

Theodore Roosevelt
1902-1909

William H. Taft
1909-1913

Woodrow Wilson
1913-1921

Warren G. Harding
1921-1923

Calvin Coolidge
1923-1929

Herbert C. Hoover
1929-1933

Franklin D. Roosevelt
1933-1945

Harry S. Truman
1945-1953

Dwight D. Eisenhower
1953-1961

John F. Kennedy
1961-1963

Lyndon B. Johnson
1963-1969

Richard M. Nixon
1969-1974

Gerald R. Ford
1974-1977

James E. Carter, Jr.
1977-1981

Ronald W. Reagan
1981-1989

George Bush
1989-1993

Bill Clinton
1993-2001

George W. Bush
2001-2004

(Refuge History Cards—Master A)

Directions: Cut cards apart and match event to presidential administration.

1903: President Theodore Roosevelt established Pelican Island (FL) as the first bird sanctuary. During his term, he created 51 bird reservations and 4 big game preserves.

1935-1936: "Ding" Darling, head of the U.S. Biological Survey (the predecessor agency of the U.S. Fish and Wildlife Service), sent biologist J.Clark Salyer to identify prime wetlands nationwide. The 600,000 acres he purchased became over 50 refuges, including Red Rock Lakes (MT) for trumpeter swans and Agassiz (MN) for waterfowl.

1905-1912: The first refuges for big game animals were Wichita Mountains National Bison Refuge (OK)-1905; National Bison Range (MT)-1908; and National Elk Refuge (WY)-1912.

1940: Rachel Carson, then a scientist with the U.S. Fish and Wildlife Service, wrote a series of "Conservation in Action" booklets examining wildlife and habitats on refuges.

1918: The Migratory Bird Treaty Act between the U.S. and Great Britain (for Canada) became the foundation for future legislation that would greatly expand the refuge system.

1939-1945: The Interior Secretary opened refuge lands to oil and gas drilling and allowed the Department of Defense to use refuge lands for bombing practice.

1924: Upper Mississippi National Wildlife and Fish Refuge (IA, IL, MN, WI), the first refuge designated for wildlife and fish, was established. Izaak Walton, League founder, and Will Dilg were instrumental in this effort.

1958: Duck Stamp Act amended to authorize acquisition of small wetland "potholes" as Waterfowl Production Areas (WPAS). The Service has acquired more than 2 million acres of wetland and grassland habitat from 28,000 landowners in 8 north-central states.

(Refuge History Cards—Master B)

1962: The Refuge Recreation Act (amended in 1966) permitted secondary recreational uses on refuges where such activities do not conflict with refuges' primary purposes, when there is money to administer them.

1974: Amendment to Fish and Wildlife Act of 1956 reassigned U.S. Bureau of Sport Fisheries responsibilities to the newly created U.S. Fish and Wildlife Service.

1964: Land and Water Conservation Fund Act authorized appropriations of Land and Water Conservation Funds derived from off-shore oil leases to acquire wildlife habitat.

1980: Alaska National Interest Lands Conservation Act adds almost 54 million acres to the Refuge System in that state.

1964: The Wilderness Act established guidelines for designating wilderness areas to protect unspoiled habitat within national parks, refuges, and other public lands. More than 20 million refuge acres are designated wilderness areas.

1994: 500th refuge established at Canaan Valley (WV) with purchase of initial 86 acres of critical habitat supporting diverse wildlife and plants, including endangered species. Refuge will ultimately encompass 20,000 acres.

1966: The National Wildlife Refuge System Act included measures to preserve ecosystems for endangered species, perpetuate migratory bird species, preserve natural diversity, and create public appreciation for wildlife protection.

1996: President Clinton issues Executive Orders. Clearly defines the Refuge System's mission and guiding principles. The EO defines six compatible wildlife-dependent recreational activities (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) as priority uses of the Refuge System.

Directions: Cut apart and use as category headings for Master B and Master C.

Refuge Objectives

Current Issues of Concern

Significant Species

Public Use

(Refuge Management Cards—Master B)

Directions: Cut apart and divide into groups using the headings from Master A.

To protect threatened and endangered species

To restore and enhance native habitat for resident wildlife and migratory birds

To provide the public with opportunities for environmental education and wildlife compatible recreation

Habitat fragmentation due to San Diego Bay development

Exotic species invasion of native habitats

Contaminants from past activities prior to becoming a refuge

Light-footed Clapper Rail

California Least Tern

Belding's Savannah Sparrow

Western Snowy Plover

Yerba reuma

**Salt Marsh Bird's Beak
(Plant species)**

Visitor Center

Limited Hiking Trails

Bird Walks

Education Programs

Refuge Fact Sheet

San Diego National Wildlife Refuge Complex
Sweetwater Marsh National Wildlife Refuge
1008 Gunpowder Point
Chula Vista, California 91910
619-575-2704
Refuge Manager: Rebecca Young
Established 1989



Refuge Objectives

- To protect threatened and endangered species
- To restore and enhance native habitat for resident wildlife and migratory birds
- To provide the public with opportunities for environmental education and wildlife compatible recreation

Current Issues of Concern

- Habitat fragmentation due to San Diego Bay development
- Exotic species invasion of native habitats
- Contaminants from past activities prior to becoming a refuge

Significant Species

- Light-footed Clapper Rail
- California Least Tern
- Belding's Savannah Sparrow
- Western Snowy Plover
- Yerba reuma
- Salt Marsh Bird's Beak

Public Use

- Visitor's Center
- Limited Hiking Trails
- Bird Walks
- Education Programs
- Volunteer Programs

Acreage

Refuge: 316

Habitat	
TYPE	% AREA
Upland	5
Marsh	90
Beach	5
<hr/>	
	100%



Pre-Lesson 4: History of Wetlands in California

Objective

Students will create a timeline of wetlands in California history and a timeline of the Sweetwater Marsh area.

Materials

- Construction paper or other "backing sheet" for each student
- "Wetlands Through California History" sheets - one set per student
- "Sweetwater Marsh History" sheet - one copy per student
- Scissors, crayons and glue (for each student)

Background Information

The majority of California wetlands have been lost to development. California once supported 300,000 Native Americans who, for centuries, lived within the limits of their environment. Great value was placed on wetland resources by Natives for all or a portion of their needs. By the time the Spanish and Mexican influence was established, there were already conflicts with Native Americans; however, the economy was oriented toward stability rather than growth. It was not until the "get-rich-quick" mentality of the Gold Rush pioneers and those that followed them that the heavy assault on California wetlands began. The view of the natural world as something to exploit fueled the destruction of wetlands for agricultural and building purposes. Unfortunately, this exploitation continues today and has resulted in the destruction of 90% of the wetlands that once existed 200 years ago. Now a balance must be established between the need to protect and maintain what is left of California's wetlands and the need to care for the well-being of its human population. Ironically, the greatest hope for the California coast may come from one of the greatest threats to its future—the 25.5 million people who live near the shoreline. Many have chosen to live there because of the quality of life that the coast offers. As a result, many place a high value on a healthy natural environment. So while they have undeniably contributed to the coast's decline, these people possess the political and economic ability to reverse the trend of destruction. More people are becoming aware of the value of wetlands and understand the serious consequences that human encroachment can have. Perhaps a new wetland awareness will erase the words unproductive, wasteland and worthless from our wetland vocabulary and replace them forever with the words productive, vital and irreplaceable.

Procedure

1. Explain to students the importance of wetlands:
 - provides a nursery that shelters, protects and feeds young wildlife
 - filters small impurities from the water
 - provides abundant food
 - helps control flooding
 - provides a resting place for migrating birds
 - provides habitat for wildlife
 - mixes nutrients and oxygen into the water
 - helps fill underground water supplies

2. Stack together ten books (or other similar items) of varying thicknesses. Explain that these represent the total number of wetlands, by percentage, that existed in California about 200 years ago, around the time the first European settlers arrived. Ask students to guess what percentage of wetlands remain after so many years of land development. After a few guesses, tell students that nine out of ten California wetlands have been lost to development, such as buildings and agriculture, airports, Sea World, and freeways. Only ten percent of wetland habitats remain from the original amount. As you say this, be sure to remove nine out of the ten books. Point to the remaining one book and emphasize that it represents the amount of remaining wetlands in California: only one in ten wetlands exists today.
3. Explain that most wetlands were lost when they were drained to become farmland or developed to create land on which to build houses, businesses, airports, industries, etc. Use the background information to lead a short discussion about the loss of wetlands. Enhance the discussion with references to events as they occurred in California history.
4. Distribute "Wetlands Through California History" sheets, and give a piece of construction paper to each student. Pass out the scissors and glue. Explain that these illustrations show the development of a wetland area over a 400-year time period. Direct the students to cut out the pictures and then glue them onto a piece of construction paper in order of occurrence. Have them label the time period of each picture. Color the illustrations if there is time.
 - Picture #1: 1600s
 - Picture #2: 1700s
 - Picture #3: early 1800s
 - Picture #4: late 1800s to early 1900s
 - Picture #5: 1950s
 - Picture #6: 1990s and beyond
5. Once most of the students are finished, compare the sequences that were established. Discuss the criteria used to determine the order. Review the development of wetlands in California using the descriptions provided. To close the discussion, explain that there are now laws that partially protect wetlands from development, but there is a great need for vigilant stewardship by all people. Some wetland areas have been designated as sanctuaries, like the Sweetwater Marsh National Wildlife Refuge, where wildlife can use the resources for food, water and shelter, just as they have been doing for centuries.
6. Extend the lesson to include the Sweetwater Marsh National Wildlife Refuge. Provide the students with a copy of the "History of the Sweetwater Marsh" hand out. Read and review the information. Divide the students into groups of seven. Assign each group member one of the following historical aspects of the Sweetwater Marsh land:
 - Stone Age civilization
 - Kumeyaay
 - Hercules Powder Company
 - Cottonseed Storage Facility
 - Farming
 - Dump Site
 - Chula Vista Nature Center and National Wildlife Refuge

Provide each student with construction paper and drawing materials. Each group member should create an illustration depicting their assigned historical event. The illustrations are then taped together to create a timeline of the Sweetwater Marsh. Point out to students that the significant changes to the land all occurred in the last 100 years.

Wetlands Through California History

Directions: Cut apart, color and glue down in chronological order.







History of the Sweetwater Marsh

Archaeologists believe that people lived at the Sweetwater Marsh area during prehistoric times. During the Milling Stone Age, from about 6,000 B.C. to 100 A.D., crude chopping and scraping tools first came into popular use by prehistoric people.

The local Milling Stone Age people were part of the Kumeyaay (pronounced Ku-mei) culture. These Native people lived in small groups and migrated throughout the year. Since the Kumeyaay ate mostly shellfish and seeds, they probably spent part of the year collecting food in the Sweetwater Marsh. When acorns ripened in the fall, the Kumeyaay people moved inland to oak groves. Archaeologists have also found evidence of later peoples who lived in the area when the Spanish arrived in 1769. Early Native Americans used the marsh for food and other products. They used the marsh plant called sea blight to dye fibers used in making coiled baskets. They steeped whole plants in water to extract a rich black dye.

The Chula Vista Nature Center is built where the Hercules Powder Company once stood. The factory, built in 1916, extracted the chemicals acetone and potash from kelp. They were used to make cordite, an explosive used for fuses by the British during World War I. During that time, three kelp harvesters worked almost continuously. There was a trolley line to the factory and the stop at E Street was called Potash Junction. The plant was in use for only four years.

After the war the San Diego Oil Products Corporation took over the plant. It was the largest cottonseed warehouse in the United States and cottonseed oil was stored here. The plant burned down in 1929. From 1930 until the mid-1970s, tomatoes and other vegetables were grown in the upland areas surrounding Vener Pond and the Nature Center. Farm workers lived in four houses on Gunpowder Point, an area west of the Nature Center.

When farming ended here, people used the area for illegal dumping, resulting in the degradation of the natural plant and animal communities present in the marsh. The Nature Center was opened on July 4, 1987. In 1989, the Sweetwater Marsh and its uplands became the Sweetwater Marsh National Wildlife Refuge. Revegetation efforts on Gunpowder Point began shortly thereafter and will continue until the 46 upland acres are a restored coastal sage scrub habitat.



Pre Lesson 5: Equipment Use

Objective

Students will learn how to properly use binoculars and Discovery Scopes.

Equipment

Eight binoculars

Eight Discovery Scopes

Teacher Note

This activity is to be used in conjunction with the Sweetwater Safari Backpacks available for check out from the Chula Vista Nature Center.

Procedure

1. Introduce the students to binoculars and Discovery Scopes. Explain that both pieces of equipment contain lenses that help the human eye to take a close-up view of objects. The Discovery Scope contains one lens and is designed for viewing very small objects, like a microscope. The binoculars contain two lenses ('bi' –a prefix meaning "two" or "twice") and allow far-away objects to appear larger than their actual size.

microscope—An instrument in which the light reflected from or projected through a tiny object is passed through a combination of lenses so as to produce a magnified image that is large enough to be seen and studied

binocular—Any optical device, such as a microscope or a pair of field glasses, used by both eyes at once

2. Binoculars—Instruct students that:
 - binoculars are always to be worn around the neck to protect them from dropping to the ground
 - fingers should not touch the lenses
 - the two optical columns are adjustable to fit the distance between each person's eyes
 - to focus on an object, use one finger to move the dial on the top of the binoculars
 - do not look through binoculars while walking
3. Discovery Scopes—Instruct students that:
 - this microscope uses the light from the environment (sun, lamps, etc.) to reflect light off of the lens and allows the object to be viewed (see Discovery Scope video)
 - fingers should not touch the lens
 - objects to be viewed are placed in the plastic viewing boxes (the viewing box can hold dry objects or water) or prepared slides can be placed in the viewing clip
 - The Discovery Scope is focused by moving the barrel chamber forward and backward until the object comes into view. If the barrel chamber separates from the optical part, simply put them back together. The scope is not broken. The Discovery Scope was designed for student use.

4. The backpack provides eight binoculars and eight Discovery Scopes for student exploration. Each teacher should decide the best organizational plan for his or her classroom. Options include:
- The students are divided into small groups, instructed in the proper use of the equipment and allowed exploration time.
 - The students, as a large group, are given instructions on proper use of the equipment and are allowed exploration time in small rotating groups.
 - The students, as a group, are instructed in the proper use of equipment, and allowed to explore during their free time.

Note: *It is recommended that an adult is present during exploration time to insure that the equipment is being used safely. Each school is responsible for the replacement cost of any broken or damaged equipment.*



Post Lesson 1: Data Publishing

Objective

Students will review, organize and condense their collected field data into a “published” document that will be displayed in a notebook at the Chula Vista Nature Center.

Suggested Time Frame

30 minutes per day over a five-day period

Materials

field notes

paper clips

colored pencils

Worksheet: “Why do scientists publish their data?”

Procedures

1. Organize students into their Research Station teams. Explain to students that they are now going to review and organize their field data to be shared with other scientists. Explain that the scientific community routinely publishes their findings to increase the learning of all people. (See worksheet: “Why do scientists publish their data?”)
2. Ask students to group their papers by field research stations. All plant illustrations should be paper-clipped together, animal data collection forms should be clipped together, etc. Once organized, distribute the four “final” data collection forms—there is one form to represent each of the four field research stations. Ask the students to attach each form with the appropriate group of data papers.
3. Explain to the students they will now be taking their field research notes and spending time reviewing and “publishing” their findings. Explain that to “publish” their findings means to prepare a final copy that would be appropriate for the public to see. Often, our notes are only understandable to us. Published papers need to be understood by others and free of errors. Explain that the students’ final papers will be sent to the Chula Vista Nature Center where the data will be organized in a notebook for future schools and scientists to review.
4. Review each of the forms with the students. Take questions and emphasize the various tasks that must be completed (drawings, complete sentences for questions, combining data, etc.).
5. Each group must decide how the tasks of rewriting notes and recreating drawings will be distributed among the group members. The group members must agree and the work load must be equitable; e.g., one person may not do all of the work. Each group must work as a team to complete the tasks. Each group should explain the distribution of tasks and gain approval from the teacher before continuing.

6. Each group should begin to complete the final data collection forms. Provide an extended amount of time for this part of the process. It is important that the students develop a flow of discussion about their data and are able to continue working until completion. This discussion will further their learning and overall comprehension. *Allowing students to take the work home or completing it independently of each other (limited collaboration) may hamper the learning process.*

7. When the final data forms are complete, have each group present their findings to the class and/or display the forms in the classroom for the other students to review. Areas of discussion and/or written response should include:
 - What data did all groups find and include in their published reports?
 - What data did only one group find?
 - Why would only one group find data? (*Did the weather change? Was the object moving?*)
 - What data will be more constant throughout the year? (*Probably plants since they are not mobile.*)
 - What data might be more variable throughout the year? (*Probably animals that migrate or move in and out of the ecosystem.*)
 - Package the final data forms and mail to the Chula Vista Nature Center, c/o Program Director, 1008 Gunpowder Point Drive, Chula Vista, CA 91910.

Why Do Scientists Publish Their Data?

In order to help increase wild populations of endangered California Least Terns, biologists of the U.S. Fish and Wildlife Service collect data on how these small white birds nest and breed in their natural habitats. For the past 15 years, during California Least Tern nesting season (April through August), biologists have monitored the nesting and breeding colonies in San Diego County. There are colonies at Sweetwater Marsh, across the bay on Navy lands, and just south of this refuge at South San Diego Bay and Tijuana Slough National Wildlife Refuges.

Biologists walk the beaches and sand dunes several times a week to count nests, eggs and fledglings. Any abnormality in the size or thickness of the egg shell is noted and each new chick is measured, weighed and banded, the number on the band recorded and then shared with scientists in other areas. Because these birds are migratory, this banding system helps us discover how long the birds live, where they travel and nest, and even the habitats they prefer and those they might abandon. The thickness or thinness of their shells indicates when there might be a problem with pesticides or other contaminants. From our data, we know that this particular species of tern nests from San Francisco Bay to Northern Baja California. We don't know how far they travel in the non-breeding season. Scientists believe they may travel as far as South America.

Why is this important? One of the reasons it is important is because biologists in many different geographic areas are studying the California Least Tern. By sharing data and cooperating they can attract funding to help prepare current areas for nesting season, to restore other areas and acquire new lands so that these birds might survive. They also need this data to make sure the numbers of California Least Terns are increasing and not decreasing in population and health. Since terns like to nest on beaches, they are at risk from people, animals (domestic, feral and wild), noise, pollution and too much light, which may cause them to abandon their nests.

How do we know all this about these birds? We know about California Least Terns because many researchers have spent many years studying them and publishing and sharing their data with others.

How will others learn about what you learned through your data collection at Sweetwater Marsh National Wildlife Refuge?

That is right. You are going to publish your data with your research team!



Plant Field Research

Date Research Collected: _____ Weather Conditions: _____

Group Members: _____ School: _____

Draw at least four examples of plants seen in the field. Label each plant.

What characteristics were similar among most of the plants seen?

How were the salt-water plants adapted to the marsh ecosystem?

How were the fresh-water plants adapted to their habitats?

What factors or predators do you think would be harmful to the plants in this area?



Animals Field Research

Date Research Collected: _____ Weather Conditions: _____

Group Members: _____ School: _____

Animal Identified:

of different clues found:

Type of clues seen:

General locations of clues:

Drawing of clues:

Animal Identified:

of different clues found:

Type of clues seen:

General locations of clues:

Drawing of clues:

Animal Identified:

of different clues found:

Type of clues seen:

General locations of clues:

Drawing of clues:

What happens to wildlife when their habitat is developed, disappears or is lost through human activities?

Why are refuges, such as the Sweetwater Marsh (NWR), beneficial to wildlife?



Plankton Field Research

Date Research Collected: _____ Weather Conditions: _____

Group Members: _____ School: _____

Illustrate and identify four different types of plankton seen during field research.

How is plankton beneficial to the aquatic environment?

What would be the result if either the zooplankton or phytoplankton population was eliminated?



Bird Field Research

Date Research Collected: _____ Weather Conditions: _____

Group Members: _____ School: _____

Illustrate four birds seen during field research. Label each bird.

How is refuge land beneficial to birds?

How has the destruction of wetland areas affected migrating birds?