Beyond the Lobo Den:
Walking on the Wild Side of Berry Bayou

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INTRODUCTION

My students are enrolled in the Environmental Magnet Academy at Cesar Chavez High School, located in the Southeast District of Houston Independent School District. The mascot for Chavez High School is the Lobo, hence the title of my unit: "Beyond the Lobo Den." This will be the fourth year the school has been open and the third year for the Environmental Magnet. My students are already somewhat familiar with the impact local energy related industries have on the air and water quality of the neighborhood surrounding our school. Students completed the introductory course, "Environmental Technology" during their freshman year. In this introductory course students learned about water and air quality. The students visited nearby Sims and Berry Bayou periodically to secure water and air samples for further investigation in the classroom. In "Environmental Technology" they also learned about the effects of global warming and the greenhouse effect. Most of the students in our magnet program are also members of the Environmental Club. This group has been involved in various projects such as the "Adopt a Block" program sponsored by the City of Houston. The group schedules workdays throughout the year to clean the debris alongside the roadway in the block they were assigned. This will be my second year at Chavez.

I am very fortunate to have a classroom that doubles as a laboratory. This lab is equipped with a 300-gallon recirculation tank, which is used to raise catfish. Although this tank is primarily used by students in my Exploring Aquaculture course, all of my students will have the opportunity to monitor water quality in this system and make necessary adjustments to assure that conditions meet the needs of the fish being raised. My classroom is also furnished with lab tables and equipment to permit students to conduct experiments related to this unit that require further investigation indoors. I also have the ability to use multimedia, including PowerPoint, to enhance student learning.

We plan to take advantage of our new outdoor learning center to bring this unit to life. The actual planning of the Chavez High School Outdoor Learning Center has been assigned to the U.S. Forest Service. The specific location of the outdoor learning center consists of 17 acres, and is primarily in a "wetlands" area. Native grasses and wildflowers will be planted in the area above the actual learning center. A 4', an elevated boardwalk will be constructed with the assistance of The Telephone Pioneers of America. There will be no direct access to the bayou at the request of the flood control district. The area is heavily covered with Tallow and Chinese Privet. These invasive plants will be removed. The trail will be made from limestone and decomposed granite.

If you do not have an outdoor learning center at your school, look for any secluded area on your campus. You would be amazed at what you can find at the far corners of the playgrounds and soccer fields, away from the main building.

BACKGROUND

I have taught agricultural science and technology courses for many years, but never before have had I had the opportunity to focus on the environment and environmental issues as I do in my present assignment at Cesar Chavez High School. My involvement in agriculture actually extends all the way back to my childhood. Growing up in a small farming community in west Texas, I learned at a very early age that taking care of the land (environment) meant higher yields and more profit. At the time I probably did not realize the other, more intangible results of our efforts, would far outlast any amount of money earned from the selling of those precious crops. Students enrolled in the Environmental Magnet at Chavez High School are following a specific, coherent sequence of coursework, which includes the agricultural science and technology electives I teach.

My students also participate in our FFA Chapter, which allows them the opportunity to develop leadership skills through various activities sponsored by state and national FFA. My students participate in wildlife related career development events as well as various public speaking events dealing with environmental issues. One such event is the Soil Stewardship Public Speaking event sponsored by the Texas Soil and Water Conservation Board. Area winners receive a $500 scholarship and state winners $1000. Past topics include "The Gift of Trees" and most recently "Food for the Future." It is my hope that my students will not only develop intellectually, but will also be well equipped to successfully compete for some of this scholarship money from the FFA organization as well as others. If your students are not members of the FFA, there are numerous other scholarships available to consider. More importantly, it is my hope that my students will leave Chavez High School with a greater understanding of the environmental mistakes of our past and a vision of what needs to be done now to protect our current environment for future generations. I feel all teachers who use this unit will agree with this goal.

In this unit I plan to continue focus on Sims and Berry Bayou through "hands-on learning" field studies. Students will further investigate the probable impact of nearby industries on the wildlife along these waterways. Berry Bayou is actually located behind our school. The average water level of Berry stands at 2.5' during the major part of the year. Of course, the levels are considerably higher following heavy rains and runoff. Berry Bayou is not as well developed for recreational activities as Sims Bayou, but once the Chavez Outdoor Learning Center is complete, students will no doubt have greater opportunities to explore recreational opportunities along this waterway in our backyard. Sims Bayou, on the other hand, has a great deal to offer local citizens who are willing to take advantage of what awaits them. The Sims Bayou watershed has been transformed from grasslands and bottomland forests, to farmlands, to an area that has a broad mix of

urban features. Sims Bayou is one of the major tributaries of the Houston Ship Channel/Buffalo Bayou. The bayou is tidally influenced up to a point near Swallow Street in Houston. The watershed is part of the San Jacinto River Basin. Students will spend a great deal of time outdoors examining the area surrounding the school to evaluate the available space, cover, and food availability for the various species of wildlife that reside in these habitats. Students will map out food chains/webs of the various organisms they find on their field studies. Our school is currently working with the U.S. Forest Service to plan an outdoor learning center, which I anticipate my students being fully involved with. One of the primary focuses on the preparation of the site will be to remove the overgrowth of Chinese Privet and Chinese Tallow. These two invasive species are a threat to the wildlife we hope to attract to our school. According to an article that appeared in the Summer 2002 issue of the *Katy Prairie Observer*, Chinese Tallow is an aggressive invader plant that can convert grassland to a single-species Tallow forest in 10 years or less. Once Tallow trees have created a monoculture, very few birds or animals will use it. Tallow has a high copper content, which is distasteful to insects that eat the leaves. Insects, of course provide the main food of choice of most of the birds that are expected to reside in this newly formed habitat (Newman, Honig 1).

I will also be able to arrange field trips to further expose my students to urban wildlife. We are fortunate to be near the Sims Woods Conservation Area, which we will visit on at least one occasion. Other field studies are also mentioned in this unit for your consideration. In addition to exploring fish pools that have been established along Sims Bayou at the Sims Woods Conservation Area, students will take advantage of the opportunity to learn about other forms of wildlife as well, including plant life, birds, insects, and small mammals such as raccoons and opossums. The variety of grasses and trees within the Sims Woods Conservation Area provide food and shelter for a variety of wildlife with little influence from visitors. Wading birds and raptors can be found in high tree branches. The thick cover of brush and tall grass provide solitude for songbirds. Migrating warblers and wintering sparrows can be spotted in the Giant Ragweed. This weedy cover also serves as home for numerous caterpillars and adult butterflies. Trees that have fallen are left to decay and provide roosting opportunities for woodpeckers. This natural breakdown of old trees and limbs also provide habitat for many smaller mammals of the region. Pools that have been formed in the oxbow wetlands provide home for turtles and other aquatic species. Students will be asked to maintain journals as we explore this as well as other locations.

This unit will also integrate writing skills by challenging students not only to record their observations in a traditional scientific or otherwise technical form, but to express their feelings about wildlife in other forms of literary work as well. Students might create poems or songs to describe their observations.

Students will conduct an inventory of plant and wildlife resources along Sims Bayou. Students will also collect and mount specimens of plant life indigenous to the "Upland Prairie" section of our campus. Students in my Range Management and Ecology course

will actively participate in the Chavez Environmental Magnet's Prairie Restoration Project as the year progresses. The area to be used for this project will also serve as a staging area that will lead students and campus visitors into the outdoor "wetlands" learning center.

Students, particularly those in Exploring Aquaculture, will conduct various evaluation type activities dealing with water, land, and air. Students must understand that it will not be enough to simply create an environment for wildlife and hope they will come. We must make certain the water and air quality is sufficient to sustain the wildlife once they arrive. Students will use modern testing equipment to monitor water and air quality of the areas we visit and use technology to record their findings. Students will be assigned to groups or teams to work cooperatively to attain, record, and interpret data specific to this yearlong project. Teams will first be given the task of coming up with a name for their team. Assignments will be rotated bi-weekly so that teams have the opportunity to collect information in all areas to be studied. Water topics to cover may include organizational planning, surveys, site selection, sampling frequency, and collection practices. Students will specifically conduct tests for the following: temperature, turbidity, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), apparent color, odor, alkalinity, hardness, nutrients, nitrate, phosphate, coliform bacteria, Total Dissolved Solids (TDS) and Conductivity, and salinity. These activities will be ongoing, and the information collected will be compared over time. Students will be able to visit the Texas Environmental Profiles website at <http://www.texasep.org> to check real-time stream flow of Sims and Berry Bayou. To find this information follow the links to this indicator by clicking on the #38 in the Value (Rank) column. This will bring up a page that lists the various bayous and creeks in Harris County. Click on the waterway of your choice to view real time information. You are given different view options, so I would have students select different options on each visit to see how they may wish to present their own data. After collecting data and returning to the classroom, students will compare their findings to the following table to determine if conditions are conducive to support the aquatic life in Berry Bayou.

It should be noted that there is more than one company that manufactures and sells water-testing equipment. The procedures described in the water-testing activities contained in this unit may not be identical to those outlined in the kit you use. Any illustrations or references to a specific test kit should not be considered an endorsement. Costs for test kits can range from relatively inexpensive to quite costly. Dissolved oxygen and pH meters can run into the hundreds of dollars. If you plan to purchase a water test kit, be sure you select one that will perform the tests you wish your students to learn. There is no reason to spend money on chemicals you may never use. Your budget will no doubt also play an important role in the decision you make.

Please be certain you stress the importance of safety to your students, particularly when handling chemicals (reagents) as you perform water quality tests. Read and make sure you understand the information contained in the Material Safety Data Sheets

(MSDS) that accompany your test kit. Students should always follow good lab safety rules each time you visit the site or conduct exercises back in the classroom. Students should be reminded ahead of time the days you plan to work in the outdoor learning site, so they can wear the proper clothing. The ground may be uneven and slippery, therefore students should consider the type of footwear they have on during these visits.

Air quality, as it impacts our immediate surrounding environment, will also be looked at. It is somewhat ironic that I was developing this part of the unit in late April and early May. The skies over Houston are hazier than usual this time of year. This annual event is not a result of any increase in industry in the city; rather, the atmosphere is filled with smoke from burning agricultural fields in Central America. If you use this unit in April, you might ask students why they think the skies are more polluted than during prior months. Other air pollutants such as acid rain and nearby industry output will also be investigated. Students will look at air quality readings by visiting the Texas Environmental Profiles website at <http://www.texasep.org>. Be sure to add this site to your favorites as you will return to it often. Locate the County Profiles drop down box and scroll down to Harris. This page will contain additional links to information about not only air quality but water quality and levels of water in area bayous and creeks. The Clear Air Act and environmental law may be included as possible topics for further development. Students will have the opportunity for several field studies, which will be documented through journals and field notes.

Lessons related to landscaping will also be developed to address how the outdoor learning center can not only be aesthetically pleasing to the eye but also limit the negative impact on the natural surroundings. All agricultural science students will be involved with the outdoor learning center. Once the center is completed, students will be involved in various projects to enhance and maintain the area.

Lessons related to advanced concepts in natural resource management will also be developed to further extend this unit. Possible topics might include resource ownership/domain, global modeling, the three E's of resource management, the tyranny of geography/resource distribution, and anthropocentricity of natural resource management. As the capstone project for this unit, student journals, complete with pictures, field notes, and mounted plant specimens, will be prepared for placement in a time capsule. The time capsule will be placed in a secure location at or near the outdoor learning center during a special ceremony. At some point in the future, Chavez teachers and students will be able to open the time capsule and gain insight as to the way it was way back in 2003. Hopefully, upon completion of the unit, students will not only have a better understanding of the wildlife in their backyard, but will be impelled to share their newfound knowledge with friends and family.

Students will use a variety of media sources to illustrate and preserve images of wildlife that they encounter throughout this unit. Students may also use digital cameras to capture wildlife on disc, and then use those images to create PowerPoint presentations

that will be shared with others. Students will be challenged to be creative in developing projects to present their message to others.

This unit is meant to be used as an ongoing project which will begin at the end of the second week of school and culminate in mid-May. If you are unable to follow this same time line you can easily pick and choose the lessons you would like to incorporate into your schedule.

The introductory lesson will occur by the end of the second week of school. This will be the "exploratory" visit to the area that will serve as our outdoor learning lab for the remainder of the school year. On this first visit, students should assume the role of an explorer to an "unknown" land. Students will be asked to take field notes to record what they see, hear, and smell. The type of schedule your school follows will dictate the number of class periods you will want to spend on this lesson. You should be able to complete this lesson in one period if you follow a "block" schedule. It will probably take two class periods for a "traditional" schedule. I am fortunate that my school is close enough to Berry Bayou that we can walk out the backdoor of my classroom and be standing at "water's edge" in a matter of minutes. We operate on a modified block schedule with classes running 100 minutes. Allowing ten minutes to move to the site and back to the classroom, we will have a full 90 minutes to take advantage of the outdoor learning experience. Classes meet on either Monday/Wednesday or Tuesday/Thursday. All class periods meet on Fridays for a shortened schedule to allow for early dismissal. Students will use Fridays to transfer their field notes to their journals.

GETTING STARTED

Prior to the initial visit to the "outdoor learning" lab, it should be understood that to actually encounter wildlife will not be easy. Most species are nocturnal (active at night), and your visits will most certainly be conducted during class time. Students will be looking for evidence of wildlife activity through the presence of tracks, scat (droppings) and left behind fur or feathers. You should be able to find traces of evidence from the following: mammals, birds, insects, reptiles, and – if near water – fish and amphibians. It should also be noted that in most cases this evidence will be observed and cataloged while in the field, and for the most part left behind.

In preparation to move outside, students should first learn as much as possible about the species of wildlife that might be found in the area. Students will look at mammals, birds, plants (flora), and aquatic life.

FLORA

For this unit, *flora* includes all types of "range plants" that might be found currently growing in our outdoor learning center or targeted for introduction into the area. Identification of plant life (flora) will be accomplished by comparing these unknown

species to known identities. Students will collect plants to compare with illustrations found in *Texas Range Plants,* written by Stephan Hatch and Jennifer Pluhar. Students will not only be able to compare their specimens with excellent line drawings found in this book, but will also learn facts specific to the common and scientific names of the "range land" plants in question. Students will also acquire knowledge about the longevity of plants, and the season during which they grow.

Students will first look at grasses that are presently growing on our campus as well as in the outdoor learning center. Grasses have linear leaves with parallel venation, nodes, and elongated internodes. Grasses are also characterized by having a somewhat rounded stem, with inconspicuous flowers that are enclosed in spikelets. Leaf sheaths may be open or split. Longevity simply refers to the life span of the plant. Students know from previous learning that plants are classified as either annual, biennial, or perennial. Season or season of growth refers to either warm season or cool season. Warm season plants make most of their growth during the summer and fall of the year. Cool season plants complete their growth during fall, winter, and spring. Some of the plants that may be native or introduced to the Gulf Prairies and Marshes region of Texas that might be included in the school's outdoor learning center are listed below. A brief description and a list of characteristics of each species are provided. However, students will be expected to conduct further research to more fully describe actual plant species found during their investigation of plant life.

The information below is merely a brief description for each species listed. This information will offer students the basic information they need to further refine their research. *Texas Range Plants*, as well as other sources, should be used to locate detailed descriptions about the floral, vegetative, and growth characteristics of the plants that will actually be growing in the outdoor learning area.

Grass Family

***Big Bluestem (Andropogan gerardii* Vitman)**

Big Bluestem is a warm season perennial grass which is native to the region. Although this is considered one of the major grasses of the True (Tall Grass) Prairies, it has poor economic value to wildlife. The plant is robust and reaches heights up to 6.5 feet. Preferred habitat of Big Bluestem includes prairies, dry upland sites, and open woods.

Little Bluestem (Schizachyrium scoparium)

Also an important True Prairie grass, Little Bluestem is blue-green, turning to reddish-brown at maturity. This cool season perennial has erect stems that arise from a densely leafy base. This native grass offers excellent nesting cover for birds.

Johnsongrass (Sorghum halepense)

Possibly the most recognizable grass for most students, because it is found along most roadways in Texas. This introduced grass is tall and is characterized by scaly rhizomes. Johnsongrass is a warm season perennial.

Buffalograss (Buchloe dactyloides)

Buffalograss is another warm season perennial grass which is native to the State of Texas. A short grass with both rhizomes and stolons, this plant spreads easily. In fact, Buffalograss is used as a lawn grass in some dry regions of the state. Plants are also dioecious, meaning male and female plants grow separately.

Bermudagrass (Cynodon dactylon)

Just like Buffalograss, this grass has both rhizomes and stolons. This introduced short growing grass is a warm season perennial. Bermudagrass has a high salt tolerance, which makes it a desirable lawn grass for the Gulf Coast area.

Dallisgrass (Paspalum dilatatum)

One of the first distinguishing characteristics that stands out about this warm season perennial is the "tomato-like" seeds of the plant's seed-head. The flattened seeds are covered with silky white hairs. Dallisgrass is an introduced grass and is generally found growing in low areas, dry prairies, and disturbed sites.

Ryegrass (Lolium perenne)

This cool season annual is often planted along roadways. An introduced species, Ryegrass, has adapted to a wide variety of sites throughout Texas. This grass may contain estrogenic compounds associated with poor reproduction in game birds (Hatch, Pluhar 165).

Legume Family

Huisache (Acacia farnesiana)

This native perennial is sometimes called "Sweet acacia" because it is considered a prized honey plant and is cultivated as an ornamental in tropical countries. Huisache is characterized as a shrub or small tree, reaching heights of six to 30 feet. This multi-branched legume grows well in a variety of soils.

Texas Bluebonnet (Lupinus subcarnosus)

Known best as the state flower of Texas, the Texas Bluebonnet is a cool season annual. Another species, *Lupinus texansis*, is actually more showy and prolific than the native species. In 1971 the law was changed to allow both species to be considered as the State Flower.

Sunflower Family

Engelmanndaisy (Engelmannia pinnatifida)

Engelmanndaisy is a cool season annual. This wildflower blooms for about two months, and can often be found along Texas highways. This plant, considered a forb, grows eight to 31 inches tall.

Maximilian Sunflower (Helianthus maximiliani)

The plant is named for Prince Maximilian of Wied Neuwied, who led an expedition into the west in the 1830s. Maximilian Sunflowers are prolific seed producers which provide valuable food for wild birds. The plant is a warm season perennial.

FAUNA (MAMMALS)

Students will learn about many different mammals throughout this unit. Mammals can generally be grouped in the following categories: game animals, fur-bearing animals, and other mammals. In this unit students will not learn about game animals, although in some suburban areas in an effort to connect to wildlife, white-tailed deer have been introduced to open spaces within certain sub-divisions. Unfortunately, in some cases these deer become well-fed "pets" that overpopulate these same high-fenced areas. Typically it is impossible to harvest these deer, and efforts to relocate them back into the "wild" often fail. Deer and other game animals are indeed found in some parts of Houston as well, but again are not going to be studied in this unit. Mammals that students will study in this unit include raccoons, squirrels, nutria, opossums, armadillo, skunks, and rabbits. Information about wildlife can be found in many different textbooks, or by visiting the Texas Parks and Wildlife website. The brief descriptive information I am providing here was taken from this website. For more detailed information have students visit the website.

Raccoon (Procyon lotor)

The Common Raccoon is a robust, medium-sized carnivore that is characterized by its distinctive blackish facial mask outlined with white, and its alternating black and buff rings on a bushy tail. The tip of the tail is black. The upper parts of the raccoon are generally grayish with some tints of orange. The top of the head is of mixed gray and

brownish black, which gives the raccoon a grizzled appearance. Raccoons are generally found near bodies of water, where most of their food is taken. Look for tracks along the water's edge. Actual sightings will be rare as the raccoon is strictly nocturnal. Large raccoons can reach 30 pounds, but some are as small as five pounds. Three to six young are born in the spring, and they stay with their mother until the following year.

Eastern Gray Squirrel (Sciurus carolinesis)

The Eastern Gray Squirrel is a large tree squirrel with rusty or reddish under parts and brownish or grayish upperparts. The tail is usually less than half the total length and is cinnamon, mixed with black. Feet are cinnamon. Where hollow trees are available, they are preferred as den sites and nurseries. Look for signs of "leaf" nests if hollow trees are not in the area. One or two litters, each consisting of five to six young, are born to mature females in the spring and summer each year. The main diet of squirrels consists of hickory nuts and acorns.

Opossum (Didelphis marsupialis)

Opossums are among the oldest, most primitive mammals of the new world. Their size compares to that of a terrier dog. The opossum has a long, scaly prehensile tail. The ears are short, black, and leathery. The opossum is easily identifiable by its long, slender snout. Opossums primarily inhabit deciduous woodlands, but they can also be found in marshes, prairies, and farmlands. Typically, opossums den in hollow trees or fallen logs. You can also expect to find opossums in woodpiles, rock piles, under buildings, in the attic, and in underground burrows. They do not burrow on their own; rather, they take advantage of the work done by other mammals.

Nine-Banded Armadillo (Dasypus novemcinctus)

The Nine-banded Armadillo is a cat-sized, armored, insect-eating mammal. The armadillo has been compared to an anteater. The bony, scaled shell protects the armadillo from attacks by predators. Armadillos are prolific diggers that dig many burrows, as well as digging for food. Quadruplets are common in armadillo litters.

Striped Skunk (Mephitis mephitis)

Skunks are found throughout North America, with the spotted skunk and striped skunk being the most prominent. The striped skunk is readily recognized by its distinct white stripes on a black body. The skunk is 20-30 inches in length and typically weighs four to just under 10 pounds. Skunks are omnivores that eat berries, nuts, fruits, insects, rodents, frogs, and birds. Skunks live in burrows or under buildings. Probably best known for their defensive ability to spray enemies with a stream of musk, skunks are still sometimes killed and eaten by a few predators, such as the great horned owl and the coyote.

Eastern Cottontail Rabbit (Sylvilagus floridanus)

There are thirteen species of cottontail rabbits, living in a variety of habitats from wooded areas to deserts. The diet of the cottontail is almost exclusively grasses and other succulent vegetation. The eastern cottontail is found in the eastern part of the United States. They are identified by their short legs and "slow speed." Eastern cottontails are usually brown to grey in color, and they measure 14-17 inches in length. The eastern cottontail prefers a woody habitat. Litters consist of four to seven young, with females giving birth to three to four litters per year.

BIRDS

Students will also learn about birds that are commonly spotted near the school, specifically near Berry Bayou. There are some game birds that can be found in most parts of the city, including dove. Songbirds are very common in the city, and with a little planning and strategically placed feeders, endless viewing opportunities abound. Opportunities to see migratory waterfowl are also very possible, considering the number of flyways that exist in the Gulf Coast area.

Many birds, such as sparrows, blue jays, cardinals, and robins are highly adaptable and are found in many environments. When setting up or looking for an area on campus to attract birds, do not be too hasty to remove dead or fallen trees unless they pose a serious safety hazard. Over 400 species of birds, mammals, and amphibians make their home in dead trees.

Many different birds can be found in the urban setting. A brief description of some of the more common birds follows. Additional information about food preferences, nesting materials, and nesting habits for these and other birds can be found in Table 1.

Birds of Prey

Birds of prey are the predators of the sky (Burton 209). North American birds of prey include four families of hawk-like birds and two families of owls.

Red-Tailed Hawk (Buteo jamaicensis)

This large bird is dark brown on the upper body and light colored underneath, with a dark band extending across the belly. The tail is light colored in juveniles and reddish in adults. The red-tailed hawk is adapted to a wide range of habitats, from desert to tundra. Rodents and insects are the prey of choice for this hawk. Females lay one to four eggs in large nests made of sticks and lined with twigs and roots of plants.

American Kestrel (Falco sparverius)

This hawk, sometimes called sparrow hawk, is reddish colored on the back, crown, and tail with blue-gray head and wings. The breast and underparts are lighter in color than the upper body, with black markings just behind the ear. Its diet is primarily mice, voles, small birds, and insects. The kestrel is a small falcon that has the ability to hover in place by rapidly beating its wings. This advantage allows the kestrel to keep its prey in sight before diving down to capture it.

Owls

Owls include typical owls and barn owls. The ability of owls to fly without being detected by their prey is attributed to down, which is found on the tips and margins of the owl's wing feathers. This deadened sound, coupled with the owl's excellent night vision, give them the upper hand on their prey. Owls prefer to eat rodents, rabbits, birds, and reptiles. Owls typically hunt at night.

Great Horned Owl (Bubo virginianus)

This "typical" owl is a very large intimidating creature with its large yellow eyes and ear tufts that resemble horns. The color of the great horned owl is generally a mottled brown with gray barring on the underside. Great horned owls sometimes resort to daytime hunting, especially in regions where it does not always get dark at night. The great horned owl is also easily identified by the way it calls with a deep voice and rhythmic sound like "hoo, hoo, hoo." Females lay two to three eggs in the old nests of other birds.

Barn Owl (Tyto alba)

This tan-colored owl is of course a member of the "barn owl" family. Barn owls are medium-sized. The plumage also consists of gray streaks and a white face trimmed with tan. The barn owl perches on trees and feeds mainly on rodents. This owl prefers to nest in protected areas, and females lay five to 11 eggs on bare surfaces. The barn owl is considered a friend of man because it preys on rodents and is willing to live in close proximity with humans (Burton).

Songbirds

These birds are the ones we are most familiar with. They use their calls and songs to define the boundaries of their territories. This singing and calling makes other birds aware of their presence. Songbirds are extremely territorial by nature and will defend their living area against other birds.

Cardinal (Cardinalis cardinalis)

The male cardinal is bright red with a high crest and black face. The females are buff brown with red wings and tail. As in many other bird species, the bright color of the male is common. Males use their color in mating rituals and to bluff other males in defense of their territories. It is believed that the dull color of females provides camouflage during the nesting season. Females lay three to four eggs in cup shaped nests located in shrubs or bushes. The cardinal is a non-migratory bird that eats fruits, insects, weed seeds and grains.

American Robin (Turdus migratorius)

Robins are recognized by their reddish-orange breast, brownish gray upper-body, and dark colored head and tail. Males have a strong singing voice that is often heard in the evenings as he sings from a high perch. Females lay 3-4 eggs in nests made of grasses, roots, string, mud, and other materials. Two broods (families of young) are often produced during the summer. The young birds have speckled breasts. Robins eat mostly insects and worms.

Mockingbird (Mimus polyglottis)

By comparison to most other songbirds, the mockingbird is actually quite plain looking. The mockingbird is gray on the upper body with white under parts. Whereas the mockingbird may be dull in color, it is anything but plain when it comes to its ability to sing. This mimic can copy the calls and songs of most other songbirds.

Blue Jay (Cyanocitta cristata)

The blue jay is blue with a crested head, gray under parts, and a black necklace. Blue jays build their nests in trees where the raise three to six offspring. This resourceful builder will use just about anything for its nest. Blue jays are very noisy birds that eat seeds, fruits, small invertebrates, and the eggs and nestlings of other birds.

Mourning Doves (Zenaida macroura)

The mourning dove is a moderate-sized member of the pigeon family. It is brownish gray in color with lighter under parts, and it sports a black spot on the ear patch. Its name comes from the cooing call of the male. A pair of mourning doves normally nests two to four times each year, producing two eggs each time. Both parents care for the young. The young, called squabs, grow very rapidly and often fledge (learn to fly) by the age of one month. Insects, seeds, grains, and fruits are the dove's food of choice.

Additional Information

To learn more about birds, refer to Table 1. This table contains information about the preferred foods, nesting materials, and nesting habits of many other birds as well as those described above. Although it is not likely that every bird listed in the table will be found near the school, most can be found in the city. I want students to be fully aware of the wildlife that exists in other parts of Houston as well as those they can find near their home or school. Students will be able to refer to this table to gain more information about the birds they see when we make our visits to the outdoor learning center and while on other field study trips.

To attract birds to the outdoor area, supplemental feeding will need to be incorporated into your plans. Although there are bird feeds readily available at your neighborhood garden center, the mixture may not offer the best variety to the birds you hope to attract. According to the findings from research developed by Dr. Aelred Geis of the Patuxent Wildlife Research Center, what wild birds like to eat and what many commercial bird mixes contain are not always the same.

His study was a part of the U.S. Fish and Wildlife Service's Urban Wildlife Research Program, which revealed new findings on bird-food preferences. Among the findings Geis reported through his research are the following:

Brown-headed cowbird	white proso millet, red proso millet, German Millet, and canary seed.
Cardinal	sunflower seeds of all types.
Common grackle	hulled sunflower seeds and cracked corn.
Mourning dove	oil-type sunflower seeds, white proso millet, thistle, wheat, buckwheat, milo, canary seed, hulled oats, and cracked corn.

It should be noted that both desirable and undesirable birds may have the same food preference. You will have to take the bad with the good.

TEACHING STRATEGIES

The main goal of this curriculum unit is to raise student awareness that wildlife is not restricted to game birds and the white-tailed deer that hunters harvest each hunting season "somewhere in the hill country." Students will understand that wildlife exists in their own backyard. The premise for successful learning in the agricultural classroom has always been based on "hands-on" learning. In fact, the FFA motto, "Learning to Do, Doing to Learn, Earning to Live, Living to Serve," is one of the driving forces that allows me to

continue teaching after 26 years in the classroom. For this reason, in this unit, students will be given multiple opportunities to demonstrate an understanding of the relationship between wildlife and the urban setting we share, through activities that involve "doing."

Students will conduct various experiments, which in many cases will span the entire school year. Since ongoing monitoring is essential to determine the effects of pollution and other environmental impacts on the air and water available to the wildlife we hope to attract to our outdoor learning area, these tasks must be repeated often. Students will also use various graphic organizers to process the information they will learn during their studies. Students will be evaluated on their degree of participation in team effort as well as individual effort. Students will be assigned a culminating project to highlight what they found to be most memorable from their experiences with the wild things outside the Lobo Den. Students will be encouraged to extend their learning through enrichment projects for extra credit.

LESSON PLANS

Remember to follow good safety practices. Students should wear appropriate clothes, including shoes, as they participate in the lessons described below. And remember to always follow the safety rules contained in the Material Safety Data Sheets (MSDS) for each experiment you conduct.

Lesson I: Water Quality

The quality of water may be defined several ways, depending on its use (Malone, Rusch 2). Clear water does not necessarily denote clean water. Some of the healthiest water may indeed be turbid. We want to make certain that the available water is of sufficient quality to be non-threatening to the wildlife that already visits the area, as well as the wildlife we hope to attract to our outdoor learning center. Students will conduct critical tests during each visit to the learning site. This lesson will be repeated several times throughout the unit. Students will be placed into groups, and each group will be responsible for conducting specific tests at least once per week. Students will rotate the testing assignments, allowing them the opportunity to conduct each test at least once during each grading period. Upon completion of each test, students will record their findings on a chart data collection chart (Table 2).

Test 1: Dissolved Oxygen

Purpose
We know from previous learning that air consists of 21 percent oxygen and about 78 percent nitrogen by volume. Oxygen dissolves poorly, and can exist in water only at low concentrations. Even so, dissolved oxygen (DO) is essential for the respiration of a wide variety of animals and bacteria in the aquatic environment (Malone, Rusch 2). Students will learn about the difference between aerobic and anaerobic oxygen molecules.

Aquatic life requires dissolved oxygen (DO). The term "dissolved oxygen level" refers to the instantaneous measurement of the actual oxygen level found in the water. Most aquatic animals need more than 1 ppm concentration for survival (Parker 343). To determine the concentration of (DO) students will use both traditional lab test kits (Figure 2) and oxygen meters (Figure 3).

Objective
The Learner Will Be Able To (TLWBAT):
Determine the dissolved oxygen (DO) level of water samples using a variety of testing techniques.

Materials Needed
Student Journals
Pen or Pencil
1 - LaMotte (or equivalent) Water Test Kit
1 – Bottle, Water Sampling, 60mL, Glass
1 – Direct Reading Titrator, 0-10
1 – Spoon, 1.0 g
30 mL - *Manganous Sulfate Solution
30 mL - *Alkaline Potassium Iodide Solution
50 g. - * Sulfamic Acid Powder
60 mL - *Sodium Thiosulfate Solution (0.025N)
30 mL – Starch Indicator
1- Electronic Dissolved Oxygen (DO) Meter
Data Collection Sheets

Warning: Reagents marked with a * are considered hazardous substances. Be sure you are familiar with the Material Safety Data Sheets that accompany the test kit.

Procedure

Collection and Treatment of the Water Sample
Steps one through four describe proper sampling technique in shallow water. For collection of sample at depths beyond arm's reach, special water sampling apparatus is required.

1. To avoid contamination, rinse the water-sampling bottle thoroughly with sample water.
2. Tightly cap the bottle. Submerge to the desired depth, and remove the cap to allow the bottle to fill.
3. Tap the sides of the submerged bottle to dislodge any air bubbles clinging to the inside of the bottle. Replace the cap while the bottle is still submerged.

4. Retrieve the bottle. Examine it carefully to make sure that no air bubbles are trapped inside of the bottle. Once a satisfactory sample has been collected, proceed immediately with steps 5and 6 to "fix" the sample.

"Fixing" the Water Sample

Note: Be careful not to introduce air into the sample while adding the reagents in steps 5 and 6. Drop the reagents into the test sample, cap carefully and mix gently.

5. Add 8 drops of Manganous Sulfate Solution and 8 drops of Alkaline Potassium Iodide Azide Solution. Cap and mix by inverting gently several times. A precipitate will form. Allow the precipitate to settle below the shoulder of the bottle before proceeding.
6. Use the 1.0g spoon to add one level measure of Sulfamic Acid Powder. Cap and gently invert to mix, until both the reagent and the precipitate have dissolved. A clear yellow to brown-orange color will develop, depending on the oxygen content of the sample.

Note: Following the completion of step 6, contact between the water sample and the atmosphere will not affect the test result. Once the sample has been "fixed" in this manner, it is not necessary to perform the actual test procedure immediately. If you run out of time, you can store the sample for up to 8 hours, allowing students to complete the experiment later in the day.

Test Procedure

1. Fill the test tube to the 20mL line with the "fixed" sample, cap. If the color of the "fixed" sample is already a very faint yellow, skip Step 3, perform Step 4, and begin the titration at Step 5.
2. Fill the Direct Reading Titrator (DRT) with Sodium Thiosulfate Solution. Insert into the center hole of the titration tube cap.
3. While gently shaking the tube, slowly press the plunger to titrate until the yellow-brown color is reduced to a very faint yellow.
4. Remove the Titrator and cap. Be careful not to disturb the Titrator plunger, as the titration begun in Step 3 will be continued in Step 5. Add 8 drops of Starch Indicator Solution. Solution will turn blue.
5. Replace the cap and Titrator and continue titrating until the blue color just disappears. Read results where plunger tip meets Titrator Scale. Read as ppm Dissolved Oxygen. Each minor division equals 0.2 ppm.
6. If the plunger tip reaches the bottom line on the Titrator scale (10 ppm) before the endpoint color change occurs, refill the Titrator and continue the titration. When recording the test result, be sure to include the value of the original amount of reagent dispensed (10 ppm).
7. Record findings on the data collection sheet.
8. Make entries in your student lab journal, summarizing the procedures you followed to determine the level of DO in the water sample collected.

Test Procedure Using a Dissolved Oxygen Meter
Dissolved Oxygen (DO) meters are very expensive but provide instant electronic readings of the levels of dissolved oxygen in the water sample. Dissolved oxygen meters must be calibrated to work properly. You must enter the elevation of your area into the meter prior to using as the elevation above sea level influences the levels of dissolved oxygen. Students enjoy seeing the color changes associated with the test described above, but will also appreciate the speed in which results can be attained electronically.

1. Make sure the DO meter is in good working order and batteries are fresh.
2. Check to make certain the probe is in proper state of repair.
3. Make sure the correct elevation factor has been programmed into the meter.
4. Follow the manufacturer's instructions to attain a reading of the DO level in the water sample.
5. Record the results on the data collection sheet, comparing this number with the one attained through the previous titration test on the same water sample.
6. Make entries in your student journal describing the process you followed to attain an electronic reading. Compare and contrast electronic testing procedures with chemical testing procedures.

Test 2: pH

Purpose
The purpose of this test is to allow students the opportunity to understand the importance of knowing the pH of the water that serves the wildlife in the outdoor learning center. The pH level of the water is a measure of hydrogen ions in the water (Parker 335). Students will determine pH levels through both chemical and electronic testing. Refer to Table 3 to determine the probable effect of specific pH levels on aquatic life.

Objective
The Learner Will Be Able To (TLWBAT):
Determine the pH level of water samples using a variety of testing techniques.

Materials Needed
Student Journals
Pen or Pencil
1 – LaMotte (or equivalent) Water Test Kit
1 – 100mL Graduated Cylinder
1 – Test Tube, 5mL, glass, w/cap
1 – Wide Range Comparator
30 mL - *Wide Range Indicator
1 – Electronic pH Meter
Data Collection Sheets

Warning: Reagents marked with a * are considered hazardous substances. Material Safety Data Sheets (MSDS) are supplied for these reagents. Be sure you read and understand the information found in the MSDS before using the reagents.

Procedure

1. Collect sample water in the same manner described for dissolved oxygen. You will not "fix" the sample.
2. Fill the test tube to the 5mL line with the sample water.
3. Add 10 drops of Wide Range Indicator. Cap and mix.
4. Cap the tube and invert several times to mix the contents.
5. Insert the tube into the Wide Range Comparator. Match the sample color to a color standard.
6. Record finding on the data collection sheet as pH.
7. Make entries in your student journal describing the pH test. Also compare the pH level to the information in tables 3 and 4 to determine the probable impact on aquatic life. Describe ways to address problems if problems exist.

Testing pH Using an Electronic pH Meter

The above chemical test is quick and easy. The process is the same used to determine pH of pools and spas, and students may be familiar with this type of testing. Electronic testing provides instant results.

Procedure

1. Collect sample water in the same manner described above.
2. Fill the 100mL graduated cylinder to the 35-40 mL line.
3. Insert the probe of the pH meter into the sample water making sure both electrodes are covered with water. Secure the graduated cylinder to prevent it from tipping over.
4. Allow the electronic readout to stabilize before recording the reading. The display will also show you the temperature of the water sample.
5. Save the data on the pH meter for future reference and comparison.
6. Record your findings on the data collection sheet, comparing them to the results from the chemical testing you performed ealier.
7. Make entries in your student journal describing the two pH tests you have performed. Also, compare the pH level to the information in tables 3 and 4 to determine the probable impact on aquatic life. Describe ways to address problems if any exist.

Indirect Effects of pH

Ammonia levels and pH are closely related. Exposure to ammonia can be fatal to organisms over time. The duration of exposure depends on the concentration of ammonia and the pH level of the water sample. Ammonia testing should also be done on a routine basis. Table 4 provides information on the LD50 values at specific pH levels. Students will compare their pH results to table 4 to determine if there are reasons for concern.

Test 3: Temperature

The temperature of the water can have a direct impact on all the qualities you will be testing and would probably be the first test you will conduct on each visit to the learning site. Temperature is also one of the easiest field tests to conduct. You will need to invest in a good thermometer to withstand the conditions you will subject the instrument to. If you are fortunate enough to be able to use an electronic pH probe for determining the pH of your selected body of water, it will probably have a built-in thermometer (Figure 5). The temperature is typically given in degrees Centigrade. You will want your students to convert their temperature readings to Fahrenheit. Remember the following formulas to make temperature conversions.

Water temperature is an important variable in many chemical tests and electronic measures for water quality. Many determinations require adjustment for the temperature or noting the temperature at the time of sampling (Parker 336).

Activity
On each visit to the outdoor learning center, secure a temperature reading of the water using either a thermometer (be sure it is attached to a string) or a pH/Temperature meter. Chart the temperature readings by date/time, along with other daily readings.

Test 4: Turbidity

Turbidity can be thought of as how cloudy, or unclear, the water is. This cloudiness is caused by solid materials that are suspended in the water. To illustrate this concept in the classroom before moving outside to conduct an actual test, provide each student with a clear glass of water, a teaspoon, and a cup of play sand. Instruct the students to drop sand into the glass one teaspoonful at a time, stirring the solution after each time. Students should notice how the water's clarity diminishes with each addition of sand. Now instruct the students that sediment is only one source for turbidity in the water. The overpopulation of microscopic plankton due to excess nutrients and sunlight also add greatly to the turbidity of natural waters. To measure turbidity you could use electronic instrumentation. The nephelometer is an instrument with a detector at 90 degrees to the light source. This meter reads the amount of light scattered by materials in the water. The greater the intensity of the scattered light, the higher the turbidity. Results are measured in Nephelometric Turbidity Units (NTU). Instruments are very expensive, therefore to demonstrate turbidity to students the use of a secchi disk (Figure 6) might be the way to go. The disc is slowly lowered into the water and at the moment the disc disappears, the depth is noted. This depth should be recorded along with other data collected at the study site.

Materials Needed
Student Journals
Pen or Pencil

1 Secchi Disk for each group
Data Chart

Objective
The Learner Will Be Able To (TLWBAT):
Determine the turbidity level of water at different locations along nearby waterways.

Procedure
1. Divide the class into groups of equal number.
2. Have the groups spread out along the waterway you wish to test.
3. Have group members take turns lowering the secchi disk into the water until it either disappears or reaches the end of the rope. The student lowering the secchi disk makes the determination as to when the disk disappears alone. Record this depth in the individual student's journal.
4. After all group members have completed the exercise, obtain the average depth and record this information on the data chart. Also record the date and time and location of the test.
5. After all groups have finished, return to the classroom to discuss the results of the test by charting data on the board.

Test 5: Total Dissolved Solids

Total dissolved solids, TDS, is defined as the material left behind after a water sample is filtered and evaporated. The quantity of dissolved particles is directly related to the solubility of rocks and soils in the water. Water that is high in calcium, carbonate, and sulfate will have high levels of TDS.

TDS can also be determined by testing the conductivity of the wet sample. Conductivity is the ability to conduct electricity. As TDS levels rise, conductivity increases. A conductivity meter (Figure 7) can be used to measure and read the flow of electricity through collected water samples. The flow of electricity is measured as "micrombhos per centimeter." The attained reading should be converted to the more accepted standard of "parts per million." To convert to ppm, multiply the meter reading by 0.67. Rainwater is almost pure and should read less than 10 ppm TDS. The desired TDS level for municipal water is less than 500 ppm TDS. River, stream, and bayou water samples should contain between 100 – 2,000 ppm, and seawater about 35,000 ppm.

Materials Needed
Student Journals
Pen or Pencil
4 one gallon containers filled with different water samples, labeled 1,2,3,4
4 large beakers for each group
conductivity meter
chart for recording data

Objective
The Learner Will Be Able To (TLWBAT):
Determine the probable sources of water samples based on the TDS of each sample.

Procedure
Prepare the water samples a few days prior to this lab. The cartons should only be identified by numbers. Inform the students they are going to determine the source of four samples of water based solely on the levels of TDS of each sample. Tell them they will have distilled water, city water, high alkaline water, and sea water. Do not tell students which carton is which. Prepare the water samples in this manner:

- Container 1 – distilled water.
- Container 2 – tap water from the classroom sink.
- Container 3 – tap water from the classroom sink with ½ cup baking soda added.
- Container 4 – tap water from the classroom sink with ½ cup salt added.

Steps to Follow

1. Students should label their beakers with masking tape, numbered 1,2,3,4.
2. Take 50 mL of water from each carton, making sure you place each sample into the matching beaker.
3. Use a conductivity meter to attain readings for each sample. Record the readings on the supplied chart. Record as ppm.
4. Based on the determined TDS for each sample, students will identify the source of each water sample by writing their choice in the space provided on the chart.

Test 6: Salinity

Students should readily associate salinity with salt. In fact salinity is the measure of the total concentration of all dissolved ions in the water, with sodium chloride (NaCl) the principal ionic compound in sea water. It should be noted that most inland ponds contain substantial concentrations of other salts such as compounds of sulfates and carbonates (Parker 337). The salinity of a water sample can be measured according to the density the salts produce in the water, the refraction they cause to light or by electrical conductance. Students will use chemical testing as well as a refractometer (Figure 8) to determine the salinity of water samples obtained during visits to the learning site.

Materials Needed
Student Journals
Pen or Pencil
1 – LaMotte (or equivalent) Water Test Kit
1 – Refractometer (if available)
1 – Bottle, Water Sampling, 60mL, glass w/cap
1 - Dropper
Data Collection Sheets

Objective
The Learner Will Be Able To (TLWBAT):
Determine the salinity content of a water sample through various testing techniques.

Notes
If students are using a water test kit, they should follow the "field reference guide" for determining salinity. Since there are several different commercial water test kits on the market, be sure to follow the manufacturer's procedures for this test. Students should record findings on the data collection sheet, and write general observations in their lab journals.

Refractometers are excellent tools to use in the field to determine the salinity content of the water in the area being studied. Be sure you are familiar with the operation of the refractometer prior to this activity. Also be sure all collection materials have been properly cleaned after each use and flushed with distilled water to avoid inaccurate reading due to contamination.

Procedures

1. Secure a sample of water to be tested by placing the collection bottle under the surface before removing the cap. This process prevents surface contaminants from entering the bottle, as well as oxygen.
2. Replace the cap, making sure the spout is closed, before removing the bottle from the water.
3. If students are using a water test kit, follow the procedures described in the "field reference guide."
4. If you are using a refractometer, follow these steps:
    a. Open the daylight plate and place 2-3 drops of sample water on the main prism.
    b. Close the daylight plate so the water spreads across the entire surface of the prism without air bubbles or dry spots.
    c. Allow the sample to remain on the prism for approximately 30 seconds.
    d. Hold the daylight plate in the direction of a light source and look into the eyepiece. You will see a circular field with graduations down the center. The upper portion of the field should be blue and the lower portion white.
    e. Take the reading where the boundary line of the blue and white fields crosses the graduation scale. This reading will provide the percent and specific gravity of salt (NaCl) in the sample.
    f. Clean the prism carefully using a damp, soft cloth. DO NOT immerse in water.
5. You could have part of the students using water test kits and others refractometers. It will obviously require more time to run the test using the water test kits, and students will have to use math skills to determine the specific gravity

of their samples. Compare the findings of the different groups after everyone has finished.

6. Return to the classroom and, after students have finalized their journal entries, ask them how this "newfound" information is important. Discuss all the possible impacts of the salinity level on the wildlife that is in the area.

Lesson II: Specific Plantings to Attract Birds

In the Gulf Coast we can see many different species of birds during the year. Birding is fast becoming a popular sport in this part of Texas. In fact, bird watching is the fastest growing outdoor activity in America (Spillman 3). Thousands of birds pass through as migrants, while others stop to nest. Birds that winter in an area have different needs than birds that are nesting. A complimentary mixture of trees, shrubs, vines, and other plants provide the variety of habitat needed for all seasons. Birds need places to feed, sing, court, nest, rest, and hide. The use of commercial feeders, baths, and bird boxes of course will attract birds to even the smallest backyard, but by planting natural attractors the number of visitors can increase greatly.

Materials Needed

Student Journals
Pencil
Graph Paper
Map Pencils
Erasers
Rulers
Landscape Symbol Templates
Plant List (Table 5)
Garden Center Ads or Seed Catalogs

Objective

The Learner Will Be Able To (TLWBAT):
Illustrate how plants, water, and other structures should be arranged in the back yard to attract birds and other forms of wildlife.

Procedure

1. Instruct students that they have been hired to develop a landscape plan to attract birds to the client's backyard.
2. Based on the information students have attained about wildlife habitats, students will sketch a plan on graph paper, indicating the location of the required components of a wildlife habitat. Feeders and nesting boxes can also be added.
3. Students can either draw symbols for specific plants freehand or can use landscape symbol templates. Students should label each specimen, using scientific nomenclature whenever possible.

4. Once the preliminary sketch is completed, students should use map pencils to add realistic color to their designs.
5. Students should use garden center ads or seed catalogs to find current prices for plant materials, feeders, nesting boxes, and any other items they wish to include in their designs.
6. Inform students that they are simply providing a design and estimated cost of plants and materials for the client. They are not responsible for providing the total cost of implementing the plan.
7. Students will write a summary paper to accompany their design. This summary should include specific information about the plants that were selected and why they were located in the specific location indicated on the drawing. This might include information such as exposure to sunlight, proximity to existing structures, client preferences.
8. Display completed projects in a prominent location for others to enjoy.

Lesson III: Air Quality Concerns

Daily maximum eight hour ozone averages can be viewed through either the Texas Environmental Profiles website by following links, or through the Texas Commission on Environmental Quality, formerly known as the Texas Natural Resource Conservation Commission, at <http://www.tceq.state.tx.us> Look for the link to "Ozone in Texas" under the Hot Topics column. When the new page opens, find the Daily Maximum Eight Hour Ozone Averages link and click. On this next page, scroll down until you come to the Houston-Galveston-Brazoria section. Locate the monitoring site you wish to attain data from and simply read across the page. Students should use the same location each time they visit, and hopefully one that is near the school. This information should be recorded on a graph and kept over time.

Materials Needed
Student Journals
Pen or Pencil
Computer with Access to Internet
Data Collection Chart
Classroom Chart

Objective
The Learner Will Be Able To (TLWBAT):
Obtain air quality data to compare over time.

Procedure
1. Log onto the Texas Natural Resource Conservation Commission's website at <http://www.tnrcc.state.tx.us>.
2. Locate the link titled "Daily Maximum Eight Hour Ozone Averages."
3. Scroll down the page to the Houston-Galveston-Brazoria section.

4. Bookmark this location for future visits.
5. Locate the monitoring site nearest your school or neighborhood.
6. Read across the page to record the information that is displayed.
7. Print a copy of the information to transfer to the classroom chart.
8. Make entries in your journal.

Lesson IV: Advanced Concepts

Students will be given the opportunity to explore issues that reach beyond the normal natural sciences concepts. These activities should be student driven, based on their interest. Students should select a topic for further research, and create a PowerPoint, multimedia program to present to the class.

Objective
The Learner Will Be Able To (TLWBAT):
Demonstrate research ability by presenting a PowerPoint, multimedia product to the class on a chosen topic.

Procedures
1. Students may select a topic from the following list or may propose a research project of their own.
    a. Anthropocentricity of Natural Resource Management
    b. Principles of Stewardship
    c. Ethics, Privileges, and Responsibilities
    d. Global Modeling
    e. The Three E's of Resource Management
2. Students will be given three weeks to research and prepare their final product for presentation to the class.
3. Presenters should prepare discussion questions for the class.

APPENDICES

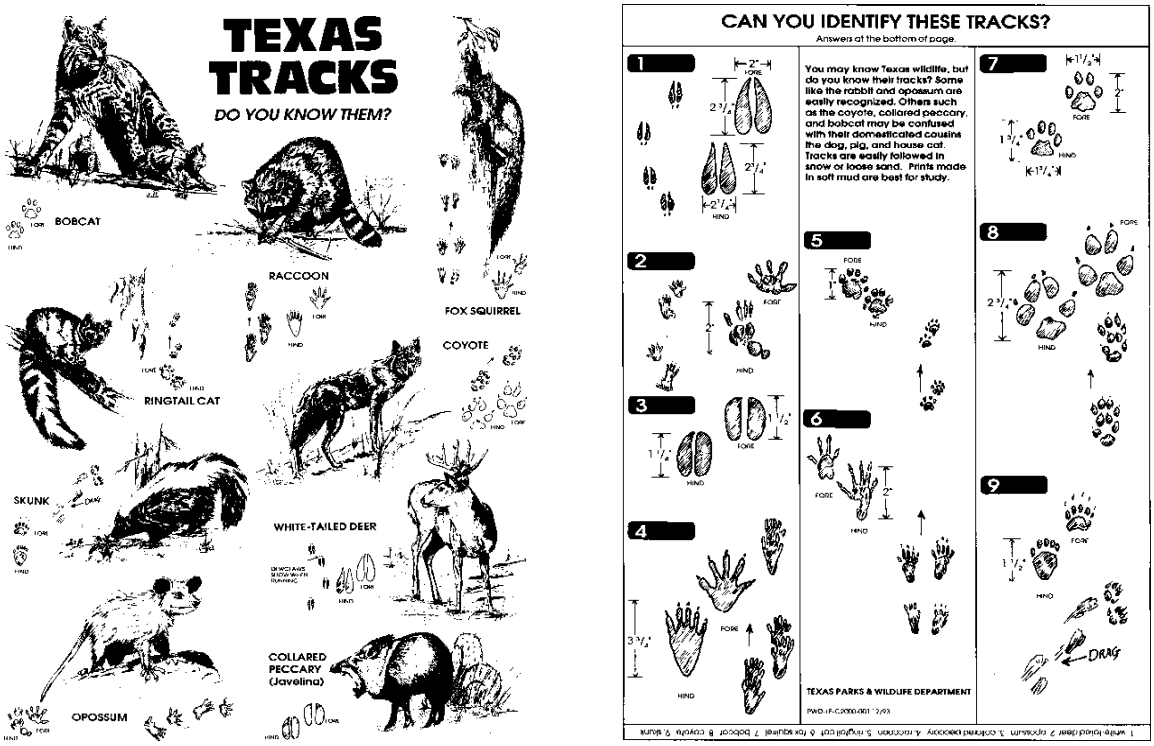

Figure 1 – "Texas Tracks – Do You Know Them?"

Figure 2 – Lab Test Kit

Figure 3 – Dissolved Oxygen Meter

Figure 4 – pH Meter

Figure 5 – pH Meter with Temperature Readout

Figure 6 – Secchi Disk

Figure 7 – Conductivity Meter

Figure 8 – Refractometer

TABLE 1: COMMON BIRD SPECIES

BIRD	FOOD	NEST MATERIAL	NESTING HABITS
Great Blue Heron	Insects, fish, amphibians	Sticks	Nests in trees in swampy areas, colonial
Cattle Egret	Insects, reptiles, amphibians, crustaceans	Sticks	Nests in bushes or trees, colonial
Mallard	Crustaceans, insects, seeds, leaves	Reeds, grasses, feathers, down	Nests on dry ground in tall grass
Turkey Vulture	Carrion	None	Ground nest, grave or wood chips
Black Vulture	Carrion, small animals	None	Ground nest, both parents incubate
Red-tailed Hawk	Small animals	Twigs and branches	Nests on rock ledges, trees and power lines
American Kestrel	Insects, small animals	None	Cavities, accepts bird houses
Mourning Dove	Seeds, grains	Twigs	Nests on ground or in trees
Barred Owl	Small mammals, amphibians, insects	None	Often hunts during day, feeding perch near nest
Screech Owl	Mice, insects	None, lays eggs on leaves	Crevices, cavity in trees, accepts bird boxes
Great Horned Owl	Small mammals, birds, reptiles, insects	Feathers and down	Often uses deserted hawk or crow nest
Purple Martin	Flying insects	Grass, twig bark, leaves, mud	Nests in colonies, accepts bird boxes
Ruby-throated Hummingbird	Nectar, sap, small insects	Lichens, plant down, spider silk	Nest size of 50 piece, eggs size of jelly beans
Northern Flicker	Ants, insects, fruit, grain	Wood chips	Cavity, accepts bird boxes
Pileated Woodpecker	Ants, insects, fruit, acorns, nuts, sap	Wood chips	Excavates a new cavity in tree for each brood reared

House Wren	Insects, spiders, snails	Twigs, grass, roots, feathers, hair	Accepts bird boxes
Mockingbird	Snails, small invertebrates, fruit, seeds, berries	Twigs, leaves, moss, hair, roots	Nests in shrubs or trees
Robin	Fruit, earthworms, insects, snails	Twigs, mud, grass, fur	Nests in trees around houses
Eastern Bluebird	Earthworms, insects, fruit	Grass, weed stems, pine needles	Cavities, accepts bird boxes
European Starling	Insects, seeds, fruit, grain	Grass, twigs, rootlets	Cavities, accepts bird boxes
House Sparrow	Insects, seeds	Grass, weeds, feathers, string, trash	Cavities, accepts bird boxes
Common Grackle	Small invertebrates, fruit, grain, eggs, nestlings	Twigs, grass, mud	Colonial
Cardinal	Seeds, fruit, grain, insects	Twigs, leaves, weeds, grass, hair, roots	Usually nests within 8 feet of the ground

TABLE 2
WATER QUALITY DATA CHART

DATE	DO	pH	TEMP	TURBIDITY	TDS	SALINITY

TABLE 3: EFFECTS OF pH ON AQUATIC LIFE

Ph	EFFECT ON AQUATIC LIFE
3.0-3.5	Fish will likely perish after only a few hours at levels in this range. Some plants and invertebrates can be found at pH levels this low.
3.5-4.0	Lethal to salmonids.
4.0-4.5	All fish, most frogs, and insects absent.
4.5-5.0	Mayfly and many other insects absent. Most fish eggs will not hatch.
5.0-5.5	Bottom-dwelling bacteria (decomposers) begin to die. Leaf litter and animal/plant debris begin to accumulate, locking up essential nutrients and interrupting chemical cycling. Plankton begins to disappear. Snails and clams absent. Mats of fungi begin to replace bacteria in the substrate.
6.0-6.5	Freshwater shrimp absent. Unlikely to be harmful unless free carbon dioxide is in excess of 100 ppm.
6.5-8.2	Optimal for most organisms.
8.2-9.0	Not directly harmful to fish, but indirect effects occur due to chemical changes in the water.
9.0-10.5	Harmful to salmonids and perch if present for extended time.
10.5-11.0	Rapidly lethal to salmonids. Prolonged exposure is lethal to carp, perch.
11.0-11.5	Rapidly lethal to all species of fish.

TABLE 4: pH LEVELS/EXPOSURE TO AMMONIA

pH	DURATION OF EXPOSURE	LD50 (ppm Ammonia)
6.5	1 hour 4 days	14.3 0.73
7.0	1 hour 4 days	11.6 0.74
7.5	1 hour 4 days	7.3 0.74
8.0	1 hour 4 days	3.5 0.47
8.5	1 hour 4 days	1.3 0.17

TABLE 5: PLANT SPECIES THAT ATTRACT BIRDS

PLANT VARIETY	NOTES
Flowering dogwood *Cormus florida*	Large shrub or small tree with fruit favored by 36 species of birds
Red maple *Acer rubrum*	Dense tree with tops suited for nesting, but only a fair source for food.
Crab apple *Malus sp.*	Small ornamental tree that produces bird pleasing fruits.
White oak *Quercus alba*	Grand shade tree that produces acorns enjoyed by blue jays, thrashers, and flickers. Also good nest site.
Elderberry *Sambucus Canadensis*	Decorative small tree. Over 30 species of birds eat the fruit of this tree.
White pine *Pinus strobes*	Provides windbreaks, screens and nest sites. Cardinals use white pine seeds for food.
Blackberries	Left unattended to tangle in a thorny mass, berry vines serve as nesting sites and escape areas. Berries are popular foods among birds.
Hawtorn *Crataegus sp.*	Small domed tree with clustered flowers and red fruits. Choice site for nesting.
Viburnum *Viburnum sp.*	Attracts blue jays, robins, bluebirds, wax wings, and many other songbirds.
Honeysuckle *Lonicera sp.*	Select a tall variety, plant along a fence.
Beech tree *Fagus sp.*	Provides nesting and food for woodpeckers, flickers, and grosbeaks.
Sumac *Rhus sp.*	Produces conical clusters of red fruits, pleasing 17 different birds.

ANNOTATED BIBLIOGRAPHY

Books for Teachers and Students

Better Homes and Gardens Complete Guide to Gardening, Meridith Corporation, 1979.
This colorful reference has a great deal of information on how to landscape the yard to attract birds and other forms of wildlife. I found the numerous charts and graphs to be particularly helpful.

Bridwell, Ferrel M. *Landscape Plants – Their Identification, Culture and Use.* 2nd Edition, Delmar Publishers, 2003.
This reference will be used to identify other species of trees and shrubs that are suitable for urban plantings. Chapter 3 provides pertinent information on the functional and aesthetic uses of plants.

Burton, L. DeVere. *Ecology of Fish and Wildlife.* Del Mar Publishers, 1996.
This excellent text provides numerous illustrations about the different species of wildlife of North America. The text is easy to follow and a glossary of terms is provided.

Camp, William G, Thomas E Daugherty, Heidi Martin, and Susan Aksamil. *Managing Our Natural Resources.* 4th Edition, Delmar Publishers, 2002.
This textbook presents a balanced viewpoint of the place of humans in the world as long-term residents. Information from chapter 35 focuses on advanced concepts in natural resource management.

Campbell, Gayla and Steve Wildberger. *The Monitor's Handbook – A Reference Guide for Natural Water Monitoring.* LaMotte Company, 2001.
This reference manual accompanies water testing kits sold by the LaMotte Company, and contains a great deal of technical information that is beneficial if you plan to include an outdoor pond to raise fish on your campus, or for our purposes, to monitor the quality of water in Berry Bayou.

Deal, Kevin. *Wildlife and Natural Resource Management.* 2nd Edition, Delmar Publishers, 2003.
This textbook presents an excellent history of wildlife management in America. Chapter 11 is devoted to wildlife parks and zoos, from early zoos in the United States to modern zoos and wildlife parks.

Gilman, Edward F. *Trees for Urban and Suburban Landscapes.* Delmar Publishers, 1997.
This technical book will be used to provide information about specific trees that are located on the school campus and surrounding area.

Growing Wild – Butterfly Habitat Program. Special project sponsored by Texas Parks and Wildlife.
Information on how to create a butterfly habitat may be included as one activity. This information will be helpful in developing an area around the school to attract butterflies.

Hatch, Stephan and Jennifer Pluhar. *Texas Range Plants.* Texas A&M UP, 1993.
This resource manual has excellent illustrations and easy to follow information about the many different types of range plants, not only grasses, found across the State of Texas.

Herren, Ray. *Exploring Agriscience.* 2nd Edition, Delmar Publishers, 2002.
This textbook, specifically Chapter 3, will be used to develop lessons related to soils.

Kreigel, John. *Houston Home and Garden - Houston Garden Book.* Shearer Publishing, 1983.
This wonderful reference leaves little doubt about the plants that are best suited for the Houston area. A great resource if you are planning to landscape a corner of your school campus or your back yard. Several photographs of Houston landscapes stimulate the mind as to what could be.

Malone, Robert and Kelley Rusch. *Using the Bead Filter in Your Koi Pond – A Comprehensive Guide to Water Quality Management.* Louisiana Sea Grant College Program, 1998.
Manual developed primarily to provide the koi hobbyist with the important water quality parameters and their interrelationships. Chapter 1 contains a wealth of information that relates to the water quality issues described in this unit.

Newman, Wesley and Bob Honig. "Tree's a Crowd." *Katy Prairie Observer* Summer 2002: 1.
This newsletter is from the The Katy Prairie Conservancy which is a non-profit land trust

Parker, Rick. *Aquaculture Science, 2nd Edition*. Albany, NY: Delmar Learning, 2002.
This text is commonly used to teach aquaculture in high school and provides valuable information on the aquaculture industry.

Project Wild. Special project sponsored by Texas Parks and Wildlife.
Project Wild is a very popular project that is currently being used by schools throughout the State of Texas. Information will be used from this guide as needed.

United States. Department of Agriculture, Soil Conservation Service. *Invite Birds to Your Home.* Washington: GPO, 1990.

This pamphlet developed by the USDA, Soil Conservation Service, provides information on providing plantings that attract birds into the backyard.

Waterwise Landscaping- Houston Guide. City of Houston, Department of Public Works and Engineering, 1999.
Xeriscape landscaping is a method of landscaping that conserves water and is a very effective practice in places like Arizona and West Texas. This publication, prepared by the Water Conservation Branch of the Department of Public Works and Engineering for the City of Houston, provides valuable information on specific vines, ground covers trees, shrubs and flowering plants that may be used in the Houston area.

Websites

Creek Connections. 10 June 2003. <http://www.creekconnections.allegheny.edu>.
This site provides information about the Creek Connections program that has swept the upper East Coast. This program is a partnership between Allegheny College and K-12 schools in that region. Students are involved in projects along different waterways to create outdoor learning labs. Visit this site to get ideas on projects you might want to try along the waterways near your school.

Texas Commission on Environmental Quality. June 2003. <http://www.tceq.state.tx.us>.
Formerly Texas Natural Resource Conservation Commission. Use this site to find data on air and water quality of your school or home. You can review historical data as well as view "real-time" data.

Texas Environmental Profiles. Environmental Defense and The Texas Center for Policy Studies. 14 May 2003. <http://www.texasep.org>.
This is another good site to check state-wide data on air and water quality.

Texas Parks and Wildlife Department. 11 Mar. 2003. <http://www.tpwd.com>.
Students can explore hunting and fishing opportunities in the State of Texas. Students can also follow links to learn specific information on various species of wildlife in the State.

Texas State Soil and Water Conservation Board. May 2003.
<http://www.tsswcb.state.tx.us>.
You can find information at this site on contests and other extension activities your students can get involved in. There are activities for all ages.

USDA Forest Service. 14 Apr. 2003. <http://www.fs.fed.us>.United States Department of Agriculture Forest Service.

This site will give you information on many areas of wildlife, but be sure to check out the "Just for Kids" link. It is really cool, and offers kids a chance to explore many other areas related to agriculture.

Von Gausig, Doug. *Naturesongs.com*. 30 May 2003. <http://www.naturesongs.com>. If you want to hear what sounds different birds make, check out this site. Click on the North American Birds link to begin your journey through the remarkable sounds of the birds that we all love. Other nature sounds can also be explored here if you so chose.