Right Outside My Door: An Ecosystem in Horn's Habitat Garden

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INTRODUCTION

This title for my unit for HTI aptly describes what I hope to be the essence of my curriculum unit. For the past three months, a transformation has been taking place outside my classroom door. Children are asking what is happening to the area that was once a little-used space that maintained several trees, a Rusty Black-Haw Viburnum seriously in need of pruning, an American Beauty-berry bush, an abundance of mowed St. Augustine grass, clover, and weeds. The area now fosters many questions. "What is happening?" "Will we be able to use it?" "What is the black plastic for?" These were the first queries I heard. As work on the site progressed, the black plastic spread over the area to kill the grass and prevent growth of weeds was removed. Topsoil, mulch, and compost were painstakingly brought in by wheelbarrow over multitudinous trips and tilled into the existing soil to provide a richer, more hospitable environment for growth.

I then heard the next series of questions: "What is going to be planted?" "When can we use it?" "What are the names of all the plants?" In early winter months a few native grasses and large shrubs were planted, as well as some hardy small plants. By early spring the final and latest activity of planting many more specimens that are native to the Texas Gulf Coast had been completed. This led to the children's more recent statements of fact, pride, and the beginnings of ownership: "We put all that dirt over there," "Be careful when you walk to stay on the path," "Right there is the plant I put in," and "That is my plant." The students have just completed planting all the diverse perennials that should become well established over the summer. The yellow caution tape, which roped off the area, has finally come down. Now the kids stop and look and are filled with even more questions about the new native habitat garden that is being developed at Horn Elementary.

The school, which was built in 1949, is located in an older residential neighborhood that is becoming "gentrified." Small, modest homes that were set on cinder block foundations are being torn down and replaced by new homes whose structures fill the entire lot as much as the deed restrictions will allow. While they may have a backyard, many times that yard is extremely small or is filled with a paved patio or a swimming pool, and is always enclosed by a fence. Because the neighborhood is older, trees are mature and there are small city parks available for the residents. Horn is one of three elementary schools in the small city of Bellaire, TX, which is surrounded by the larger city of Houston. A large portion of the culturally diverse students come from the neighborhood and about 20% have requested a transfer to the school because the campus offers a magnet program. One component of this program is the science lab.

The habitat area right outside the door of the science lab is about 30' x 100' and is larger than many of the students' backyards. It is a natural extension of my classroom. In this area children will learn by doing science observations and investigations; observing changes; making decisions; and most importantly by asking questions about the habitat garden, its organisms, and how it functions. They have already begun asking some of their questions.

The unit should teach the students that nature has interdependence with all living things. A plant cannot exist without its food, its space, and its ability to reproduce. Many things influence whether that happens successfully. An ecosystem involves this interrelationship and interdependence that each living thing has with other living and non-living things it encounters in its environment. Just as my students have relationships with other students in the school, with the principal, with their teacher, with their parents, their grandparents, their neighbors, and everyone who contributes to their well-being, nature also has these relationships. In our garden the plants depend on the sun for energy and the minerals in the soil for the nutrients necessary for proper growth. If we do not have sunlight, there can be no growth. Again, if we do not have soil enriched by decaying organic life, the proper minerals, proper drainage, and proper aeration, can there be growth? If we do have plant growth, what factors affect the plant? Will the plants have enough space? What types of living things will pollinate the plant? Will the insects that are right for pollination come to the garden area? If the insects come, will they be able to survive, or will there be predators that will make the insects their daily meal? If the leaves are eaten by an insect as its larval food, will the plant be damaged or will the leaves regenerate? What about the factors that man interjects into the system? Will the students protect the plants as they visit the garden or will there be destruction as many feet compact the earth or step on a plant and break its stems? Will the maintenance workers spray insecticide in the garden by mistake? The questions could go on and on. I hope they will. That is beginning science inquiry.

RATIONALE

Science inquiry is asking questions to which the children will be able to find an answer. Finding the answer may be done by reading books, by searching the Internet, or by direct observation and hands-on experimentation such as is found in my classroom.

My science lab is an enrichment class that every child in the school attends for a 45-minute period one day each week. Approximately 500 students each week come to me for a hands-on science inquiry lesson in addition to the science taught by their classroom teacher. In the lab children investigate the world around them and learn to use the science processes to answer their questions. I use the Texas Essential Knowledge and Skills and Houston Independent School District CLEAR as my curriculum documents. These are based on the National Science Education Standards, which are designed to help the nation

achieve the goal of science literacy for all students. In describing science inquiry, the Standards state:

> When engaging in science inquiry students describe objects and events, ask questions, construct explanations, test the explanations against current scientific knowledge and communicate their ideas to others. (*National Science Education Standards* 2)

In this way, students construct their knowledge by combining scientific observation and facts with reasoning and thinking skills.

One fundamental, unifying concept and process that will be taught in this unit is "Systems." The National Standards define a system as "an organized group of related objects or components that form a whole (*National Standards* 116). Project CLEAR Science Concepts states by the fifth grade the student should know that "a system is a collection of cycles, structures and processes that interact" (IV-4) and that "they should know that some change occurs in cycles and be able to describe and compare life cycles of plants and animals" (II-7). Using these documents as a curriculum, Horn students will be engaged in their learning with hands-on science inquiry investigations in the habitat right outside their science lab.

Why is this important? Why examine an ecosystem? Besides being required by HISD and Texas to address these concepts, I have a personal goal as well. Nature is all around us, but students today seem to be so busy with all of the video games, sports, and other activities in their involved lives that they forget or dismiss the natural world right outside their door. Everywhere we look, the natural world seems to be diminishing. Cities like Houston, and especially the area in which I teach, essentially have an explosion of concrete corridors. Homes are being torn down, and new, larger homes are being built lot line to lot line, with little space left for green areas or gardens.

In the inner city in which my school is located, development is proceeding at a hectic pace, with little thought given to how important green space is to the quality of life. It shouldn't be necessary to take a trip away for the weekend to be able to see trees, native plants, wildlife, and the open spaces that we fondly remember as the "wilds" of yesterday. Most of the fellows in our HTI seminar could remember living in an area with much more freedom to roam pastures, forests, hills, and backyards that were not surrounded by six-foot high cedar fences or wrought iron enclosures. Even when growing up in a mid-western city, I built a hide-away in the lilac bushes that separated our neighborhood lots and playing late in the evening catching fireflies. I haven't seen a firefly yet in the city of Houston, and I have been here over 25 years.

The long-term goal of this unit is to highlight the beauty and complexity of natural things, and to have students realize the tremendous diversity and interdependence in

nature. Without one natural thing the other might not exist. Most importantly, I hope to teach them that the earth and its inhabitants are theirs to cherish, to nourish, to protect, and to keep for the future. I plan to use this garden to teach children to love and appreciate the natural world and to teach them that the earth needs their care if we are to have it for generations to come. They are the keepers of the earth. By participating in the care of the garden, by careful observation of the way the garden develops, and by learning about the ecosystems that are present, students will create ownership of the garden and a part of the earth. They will also be beginning a life as an inquiring person, with the abilities to begin to find answers to their questions. They will be learning something that I hope will last a lifetime.

THE GARDEN

A habitat is an environment where an organism or animal lives. It can include many elements such as plants, soil, water, space, available food, and diverse animal life in the area that the plants attract. Horn's garden is to be a school habitat for native Texas plants and the wildlife associated with those plants. Texas Parks and Wildlife authors Diana Foss and Ronald Jones have written an excellent "how to" book for anyone wanting to establish a habitat garden. Their manual is filled with ideas about what to plant, the requirements of the plants, and the animals the plants will attract. In their book, Foss and Jones describe a habitat garden as a place that provides food, water, shelter, and space for wildlife (1). Within this habitat there are many interactions taking place. This interaction of living organisms or wildlife, called an ecosystem, will be the basis of my teaching unit. It will include life cycles of plants and insects, as well as other types of cycles such as seasons, migration, and the cycle of decomposition.

As my students and I look at the garden and how it grows during the year, the changes and cycles will be readily apparent with the blooming plants and the wildlife that come to the area because of the plants. Certain plants will bloom all year long and others will die back as the school year progresses from fall to winter to spring Birds and butterflies will appear during migrating times of the year. Will they stay all year long in this hospitable environment? Which birds and insects are seasonal and which will find Houston, with its warm winters and really hot summers, as the perfect home? Will we see more than one type of bird or butterfly? What insects will feed on the plants? Will they harm the plants? Will we see other animals such as squirrels, lizards, and toads? The questions continue.

There are over 40 plants in Horn's garden, each one chosen for its ability to attract birds, butterflies, and other wildlife. There are native Texas grasses and many different Salvias, Lantana, and Buddleias. The Hummingbird Bush is there as well as daisies, coneflowers and a red yucca. Louisiana iris and other bog plants reside in a low wet area. Just like my students, each one brings its own beauty and usefulness to the garden. I will use the native Texas plant, *Asclepias tuberosa*, as a model in our garden to examine the components of one ecosystem. It will be a model for other ecosystems that exist there.

The Milkweed

This plant is a weed. It is not noted for its beautiful blossom, although it has a pretty enough five-petal cluster of blossoms, and ranges in color from orange to red to yellow. A model of form and function, the flower surface is slippery so that whenever a pollinating insect steps on the petals, it will slide right off the petal and right into the center of the flower where it will get covered with pollen. As the children study how plants are pollinated and how they reproduce, this will be an excellent example. Its opposite paired leaves have an oblong shape with a central vein and are about four to six inches in length.

But it is still a weed. It is one of over one hundred species of milkweed native to the United States. Milkweeds are a common wildflower of fields, roadsides, and open areas. The milkweed's name comes from the fact that whenever the main stem or a leaf is torn off, it oozes a milky sap. This sap is toxic and contains a chemical ingredient called glycoside, which can be poisonous to both humans and livestock. No wonder that today farming states use pesticides and herbicides to control it, and many efforts have been made to eradicate it. Toxicity of the milk can vary with the species of milkweed; fortunately the one in our garden has very low toxicity for humans. One question that I hope our young scientists think about is what happens when farmers eradicate a weed that is toxic to cattle and farm animals, but that same weed is the only food source for a beautiful insect.

This weed is named after the Greek god of medicine, *Asklepios.* The sap or milk of the milkweed has been used often for medicinal purposes and was once used to induce vomiting, as a diuretic, and to treat dysentery. Native Americans and colonists used the roots for pulmonary and bronchial troubles. Chewed roots were placed on wounds for swelling and rashes. The root of the butterfly weed was significant enough to officially be listed in the *U.S. Pharmacopoeica* from 1820 to 1905, according to the Natural Conservation Service Plant Guide.

But it is still a weed and even a weed has uses. In her article in the *Butterfly Gardener's Quarterly*, Claire Dole says the colonists used to call the plant "silkweed" because they carded and spun the silky seedpod fibers into thread for candlewicks. The seedpods that develop are about three to four inches long, and when pods break open in the late fall, about 100-200 seeds are released with silky parachutes that drift into the wind. Ms. Dole goes on to say that Native Americans used the milkweed pod floss for lariats, fishing line and sewing thread (3)." During World War II milkweed farms were set up by the military to harvest the seed fibers for flotation vests and for flight suits because the seed hairs contain an oily material found to be very water-resistant. They can easily float in water supporting about 30 times their own weight. This is a history more interesting than that of most plants. But more important is that the drifting milkweed seed is but one of the many types of seed dispersal mechanisms that students should learn as they progress through the elementary grades.

A weed is something to be torn out of an area and thrown away. Why is this one different? This weed feeds visiting royalty. The *Asclepia tuberosa* has a fond place in the garden of butterfly enthusiasts because its nectar and leaves provide food and energy for a familiar and loved insect, the Monarch butterfly. It also attracts a couple of other well-known insects, the aphid and the ladybug.

The Monarch

In the depiction of the natural world today, it seems like the Monarch is the "queen for a day." Its picture adorns many advertisements, newspaper articles are written about it, and it has more than its share of children's books devoted to it. After observing this butterfly in the fields, the early colonists named it after William of Orange who later became King William III of England (Pringle 11). It is an outstandingly beautiful orange and black butterfly, and deserving of the "monarch" name. It has been a "native North American species for at least two million years (Pringle 51)." It has a life cycle that is easy to observe in the wild, for the adult female Monarch lays approximately 400 eggs on the underside of the milkweed leaf, each egg on a different leaf or plant. From this tiny egg, which is usually visible upon close inspection of the milkweed leaf, the larva or caterpillar emerges. The caterpillar is an almost constant eater, resting only when necessary, and molting five times until it reaches about two inches in length. Each of these molts is called an *instar*. At this point it leaves the milkweed plant and forms a chrysalis, which is a beautiful jade green in color. After about 10 to 15 days, the Monarch butterfly emerges. This is just the beginning of the lessons my students will learn, for insect metamorphosis is followed by learning about migration patterns, predators and prey, and animal defenses such as camouflage and adaptation. The Monarch is a master of them all.

In his informative book, *An Extraordinary Life*, Laurence Pringle tells the fictionalized story of a Monarch from the beginnings of its life as an egg through the larval, chrysalis and adult stages and the subsequent adventures the Monarch has as it migrates to the over-wintering sites in Mexico. This is a book to be shared with the class as they discuss their observations of the garden. As student-scientists, we will be reporting sightings of Monarchs in our garden to the Texas Monarch Watch, which is sponsored by the Texas Parks and Wildlife Department. Fortunately for us, Texas is on the major pathway for the Monarch in its migration to Mexico for the winter and its return in the early spring. Students are asked to help scientists track the migration patterns of the Monarch and in return this site offers a wealth of information on the Monarch. We will be watching, reporting, researching and learning. A Web site that details the migration of several different animals including the Monarch, *Journey North*, also has detailed information about the Monarch and will be a research source for the students as they do research on the Monarch.

The Monarch's migration should be a source of wonder to all students. After a summer in the northern areas where there are lots of milkweeds to support their growth,

the changing seasons bring a migration of the Monarch through the coastal areas of Texas (and Houston) to the overwintering areas high in the forests of central Mexico. Although scientists knew about the Monarch migration, they did not know where the Monarch overwintered until 1975, when a researcher discovered one site. Author Eric Grace describes this discovery in *The World of the Monarch Butterfly*:

> Adjusting their eyes to the dark, they saw orange in patches of sunlight that penetrated the canopy, and realized they were looking at tens of millions of monarchs festooning every branch and tree trunk. The clusters of butterflies were so incredibly thick that heavy branches sagged under their weight (53).

Since the discovery of this site more have been found, and scientists have gained a much better idea of the butterfly migration patterns and pathways. Also the needs and conditions that allow the yearly journey have been clarified and defined. The students will be helping scientists track the yearly migration through the Texas Monarch Watch program.

Color can be a form of adaptation or camouflage. The bright yellow, black, and white colors of the Monarch caterpillar are nature's signal to birds and other predators that it contains a poisonous material. It is not good eating, and some insects such as the Queen butterfly have adapted the coloration of the Monarch in an effort for preservation. The beautiful jade green of the Monarch's pupa makes it hard to find in a garden, and thus protects it from hungry insects. Monarchs are not without their predators, or else we would be overpopulated with them. With over four hundred eggs per adult female, some eggs do not reproduce and some are eaten by predatory insects or crab spiders. "Most Monarchs face little predation from frogs, lizards, mice, birds and other species with backbones" (*Monarch Watch*). However, we hope to see these animals and others with backbones in our garden as they seek nourishment from the plants and animals.

Other Garden Inhabitants

What are other interactions the milkweed plant has with insects and animals in its ecosystem? What are these insects and what is their role in the ecosystem? The questions continue. Insects are one of the most abundant creatures on earth, with over one million known species. They are found just about everywhere, from the coldest climates to the warmest, from the highest mountaintops to homes beneath the soil. They are an invertebrate group belonging to a class of animals called arthropods, which means "jointed legs." By definition, insects have six legs, three body parts, two antennae, an exoskeleton, and up to two pairs of wings. And insects are everywhere in our garden.

Bugs usually found on or near the milkweed include milkweed bugs, crab spiders, aphids, and assassin bugs, as well as the bumblebees, butterflies and moths responsible for pollination. All should be readily seen in Horn's garden. The milkweed bug is orange or

red-orange and black, and feeds on the seedpods and the tissue of the milkweed. Because they feed on the milkweed, its seedpods and blossoms, and can tolerate its toxins, this bug has few predators. Like the Monarch caterpillar, its bright coloration is a signal to potential predators it is toxic; therefore, milkweed bugs are left alone. This coloration is one example of the many adaptations that insects can possess. A crab spider can camouflage itself according to the color of a blossom, and will prey on the insects that visit the milkweed, including the monarch caterpillar. Its front legs, which are longer than the back legs so that it might catch its unsuspecting prey, also cause it to walk similar to a crab. When flowers are in bloom, the crab spider can eat enough prey to increase its weight one hundred fold in two weeks.

Aphids, another insect found on the milkweed, don't greatly harm the plant or Monarch larva. Aphids use their piercing sucking mouthparts to feed on the milky sap. Usually they leave a residue of sugary sticky waste called honeydew on the plant, and that in turn often is food for other insects or a "sooty" fungus. One of the predators of aphids is the ladybug, which is known as a beneficial insect. Students definitely need to know that not all insects are harmful and that some are a great help to gardeners who might not want to use insecticides and other chemicals that upset nature's balance. These beneficial insects are those that eat other insects that might harm a plant, thus enabling the plant to flourish. Why make extra work and use chemicals when we can use the ladybug to eat the aphids? Already in early April, just three months after the garden is planted, ladybugs have been seen by the ever-observant eyes of the students.

Finally, we will see birds that come for seeds, insects, and cover, as they are natural inhabitants of the garden. As we are also on the migratory flyway for birds, the garden will become a natural laboratory for budding "birders." Already we have seen cardinals, sparrows, mockingbirds and doves. Some are easily recognized by their distinctive call. We can become listeners to help us identify these birds by sound, and soon we will recognize the differences in the bird beaks and the bird feet as well as their calls. In the classroom we can experiment with different tools as we model bird beaks and find out how they are especially suited for the different food they eat. The bills of the seed-eating birds are much different from those birds that gather nectar, and the birds that dig in the ground have beaks much different from those of birds that catch flying insects. Once more this adaptation for preservation of the species and finding a unique niche in nature illustrates what an important concept this is for elementary students.

Soil

Must of us have an idea that dirt is not a good thing and that message gets to our students. We tell our children not to get dirty on the playground, and not to get their clothes dirty. We want to sweep up all the dirt immediately, and put it in a safe container that will be taken elsewhere. Raymond Bial, in his wonderfully informative book, tells us that the word dirt comes from the Old English word meaning manure (Bial 15). But you can't

have a garden without dirt or soil. This is perhaps the most important, and yet the easiest, part of the garden to overlook. It is about as unglamorous as the weed I chose to study, yet it is every bit as important. Without food, sunlight, space, and water, our plants and animals would not be able to exist. The food chains and webs that are integral to any environmental study all begin with plant life. And plant life needs food. The soil is the basis for that food, whether by composting leaves, grasses, and twigs or by adding already decomposed organic material such as humus to our dirt. It is also vital to the nitrogen cycle, which all fifth grade students should know.

Horn students started out by observing the garden as it was being prepared for planting. The first thing we did was provide a proper growing area for the plants. This included removing all the existing grass and weeds by removing the light source, and letting the sun provide heat to kill seeds that might germinate. After that, nutrients were incorporated into the soil in the form of mulch, molasses, and Medina (an organic seaweed product), providing organic matter and bacteria that would hasten and readily decompose any organic matter. Finally, tilling the earth loosened the compact soil and provided oxygen. With this preparation, should we expect to have healthy soil? Our garden has been treated well. The soil has lots of organic matter. We expect that a sampling of the soil will yield living creatures such as earthworms, nematodes, small earwigs, snails, and maybe a sow bug or two that has sought cover under the mulch. After all, microscopic bacteria and protozoa devour the leaves and branches that have fallen, the roots that no longer are needed to sustain life, and the dead animals present in the soil. They turn all of these discarded once living organisms into ingredients for fertile soil needed for plant growth in the future.

Our garden has a compost bin, although I am not sure what will be added to it as the maintenance men have been told not to mow the area, and all trimmings seem to be taken away in the dark of the night. So far there is an abundance of fallen limbs from a nearby tallow tree and some leaves. I will always remember one wonderful poster I received at a national science convention, stating that in the time it took ...for the Christopher Columbus's voyage to the New World War until the latest space shuttle launch, one inch of soil had been created. That is a time span of over 300 years. For our students who are used to instant results, and might not appreciate the slowly diminishing pile of garden debris, perhaps a faster model can be found. Using miniature composting bins in the classroom and lunch or kitchen scraps, we can use earthworms to show the students that today's debris and garbage can be tomorrow's gold.

CHILDREN'S BOOKS

A secondary aspect of this unit is to find appropriate children's literature and books that would be a suitable introduction to the classroom lessons. I will be looking for picture books that can be quickly read by the teacher which will captivate students' interest or spark their curiosity about a subject. Some I have found are very elementary, leaning to a quick springboard for a 45-minute guided science inquiry lesson. Others are so filled with

information they would take daily readings over an entire unit. But all that I mention I hope will engage children and spark their curiosity about the natural world. These are listed under the bibliography of children's books. Mostly the pictures are wonderful and the text is inspiring and filled with words that I think are either intensely interesting or just plain poetic. Some may even be silly and uplifting in a humorous way.

CONCLUSION

I think children have an innate love of nature. I know that most children I teach are awed at the tiniest bug, and proudly bring them to me for instant identification. The bugs' shape, body parts, how they live, and what they eat fascinate them. I hope to teach the students that there is a purpose for all of nature, and to treat nature with respect. There is a tremendous diversity and interdependence in nature. If students can appreciate this diversity and the interdependent aspects of wildlife and the plants that contribute to the home for all of them, I believe they will in turn love the earth and take care of it.

LESSON PLANS

All lesson plans have objectives from HISD CLEAR Grade 4. *Uses scientific inquiry methods (112.6 4.2 A, B, C, D, E). *Uses critical thinking and scientific problem solving to make informed decisions (112.4 4.2, A, B, C, D, E). *Knows how to use a variety of tools and methods to conduct science inquiry (112.6, 4.3 A, B, C, D, E). * Knows that change can create recognizable patterns (112.6, 4.6 A, B, C). * Knows that complex systems may not work if some parts are removed (112.6, A, B). * Knows that matter has physical properties (112.6 4.7 A, B). * Knows that adaptations may increase the survival of members of species (112.6 4.8 A, B). *Knows that the natural world includes earth materials and objects in the sky (112.6 4.11, A, C).

Lesson Plan One: Plant Observation Journal

Objective
This lesson will focus on the students' selection of a plant to observe throughout the school year. They will be expected to make observations using all but the sense of taste.

Materials Needed
Paper and Pencil
Small transparent centimeter ruler, 10 cm long; metric tape measure to 150 cm.
Colored pencils
Digital camera if possible
Thermometer

Activity One
The teacher will share with students several examples of journals kept by young scientists Students will go into the Horn habitat garden and do observations, creating their own journal of observations over a period of time. They will listen for sounds in the garden, observe colors and textures, and record the temperature and the weather/light conditions. They will eventually pick a plant to observe throughout the year. They will make careful notes on paper that will include the following: date, time of day, lighting conditions, and a description of the plant they choose to observe for the year. This will include any apparent insects, shape of leaf, color of any blossom, type of blossom if applicable, any smells, sounds of birds, or other wildlife.

There will be a worksheet prepared for the recording of this and subsequent observations. Students will take a digital picture of their plant if possible; otherwise, they will sketch the shape of the plant, leaf type and blossom type, and any seedpods visible. Students will repeat this activity at regular intervals, at least six times during the school year. Observations should be consistent so that they may be compared to one another.

Activity Two
Students will make a cover for their journal using either a magazine picture(s) or a picture they have created with KidPix or a similar computer program with a drawing component. The picture will be their interpretation of the year's work in the garden. The picture will be mounted on cardstock and laminated by the teacher. The journal will be bound if possible, using yarn, plastic or similar material depending on availability.

Activity Three
Students will do a short research project with the Internet and student books about one plant in the garden and the type of seeds the plant produces. If possible, they would take the seed/seed pod of that plant and attempt to grow the plant from seed, comparing it to the mother plant. The plant would then be added to the garden at Horn or to a home garden.

Assessment
Journals will be assessed by the quality of the observations and the comparisons of the findings during the different seasons. At the end of the year students must create a one page story, song, or play about their plant's life and what they have learned. They may also create a game based on their observations throughout the school year. Students will be given a teacher-created rubric as a guideline for the journal.

Lesson Plan Two: Monarch Life Cycle

Objectives
Students will witness the Monarch life cycle through careful observation. All stages of metamorphosis should be observed. The students will compare and contrast the Monarch with another insect, the mealworm.

Materials Needed
Milkweed plant with eggs
Digital camera or materials to make drawing
Butterfly habitat in the classroom (box or netting for a contained environment)
Mealworms
Books, appropriate Web sources for research

Activity One
Students will work in small groups to observe the life cycle of the Monarch butterfly, first observing the egg on the underside of the milkweed plant. Ideally this will take place during March or October, or peak migration months. Observations will include the shape and size of the leaf, the number of leaves on the plant, as well as the condition of the leaves on the plant. Observations will be made of the plant daily, to see how long the egg phase of the life cycle lasts. When the egg has turned into a larva, students will measure the approximate rate of growth of the caterpillar (without touching the caterpillar). Daily records will be made of both the size of the caterpillar and the approximate amount of larval food (milkweed leaves) consumed. When the caterpillar has reached about 1½ inches in length, a leafy portion of the milkweed will be brought into the lab and placed in an enclosed habitat so that students may observe the chrysalis formation and that stage of the Monarch life cycle. Again, the student will record how many days it takes to complete the chrysalis stage. After the chrysalis turns into a butterfly, students will release the Monarch into the outdoor habitat garden.

Activity Two
Students will make comparisons of the Monarch and another insect, the darkling beetle. Starting out with a mealworm, students will care for the animal as it completes its life cycle. Records should be made as to how long each stage of the life cycle lasts. Students will make a chart comparing the two insects, and construct a Venn diagram for the two.

Activity Three
Students will select an insect and do a short research paper or web quest on an insect of their choosing. One aspect of the paper will be the animal's defense or camouflage. They then will build a model of an insect that exhibits camouflage using clay, chenille stems, wood, and whatever is available in the classroom. Each class member will have time to place his/her insect in an appropriate place in the garden. The class will look and see how

many they can/cannot find. The teacher should discuss how camouflage helps insects survive and also discuss other conditions that allow a plant/animal to survive.

Assessment
Most of these are quantitative observations, and students should have complete records as much as possible. Students will make some type of graph, Venn diagram, PowerPoint presentation, or game to present the information to the class and share their results. Assessment is imbedded in Activity Three.

Lesson Plan Three: Soil

Objectives
Students will make observations on types of soil. They will observe the components of soil, identify any visible life, and they will compare different soils. They will compare soil porosity with models and apply that to the soil they find in he school area. They will test the soil for available nutrients using standard soil test kits found at garden supply stores.

Materials Needed
Spoons and cups, shovel
Three or more different sites on campus to take soil samples
Three different cereals to do soil porosity study
Earthworms
Two containers, one of which fits inside the other
Black paper
Soil test kits

Activity One
Using the spoons and cups, students will select three or more different sites on campus where they will gather soil samples. If possible, have the samples about four to six inches under the surface of the ground. Students will then examine the samples using the four senses; classifying whether material found was living, once living, or never living. They can also classify according to color and texture. Students will then follow the procedures outlined on the soil test kits and test for nitrogen. Soil samples will be saved for Activity Three.

Activity Two
Using cereal as a model of different types of soil, students will test the ability of the model soil to hold water. Using a large type of cereal like Cheerios (sand), a smaller type of nugget cereal like Grape Nuts (silt) and a finely ground mixture of cereal (clay), prepare three cups of the representative "soils." Have students slowly add about 10 ml of water to the side of each cup and watch to see how the liquid goes to the bottom of the cup. They should observe that the clay does not absorb the water at all and the sand lets the water

through very fast. Using this model, have them identify if possible the type of soil found in the schoolyard. Discuss the limitations of models.

Activity Three
Students will measure how much water their soil will hold. After discussing proper experimental procedures and variables, students will test a portion of each of the soils gathered in Activity One for the amount of water each soil will hold. Make sure the soils are dry before starting, and make sure equal volumes of soils are used. Graph the results and write a paragraph about the ability of the soil to grow plants.

Activity Four
Set up a miniature "earthworm farm" or compost pile. Nest an empty container inside of a larger transparent one, so that students can put soil and vegetable scraps mixed together between the two containers. The layer of soil that is formed can be observed for earthworm activity. Add earthworms, cover outside with dark paper, and set in an out of the way spot. Observe occasionally to see what is happening to the "farm."

Assessment
Students will create a book summarizing their knowledge about soil, create a play about life "down under," or create a game/song about the importance of good soil. They can design and complete an experiment using different types of soil to see which supports growth the best.

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