

For the Birds: Ecosystems and Adaptation in the City

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You cannot go against nature, because when you do go against nature it's part of nature too.
- Love and Rockets, "No New Tale to Tell"

INTRODUCTION

As I look around my classroom, I notice that I am surrounded by the comforts and conveniences of the modern world. The outside world of trees and animals seems so far away from my everyday life. I wake up in my house, drive to work on the Houston freeways, and come to my inner-city classroom. On weekends I may see nature in small glimpses: a bike ride through a park, an occasional camping trip, a few hours in the garden. My students live in the sprawl of apartments surrounding our school. It is a concrete jungle miles in diameter, where even the local Nanieto Park is virtually devoid of nature. Their interaction with nature is even more limited than my own. We are urban dwellers. We cannot survive without the conveniences of the stores that we depend on for our sustenance. My students rarely travel outside of a five-mile radius of their residences.

When I was in elementary school, I was fortunate to be a part of a program where I went to a nature center twice a week for classes. I learned about marine biology by casting nets into the bayou and studying the life we dredged up. I learned about forest ecology by walking through a forest with a scientist who explained shelf fungi and the importance of decay in the forest ecosystem. I was able to touch, explore, and ask questions in the actual environments I was learning about. Until college, I did not take another science class that matched the amount of knowledge I received from that experience. Now I am teaching science, and I long to give my students that sort of experience. I am, however, limited in my resources. It is unrealistic to think that I can take my students on bi-weekly field trips to different habitats to explore. But we can explore the habitat in their neighborhood, the urban ecosystem.

My students care about the environment. When we have discussions about animals becoming extinct or animals being hurt by our trash; they (the students) are really affected. They worry about clean air and clean water. They can tell you reasons that we should and ways that we can help the earth. But this concern is isolated. If I ask them about the environment, they mention fish and forests, mountains, and jungles, but they do not say my "apartment complex" or "our neighborhood;" they do not see the area in which they live as part of the environment. Often times my students see the ecosystems portrayed in their science books as irrelevant to their lives because they do not live in forests or near ponds that they can observe firsthand. The students need to first understand that they too live in the environment, that their surroundings are a part of an ecosystem, before they will be able to transfer that knowledge to other ecosystems.

I hope to begin to bring an understanding of all ecosystems that exist on our planet to my students by beginning with their surroundings. We will focus on birds because they are directly observable for my students. The unit will be integrated with their reading and language to add a more in-depth understanding of the concepts. I have found that integrated thematic units are the most effective way to really energize the students to learn independently. Our educational system today is so fast-paced and often disconnected that we regularly lose students in our mad rush to prepare for the tests. Integrated units give both the teachers and the students a chance to slow down a little and focus.

As the human population grows, it is increasingly important that the general population understands the effects that man has on our environment. It is also important that we, as a society, understand the science behind the environment in which we live. The definition of ecosystems needs to be expanded in the minds of the majority to include urban areas. Right now, it seems that the urban landscape is often times excluded from the conventional teaching of ecosystems. The only way we can fix this is to ensure that our students really understand the science behind ecosystems and that they understand that ecosystems occur everywhere that there is life, even in places where concrete is more prevalent than natural ground. This unit seeks to lay the foundation for understanding the complex concept of ecology by looking at the ecosystem of an urban area.

As our environments change, the plants and animals within our environment change. Some species are unable to adapt to the changes in an environment, and they become extinct. Sometimes a species with new characteristics that are better suited to the new environment emerges; when this occurs it is called adaptation. At the end of this unit, I want my students to be able to understand the concept of adaptation. I want them to be able to explain the ways in which animals have come to survive in the city. I want them to understand how man has influenced the natural world in several ways including, man's competition with other species for space and the introduction of new species into our environments. I feel that this is important for my students to understand because our impact on the environment is not diminishing but increasing. The space that humans take up on this earth is increasing as our population grows, and as it increases there will be more displacement of other species. Urban areas are expanding to accommodate the rise in population and as a result the rural areas are shrinking. My students need to understand the consequences that humans have on the world around us.

UNIT BACKGROUND

This three-week integrated thematic unit will focus on adaptation and ecosystems starting with the birds and animals that we find in our neighborhood. Language arts will be used to reinforce the science concepts using both fiction and non-fiction stories. We will begin by discussing the difference between bird species. The students will be looking in-depth at different kinds of beaks such as pelican, sand piper, and startling beaks. They will then be exploring the reasons for the differences among them. Then we will look at

the food sources that birds need to survive such as fish, insects, and grains. The students will explore how these differences influence where the birds live. We will look in-depth at the birds in our neighborhood. Students will discuss where these birds get their food in the city. They will also look at where they roost and how they are able to survive in the city. Their final project will entail choosing a bird from another habitat and describing how the bird will have to change to be able to survive in the city. The unit will focus around three questions that will be explored in-depth in each of the three weeks.

The purpose of setting the unit up in this way is to allow the student to construct his/her own model of an urban ecosystem. I want the students to ultimately be able to take ownership of their own learning. It is my hope that students will obtain most of the research and fact finding on their own, using both the library and the Internet as resources. I have focused the unit around key questions to guide the students through creating their own understanding rather than having their knowledge be dependent upon what I tell them. Ensuring that the students are adept at using and understanding the scientific method is of far greater importance than them being able to name the facts it has produced.

What Animals Can Do to Survive in the City

In the first week of the unit, students will be looking in-depth at the nature that they are embedded in. They will be zoologists exploring and observing the ecosystem that surrounds them. We will take a walking field trip to Nanieto Park and record the wildlife that we see.

Students will read *City Critters: Wild Animals Live in Cities Too* from their Open Court Reading books. This piece focuses on the ways in which some animals have adapted to city living. It discusses how sometimes we do not think of urban areas as containing wildlife and will be a great introduction for our discussion on urban ecology. It also introduces some vocabulary that we will be using throughout the unit.

At home, students will record the animals they find in their neighborhood by keeping a log of animals they discover over the week. They will bring their findings to school, and as a class we will identify the different animals that they observed and determine where and how they get their food. Students will be asked to pay special attention to see if they can catch any animals in the act of eating.

We will also look at some historical documents of Houston to see if there were any animals that used to live in their neighborhood but do not live here any longer or that are now endangered. We will explore the reasons behind why those animals may no longer live here. One example is the Houston toad, which used to thrive in our area but is now endangered, partly because of development, but also because of the red fire ants that are not indigenous to Houston. Students should begin to see that animals have become scarce in our area in recent history for two main reasons. The first reason is that some species have had to compete for resources with humans. The second reason for the

diminishing numbers is that native animals must now compete for resources with species that have been introduced into their environment.

How Are Birds Different from Each Other and How Do Those Differences Help Them Survive?

In the science lab, students will explore the differences between a variety of bird beaks and the kinds of food sources that the beaks allow the birds to eat. They will try to use models of the different beaks – such as a scoop for the pelican and a toothpick for the sandpiper – to try to eat different kinds of foods like golf balls that represent fish and rice that represents insects. Then we will discuss what would happen to the birds if there were a change in the food sources. For example, what would happen to the pelican if there were less fish? Could it eat something else? Would it have to move to a new environment?

Students will read *Make Way for Ducklings* by Robert McCloskey and will discuss how and why ducks live in the city. *Make Way for Ducklings* is a fictional story about a pair of ducks that move to Boston to have their ducklings. The story is filled with interesting facts about ducks, and it shows the family of ducks adapting to their urban surroundings.

The final project will be introduced in conjunction with the book *Make Way for Ducklings*. The book will introduce vocabulary that will be useful for their final project and will set the stage for discussing the requirements of their project. I will facilitate the students in the creation of the rubric for their final project by allowing them to come up with the criteria and letting them weigh the importance of each piece. Students will pick their bird and begin research using the computer lab and the library to find out what their bird eats and where it lives.

The students will look at the reports of problems people are having with the exploding duck populations in Florida cities and other cities around the country. We will talk about the relationship between people and animals in the city. They will respond in their journals to written prompts such as: What do you think the effects are on the ducks when people feed them at Hermann Park? How can ducks affect an urban area? We will look at the effects on indigenous species when people introduce new species into the environment and the effects on the environment itself.

In class, students will predict what happens to the food source of animals when humans move into their environment. We will make a food web using yarn. Each child will become an animal or plant in our ecosystem. They will be connected to the food that they depend on for survival with the yarn. Then we will show what happens when one food source is taken out of the food chain by having the child with that source drop their yarn and showing all of the species that are affected.

How Are Traits Passed On?

Students will do an experiment on food sources for birds by pretending to be birds and looking for worms in the grass. The worms will be different colors of yarn. The students will see that it is easy for them to find worms that are bright colors, but that the worms that are brown and green are much harder to find.

Students will also look at the peppered moths in England. The peppered moths are an excellent example of adaptation. Before the industrial revolution in Europe, most of the peppered moths were white; however, a few were black. After the industrial revolution, soot from the factories covered the surrounding trees and made the bark black. As a result, the population of white peppered moths decreased, and the majority that survived were black. Students will do a computer lab where they are robins trying to eat peppered moths off of clean trees and soot-colored trees and will observe what happens to the populations in both instances.

Students will read *Urban Roosts: Where Birds Rest in the City*. This article discusses several species of birds that have adapted to urban ecosystems. Students will explore the ways that these birds have been able to survive in the city. They will look at the different factors that have helped the birds survive, such as using man-made structures as nests and eating the food that humans throw out.

We will read the story *The Lorax* by Dr. Seuss as a class. This story tells the tale of a man called the Oncler who destroys the environment around him because he has found a way to make money by using the trees. The story shows how his use of the trees and the effects of his factory cause the animals around him to suffer. In the end all of the animals have to move because the environment changes to the point where they can no longer survive there. Students will brainstorm ways in which man changes the environment and how those changes can affect the existing species in an ecosystem. They will think of how the animals could have changed to live in the environment that Oncler created.

For their final projects, the students will take what they have learned about their bird and come up with an adaptation that would help it to survive in Houston. They will discuss the possible negative effects that releasing their new bird would have on the Houston ecosystem.

Science Background

Often times we do not fully realize the effects we have on nature until the damage has already been done. As our scientific knowledge increases, we are able to get a clearer and clearer picture of our actual effect on the environment. However, as our scientific knowledge increases, our educational system is not ensuring that our students understand this knowledge. Science has taken a back seat to reading and math in education, and even if it became a priority, it would require a serious amount of training for the teachers just to cover a few basic concepts. We are a scientifically illiterate country at a time when it is

so important that we understand. The effects of this discrepancy between our advancement and ignorance of science have the potential to be detrimental. We need to be aware so that we can advocate policy that takes into account the realities of the scientific world and our environment. This is difficult when most of us do not have a strong enough understanding of science to fully comprehend the current state of our environment.

Part of the problem is that there has been an increasing disconnect between our lives and nature, especially in the western world. We have created environments that make us increasingly dependent upon man-made products and technology. This has made a majority of us incapable of surviving in the natural world around us. Given this existence, how can we really see the effects we are having on the environment? How can we understand the effects that nature has on us and vice versa? This disconnect removes us from the environment in such a way that we no longer see the impacts of our actions on nature. And yet we are still affected, we still affect, and there is still an ecosystem in which we live.

Our earth is constantly changing, and with it the organisms that live on it also change. As transformations happen to the earth, the life on earth changes as well. It changes slowly at times, but sometimes it changes very quickly. Several factors have caused the earth's environment to change. Climates become colder or warmer, causing some species to flourish, some to die out, and some to move to a new location. Volcanoes erupt, causing the destruction of entire ecosystems and the grounds on which new ones can build. Meteors hit the Earth, possibly changing the weather patterns. Living organisms may cause the destruction of each other by diminishing the population of the food source on which they depend. Perhaps none of these has had the effect that man has on the environment over the last 200 years.

Life is able to change because life reproduces. Offspring are not exactly the same as their parents. There are always genetic mutations taking place. Some mutations make it harder for living organisms to survive. Most mutations don't make it any harder or easier for an organism to survive. Some mutations can make it easier for a species to survive when the environment changes. When this happens it is called adaptation. Genetic mutation is random. The ability for a species to survive and pass on traits to offspring is a direct result of the species' success in an environment.

It was once thought that species mutations happen slowly over time, that it takes millions of years for animals and plants to change into entirely new species. However, as the ability to study different animals' DNA increases, scientists are learning that it might not take as long as we thought. According to a recent article "The Genes That Change the Cichlid Jaws" by Elizabeth Pennisi in *Science* magazine, the cichlid, a fish of the East African Rift Valley, has mutated into about 1,000 different species in just the last million years (Pennisi 383). The reason for this appears to be caused by one gene mutation that controls the size of the jaw. "The work suggests that the entire jaw is evolving as a single unit" (Pennisi 383). This allows new species to develop rapidly as the ecosystem

changes. It also allows the different species to live together because their different jaw shapes influence what they eat, how they breed, and their lifestyles.

Our interaction with the environment affects every aspect of the environment. When we alter a species or cause the extinction of another species, the effects are sometimes not realized for generations. An example of this is the dodo bird of Mauritius Island. Three hundred years ago the dodo bird became extinct as a result of the arrival of man on Mauritius Island. It has just recently been discovered that a species of tree on the island is also on the verge of becoming extinct. The reason for this is that the tree was dependant on the dodo bird for breaking down the hard shells of its seeds so that it could grow. Recently there have been efforts to restore the native tree by using turkeys that also have gizzards to try to break down the seed, but this has not proved to be effective (*In the Wild: Islands*).

Pollution affects ecosystems in several ways. One example of this is the pepper moth of the United Kingdom. The peppered moth was mostly white in pre-industrial England. With the rise of industry that used coal as its primary source of fuel, the trees were covered in soot. In the industrialized regions the peppered moth was recorded as evolving from white that originally blended with the bark of the area's trees, to the black as the industrial revolution stained the surrounding trees black. The peppered moth evolved back to white again when the coal was no longer used as the primary fuel source (*Virtual Peppered Moths*).

When non-indigenous species are introduced to an ecosystem that ecosystem is forever changed. "When alien species enter into an ecosystem, they can disrupt the natural balance, reduce biodiversity, degrade habitats, alter native genetic diversity, transmit exotic diseases to native species, and further jeopardize endangered plants and animals" (*Environment of Planet Earth*). Man has been the main culprit of introducing non-indigenous species. Sometimes the introductions are accidental, but often times they are intentional. People brought plants and animals from their old country over to the States to remind them of their old home. Sometimes the species they brought with them were released into the ecosystem and flourished. But their success was often at the expense of the native plants and animals that were already established in the ecosystem. Sometimes new species were introduced by accident, like fire ants from South America, Africanized bees from Africa, or Lamprey eels in to the great lakes by the opening of the St. Lawrence Seaway.

Implementation Strategies

This unit is primarily targeting the science curriculum in my classroom. The lessons will focus on the following TEKS for science and established by the Texas Education Agency (TEA):

5. The student knows that systems exist in the world.
 - B. Observe a simple system and describe the role of various parts such as a yo-yo and string.

8. The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live.
 - A. Observe and describe the habitats of organisms within an ecosystem.
 - B. Observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, or space.
 - C. Describe environmental changes in which some organisms would thrive, become ill, or perish.
 - D. Describe how living organisms modify their physical environment to meet their needs such as beavers building a dam or humans building a home.
9. The student knows that species have different adaptations that help them survive and reproduce in their environment.
 - A. Observe and identify characteristics among species that allow each to survive and reproduce.
 - B. Analyze how adaptive characteristics help individuals within a species to survive and reproduce.
10. The student knows that many likenesses between offspring and parents are inherited from the parents.
 - A. Identify some inherited traits of plants.

Adaptation is a challenging concept for third-graders. There are many misconceptions that students may have regarding how traits are passed down from parents to offspring. Most students know that offspring look like their parents. Some students may think that they only receive traits from their same-sex parent; still others may believe that they only get traits from their mothers because the mothers are the one's who give birth. Some students believe in a "blending of characteristics" (*Benchmarks for Science Literacy*). To overcome these possible misconceptions, the students will first be given a pretest to assess what they already know about adaptation. This should help to bring out whatever misconceptions the students already hold. The unit will then attempt to allow students to discover for themselves how adaptation works in nature through hands-on activities such as the worms in the grass activity and the peppered moth website.

Throughout the course of the unit, the classroom library will contain books (both fiction and non-fiction) and articles that relate to different bird species and ecosystems. The classroom will have many resources to reinforce what we are learning. There will be a Think/Question/Learn chart that helps us track our progression through the unit. There will be pictures of birds on the classroom walls. In the science center, there will be different examples of bird feathers and activities for the students to explore. The computer center will hyperlink students to a variety of sites that gives them a chance to explore more about birds and ecosystems.

Students will explore how plants and animals interact in a habitat. An experiment using yarn will demonstrate how the species are dependent on each other. Each student will have a nametag containing the name of a particular animal. Yarn will connect the

prey to their food sources until a pattern of interdependence arises. The visual reinforcement of an actual “web of life” will solidify the idea of interdependence for the students. It is my intention to get students to understand that changing just one species in a habitat can affect all of the other species in that habitat in sometimes-unexpected ways. By removing certain animals from the food chain, the students will begin to understand the effect that the extinction of a species can have on the food chain. Several examples will also be shared of how introducing new species to a habitat can change the interdependent web. Some examples include the introduction of dogs to Australia or blackberries to the northwest United States. The student will also learn about different types of ecosystems such as a forest ecosystem, a marsh ecosystem, and a desert ecosystem.

LESSON PLANS

Lesson Plan 1: Exploring Nanieto Park

Objectives

TEKS 8: The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live.

A. Observe and describe the habitats of organisms within an ecosystem.

B. Observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, or space.

. Describe environmental changes in which some organisms would thrive, become ill, or perish.

Materials

- Digital Camera
- Recording sheets for each student
- Clipboards
- Computers

Procedure

This lesson will take the students on a walking field trip of the nature in their neighborhood. Before we begin I will have the students brainstorm a list of the animals that they think we will see on our field trip. We will put the list on our Think / Question / Learn chart for later use.

As we walk through Nanieto Park, we will be on the look for different animals. When we find animals, I will attempt to take pictures of them with the digital camera. Students will record their observations on their recording sheet. They will draw a picture of one of the animals that they see. Then they will think of what their animal eats and where it gets its food.

When we get back to the classroom, we will use our pictures and animal field guides to identify the animals that we have found. We will make a list of the animals we have found to add to our Think / Question / Learn chart. Then students will research their animals on the Internet to check their predictions about what they eat. Students will continue this activity at home by keeping an animal journal for one week for each of the animals they observe in their neighborhood.

Lesson Plan 2: Bird Beak Adaptations

Objectives

TEKS 9: The student knows that species have different adaptations that help them survive and reproduce in their environment

A. Observe and identify characteristics among species that allow each to survive and reproduce

B. Analyze how adaptive characteristics help individuals within a species to survive and reproduce

Materials Needed

- Slotted spoon
- Skewer
- Tweezers
- Golf balls
- Popcorn packaging
- Rice

Procedure

The lesson will start with a discussion of what animals need to survive. They will discuss that all animals need air, shelter, water, and food. Then they will be asked how animals get their food. Because not all animals eat the same things, the way that food is collected varies depending on the food source. To demonstrate this, students will be looking at different species of birds.

The students will be divided into groups of five, and each student will be given a different tool representing a different type of bird beak. Students will use the variety of tools that represent different bird beaks and will use them to “eat” different types of food. They will see that differently shaped beaks are better suited for different kinds of food. This will allow student to see why there is a need for animal to have different traits.

Students will then extend this activity to the birds that the materials represent. They will match the real birds to their main food source. Students will explain how the different beaks allow the birds to eat different foods. Then they will explain why they think different species of birds came to have such different shaped beaks.

Lesson 3: Finding Food

Objectives

TEKS 9: The student knows that species have different adaptations that help them survive and reproduce in their environment.

A. Observe and identify characteristics among species that allow each to survive and reproduce

B. Analyze how adaptive characteristics help individuals within a species to survive and reproduce

TEKS 10: The student knows that many likenesses between offspring and parents are inherited from the parents.

A. Identify some inherited traits of plants

Materials Needed

- Red, blue, yellow, green and brown yarn cut into two-inch strips (40 each)
- Green and brown yarn cut into two-inch strips (100 each)
- A patch of grass
- Rope
- Stakes to hold the rope
- Timer

Procedure

This lesson will begin with a discussion of how animals protect themselves from predators. Students will discuss different strategies animals could use to protect themselves.

We will go outside to a roped off patch of grass. I will show the students the yarn strips and explain that they represent worms. The students will pretend that they are birds and it will be their job to collect enough worms to survive. The first set of worms containing multi-colored string will be dispersed on the ground. Students will have one minute to “eat” as many worms as they can. When the minute is up they will record how many they were able to get and what color the worms were. They will then go back out and see if there were any worms that were missed. We will record our findings and note the colors of the worms we find.

For the second “feeding,” only the brown and green worms will be dispersed. Students will again act as birds and will have one minute to eat as many worms as possible. After the minute they will come back and repeat the recording procedure. The experiment should reveal that certain colors in the right environment help animals survive by blending in with their surroundings.

ANNOTATED BIBLIOGRAPHY

Works Cited

Bash, Barbara. *Urban Roosts: Where Birds Nest in the City*. San Francisco: Little, Brown and Company, 1990.

This book discusses different ways that birds adapt to life in the city. There are several examples that discuss the benefits and problems urban environments create for our aviary friends.

Benchmarks for Science Literacy. New York: Oxford UP, 1993.

A great resource for what students need to know by each grade level in order to be scientifically literate adults. Contains information on common misconceptions students may have and the latest education research.

Chevat, Richard. *City Critters: Wild Animals Live in Cities, Too*. Columbus, Ohio: SRA/MacGraw Hill, 2000.

From birds to deer, this article discusses not only some of the animals that live in the city but how to observe certain critters.

Environment of Planet Earth. 1999. Eco-Pros. 1 May 2004. <<http://www.eco-pros.com/>>.

This site offers information on non-native plants and animals. It also has a lot of information on the environment including links to current weather and environmental conditions.

In The Wild: Islands. 1996-2000. Bagheera and ESNB. 1 May 2004.

<http://www.bagheera.com/inthewild/ext_dodobird.htm>

This website describes the recent attempts to save the dodo tree on Mauritius Island. The dodo tree was dependent on the dodo bird for reproduction. There are only 13 still alive.

McCloskey, Robert. *Make Way for Ducklings*. New York: Viking Press, 1941.

Make Way For Ducklings is about a pair of ducks, Mr. and Mrs. Mallard, that are looking for a nice, safe place to nest and start a family in the city of Boston. As the Mallards look for a place to nest, the story discusses all of the things the ducks need to survive in the city.

Pennisi, Elizabeth. "The Genes that Change the Cichlid Jaws." *Science* vol.304, no. 5669: 383.

This article talks about the variations of the cichlid fish in an East African River. The variance between the fish is dramatic but cause by the mutation of a single gene. The gene controls the shape of the fish's jaw.

Suess, Dr. *The Lorax*. New York: Random House Children's Books, 1971.

A great book for introducing environmental concerns to children. Very good for introducing ecosystems.

Virtual Peppered Moths. 2004. Fort Bend Independent School District. 1 May 2004.
<<http://www3.district125.k12.il.us/faculty/nfischer/Moth/default.htm>>
This is an incredible website. It allows students to pretend that they are robins eating peppered moths. The students see the difference between lichen-covered trees and soot-covered trees when trying to eat the peppered moths.

Supplemental Resources

Student Resources

Agriculture in the Classroom. 2004. United States Department of Agriculture. 5 Aug 1999. <<http://www.agclassroom.org/>>.
A resource for students to learn about agriculture through several student based activities. This site includes student friendly article links to the topic of biotechnology.

Controlling Non-native Species. 2001. Cornell Lab of Ornithology. 1 May 2004.
<http://birds.cornell.edu/birdhouse/getting_started/controllexotics.html>.
This site is a good resource for students investigating native birds. It provides good information in an easily readable format.

Dixon, Terrel. *City Wilds*. Athens: University of Georgia Press, 2001.
A collection of short stories and essays that focus on nature in an urban setting. Includes ideas for using it in your classroom to teach about ecology in the city.

Food Safety Network. 2002-2004. University of Guelph. 9 Feb. 2004.
<<http://www.foodsafetynetwork.ca/>>
This site is from Canada and provides links to the most recent articles concerning the use of biotechnology. It also has a page dedicated to virtual tours, which is a great resource for the students.

Landry, Sarah B. and Rodger Tory Peterson. *Petersons First Guide to Urban Wildlife*. Boston: Houghton Mifflin, 1998.
This field guide is student friendly and has animals and plants typically found in a city.

Mitchell, John. *A Field Guide to Your Own Backyard*. Woodstock, VA: Countrymen Press, 1999.
This field guide is a good resource for the students to use for identifying animals but does not contain many common Houston animals.

Raphus Cucullatus – Dodo Bird. 2002-2004. Encyclopaedia Mauritian. 1 May 2004.
<<http://www.encyclopedia.mu/Nature/Fauna/Birds/Extinct/Dodo.htm>>.

This site offers an in-depth look at the dodo bird. It has the history of the bird and its extinction.

Teacher Resources

Burkowitz, Allen, et al. *Understanding Urban Ecosystems*. New York: Springer Verlag, 2002.

This is a series of papers that focus on current trends in urban ecology education and on the importance of teaching urban ecology. This is a great resource for background information.

Carol, Janet and Robert Huelbig. *City Kids and City Critters*. Houston: McGraw Hill, 1996.

Activities teach children in populated areas about the value of protecting remaining wildlife habitats. Projects include photography, drawing and observing creatures in natural surroundings, and creating habitats that provide shelter or food for wildlife.

Emerging Technologies—Biotechnology. 2004. U.S. Food and Drug Administration. 1 May 2004. <<http://vm.cfsan.fda.gov/~lrd/bioeme.html>>.

This site provides the FDA guidelines and concerns surrounding genetically modifying food.

Epstein, Ron. *Dangers of Genetic Engineering*. 1996-2004. San Francisco State University. 9 Feb. 2004.

<<http://online.sfsu.edu/~rone/GEessays/gedanger.htm#General>>

This site includes links to several essays on genetically engineering plants and its dangers. Many good resources are available here, but the site is biased in that it focuses on the negative aspects of biotechnology and how genetically engineered plants affect an ecosystem.

Independent Scientists Explain. 2004. Physicians and Scientists for the Responsible Application of Science and Technology. 26 Jan 2004. <<http://www.psrast.org/>>

An educational site devoted to helping people understand the science behind how plants are genetically engineered and the benefits and consequences of genetic engineering.

Nature Neighborhood. Port Royal, SC: Environmental Media Corp., 2001

A book that discusses the environment as it relates to urban living.

Our Living Resources. 1995. Status and Trends. 1 May 2004.

<<http://biology.usgs.gov/s+t/index.htm>>.

This is an online report of several species of plants and animals in America. There is a very good section on the effects of non-native species to U.S. ecologies.

Pusztai, Arpad. *Genetically Modified Foods: Are They a Risk to Human/Animal Health?* 2000-2004. American Institute of Biological Sciences. 16 Feb. 2004.
<http://www.actionbioscience.org/biotech/pusztai.html>.
This article goes into detail on the risks and risk assessments of genetically modified foods.

Rockman, Alexis. *Concrete Jungle*. Minneapolis: Sagebrush Educational Resources, 1997.
This is a book about the environmental effects of urban living. This reference is purely for background for the teacher.

Science and Technology: Agricultural Biotechnology. 2004. Monsanto Company. 10 Feb. 2004.
<http://www.monsanto.com/monsanto/layout/sci_tech/ag_biotech/default.asp>.
An explanation of how biotechnology works and is being used in the Monsanto Corporation, which is on the cutting edge of biotechnology. Gives mainly the positives in regards to biotechnology.