2001

Where have all the species gone?: An interdisciplinary unit on endangered species

Rebecca Joan Goldberg

WHERE HAVE ALL THE SPECIES GONE?

AN INTERDISCIPLINARY UNIT ON ENDANGERED SPECIES

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education:

Environmental Education

---

by

Rebecca Joan Goldberg

June 2001

WHERE HAVE ALL THE SPECIES GONE?

AN INTERDISCIPLINARY UNIT ON ENDANGERED SPECIES

A Project

Presented to the

Faculty of

California State University,

San Bernardino

---

by

Rebecca Joan Goldberg

June 2001

Approved by:

[redacted]

Darleen Stoner, Ph.D.,
First Reader

June 7, 2001
Date

[redacted]

Anne E. Boshoven, M.A.,
Rialto Unified School District
Second Reader

ABSTRACT

Where Have All the Species Gone? is an inter-disciplinary thematic unit that offers today's students a challenging, outdoor, hands-on curriculum encompassing the problem of endangered species. This curriculum is designed to educate, interest and inspire students to seek solutions to the problems associated with the causes for endangered species. The lessons cover the areas of mathematics, language arts, American history, science, art and technology. The unit can be taught in its whole over three to four weeks or individual lessons can be infused into existing middle/junior high school curriculum throughout the school year.

ACKNOWLEDEGMENTS

To the William S. Hart Union School District for their supportive educational technology grant.

To Dr. Darleen Stoner for teaching me to be a better teacher through environmental education.

To my mom, Joan C. Russell and husband, Seth M. Goldberg for their encouragement and support during the creation of this project.

And, to my dad, James R. Blanton, for providing the inspiration for this project. It was through our many wonderful outdoor experiences that he taught me not just to look, but to listen, feel and participate in the great outdoors.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

I grew up in The Great Lake State of Michigan. My family spent a great deal of time outdoors camping, hiking, fishing and hunting. One experience changed my views on the way that humans interact with nature.

When I was about five, my dad and I had a discussion while cleaning fish. Just before we placed the cleaned fish back into the creel, my dad cut the bottom centimeter of meat from the fish. I asked him why we did this and he explained that bad things in the fish's water and food sometimes end up in the belly meat of the fish. I remember thinking that was strange because the water looked clear and clean to me. To this day when I catch and clean a fish, I cut off the belly meat.

When I take long hikes outdoors, I am amazed at the abundance of life around my home. As a science teacher I wonder if all is well. Is the ground water clean? Are any plants or animals missing? What effect would any missing plants and animals have on me? In the National Geographic article, "On the Brink: Hawaii's Vanishing Species" by Elizabeth Royte, conservationists "stress that the loss of even one species may contribute to the decline of entire ecosystems" (1995, p. 14). Every species is important. A key example is the Pacific yew. The Pacific yew was

eliminated from many areas of the Northwest because it was a "trash" shrub, that is until its bark yielded cancer fighting compounds (Chadwick, 1995). Thankfully the U.S. Congress recognized this fact and responded with the Endangered Species Act (ESA) of 1973. This act is based on the premise that "each life form may prove valuable in ways we cannot yet measure and that each is entitled to exist for its own sake as well" (Chadwick, 1995, p. 7). This act is by no means a cure for the problems of endangered species, but it has saved many species from further endangerment.

Many great environmental protection laws were enacted in the early 1970s: The Clean Water Act, the Clean Air Act, the Federal Environmental Pesticide Control Act and the establishment of the Environmental Protection Agency (EPA). It was the National Environmental Policy and the National Environmental Education Acts (of 1969 and 1970 respectively) that invited children to become a part of saving the environment. Through those acts our government recognized education as way for "improving the quality of the human environment" (Disinger, 1993, p. 24). Finally the door opened to ensure improvement of the environment through our children.

Where Have All the Species Gone? is an inter-disciplinary curricular guide designed to help middle school and junior high teachers infuse the theme of endangered species into existing curricula. This project offers

students the chance to experience curriculum that intertwines environmental education with language arts, math, science, American history, art, physical education and technology. Furthermore, the activities and lessons included in this guide are designed to be experiential. The Science Framework for California Public Schools: Kindergarten Through Grade Twelve (1990) recommends that all grade levels should experience hands on active participation at least forty percent of the time. The lessons in Where Have All the Species Gone? are designed to include such active participation.

In closing, it is important to note that humans have been concerned about the environment for millennia. But concern is not enough. "The survival of hundreds of endangered species now depends on human intervention" (Royte, 1995, p. 14). This unit offers students the inspiration and opportunity to make a change in their own environment and to make a difference in a world of endangered species.

CHAPTER TWO

REVIEW OF THE LITERATURE

The review of the literature first defines environmental education and explains the goals of environmental education. Curricular approaches to environmental education through infusion and interdisciplinary teaming practices are then explored. Finally, teaching strategies for environmental education are examined to include cooperative learning, reflection through journaling, outdoor education and finally constructivism.

Defining Environmental Education

In October of 1977 the Intergovernmental Conference on Environmental Education was held in Tbilisi, Georgia in the former USSR. The Tbilisi Conference set objectives for environmental education that created the framework for future curriculum development. In their article on local and global environmental perspectives, Lisowski and Williams summarized the Tbilisi objectives (1993). Those objectives defined environmental education as developing:

1. Awareness: to help social grops and individuals acquire an awareness and sensitivity to the total environment and its allied problems,

2. Sensitivity: to help social groups and individuals gain experiences in, and acquire a basic understanding of the environment and its associated problems,

3. Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for active participating in environmental improvement and protection,

4. Skills: to help social groups and individuals acquire skills for identifying and solving environmental problems, and

5. Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems (p. 74).

Klein and Merritt (1994) simplified the Tbilisi objectives into one goal. They maintained that the goal of environmental education is to help children develop a sensitivity toward their environment, knowledge about the environment, and a commitment to taking action in defense of the environment. According to Disinger (1993) the most often cited definition of environmental education is by Stapp et al. Their assertion was that "environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (p. 35). Lastly, Stoner stated that "the heart of environmental education is interdependence, whereby everything is connected in some way" (1990, p. 65).

There are other definitions, but the following themes can be found to underlie all of them. First, effective environmental education includes the development of awareness, knowledge, attitudes and skills necessary to take thoughtful, positive action toward the resolution of environmental issues and problems. Secondly, all life on this planet is interconnected and each individual's actions have an impact, not just on the immediate locale, but on the entire ecosphere as well. Fundamentally, environmental education "brings relevance to each child's learning" (Stoner & Overby, 1989, p. 148).

Human behavior drives human action. Newhouse (1990, p. 26) stated that "it has been recognized that the root of environmental problems is human behavior". Since "the ultimate aim of education is shaping human behavior" (Hungerford & Volk, 1990, p. 8), then it follows that "the bottom-line purpose of environmental education . . . is the promotion of responsible individual and societal environmental behavior" (Disinger, 1993, p. 35). Educators must continue the efforts set forth by Congress to shape environmental behaviors in children.

Curricular Approaches to Environmental Education

There are many approaches to getting new subjects into an already existing and overcrowded curriculum. Through infusion and interdisciplinary planning, environmental

education can become a part of any curriculum in any subject.

Very little has been done to integrate environmental education into schools at the secondary level (Samuel, 1993). According to Disinger, many special interest groups are trying to add their subject matter causing curriculum overload to be a serious and growing problem in our schools. He advocated that "infusion is a pragmatic approach to finding room for environmental education in a crowded curriculum" (1993, p. 39). Through infusion environmental education need not be taught exclusive of the original curriculum. This is confirmed by Simmons who suggested the infusion of environmental education into the curriculum is beneficial in that environmental education does not become "another add-on subject that needs to be fit into an already overburdened schedule." She further asserted that it just takes a little extra time to teach the concepts and issues "within the normal scope and sequence of subject areas" (1989, p. 15).

Environmental education can be easily infused into existing curriculum through team interdisciplinary projects. Wade supported this concept in her article on teacher inservicing. She stated that teachers and schools need to "communicate more effectively the interdisciplinary nature of environmental education to all sectors of the formal education community" (1996, p. 15). Lisowski and Williams

(1993) agreed with this approach and took it one step further. They advocated that it is through an interdisciplinary approach that environmental education is taught the most effectively. These approaches are supported by the California Department of Education, which recommended that education be taught "thematically in every classroom at all grade levels" (1990, p. 4). Finally, when you consider that "all education is environmental education" (Orr, 1990, p. 54), it makes perfect sense to infuse environmental lessons into already existing curriculum.

Teaching Strategies

There are many ways to teach a subject. The following teaching strategies examined are those most likely to foster the goals of environmental education. They are constructivism, outdoor education, journaling, and cooperative learning.

According to Brooks "constructivists believe that knowledge is the result of individual constructions of reality" (1990, p. 68). Basically, students learn to construct knowledge through their own trial and error, not someone else's. Klein and Merritt expanded on this topic and described four key components to a successful constructivist lesson or unit as

(a) introduction of a real life problem by the students or teacher for the students to resolve, (b) student centered instruction facilitated by the teacher, (c) productive group interaction during the learning process, and (d) authentic assessment and demonstration of student progress (1994, p. 16).

O'Brien (1992, p. 422) stated that "learning is an active process of conceptual construction and reconstruction that is facilitated by hands-on/minds-on activities and social interactions, not passive absorption of prepackaged knowledge". This occurs when the teacher facilitates the students' learning through questioning, while the students develop their own understanding of the material being studied by active participation. Basically a constructivist lesson requires cooperative learning, reflection, hands-on activities and outdoor education.

There are parallels between environmental education and constructivism. "Both philosophies require students to take an active role in learning and building factual knowledge to improve investigation and critical thinking skills" (Klein & Meritt, 1994, p. 20). They further emphasized that for learners to practice new skills they must interact with their peers. Ballantyne and Packer (1996) suggested group-learning situations for environmental education in which students are presented with alternative conceptions or incompatible knowledge because students are required to

"explain, elaborate, or defend their positions to others" (p. 30).

A great way to get students to take an active roll in their learning is to let them learn outside. "Outdoor education is an effective way of improving environmental attitudes and values" (Iozzi, 1989a, p. 7). Iozzi further advocated that teachers should include outdoor experiences whenever possible (1989b). Lisowski and Williams agreed that educating students outside has led to positive attitude changes and an improved skill development in the areas of data collection techniques and critical thinking skills (1993). Often students find relevance in a subject if it directly relates to their lives. According to Samuel (1993, p. 27) "teachers found that focusing on awareness and responsibility for the immediate environment, including the school and grounds, were effective ways to promote environmental values." Environmental education and kids have a lot in common; they both like the outdoors, active hands-on learning and a feeling of relevance.

Finally, reflection is key in order to change existing student behaviors. John Barell (in Knapp, 1992, p. v) stated "students are thinking all the time, but experience teaches us that, without reflection on what we do, we are not likely to benefit from our good thinking". Ballantyne and Packer (1996) advocated the use of journals whereby students reflect and record their experiences. They

explained how journal writing enables students to become "aware of and explore their feelings toward the environment, reflect on their own and society's interrelationship with the environment, and re-evaluate their conceptions of why particular environmental issues are important" (p. 30). Newhouse, (1990) has shown that "what a person says he or she would be willing to do in the future is based almost entirely on his or her emotional reaction toward the issue" (p. 27). Journaling allows students privacy while reflecting on their emotions and environmental problems are emotional issues. Lane and Rossow (1993) advocated that students can write self evaluations documenting how they believe experiences with a project have affected them to ensure long-term positive outcomes.

The 1990 National Environmental Education Act "reemphasized the need to increase public understanding of the natural environment" (Klein & Merritt, 1994, p. 15). Hines et al. (1987) stated the ultimate goal of environmental education to be the "development of environmentally responsible and active citizens" (p. 1). It is our job as educators to realize the goals of environmental education in order to ensure that the adults of tomorrow will exhibit positive interactions with the planet we all share.

CHAPTER THREE

GOALS AND OBJECTIVES

The goal of this project was to create a cross-curricular, interdisciplinary two to three week unit on the theme of endangered species for middle/junior high school teachers. The purpose of the unit is to help students see the interconnectedness of environmental problems in all curriculums. It is also designed so students would gain specific knowledge, responsible and positive attitudes and the commitment to take action on environmental problems.

The goal was achieved in the following manner:

1. Developed a two-three week cross-curricular, interdisciplinary unit on the theme of endangered species. The unit involves outdoor, reflective, technological, kinesthetic, and artistic activities for science, language arts, American history and mathematics classes.
2. Applied for and received a $900.00 grant from writer's district to purchase software relating to the infusion of technology into curriculum with the theme of human impact on the Earth's biomes.
3. Reviewed by writer's colleagues.
4. Field-tested in the writer's and interdisciplinary team members' classrooms. Modifications were made to some of the lesson plans.

5. Shared with other science teachers in school and district.

CHAPTER FOUR

DESIGN OF THE PROJECT

Where Have All the Species Gone? was designed to be used as an interdisciplinary team project for middle/junior high school teams. To develop lessons, several curricular guides containing lessons relating to environmental education were reviewed. Some lessons were adapted from their original source; others are original and designed by the writer over the course of several years. Also examined were CD-ROMS on endangered species and various ecological balance computer simulations and games.

The unit consists of lesson plans to be taught over the course of a two to three week period. The lessons were designed for infusion into team interdisciplinary curriculum. For example, when the history teacher discusses the westward expansion of the United States, over hunting and introduced species lessons can be integrated through that teacher and curriculum. Alternately, the lessons can be taught as a separate unit in science.

The unit begins with a general overview of the causes for endangered species. The lessons list the curricular connection, time required and the materials needed for each activity as well as background information, procedural steps and extension activities. Unit masters and their keys are also included.

CHAPTER FIVE

RESULTS

The writer field-tested the unit in her classes and with her team teachers. The lessons were then modified using feedback from students and participating teachers.

Students enjoyed the lessons. They especially liked the outdoor activities. The participating teachers also enjoyed the activities. The math teacher was enthusiastic that her students saw the interconnectedness of her curriculum with that of other classes. She also wrote that her students "couldn't wait to make the circuit of the room and compare answers" during the rainforest math activity.

The writer enjoyed reading the student reflection journals. Many students remarked "they had no idea" that there were that many causes for endangered species. One of the more serendipitous learning moments came when the classes were repairing the hiking trails at Towsley Canyon, a local area of the Santa Monica Mountain Conservancy. Students observed coyote scat in several locations that contained partially decomposed plastic grocery bags. They were amazed that the coyote ate such a thing, that the coyote survived and that the grocery bag ended up so far into the mountains.

APPENDIX:

WHERE HAVE ALL THE SPECIES GONE?

Where Have All The Species Gone?

An Activity Based Interdisciplinary Unit on Endangered Species

By Rebecca Joan Goldberg

Section 1:
Introduction to Endangered Species

Objectives: Students will

- define key terms;
- interact as part of a food web;
- create a picture using only vegetation to illustrate species interacting in their surroundings; and
- respond to a writing prompt.

Lessons:

- Food Web Activity
- Outdoor Artwork
- Where Have All the Flowers Gone? Activity

Teacher Background:

In the United States at least 500 species and subspecies of plants and animals have become extinct since the 1500s. "Natural causes appear to have claimed just one" (Chadwick, 1995, p. 7). Currently there are more than 1100 endangered or threatened species in the United States. Worldwide, that number is much greater. In 1973 the United States Congress passed the Endangered Species Act (ESA) to combat this growing problem. A National Geographic article on endangered species summarized the U. S. Endangered Species Act:

> The Endangered Species Act of 1973 set forth the basic rules that apply in the U.S. today. Two agencies, the Fish and Wildlife Service and the National Marine Fisheries Service, are responsible for reviewing the status of species in trouble to see if they warrant listing as either threatened or endangered. The decision is to be based solely on scientific data rather than on economic and political factors. Once a species is listed, no branch of the federal government – not even the Department of Defense – is to proceed with a project that might harm the creature without first consulting the wildlife or fisheries service (Chadwick, 1995, p. 15).

According to the California Endangered Species Resource Guide (1993), there are more than 80 plant and 80 animal species listed as endangered or threatened in the state of California. California has three primary laws that protect our indigenous species: the California Endangered Species Act (CSEA) of 1984, the California Environmental Quality Act (CEQA) of 1970, and the Native Plant Protection Act (NPPA) of 1977.

There are several causes for species endangerment. They are habitat destruction, feral/introduced species, pollution and over hunting. In the following unit, Where Have All the Species Gone? those causes are explored.

Food Web Activity

Time: This activity will take about 50 minutes.

Subjects: Science and physical education

Materials:

3 x 5" cards
200 meter length of climbing rope
tape (optional)

Procedure:

1. Preparation: Choose a habitat and write the names of several animals and plants found in that habitat onto 3 x 5" index cards. For example, a fresh water pond habitat might include:

leopard frog	red tail hawk	gypsy moth	dragon fly
maple tree	sun fish	common toad	robin
elm tree	daisy	salamander	ant
mouse	milk weed plant	owl	mosquito
lily pad	monarch butterfly	black fly	bob cat
grass	minnow	crayfish	raccoon
worm	garter snake	bull frog	beetle

2. Take the students, the food web activity cards and 200-meter climbing rope outside. Find a grassy area in which to carry out the lesson.
3. Assemble students into a circle on the grass and have students either hold the card at chest level or tape it to their shirt. Discuss how species interact with each other within a habitat and give some examples.
4. Give a student one end of the rope and have that student find an interaction with someone in the circle. When the student has, have him/her explain the interaction then pass the rest of the rope to that person.
5. Next, have that student repeat the activity until all of the rope is used up. The students should have created a web with the rope. At this time, the rope has crisscrossed the circle numerous times. You have formed a food web.
6. Discuss the food web. Ask the students if any of the plants or animals in the food web is endangered. Pick one student's plant or animal to be an endangered species.
7. Take one of the remaining students who has not yet interacted in the food web and have him/her sit in the center on top of the crisscrossed rope and hold on.

8. Now, have the student whose animal was endangered let go of the rope. Have the students who interacted with that animal also let go of their ropes (one at a time). Observe what happens to the food web and discuss what happens to the animal that the food web supports. The food web should collapse and the plant or animal sitting on the food web slides through the web. This represents an extinct species. Discuss the meaning of those observations.
9. Repeat activity (if time) and have students interact with different species than they did previously.
10. Either outside or after returning to the classroom, have students write and or illustrate some of the food chains they observed in the activity. Have them write their concept of what endangered and extinct mean.

Extension:

Homework: have students create a food web of the species interactions around their school or neighborhood.

Outdoor Artwork

Time: This activity will take about 30 minutes.

Subjects: Art, science and language arts

Materials:

access to outdoors and vegetation
student journal

Procedure:

1. Take students outside and have them gather different kinds of vegetation like grass, leaves, flowers, bark, fruit etc. (You might bring in grapes, orange peels and other colorful fruits.)
2. Have the students sit quietly while observing the species in their surroundings. Students should listen and look for interactions between plants and plants, plants and animals and animals and animals in their habitat.
3. Instruct students to smear the vegetation onto a page in their journal to create an illustration of their surroundings.

Extension:

"Where Have All the Flowers Gone?" music appreciation and quick reflection activity.

"Where Have All the Flowers Gone?" Activity

Time: This activity will take about 20 minutes.

Subjects: Science, language arts and music appreciation

Materials:

CD with "Where Have All the Flowers Gone?" and "This Land is Your Land," by Pete Seeger
CD player
pencil or pen
student journal

Procedure:

1. Play the songs "Where Have All the Flowers Gone?" and "This Land is Your Land" by Peter Seeger. You may need to play them twice.
2. Using the journal, have students reflect on what life would be like if their favorite animal was now extinct. They should incorporate key unit terms in the quick write.

Section 2:
Habitat Destruction

Objectives: Students will

- define key terms;
- understand the impact habitat destruction has on all life;
- utilize and strengthen common mathematics skills;
- increase cooperative learning and group working skills;
- create an original ending to a story;
- list common rainforest products;
- learn how to "make" paper;
- investigate ways to recycle and reuse substances on their own campus; and
- hypothesize and draw conclusions about the environmental impact of human behavior.

Lessons:

- Classroom Jumble
- Lesson of the Lorax
- Rainforest Math
- Making Recycled Paper

Teacher Background:

Habitat destruction is by far the greatest contributor to the growing list of endangered species. When humans interfere with the food, water, shelter and space needed for a species to thrive, the species will fail to reproduce and their population will drop in an area. Florida's population increases by 2,000 people about every three days (Chadwick, 1995). These people need homes and compete with the native plants and animals for space.

People tend to think of tropical rainforests as being the most threatened biome, but deserts, tundras, grasslands and both deciduous and coniferous forest biomes are also suffering greatly from human interaction. What follows are lessons on species endangerment caused by habitat destruction.

Classroom Jumble

Time: This activity will take about 20 minutes.

Subjects: Science and language arts

Materials:

student journal

Procedure:

1. Before class begins, rearrange the classroom: stack chairs and move desks or tables. When students enter the classroom, greet them at the door as normal.
2. Many students will act confused. Just tell them to find a place to sit down and to start their work.
3. After the students have settled, ask some questions and discuss the activity.
   - What did you think when you entered the classroom?
   - Were you confused or disoriented?
   - Were you expecting this?
   - How did you feel?
   - Were you able to start your work and function normally?
   - Explain that habitat destruction is the leading cause for endangered or extinct species.
   - How would you take this activity one step farther?
4. Return the desks and chairs to their normal position or keep the open floor for the next activity: Lesson of the Lorax.

Extension:

Assign homework: students need to interview someone who experienced a natural disaster. It can be anyone who survived a tornado, flood, mudslide, house fire or earthquake. Students will record the results of the interview in their journal.

Lesson of the Lorax

Time: This lesson will take about 50 minutes.

Subjects: Language arts and science

Materials:

The Lorax, by Dr. Seuss
student journal

Background:

In The Lorax, Dr. Seuss introduces the "Once-ler" who cuts down the beautiful Truffula trees so that he can use their wonderful silk tufts to knit "thneeds." Thneed sales are so successful that the Once-ler builds a factory and invents the Super Axe Hacker which cuts down four trees at one time. The Lorax speaks up in defense of the trees, animals, air and water that the Once-ler is destroying in pursuit of bigger and bigger profits. Finally, when the last Truffula tree is cut down, production of thneeds ends. Closed factories, polluted air, polluted water and an uninhabitable wasteland are all that remain on the once beautiful site. The Lorax can no longer live here, but he leaves behind a small pile of rocks on which the word "UNLESS" is inscribed.

The Lorax illustrates an ecosystem, a unit in which living and non-living parts interact. All of the parts are linked together and function as a unit. When one of the parts is damaged or removed, the entire system may be affected.

Procedure:

1. Encourage the students to sit in a comfortable position.
2. Read the story, showing the students the illustrations as each page is read.
3. Focus the follow-up discussions on the concept of an ecosystem and note how each step of the Once-ler's developing business removed a piece of the ecosystem until the entire system ceased to function. Encourage students to speculate on:
    a. why the Super Axe Hacker was invented
    b. why the Once-ler ignored the Lorax's warnings
    c. what happened to the Lorax
    d. why the Once-ler is called "Once-ler."
4. Ask Students
    a. to name some "thneeds" – things that we "think" we need
    b. how the "thneeds" are sometimes only "thwants" (things we want), but we get them confused
    c. how our "thneeds" conflict with protecting the environment
    d. to list ways we can control our "thwants" and live in harmony with the environment

e. to explain what happened to the Once-ler when there were no more Truffula trees, and what he could have done to minimize his factory's impact on the ecosystem.

5. Have students write a paragraph about each of the following issues:
   a. why the Once-ler cut down the Truffula trees
   b. why the Brown Bar-ba-loots had to leave
   c. what the Lorax's message "unless" means.
6. Have students list three ways the Thneeds' Factory caused problems for the Truffuula Tree forest and its residents.
7. Have students write in their journal a new conclusion to The Lorax picking up where the word "Unless . . ." leaves off.

Extension:
Have students create a collage of thneeds, either as a class project or individually, by cutting pictures from magazines.

Rainforest Math

Time: This activity will take about 20 minutes.

Subjects: Math and science

Materials:

3 x 5" index cards
student journal
Rainforest Inventory activity sheet, one for each student (A.S.1)

Procedure:

1. Assign the Rainforest Inventory (see Rainforest Inventory Master) to be completed the day before this activity. On the day of this activity ask students if they were surprised that many of the common substances in their homes are produced in rainforests. It is important to note that all of the items listed in the Rainforest Inventory are produced in tropical rainforests.
2. Make 3 x 5" cards using the "Topics for Rainforest Math Activity" questions (found below). Put them on the wall around the room.
3. Have students take their journal around the room and answer the questions. You might assign half of the class the odd numbered questions and the other half even numbered questions to save time. Go over the answers in class and discuss the problems of waste management.
4. When finished, have students get into groups to discuss the results of their rainforest inventory.

Extension:

1. Watch the movie "Medicine Man" (1992) and discuss. Video can be rented from any video store.
2. Have a fundraiser and purchase an acre of rainforest through the Nature Conservancy. Write the Nature Conservancy Adopt an Acre Program, 1815 North Lynn Street, Arlington, Virginia 22209. You will be sent an honorary land deed (you won't actually own the land) specifying the location of your adopted acreage and the name of the local conservation authority.

Topics for Rainforest Math Activity

1. A tropical rainforest is defined as a forest in the tropics which receives four to eight meters of rain per year. a. How many feet is that? b. How many centimeters is that?	**5. One in four medicines comes from a plant in a tropical rainforest.** a. What percentage is that? b. Write the percentage as a fraction in lowest terms. c. Write the percentage as a decimal.
2. 125 different mammals, 400 kinds of birds, 100 reptiles and 60 amphibians inhabit a typical four-mile –square patch of tropical rain forest. a. How many animal species is that altogether? b. Round your answer to the nearest hundred.	**6. Rainforests are often cleared by fires. In 1987 about 518 million tons of carbon from these fires was emitted into the air.** a. Write 518 million in numerals and words. b. If the same amount of carbon was emitted in each of three years, how much would that be altogether?
3. Rainforests make up only 5% of the earth's surface. a. How much of the earth's surface is not rainforest. b. Write 5% as a fraction in lowest terms. c. Write 5% as a decimal.	**7. One hundred fifty types of butterflies have been identified in a rainforest.** a. If only 17% of them have been studied, how many butterflies is that? b. Round off your answer to the nearest one's place.
4. Around 80 inches of rain falls annually in rainforests. a. Convert 80 inches to centimeters. b. Calculate the amount of rainfall an average rainforest has had during your lifetime.	**8. Seventy percent of the plants used in cancer treatment are found only in rainforests.** a. What percentage is found elsewhere? b. Write that percentage in words. c. Write that percentage as a decimal.

Name:	Date:	Period:

Rainforest Inventory

It's 7 a.m. Your alarm goes off and you get in the shower. At 7:15, you dress, pulling on your high-top sneakers. Fifteen minutes later, you grab a glass of juice and a banana. At 7:45, you catch the bus, take a seat, pop a piece of gum into your mouth, and pull out your notebook to look over your homework. At 7:50, you catch a mistake and erase it. You've been up less than an hour but already you've used at least four products that grow naturally in rainforests. Some of these products have proven so popular that companies now grow them on plantations. Do you know what these products are? Complete this rainforest inventory to fine out. Circle the products that you find in and around your home.

lemon	cloves	rain slickers
pineapple	nutmeg	golf balls
banana	chocolate	rattan
coconut	cashews	bamboo
sugar	cola drinks	rope
tapioca	coffee	burlap
cinnamon	herbal tea	ramie (in clothing)
vanilla	chewing gum	sesame seeds
pepper	rubber-soled footwear	paints

shampoos/soaps or cleaning products containing camphor, eucalyptus, balsam or palm

Making Your Own Recycled Paper

Time: This activity will take three 30 minute periods on successive days.

Subjects: Art, language arts and science

Materials:

old, white, discarded paper
water
wire whisk or old blender
plastic or metal bucket
cornstarch
measuring cup
piece of window screen which fits inside the bucket
rolling pin
wooden spoon
blotting paper
thread
food coloring

Procedure:

1. Spend the weeks leading up to this activity collecting discarded white paper from your classroom. (It might be one of the extension activities from the last section on pollution.)
2. On the day of the activity, have students rip the paper into little pieces.
3. Fill the bucket half full with the torn, white, discard paper pieces.
4. Pour enough water into the bucket to completely cover the paper; then add about two more inches of water.
5. Allow the paper to soak overnight.
6. Add one-fourth cup of cornstarch and some food coloring to the contents of the bucket.
7. Pour the mush into a blender or use a wire whisk in the bucket and beat the mixture until it is thoroughly mixed.
8. Bend the wire screen to fit inside the bucket.
9. Scoop up some pulp onto the screen. Put some colorful thread pieces into the pulp and mix with your hands.
10. Lift up the screen and hold over the bucket while spreading the mixture to an 1/8" thickness over the screen (use the wooden spoon).
11. Place the screen and wet pulp between two sheets of blotting paper (or newspaper).
12. With a rolling pin, press out excess water. Do this on a flat surface.
13. Remove the blotting paper.
14. Allow to dry overnight or longer, then gently peel the recycled paper from the screen.

15. Have students take a favorite poem or compose one of their own and write it on the recycled paper and dedicate it to a special friend or loved one. It makes memorable Valentine's, Mother's and Father's Day cards.

Extension:

1. Find out how paper is made.
2. Research what people used before paper was invented.
3. Find out when paper was invented.
4. Plant a tree. Many nurseries will donate trees to schools. Plant a donated tree on the school property and or encourage students to plant donated trees on their property.

Section 3:
Alien / Introduced Species

Objectives: Students will

- Define key terms;
- improve research skills using the World Wide Web;
- teach others about endangered species;
- improve graphing and technical reading skills;
- utilize and strengthen common mathematics skills;
- predict outcomes to a given situation; and
- create solutions to given problems.

Lessons:

- A Plague
- Alien Invasion! A Situation – Solution Activity
- Alien Species Wanted Poster

Teacher Background:

Since our country was first colonized, many species of plants and animals not native to this continent have established themselves in the U.S., as have hundreds of animal and plant diseases. Scientists refer to these as alien, introduced or exotic species. "Like the kudzu, fire ants and many other exotics, the U.S. is contending with 4,500 alien species at the moment" (Chadwick, 1995, p. 23). Most of our nation's food comes from introduced plants like crops, and introduced animals like chickens, pigs and cows.

According to the California Endangered Species Resource Guide, problems arise when alien species "compete with native species for water, sunlight, food, shelter and space" (1993, p. 6). Alien species are the second largest cause for species endangerment. Unfortunately, this cause for endangered species is especially amplified in delicate island ecosystems and is the leading cause for species endangerment in Australia , the Galapagos Islands and the Hawaiian Island chain where most of the introduced species lack natural predators. The impact of alien species on plants and animals is explored in the following lessons.

A Plague

Time: This activity will take about one 50 minute period.

Subject Matter: Math, science and language arts

Materials:

graph paper
student journal
colored pencils
ruler
pen or pencil
3 bags of white popcorn kernels
3 bags of yellow popcorn kernels

Teacher background:

What is a plague and do we have them today? You bet we do! Almost every year there is a locust (grasshopper) plague somewhere in Asia or Africa that destroys crops and causes billions of dollars in losses. These crop losses lead to the starvation of thousands of animals and humans in developing countries.

Plagues need just the right environment to appear. First, the plague species must be able to reproduce quickly and in large numbers. Second, there must be a lack of natural predators. Third, there must be an abundance of food. When these three situations come together, plagues of mice, rats and locusts can be found. This lesson is based experiences that Northern Queensland, Australia has had with mouse-plagues.

Procedure:

1. Have a discussion with students about plagues and disseminate the three requirements for a plague to form.
2. Show video clips on a plague. These are common enough. Most videos on the natural wild life in Australia have some mention of plagues. My personal favorite is an episode of the Crocodile Hunter called "The Feral and Introduced Species of Australia." It shows a plague of placental mice in Northern Queensland. There are millions of mice, literally buckets full of them!
3. Tell students that they are going to recreate the placental mouse plague of Northern Australia. Have them draw a data table in their student journal like the one below.

Time	# mice	# female (yellow)	# male (white)
Time 0			
Time 2 months			
Time 4 months			
Time 6 months			
Time 8 months			

4. Pass out two cups of mixed kernels of corn in equal amounts of yellow and white to each table of students. If you can't find different colors of popcorn naturally, use food coloring to change the color of half of them. Be sure to allow the dyed corn plenty of time to dry.
5. Explain the ground rules of the plague. Mice have a gestation period of about 3 weeks. It takes the young about 6 weeks to reach sexual maturity. On average a female mouse can have 8 litters per year. Each litter averages about 6 young with 3 being male and 3 female. There is a lot of food around and because placental mice are feral species in Australia, there are very few predators.
6. Tell the students that you are going to start the simulation and that it will go very fast!
7. It is time 0. One female mouse just had a litter of 6 young. Take one yellow for the mother and then pick 6 other kernels at random to represent the young. Record the results.
8. It is now time 2 months. It has been two months and each female has now reproduced. Pick 6 kernels of corn for each female you have. If you had 5 yellow kernels, pick out 30 (5 x 6) new kernels. Record the results in the data table.
9. It is now time 4 months and all females have reproduced. Pick 6 kernels of corn for each yellow kernel you have. Record your results in the data table.
10. Give the students as much time as they need, but keep them busy.
11. Announce that it is time 6 months and all females have reproduced. Again, each student needs to pick 6 kernels of corn for each female mouse (yellow kernels) that they have. Record the results.
12. Finally, announce that it is time 8 months and all females have again reproduced. Have each student pick out 6 kernels of corn for each female mouse. Record the results.
13. Have students compare their results to the others in the group.
14. Journal questions:
    - Were the number of females and males even? Why or why not?
    - How did your final number compare to those in your group. If another student had a lower total than you, what was the cause?
    - Compute the average number of mice your group had at time 8 months.
    - Were you surprised at the outcome?
    - Construct a line graph using your data. Put the number of mice on the Y axis and the time on the X axis.
    - Using your graph, predict the number of mice you would have at time 10 months and at time 12 months.
    - How did the mice get to Australia? Was it intentional or not? Explain.

Extension:

Have students look up "plague" in the encyclopedia or use it as a search word on the internet. Where have plagues occurred before?

Alien Invasion! A Situation – Solution Activity

Time: This activity will take about one 50 minute period.

Subject Matter: Science and language arts

Materials:

information sheets on various alien species
student journal

Procedure:

1. There are many plants and animals from which to choose for this activity. Attached are a few of the more notorious alien species examples.
2. Put the situation for each species on a piece of paper. Put students into groups of 4 and give them the situation.
3. Give students 10 minutes to form a solution. Be sure to tell the students that there is no wrong answer and that all problems are solved based on trial and error!
4. Have a student from the group present the group's problem and solution.
5. Give the students the "control measures" taken by biologists to eradicate or decrease the population of the plant or animal.

Extension:

1. Have students research the pests further.
2. Have students write a story on the theme "Invasion of the Kudzu vine."

Kudzu Vine of the Southeastern United States "The Vine that Ate the South"

Situation:

At the 1876 Centennial Exposition in Philadelphia, countries were invited to build exhibits to celebrate the 100th birthday of the U.S. The Japanese government constructed a beautiful garden filled with plants from their country. The large leaves and sweet smelling blooms of the kudzu captured the imagination of American gardeners. Soon it was planted in many U.S. gardens for ornamental purposes. It was discovered that many animals could eat the vine and it became an easy plant to grow for livestock nourishment. During the Great Depression of the 1930s, the Soil Conservation Service promoted the planting of kudzu for erosion control. Many were given work planting the kudzu and farmers were paid as much as $8 dollars per acre to plant fields of the vines.

Later, it was discovered that the vine grew too well. The vine grows as much as a foot per day during the summer months. Under ideal conditions, kudzu vines can grow sixty feet per year. This kind of growth smothered indigenous plants, causing endangerment to animals that relied on indigenous vegetation. This growth also destroyed forests by preventing trees from getting sunlight. In 1972 the USDA declared the kudzu a weed! How would your group handle this situation?

Solution:

1. Pesticides were used. Some were found to actually make kudzu grow better. Most had little or no effect. But, if you are persistent and apply some herbicides every year, the kudzu may die in 4-10 years.
2. Cut it back constantly. While this may work for small areas of infestation, it is not practical for large plots of land and forests.
3. Live with the vine and find uses for it! One study used angora goats as a control measure. The goats ate the vine, produced milk and an amazing coat used in angora clothing. Some people harvest the vine to produce baskets, paper, kudzu blossom jelly and syrup, bales of kudzu for livestock feed, kudzu quiche (some have written books on kudzu vine recipes) and as a source for healing alcoholism.

European Rabbit (*Oryctolagus cuniculus*) Infestation of Australia

Situation:

It is believed that Thomas Austin of Winchelsea, Victoria first introduced rabbits into Australia in 1859. He released 24 animals he had brought from England onto his property for sport hunting. By 1886 rabbits had spread throughout most of Australia. By the mid-1900s they were reproducing at plague proportions due an abundance of food and lack of natural predators. Their sheer numbers caused damage to the environment and reduced agricultural production. They compete with native wildlife for food and shelter, and contribute to the decline in the numbers of many indigenous plants and animals, especially the small ground-dwelling mammals of Australia's arid lands. Rabbits also compete with livestock for food. They select the most nutritious plants and eat them to below ground level. Currently, production losses in South Australia alone are estimated to be around $20 million each year. Finally, when native and cultivated lands are overgrazed, they lose their plant cover resulting in erosion. The government of Australia was forced to intervene in the rabbit problem due to their plague proportions. How would your group handle this situation?

Solution:

1. A year round hunting season was established to reduce the population but it only worked minimally.
2. Poisoning and fumigation were attempted but were only minimally successful.
3. Officials attempted to build rabbit excluding fences but this method was very costly and only marginally effective.
4. Officials introduced a foreign disease called myxomatosis and it worked well, initially. It is a disease that occurs naturally in South American rabbits. It was released into Australia in 1950. At first, results were promising with well over 90% of infected rabbits dying. Today, the virus affects up to 60% of rabbits due to a built up resistance. This solution was only minimally effective in arid regions because the mosquito and flea populations, which spread the disease, do not survive for long periods in harsh conditions. The disease also killed pet bunnies.
5. To combat the disease in arid regions, the South Australian Animal and Plant Control Commission has considered releasing another introduced species called the Spanish flea to carry myxomatosis into the arid regions.

Cane Toad (*Bufo marinus*) of Australia

Situation:

Farmers introduced the cane toad of South America to Northern Queensland in 1935. It was released to combat another introduced species, the cane beetle, that was eating the sugar cane crop. The toad was introduced despite warnings from both scientists and naturalists. The cane toad can live up to 20 years and each female can lay up to 40,000 eggs. Due to a lack of natural predators or parasites, the cane toad quickly found its way into most Australian ponds, lakes, streams and rivers in Queensland. These toads were found to be very detrimental to the local flora and fauna. Besides competing with indigenous animals in the area for food, the cane toad is very poisonous! If an animal just attempts to eat the toad by grasping it in its mouth, the glands on the toad's head will release a toxic substance killing the creature. Even the cane tadpoles are poisonous and many native tadpoles cannot live in the same water. Ironically, the toad did nothing to control the cane beetle problem. How would your group solve this ecological problem before it creates an unfixable hole in Australia's food web?

Solution:

The scientists in Australia are not sure how to handle this problem. They do not want to release any of the toad's natural predators from South America because they are sure that it will only create a new introduced species problem. Currently, they are working on a virus from Venezuela that will kill the toad. In one trial, the virus killed the cane toads but also killed one natural species of tadpole. To slow the infestation, many naturalists are wading into the water themselves to pull out the toads.

Alien Species Wanted Poster

Time: This activity will take several 50 minute periods.

Subject Matter: Art, technology and science

Materials:

Wanted Poster activity instruction sheet, one for each student (A.S.2)
Wanted Poster template, one for each student (A.S.3 & A.S.4)
access to a computer lab and the internet

Procedure:

1. The students have been studying feral and introduced species for the past few days. Tell them that they are now going to do something about the problem.
2. Take students to the computer lab to use the internet to research an alien species. They can find a species using "introduced species" or "feral species" as key words in an internet search.
3. Pass out the directions and go over them.
4. To enlarge the templates, copy them onto an overhead transparency and project it on the wall for students to trace.

Extension:

Hang the posters in the classroom and include them in your community outreach program in the next unit.

Name:	Date:	Period:

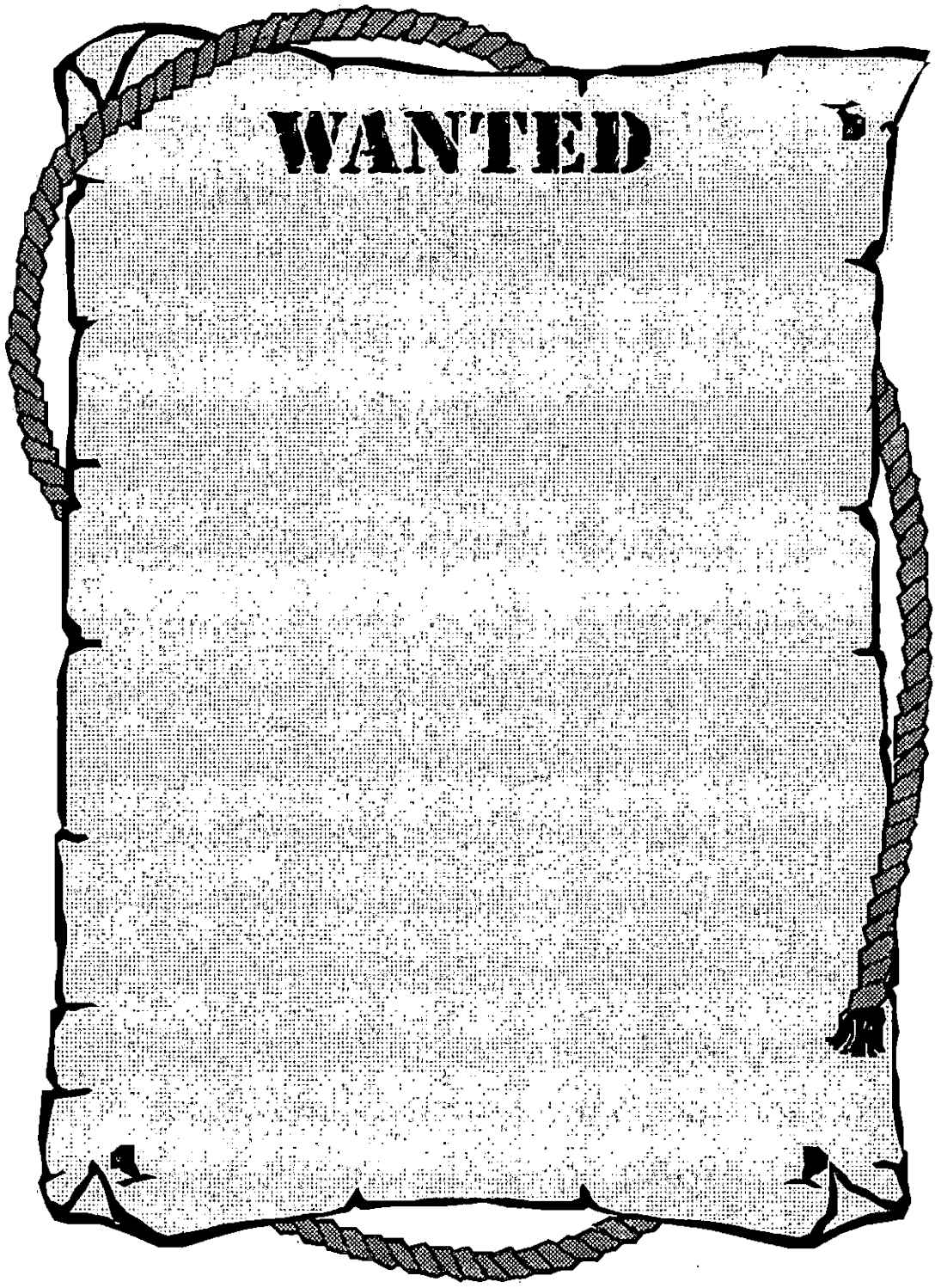
Alien Species Wanted Poster

You have been studying feral and introduced species for the past few days and know that many can cause harm to indigenous plants and animals. It is time to complete an in-depth research of one species and create a wanted poster.

Directions: Once you have researched an alien species, use the information to create a wanted poster for that species. Be sure to:

1. Put the common name at the top of the poster.
2. Draw and color a picture of your plant or animal in the center of the poster.
3. Put the genus and species name at the bottom of the poster.
4. Put information about the alien species on the back of the poster. You must include information on
    - description of the species;
    - location and habitat of the species;
    - how the species found its way to that location;
    - how it has harmed indigenous plants and animals;
    - how it can be eradicated if needed; and
    - the cost of the species to people.
5. Neatness counts!

Notes on Alien Species
Common name of species:
Scientific name of species:
General Information:


WANTED


WANTED

Section 4: Pollution

Objectives: Students will

- define key terms;
- understand the impact pollution has on life;
- utilize math and measuring tools with the metric system to create a timeline;
- improve technical reading skills;
- increase their cooperative learning and group working skills;
- give examples of ways in which pesticides enter food chains; and
- describe possible consequences of pesticides entering the food chain.

Lessons:

- Cuyahoga River Fire and Landmark Moments Time Line
- Mr. & Mrs. Trashman
- Pollution Math
- Invisible Death

Teacher Background:

In 1962 Rachel Carson wrote a book titled Silent Spring. This book examined the debilitating side effects that the pesticide DDT had on plants and animals. It was "generally identified as the trigger of the American environmental movement of the 1960s and 1970s" (Disinger, 1993, p. 24). Eventually the use of DDT was banned in the United States in 1973 but not before it entered the food web and caused the endangerment of many bird species. DDT is still produced in this country and exported to many developing nations (Gore, 1994).

Pesticide use is not the only cause for species endangerment by pollution. The lessons in this section explore other causes as well.

The Cuyahoga River Fire & Landmark Moments Time Line

Time: These activities will take about two hours.

Subjects: History, math and science

Materials:

Environmental Landmarks Timeline instruction handout, one per student (A.S.5)
metric ruler
paper
student journal
pencil or pen

Teacher Background:

On June 23, 1969, the Cuyahoga River outside of Cleveland, Ohio, caught fire and burned for hours when a spark from a train's engine ignited the pollution floating on its surface. According to a Time magazine article from August 1969, "there was no visible life in the Cuyahoga, not even leeches or sludge worms that thrive on waste" ("Environment", p. 41). The people of Cleveland knew how dirty the river was. They used to joke that the river oozed rather than flowed. If someone fell into the Cuyahoga, they didn't drown; they decayed as the old joke goes. This is a dirty river but the pollution does not stop there. This river in combination with large industrial centers on its shores, made the Lake Erie of the 1960s and 1970s a dirty and dying lake.

The 1972 U.S. Clean Water Act, according to Senator John Chaffee, was passed by "a Congress that was shocked when the Cuyahoga River in Cleveland caught fire as a result of pollution" (1995, p. 1). The Clean Water Act provided guidelines for further dumping of waste into the Nation's rivers, streams and lakes and also provided for much needed funds to clean up very dirty rivers. Today, the river area in Cleveland is a beautiful riverfront park. The residents are not repulsed by the river's scent anymore and the old jokes about Cleveland being the "armpit of America" are a distant memory.

Procedure:

1. Discuss with students if it is possible to burn water. Can a river burn?
2. Tell students the story of the Cuyahoga River Fire of June 1969. Use the internet to get more information. Have a discussion and give students Sen. Chaffee's quote.
3. Go over the landmark moments in the environmental history of our country.
4. Explain how to make a timeline and show some examples. Stress that the time line needs to be proportional and that is where the ruler comes in. (Many history books have timelines that you can show students.)
5. Reflection discussion: ask students many questions
   - What does your lawn look like? Is it green, does it have weeds? Are there weeds in the cracks of your sidewalks?
   - Do you put anything on your lawn?

- Do you ever see trash in the gutters in your neighborhood?
- Do you ever notice oil spots in parking lots?
- When it rains, where does the water go?
- Does the water pick up anything as it washes down the sewer?
- What about doggy do-do. Where does it go when it rains?
- After the rain water goes to the sewer, where does it go after that?
- Why are many of the beaches in Southern California closed after hard rains?

6. Journal Reflection: have students write in their journal how they feel about an ocean that is so dirty that people can't even swim in it based on the reflection discussion above.

Extension:

1. Have students reflect on the subject of dirty water. What would you do if you had to boil water before drinking it?
2. Have students use the internet to look up the Cuyahoga River and investigate the current status of the river. Has it been cleaned up? Has the habitat of the river been restored so that plants and animals can thrive? Have students look up the Clean Water Act of 1972.
3. What piece of legislation is missing from this time line? Where do we want our government to go from here? Have students predict the next piece of legislation and add it to their timeline.

Name:	Date:	Period:

Environmental Landmarks Timeline

What happened to a little known river outside Cleveland, Ohio in 1969? It burst into flames! The Cuyahoga River was so polluted that it caught fire from a train engine spark and burned. This brought infamous notoriety to Cleveland and international attention to the effects of liquid waste on the environment. According to Senator John H. Chafee, the Clean Water Act was approved in 1972 "by a Congress that was shocked when the Cuyahoga River in Cleveland caught fire as a result of pollution (1995). Read on to find out more information on landmark environmental moments in our country.

Directions: Using a metric ruler and the information below to create a proportional timeline.

1948: Paul Muller, a European, was awarded the Nobel Prize in Medicine for examining the effects of dichloro-diphenyl-trichloromethylmethane (DDT) on the nervous systems of insects. Worldwide spraying of DDT lead to great decreases in human deaths from typhus, malaria and yellow fever; diseases transmitted by insects.

1961: World Wildlife Fund (WWF) established. The WWF is a privately supported international conservation organization that directs its resources towards protecting endangered spaces, saving endangered species and addressing global threats. The WWF has invested in over 13,100 projects in 157 countries.

1962: The book, Silent Spring, by Rachel Carson was published. This book directly blames DDT for the decrease in bird populations and establishes research into the side effects of DDT on natural flora and fauna. This book helped draw attention to the negative and destructive side effects associated with pesticides.

1969: The heavily polluted Cuyahoga River near Cleveland, Ohio catches fire.

1970: The U.S. Environmental Protection Agency (EPA) was established in response to the ineffective environmental protection laws enacted by states and communities in order to fix national guidelines and monitor and enforce them. By 1990 the EPA was enforcing 12 major statutes including laws designed to control uranium mill tailings, ocean dumping, safe drinking water, pesticides and asbestos hazards in schools.

1970: The U.S. Clean Air Act. It established guidelines to improve air quality in the U.S. regarding smog. It has since been amended to include programs designed to reduce the hole in Earth's ozone layer.

1970: First Earth Day celebrated on April 22. Earth Day is celebrated every year and was established to bring to light the need for conservation of the earth's resources.

1970: The U.S. Environmental Education Act. This act provided funds for the creation and implementation of environmental education curriculum through 1975.

1972: The U.S. Clean Water Act. This legislation passed as a result of the dying Lake Erie, the Cuyahoga River fire and sewage polluted beaches. This act decreases the amount of allowable industrial fluid waste dumping and provides funds for the clean up of polluted water. It also provides funds for pollution prevention through public education.

1972: Federal Environmental Pesticide Control Act. The need for controlling pesticide use was finally recognized by Congress.

1973: The U.S. Endangered Species Act. This legislation was enacted to protect **all** plant and animal species formally listed as threatened by the Secretary of Interior or the Secretary of Commerce. The act calls for the listing of species to be based solely on scientific data. More than 640 species are listed as threatened or endangered in the U.S.

1973: DDT banned in the United States. (But still used in other countries.)

1980: The Superfund (Comprehensive Environmental Response, Compensation and Liability Act) was established by congress to provide money to clean up abandoned waste dumps.

1990: The National Environmental Education Act. This act like that of 1970, granted funds for learning institutions to provide environmental education activities to all students.

2000?: Where should our government go from here?

Mr. & Mrs. Trashman

Time: This activity takes about two one-hour periods or one two-hour block.

Subject: Science, language arts

Materials:

Mr. & Mrs. Trashman activity sheet, one per student (A.S.6)
colored butcher paper: 5.5 feet per cooperative group
tape and stapler for each group
grocery bags (one per group)
student journal

Procedure:

1. Assign homework. During the days leading up to this activity, have students observe their peers during lunch. They need to write in their journal three quantitative and three qualitative observations on how their peers dealt with trash.
2. Organize students into cooperative groups. Each group needs to trace and make a cut out of one member of the group. This cut out will be either a Mr. or Mrs. Trashman.
3. Give each group a grocery bag and take them outside to gather trash from around the campus. Caution them not to pick up broken glass and to only collect trash that is on the ground. When they return they are to affix the trash to the cut out using the tape or staples. They must wash their hands thoroughly after constructing their trash person.
4. Have students staple their trashman to the wall, analyze the trash and fill in the chart on the activity sheet.
5. Next, have each group brainstorm ideas on how to keep the campus clean and present them to the class.
6. Student journal entry: Has your attitude about litter changed after observing your peers and the amount of trash found on your campus? Explain why or why not.

Extension:

Have students implement one of their campus clean-up ideas.

Names:	Date:	Period:

Mr. & Mrs. Trashman

Directions:

1. Pick up your supplies

   butcher paper — grocery bag
   tape — student journal
   stapler

2. Have someone in the group lay on the butcher paper and have another person of the same gender trace that person. Be sure to trace the arms and legs wide enough. Cut out the silhouette.
3. Go outside with your group and pick up trash. See how much you can pick up in 10 minutes.
4. Affix as much of the garbage as you can to the cut-out using the tape or stapler.
5. As a group, pick 10 different items on your trashman and describe them in the table below.

Trash Item	Recyclable?	Biodegradable?	How might this item harm plants or animals?

Mr. & Mrs. Trashman Questions (answer on the back of this sheet.)

1. Summarize the kinds of trash you found.
2. This trash was found on your campus. How does this make you feel?
3. Brainstorm within your group some ideas for reducing the amount of trash on the campus.
4. Pick one of the ideas above and expand on it in your journal.

Pollution Math Activity

Time: This activity will take about 20 minutes.

Subjects: Math and science

Materials:

3 x 5" cards
student journal

Procedure:

1. Use 3 x 5" cards with the following questions on them and put them on the wall around the room.
2. Have students take their journal around the room and answer the questions. You might assign half of the class the odd numbered questions and the other half even numbered questions to save time. Go over the answers in class and discuss the problems of waste management.

1. In a 1998 Florida beach cleanup 13,200 plastic six-pack rings were found in three hours. How many rings were found in one hour?	6. A small drip from a leaky faucet can waste over 50 gallons of water per day. About how many gallons of water are wasted per hour from one leaky faucet?
2. A six pack ring is .25 meters long. If the six pack rings found along Florida's shoreline (13,200) were placed end on end, how far would they reach? In meters and kilometers.	7. It takes 26 recyclable plastic soda bottles to make one polyester suit. How many bottles will be needed to make a dozen suits?
3. Approximately 240 million tires are discarded annually in the U.S. How many tires is that per month?	8. One hundred fifty-four million tons of trassh is produced in the U.S. in one year. Half of this trash is recyclable. How many tons is that?
4. One 15-year old tree makes enough paper for 700 grocery bags. How many 15-year old trees will it take to make 9,800 grocery bags?	9. If a five-minute shower can consume 35 gallons of water, how many gallons of water will be consumed in a nine-minute shower?
5. About 70 billion beverage cans were used in 1985. 94% of those cans were aluminum. How many aluminum cans is that?	10. Americans throw away 22 billion disposable diapers a year. How many diapers is that each month?

Extension: have students research trash related topics and make their own math calculation statistic to present to the class.

Invisible Death Activity

Time: This activity will take about 40 minutes.

Subjects: Science, physical education

Materials:

lunch bags (about 20)
popcorn kernels (about one quarter of a cup per student at a ratio of two-thirds white to one-third yellow)
class set of the Los Angeles Times Article "Ruling Finds DDT Injured Channel Islands Fowl" (A.S.7)

Procedure:

1. Tell students that this is an activity about food chains. If they are not familiar with food chains, spend time establishing a definition and giving examples.
2. Divide students into three groups and assign the role of falcon, ground squirrel or grasshopper. In a class of 26 students, there would be two falcons, six ground squirrels and 18 grasshoppers. There should be approximately three times as many ground squirrels as falcons and three times as many grasshoppers as ground squirrels.
3. Tie green yarn around the upper arms of the grasshoppers, yellow yarn around the upper arms of the ground squirrels and red yarn around the upper arms of the falcons.
4. Give each grasshopper a small paper bag. This bag represents the stomach of whatever animal is holding it.
5. Take the students outside to a large open area (preferably a surfaced area). Distribute the popcorn kernels without the students watching. Give the students their instructions. The grasshoppers are the first to go looking for food. The predatory falcons and ground squirrels are to sit quietly on the sidelines watching their prey or grasshoppers. The grasshoppers have to move quickly to gather food. At the end of 30 seconds, the grasshoppers are to stop collecting food.
6. The ground squirrels are now allowed to hunt the grasshoppers. The falcons are still on the sidelines quietly watching the activity. Give the ground squirrels about 60 seconds to catch and seize the grasshopper. Any grasshopper caught or tagged by a ground squirrel must give up its bag then go sit on the sidelines. Grasshoppers can still continue to search for their food by filling their lunch bags.
7. Now the falcons are allowed to hunt the ground squirrels. Give the falcons about 60 seconds to chase, tag and confiscate the ground squirrels' bags of food. While this is going on, the ground squirrels can still chase the grasshoppers and the grasshoppers can still continue their search for their food.
8. After the time us up, ask all students to come together in a circle bringing whatever food bags they have with them. Ask the students who are dead to identify what animal they are and what animal ate them.

9. Next, instruct each student with a bag to empty their food bags and separate the white from the yellow kernels. Count and record the kernels for each individual animal. Use this information to create a table on the board and fill in the food data for every grasshopper, ground squirrel and falcon. See example below.

animal	# yellow	# white	consequences

10. Tell the students that there was a pesticide in the environment. It was sprayed onto the crop the grasshoppers were eating to kill the grasshoppers. The yellow kernels of popcorn represent the pesticide.
11. Analysis:
    a. All the grasshoppers not eaten by the ground squirrels are now dead if they had any yellow kernels of popcorn in their bag because they ate the poisoned crop.
    b. Any ground squirrel with more yellow kernels than white kernels is now to be considered dead.
    c. The female falcon with the most yellow kernels will not die at this time. But it has accumulated so much of the pesticide in its body that the eggshells produced by it and its mate during the next season will be so thin that the eggs will not hatch successfully. The other falcon is not visibly affected at this time.
12. Talk with the students about what they just experienced in the activity. Ask them for their observations about how the food chain seems to work and how toxic substances can enter the food chain causing a variety of results. Have students give other food chain examples.

Extension:

1. Split the students into two groups. Have one group assume the roll of a farmer and write why spraying pesticides is important to him/her in their journal. Have the other group assume the roll of an environmental scientist and write about why it is harmful to the environment to use pesticides. When finished, have students with opposing viewpoints pair up and compare positions.
2. Have students use the internet to research current organic insecticides.
3. Show students the article on the effects of DDT on Channel Islands wild fowl. Put the students into groups to discuss the results of the study and to draw conclusions on the extremely long range effects of DDT. (Remember it was banned in 1973.)

This activity was adapted from the Project WILD activity "Deadly Links."

Regional News

Ruling Finds DDT Injured Channel Islands Fowl

■ **Environment:** Judge blames pollution on ocean floor off Palos Verdes Peninsula for eagles' and falcons' problems.

By MARLA CONE
TIMES ENVIRONMENTAL WRITER

A federal judge ruled Monday that DDT pollution on the ocean floor is responsible for decades of injuries to bald eagles and peregrine falcons on the Channel Islands.

The ruling by U.S. District Judge Manuel L. Real resolved a key issue in a decade-old environmental case against Montrose Corp. and two other chemical companies. The decision set the stage for potential damage awards against the companies that could run into tens of millions of dollars.

The U.S. Justice Department and the California attorney general's office are seeking about $150 million for damage to natural resources plus about $10 million for past cleanup costs in the litigation, which is the largest case in the nation seeking damages for pollution of natural resources.

In a trial scheduled to begin Oct. 17, Real must determine whether the DDT discharged by the companies was the substantial cause of the wildlife injuries, and if so, how much money the companies must pay.

Los Angeles County, 150 municipalities and three other companies already have agreed to pay $67 million in damages for their roles in the pollution.

The government is also seeking money from the companies to pay the future costs of cleaning up the DDT. Last month, Real ruled that the firms could not be forced to pay those costs. The government is now appealing that decision.

About 100 tons of DDT lies on the Palos Verdes Shelf about a mile offshore. The pesticide was banned in the United States almost 30 years ago because of links to cancer in humans and reproductive problems in birds and marine animals.

The offshore DDT came from a Montrose plant near Torrance that operated for 25 years until 1972, flushing its waste water into county sewers that flowed into the ocean off the Palos Verdes Peninsula.

In 1996, the U.S. Environmental Protection Agency named the 17-square-mile area of the ocean floor a Superfund site, ranking it among the most dangerous waste sites in the country.

The companies have argued that there have been no injuries to the falcons and eagles because they are about as numerous on the islands as they were before DDT was introduced. They argue that the ocean deposit off the peninsula is being buried under ocean sediment and is not the source of whatever contamination is found in the birds and fish.

Attorney Karl Lytz, who represents Montrose, said after the ruling that while the companies lost their argument that the birds have not been injured by DDT, Monday's decision does not resolve the question of who is liable for the injuries. That remains an issue for the trial.

The offshore DDT came from a Montrose plant that operated for 25 years until 1972, flushing its waste water into county sewers that flowed into the ocean.

Government attorneys called the ruling a major victory but declined to speak in detail about the case because the trial is about to begin.

"The judge has found that certain injuries were caused by DDT. Obviously, we feel the judge issued the correct ruling and we're gearing up to go to trial on the remaining issues," said Steve O'Rourke, a Justice Department attorney.

Monday's ruling involved damages to birds in the region. Bald eagles on Santa Catalina Island have suffered complete reproductive failure because of the pesticide. Even now, so much DDT is found in eagle eggs that chicks cannot survive without human intervention. As recently as 1992, an adult bald eagle on the island died from DDT poisoning. The eggshells of peregrine falcons also have been thinned by DDT.

The government is seeking $17 million to restore the eagles and falcons to the Channel Islands, plus an unstated amount for loss of the birds as natural resources.

In June, Real decided that fish were injured by the DDT on the Palos Verdes Shelf.

Please see DDT, B20

DDT

Continued from B15

The state has banned commercial fishing of white croaker, a bottom-dwelling species popular in Asian diets, around the deposit.

Despite the fishing ban, the environmental group Heal the Bay has found croakers with high levels of DDT being sold in local Asian markets. The EPA says eating a weekly meal of the fish multiplies the risk of cancer.

On the issue of who must pay to clean up the DDT, Real ruled last month that the companies were liable for the EPA's cleanup of the offshore deposit as well as the costs of cleaning an onshore industrial site near Torrance. But he greatly restricted the amount the EPA can obtain by limiting the recovery to past costs, not future ones.

Real made his ruling as a sanction against the government for failing to comply with a May 31 deadline to identify what cleanup actions will be taken on the ocean floor.

The EPA argued that the deadline was unreasonable and unlawful and did not comply with it. The agency, under Superfund regulations, is required to conduct a lengthy investigation and public review before deciding on a cleanup method.

If the order is upheld on appeal, the EPA would be able to collect no more than the $10 million it has spent since 1982. Federal officials estimate that the eventual cleanup costs could total $150 million.

The EPA has been experimenting this summer with an operation designed to cover the ocean deposit with clean sand dredged from Long Beach Harbor. Montrose Corp. attorneys say covering the deposit is risky and a waste of money.

The DDT appears to be leaking from the deposit and is being consumed by marine organisms on the ocean floor, government scientists believe. From there, it moves through the food chain. Most experts say it breaks down slowly, remaining in ocean sediments for decades if not centuries.

The Montrose case is being closely watched because it is exceeded in potential damages only by the $1 billion that federal and state officials won for the Exxon Valdez oil spill in Alaska.

The Montrose lawsuit, filed in 1990, originally was dismissed by U.S. District Court Judge Andrew A. Hauk. His ruling in 1995 was overturned by the 9th Circuit Court of Appeals.

Real took over the case earlier this year.

Section 5:
Over-Hunting

Objectives: Students will

- define key terms;
- understand the impact hunting has on all life;
- utilize and strengthen basic mathematical functions;
- differentiate between hunting and slaughtering; and
- improve interactive group skills.

Lessons:

- "Dances With Wolves" Activity
- The Buffalo Supermarket
- Buffalo Math

Teacher Background:

Humans hunted the Passenger Pigeon, Dodo, Tasmanian Tiger and many more animals to extinction. Whether these animals were hunted for food or to "protect" humans, they are still gone from the face of the earth. Even though this cause for species endangerment is relatively small, it is historic in its demonstration of the human impact on the world's animal population.

"Dances With Wolves" Activity

Time: This lesson will take about one class period.

Subjects: American history and science

Materials:

"Dances With Wolves" video (can rent from any video store)
"Dances With Wolves" activity sheet, one per student (A.S.8)
"Dances With Wolves" activity sheet answer key (A.S.9)
access to TV and VCR
student journal

Teacher Background:

With the birth of our nation in 1776 came our need to grow and expand on the North American continent. One great tool of that expansion was the growth of the railroads. It was the railroads that opened up the western United States to folks east of the Mississippi. But there was a problem: the railroads went through "Indian Territory." Naturally, this created friction with the Native Americans whose lives were affected by the growth of white settlements. Thus began the systemic over hunting of buffalo by white man. This practice effectively removed the Plains Indians' source of food, clothing, shelter and tools. In the 1800s, the buffalo were nearly hunted to extinction.

Procedure:

1. Send home permission slips to parents asking permission for students to watch a 19-minute clip from the movie, "Dances With Wolves." The movie is rated PG-13 due to violence in other parts of the movie.
2. Inform students that the buffalo in the movie are technically bison. But, because the movie refers to the animals as buffalo, for simplicity's sake, we will too.
3. Pass out the "Dances With Wolves" study sheet. Go over the information at the top of the study sheet and answer any questions. Also, have students pay attention to the Native American uses for the buffalo. Show the movie clip from time 1:15-1:34 (one-hour and fifteen minutes through one-hour and thirty-four minutes).
4. Give students time to answer the questions at the end of the movie.
5. Next, give students 3-5 minutes to pair share and discuss the movie clip with a buddy.
6. Go over the answers with students.

Extension:

1. Encourage students to locate Native American reservations on a map.
2. Have students research Native American tribes and their locations.
3. Have students research the measures taken to protect and encourage the increase of buffalo in Yellowstone National Park and elsewhere.

Name:	Date:	Period:

"Dances With Wolves"

Background:

- The Great Plains Native American population just after the Civil War was about 225,000.
- There were many tribes and all were hunter-gatherer cultures.
- There were 40,000,000 buffalo that roamed the Great Plains just before the American Civil War.
- By the 1880s, there were only a few straggling herds of buffalo.
- By 1900 there were less than 1000 buffalo left on the Great Plains.

Video Questions:

1. What was the reaction when the Sioux finally realized that LT Dunbar saw buffalo?

2. What skills would aid in a successful buffalo hunt?

3. What might have prompted the silence and tears at the **first** buffalo sighting?

4. What do you believe LT Dunbar meant by " . . . only the confusion of a people unable to predict their future?"

5. Predict the change in lifestyle that the loss of buffalo would create for the Plains Indians.

Name: Answer Key	Date:	Period:

"Dances With Wolves"

Background:

- The Great Plains Native American population just after the Civil War was about 225,000.
- There were many tribes and all were hunter-gatherer cultures.
- There were 40,000,000 buffalo that roamed the Great Plains just before the American Civil War.
- By the 1880s, there were only a few straggling herds of buffalo.
- By 1900 there were less than 1000 buffalo left on the Great Plains.

Video Questions:

1. What was the reaction when the Sioux finally realized that LT Dunbar saw buffalo?
Answer: The Sioux were very happy! They celebrated!

2. What skills would aid in a successful buffalo hunt?
Answer: A Sioux brave would need good riding, tracking, bow handling, bow making and arrow making skills for a successful hunt.

3. What might have prompted the silence and tears at the **first** buffalo sighting?
Answer: Since the Sioux did not waste any part of the buffalo, they were aghast at the white hunter's slaughter of the buffalo: only for the tongues and skins.

4. What do you believe LT Dunbar meant by " . . . only the confusion of a people unable to predict their future?"
Answer: The Sioux knew changes were coming; the buffalo were becoming scarcer and harassment by white settlers and the U.S. Army was increasing.

5. Predict the change in lifestyle that the loss of buffalo would create for the Plains Indians.
Answer: The buffalo were everything to the Sioux; they meant food, clothing, shelter and culture. The loss of the buffalo would mean the loss of everything.

The Buffalo Supermarket

Time: This lesson will take about one class period.

Subjects: Science, American history and language arts

Materials:

student journal
construction paper
markers

Procedure:

1. Assign the students homework. They need to keep track of what they throw away a day or two before the classroom activity is to begin. They can go through their own garbage and write down what they have thrown away in their journal under the title: What do you waste? Keep track of your waste as well.
2. Go over with the students your list of what you wasted on the board and discuss what is really wasted verses what is just waste. This is a good time to again discuss the reuse and recycling of trash.
3. Next, put students into their cooperative groups. Assign them the task of listing all possible Native American uses of the buffalo. Have them record the buffalo uses on the construction paper and title it "The Buffalo Supermarket." After 10 minutes, if students have not come up with spiritual and emotional uses, inspire them to remember the bon fire scene in the movie.
4. Create a list of buffalo uses on the board by having one student from each group take turns writing a use. Below is a list of how the Native Americans used products from the buffalo.

   meat: staple of their diet
   hide: clothing, blankets, teepee, shields, string, gear for horses, trade and for ceremonial drums and robes.
   stomach: water storage containers (like a canteen)
   hooves: glue
   tendons: thread and bowstrings
   manure: fuel for fires
   bones: tools, jewelry, needles, weapons and the fatty and edible bone marrow
   horns: soup ladles, combs, spoons and jewelry
   the hunt: cultural
      a. The hunt celebrated the unity of the tribe.
      b. The hunt practiced key skills needed for battle with other tribes.
      c. Tribal songs and dances were created around the buffalo hunt theme.

d. A young man's first hunt was celebrated as the rite of passage for all boys into adulthood. This key event demonstrated a young man's ability to provide for a family.

5. After all uses are listed on the board, have students prioritize them on the board as well as on their charts. Post the charts on the classroom walls.
6. Discussion and empathy exercise: Ask students how they felt when they saw the slaughtered buffalo in the movie. Next, ask students to picture all of the supermarkets and restaurants disappearing in their town. What would their families need to do in order to survive?

Extension:

1. Have students expand on their response to the above question in their journal.
2. Have students write reflect on and write a response to the following information.

> Railroads sealed the fate of the vast herds of plains buffalo that once roamed the frontier. Passengers shot them from passing trains for fun and sport. One railroad conductor claimed that it was impossible to get off the train in parts of Colorado with out stepping on a buffalo carcass.

3. Discuss values and how they relate to culture. Have students compare and contrast the values of the U.S. Government with those of Native Americans.
4. Have students research Buffalo Bill and decide if he really was a hero.

Buffalo Math

Time: This lesson will take about one class period.

Subjects: Math, American history and science

Materials:

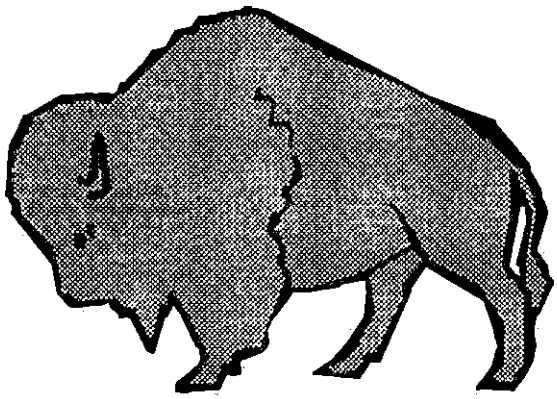
buffalo cutouts (A.S.10)
Buffalo Population activity sheet, one per student (A.S.11)
Buffalo Population activity sheet key (A.S.12)
access to an overhead projector
copy of A.S.11 on an overhead transparency
butcher paper
markers
scissors

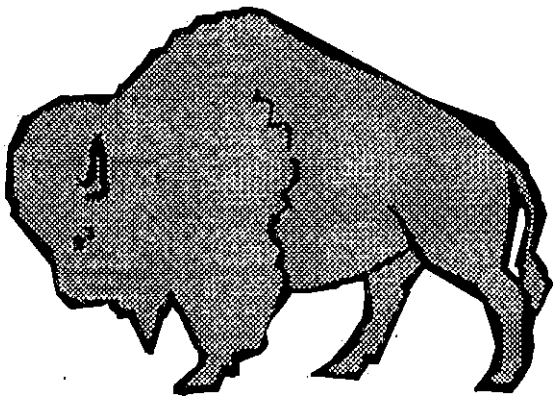
Procedure:

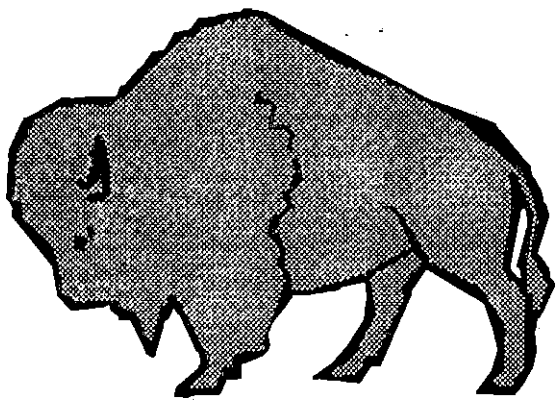
1. Review the "Dances With Wolves" study sheet data on the numbers of buffalo in the United States before and after the American Civil War.
2. Have students denote with an X the number of buffalo in America on both maps. Have the X represent 100,000 buffalo. How many Xs need to be placed on each map?
3. Use the above concept to decorate classroom walls. Enlarge using an overhead projector and trace the outline of North America twice onto butcher paper on a classroom wall. Label the maps as "Buffalo Population Before the Civil War" and "Buffalo Population around 1900."
4. Have each student color and cut out the buffalo figures and calculate how many figures need to go onto each wall map. Be sure to include a key on each map.
5. Have students calculate how many buffalo needed to be killed per year to reach the abysmally low population in 1900. (Only a fraction of one buffalo will be put up.)

Extension:

The Last Passenger Pigeon: Either have students research the passenger pigeon or tell students about the plight of the passenger pigeon (or the dodo or Tasmanian wolf). Explain how the passenger pigeon population once numbered in the billions during the early 19th Century and how they are now extinct. Tell students that the very last known passenger pigeon, Martha, died in the Cincinnati Zoo in 1914. Have students write a story about the life of that last pigeon.







Color the buffaloes brown, cut them out and paste them onto the large wall maps of North America.

Name:	Date:	Period:

Buffalo Population Before the American Civil War

Buffalo Population in 1900

Name: Answer Key	Date:	Period:

Buffalo Population Before the American Civil War

Buffalo Population in 1900

Section 6:
Unit Culminating Projects

Objectives: Students will

- research a topic using the World Wide Web;
- create graphics using a computer program;
- compose a business letter;
- utilize information to create a presentation using either Hyperstudio or Power Point computer programs;
- perform community service; and
- teach others about endangered species.

Lessons:

- Endangered Species Hyperstudio or Powerpoint Project
- Team Study Trip and Community Service Project
- Endangered Species Open House: Unit Culminating Activity

Endangered Species Hyperstudio or Powerpoint Project

Time: This project will take 4-5 class periods on consecutive days.

Subjects: Technology, science and language arts

Materials:

student journal (for reference)
access to a computer room with either a 2:1 or 1:1 ratio of students to computer
access to the internet
books on a variety of plants and animals
encyclopedias (books or CD ROM)
Endangered Species Computer Presentation Instruction Sheet, one per student (A.S.13)
blank project storyboard activity sheet, one per student (A.S.14)

Procedure:

1. You will need to sign up for the computer lab at your school several months in advance. If you have a Mac lab, you will use the Hyperstudio program. If you have a PC lab, you will use the Powerpoint program to create a presentation.
2. Before going to the lab, give out the instruction sheet for the project and show examples of the pages you created.
3. On the first day of the computer lab, you will need to give instruction on how use the internet, how to create a Hyperstudio card and how to connect cards with buttons. Students are remarkably tuned-in to this kind of learning and take to it easily.
4. Remind students that they are not inventing this knowledge and that they must give credit for information they gather from the internet and other sources. This information will go on the bibliography page.

Extension:

1. Share project with other students in the class.
2. Share project with another grade at another school. Students often feel a close bond with their previous elementary teachers. They can contact them and set up a day to present their project to an elementary class. Many junior high and middle schools have minimum days for teacher planning where students are released early. These would be great days to share with elementary schools.
3. See Unit Culminating Activity.

Endangered Species Hyperstudio Project

Directions: You will use your time in the computer lab to create a Hyperstudio project on the endangered species of your choice. You may use the internet, encyclopedias or books to gather research. Your project must include a

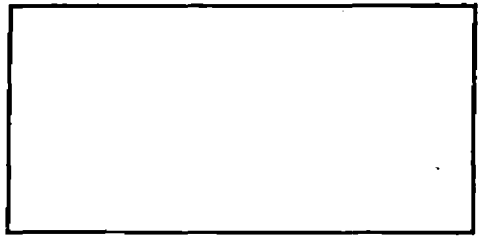
- **title/home page with your name, class and the name of your species, as well as the buttons that lead you to different pages;**
- **picture page with information on your plant or animal;**
- **page devoted to the habitat of your species;**
- **page devoted to the food web and what will happen if the species goes extinct;**
- **page devoted to why the species is endangered;**
- **page devoted to how people can help preserve the species; and**
- **bibliography page.**

Additional Information

- Besides the project, your behavior in the lab will be graded.
- When you are writing your project, keep in mind that you may be presenting this project to 5th and 6th grade students.
- You must use your own words when creating text. It is easy to spot copied text!

Project Information
Common name of species: **Scientific name of species:**
Favorite web sites:
Book names and pages used:
Encyclopedia and pages used:
Notes:

Storyboard Planning Sheet



Title Card

Button/Links: _____

Notes (Text/Sounds/Animations):

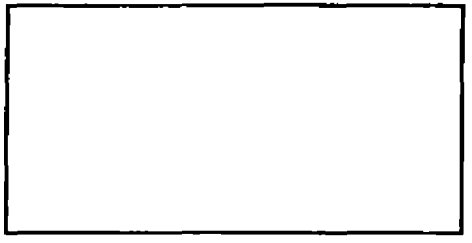
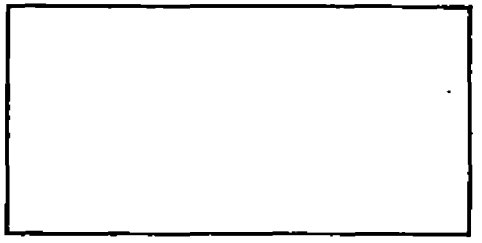


Table of Contents Card

Button/Links: _____

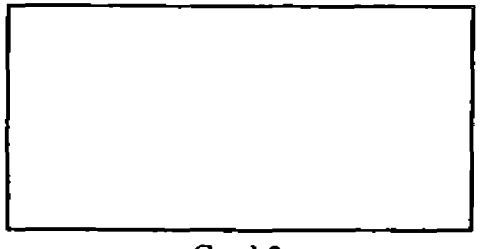
Notes (Text/Sounds/Animations):



Card 1

Button/Links: _____

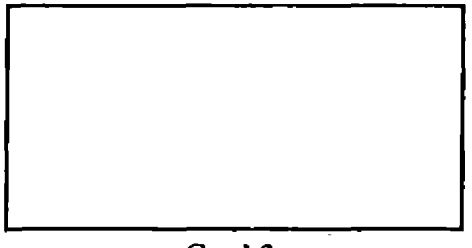
Notes (Text/Sounds/Animations):



Card 2

Button/Links: _____

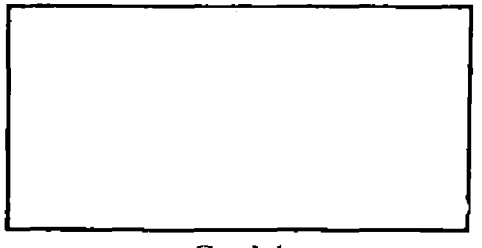
Notes (Text/Sounds/Animations):



Card 3

Button/Links: _____

Notes (Text/Sounds/Animations):



Card 4

Button/Links: _____

Notes (Text/Sounds/Animations):

Team Study Trip and Community Service Project

Time: This project will take one school day.

Subjects: Science, English, history and physical education

Materials:

student journal (for reference)
materials from the "Food Web Activity" in the introductory section of this unit
garbage bags
access to a local park, nature center or hiking trail

Procedure:

1. Explain to students why it is important to give back to the community in the form of community service.
2. Within the team, locate a nature area that needs cleaning up. Plan the day as a school day study trip.
3. Once you have finished the community service activities, have students rotate through some outdoor activities. Even though some of the activities are repeats, students ask to do them over and over. Here are some activities:
    a. Outdoor Artwork
    b. Food Web Game w/ endangered species: use names of local flora and fauna to make the index cards
    c. "Oh, Deer!" from Project WILD
    d. Poetry reading: either the teacher or students can read poetry from their favorite author
    e. Have a ranger give a talk on the history of the area.
    f. Hike the trails and identify wild life.

Extension:

Encourage students to take their families hiking in the area.

Endangered Species Open House: Unit Culminating Activity

Time: The length of this activity will vary depending on the depth of the activity.

Materials:

classroom
all student work for this Endangered Species Unit

Procedure:

1. Organize an Endangered Species Open House to showcase student work, knowledge and to educate the community.
2. Put students into groups. Assign each a task for planning an open house for parents, family, other classes and the community. Some activities include creating the invitation, handling refreshments, set up and clean up activities and advertising and promotion.
3. Be sure to set up computers to demonstrate student computer presentations. Set up a TV and VCR to show videos of students on the community service study trip. Develop film from previous unit activities and post on the classroom walls.
4. Train a master of ceremonies for the evening. This person's job will be to give an overview of the unit and to introduce student projects.

Extension:

Create a page on the school web site devoted to endangered species education featuring student activities and student projects.

Glossary of Key Terms

abiotic: components in an environment that have never lived. Some examples are sunshine, sand, water, and chemicals.
adaptation: the process of making adjustments to the environment. For example, over the course of many years, desert plants have made adjustments to intense sunlight and a reduced water supply.
biodegradable: the property of a substance that permits it to be broken down by microorganisms into simple, stable compounds such as carbon dioxide and water.
biodiversity: a term used to represent the variety of life forms in a given area.
biotic: components in an environment that are living or that were once living. Some examples are plants and animals, dead trees and leaf litter.
conservation: the use of natural resources in a way that assures their continuing availability to future generations.
control: any measures taken that will aid in the eradicating, suppressing or reducing the introduced species population. This also includes the restoration of native species and prevention of further invasions of non-native species.
culture: the socially transmitted behavior patterns, arts, beliefs and institutions characteristic of a community and population.
DDT: abbreviation for the insecticide dichloro-diphenyl-trichloromethylmethane. This pesticide was widely used from about 1950 – 1973 in the U.S. (and worldwide) to kill unwanted insects and was found to stay in an ecosystem for years, long after the perceived pests were gone. DDT is considered to be the primary reason many bird species are endangered due to its eggshell weakening side effects.
ecological niche: the role played by an organism in a biological community; its food preferences, requirements for shelter, special behaviors and the timing of its activities.
ecosystem: a natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between the living and nonliving parts follow closed paths; all living things and their environment in an area of any size linked together by energy and nutrient flow.
endangered species: one which is in danger of extinction throughout all or a significant portion of its range.
extinct: the condition of having been irretrievably removed from existence.
feral species: an introduced domesticated species that thrives in the wild when it escapes or is let go into the wild. Wild pigs, cats, goats and dogs are some common examples of feral species.
food chain: the transfer of food energy from the source in plants through a series of animals by animals eating plants and other animals. For example, a green plant, a leaf-eating insect and an insect-eating bird would form a simple food chain. Most species are represented in many different food chains.
food web: an interlocking pattern of food chains.
game animal: legal designation for animals which may be managed and hunted only under regulation.

habitat: the arrangement of food, water, shelter or cover and space suitable to an animal's needs.
habitat destruction: the process by which a natural habitat is changed to reflect the needs of humans.
hybridization: when an introduced species mates with a native species in an area.
interaction: the relationship of one organism to another; the action of one population affecting the growth or death rate of another population. Some interactions are positive, some negative and some are completely neutral.
introduced, alien or exotic species: any species, including its seeds, eggs, spores or other biological material, capable of propagating that species that is not native to that ecosystem.
invasive species: an alien species whose introduction is likely to cause economic or environmental harm.
native or indigenous species: a species that historically occurred in that ecosystem.
natural selection: a process in nature resulting in the survival and perpetuation of only those forms of plant and animal life having certain favorable characteristics that enable them to adapt best to a specific environment.
non-biodegradable: the property of a substance that does not permit it to be broken down by microorganisms or other environmental factors and therefore remain in the environment for an inordinate amount of time causing litter pollution. Plastics are non-biodegradable substances.
over hunting: removal of a population of animals from an area to the point where their natural breeding practices will not successfully return the species to a healthy population. This often creates endangered or extinct species.
pesticide: any chemical preparation used to control populations of organisms, including plants and animals that are perceived to be aggravating.
plague: an overabundance of common animals in an area caused by a combination of factors like an abundance of food, lack of natural predators and a fast reproduction rate. Locusts, mice and goats are examples of plague animals.
pollution: harmful substances deposited in the air, water or land, leading to a state of dirtiness, impurity or unhealthiness.
preservation: protection which emphasizes non-consumptive values and uses, including no direct use by humans.
rare species: a species that has naturally occurring low numbers due to its small habitat or extreme location that is vulnerable to over hunting. Big cats like snow leopards, siberian tigers and lynxes are examples of rare species.
recycle: taking waste, such as glass and plastic, and melting it down to make other products.
reintroduction of species: putting a species back into a portion of its range where it has previously died out.
reuse: finding new ways to use old things, like taking old tires and using them as bumpers docks to protect boats.

reservation: a tract of land set apart by the federal government for the relocation of Native American tribes. Native Americans were moved off their native lands to make more room for white settlers.
stewardship: related to the environment, the concept of responsible care taking; based on the premise that we do not own resources but are managers of resources and are responsible to future generations.
succession: the orderly, gradual and continuous replacement of one plant or animal by another.
threatened species: one which is present in its range but in danger because of a decline in numbers.
values: a principle, standard or quality considered worthwhile or desirable by an individual, family or community.
westward expansion: the process of white settlers moving westward from the East Coast of the U.S. , often due to governmental incentives of "free land." The California gold rush and completion of the trans-continental railroad greatly increased the rate at which white settlers flowed into lands west of the Mississippi River.

BIBLIOGRAPHY

Ballantyne, R. R., & Packer, J. M. (1996). Teaching and learning in environmental education: Developing environmental conceptions. Journal of Environmental Education, 27(2), 25-32.

Brooks, J. (1990). Teachers and students: constructivists forging new connections. Educational Leadership, 47(5), 68-71.

California Department of Education. (1993). California Endangered Species Guide. Sacramento, CA: Author.

California Department of Education. (1990). Point of View on Environmental Education. Sacramento, CA: Author.

California Department of Education. (1990). Science Framework for California Public Schools: Kindergarten Through Grade 12. Sacramento, CA: Author.

Carson, R. (1962). Silent Spring. New York: Houghton Mifflin Company.

Chadwick, D. H. (1995). Dead or alive: The endangered species act. National Geographic, 187(3), 2-41.

Chafee, J. H. (1995). Preparing for the next century [14 paragraphs]. EPA Journal [On-line serial], 21(2). Available E-mail: http://www.epa.gov/epajrnal/spring95

Cone, M. (2000, October 3). Ruling finds DDT injured Channel Islands fowl. Los Angeles Times, pp. B15, B18.

Disinger, J. F. (1993). Environment in the K-12 curriculum: An overview. In Wilke, R. J. (Ed.), Environmental Education: Teacher Resource Handbook (pp. 23-43). Millwood, NY: Kraus International Publications.

Environment: The cities: The price of optimism. (1969, August 1). Time, 94(5), 41.

Geisel, T. S. (1971). The Lorax. New York: Random House.

Gore, A. (1994). Introduction by Vice President Al Gore. In Carson, R., Silent Spring (pp. xv-xxvi). New York: Houghton Mifflin Company.

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1986/87). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. Journal of Environmental Education, 18(2), 1-8.

Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. Journal of Environmental Education, 21(3), 8-21.

Iozzi, L. (1989a). What research says to the educator. Journal of Environmental Education, 20(3), 3-9.

Iozzi, L. (1989b). What research says to the educator. Journal of Environmental Education, 20(4), 6-13.

Klein, E. S., & Merritt, E. (1994). Environmental education as a model for constructivist teaching. Journal of Environmental Education, 25(3), 14-21.

Knapp, C. E. (1992). Lasting Lessons: A Teacher's Guide to Reflecting on Experience. Charleston, WV: Clearinghouse on Rural Education and Small Schools: Appalachia Educational Laboratory.

Lane, J.F., & Rossow, C.E. (1993). Sources and ideas for special projects. In R. J. Wilke, R. (Ed.), Environmental Education: Teacher Resource Handbook (pp. 225-260). Millwood, NY: Kraus International Publications.

Lisowski, M., & Williams, R. (1993). Environmental education: Some global and local perspectives. NASSP Bulletin, 77, 72-78.

Lovett, S. (1992). Extremely Weird Endangered Species, Santa Fe, NM: John Muir Pubications.

McKisson, M., & MacRae-Campbell, L.,(1990). The Future of Our Tropical Rainforests. Tuscon, AZ: Zephyr Press.

Newhouse, N. (1990). Implications of attitude and behavior research for environmental conservation. Journal of Environmental Education, 22(1), 26-32.

O'Brien, T. (1992). Science inservice workshops that work for elementary teachers. School Science and Mathematics, 92(8), 422-425.

Orr, D. (1990). What is education for? Annals of Earth, 8(2), 52-55.

Royte, E. (1995). On the brink: Hawaii's vanishing species. National Geographic 188(3), 3-24.

Samuel, H. (1993). Impediments of implementing environmental education. Journal of Environmental Education, 25(1), 26-29.

Seeger, P. (1984). Clearwater Classics [CD]. New York: Sony Music Entertainment Inc.

Simmons, D. A. (1989). More infusion confusion: A look at environmental education curriculum materials. Journal of Environmental Education, 20(4), 15-18.

Stoner, D. K. (1990). Student dropout prevention: Teacher in-service connections to environmental education. In D. C. Engleson & J. F. Disinger (Eds.), Monographs in Environmental Education and Environmental Studies 6, 65-82. NAAEE.

Stoner, D. & Overby, Z. (1989). Effective environmental education in action: A model for success. Contemporary Education 60(3), 146-148.

Wade, K. S. (1996). EE Teacher inservice education: The need for new perspectives. Journal of Environmental Education, 27(2), 11-17.

Western Regional Environmental Council, Inc. (1992). Project WILD. Bethesda, MD: Author.