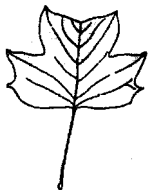
DEVELOPING USING &
MAINTAINING

OUTDOOR CLASSROOMS

IN KENTUCKY

DEVELOP NG, USING, & MAINTA NING OUTDOOR CLASSROOMS IN KENTUCKY

A Publication of the
Kentucky Environmental Education Council



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1996

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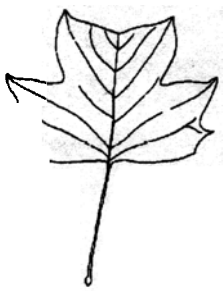

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Preface

According to national polls, more than 80 percent of Americans care about their environment and want to protect it. Yet too few of us really understand the concepts, or have the skills, to deal with environmental issues in a rational and effective way. Over the past few years, schools across the country have recognized this need to better understand environmental issues and concepts, and have begun adding environmental education to their curricula. The national effort to make education more relevant to real world issues has supported this movement.

One of the most valuable tools in teaching about the environment is the outdoor classroom. In this day of Internet access and video games, there are many children, including many rural children, who play only rarely in their own backyards, let alone in the fields, creeks and woods that were so much a part of their grandparents' childhood experiences. Thus, children miss the many valuable lessons that nature has to offer, such as the interdependence of all living things, the ways in which things change over time, and the importance of air, land and water to our own existence.

Outdoor classrooms and outdoor experiences offer an opportunity for teachers and children to learn these valuable lessons together. In addition, the hands on, problem solving techniques used in outdoor learning are ideally suited to the curiosity and exuberance of young people, no matter what their learning style. In fact, the most often reported advantage of outdoor learning is the strong motivation it provides for both students and teachers.

This guide offers a step-by-step strategy for using the outdoors as a learning tool. It discusses the advantages of using an outdoor classroom and how to organize your school to develop and maintain one. It also describes

some of the features that are valuable to include in an outdoor classroom, as well as the resources available to you to help plan and develop your site. Finally, the guide provides a sampling of activities for outdoor classrooms and a discussion of how outdoor learning can help teachers and students achieve specific educational goals.

Throughout, the guide emphasizes that every school comes pre-equipped with an outdoor classroom. It may be a field behind the school. It may be a concrete parking lot that catches rain water during a storm. It may even be a local city park, or a nearby cornfield. All one really has to do is step outside and take a deep breath to begin understanding, and teaching students, the relationship between human beings and their environment.

Members of the Kentucky Environmental Education Council, as well as its staff, hope that this guide will both assist and encourage schools and communities to use Kentucky's beautiful outdoors as a life-long learning tool. If you need further information, we are only a phone call away, and stand ready to assist you in your efforts.

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The Kentucky Environmental Education Council, in cooperation with KET, has produced a series of videos that compliment this guide.

For information about obtaining these videos, contact KEEC:

Telephone: 502/564-5937
In Kentucky: 1-800/882-5271
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"My love is watching people learn, rather than teaching."

—Leonard Bernstein
"The Love of Three Orchestras,"
Viewed on A&E,
August 18, 1996

Introduction

What is an outdoor classroom?

An outdoor classroom is

- any site outside the school building that can be used effectively by students and their teachers as a place for learning;
- a park, a stream, an empty lot, a nature preserve, the streets of a town, a farm, or a neighbor's garden;
- the grounds on which the school is located.

This guide focuses on the school yard as an outdoor classroom—how to use it, how to enhance it, and how to maintain it.

NOTES:
IDEAS I HAVE ABOUT
OUR OUTDOOR CLASSROOM

What are the benefits of an outdoor classroom?

Interest in learning about real-world situations has never been greater. Connecting classroom learning to the students' world outside the classroom has never been so important. Successful outdoor classrooms can help make that connection.

The living systems within an outdoor classroom are dynamic; that is, they are constantly changing. These changing systems provide examples of such concepts as connections between things, interactions among parts of our environment, and diversity of living and nonliving things.

Outdoor classrooms, rich with opportunities, provide unlimited learning experiences for everyone—students, teachers, and other members of the community.

Benefits for students

- Students enjoy being in outdoor settings and they are motivated to learn when they are having fun. Many

"...I reluctantly concluded that I had to look inside myself and confront some difficult and painful questions about what I am really seeking in my own life..."

—Al Gore
Earth in the Balance, 1992

students, in rural areas and in cities, don't have many outdoor experiences. But they do enjoy being outdoors.

Students can use their skills in real-world settings.

Students can demonstrate leadership skills as they help create their own learning environment. Outdoor classrooms are good places for that to happen.

Students feel good about themselves when they have opportunities to be successful. There are many places for this to happen in outdoor classrooms.

As students become involved in creating their own out-of-doors classroom, they take interest in caring for the environment.

- Different students have different ways of learning (learning styles) that work best for them. For example, some learn best when they listen; some, when they see and touch and smell; others when they have an opportunity to do something. Outdoor classrooms provide opportunities for all of those learning styles.

Benefits for teachers

As students become excited about learning, teachers become more enthusiastic about teaching.

Teachers find that the outdoor classroom is a good resource for teaching scientific inquiry, concepts such as patterns of change, cycles, systems and interactions, flow of energy, forces of nature, biodiversity, and the interdependence of life. These are all important topics for education in Kentucky.

Teaching out of doors increases the opportunity for using a variety of strategies, approaches, topics, and experiences within the curriculum.

Teachers find that an outdoor classroom provides opportunities to demonstrate their own leadership skills.

Outdoor classrooms provide opportunities for teachers to grow in their own skills, as well as to be a leader. Teachers do not need to know everything about the outdoors. They learn right along with the students.

"Students are excited about learning new concepts."

—A teacher talking about the nature trail in the Outdoor Learning Center at Tompkinsville Elementary School

That is the beauty of outdoor classrooms.

Outdoor classrooms spark a curiosity for both teachers and students.

Teachers find that parents often become more involved with their children's learning through the outdoor classroom experience.

Other teachers and members of the staff have a place where they can come together as a team in the outdoor classroom.

- Outdoor classrooms are accessible; they are right outside the door.

Benefits for the community

- Students connect knowledge, principles, and concepts learned in the classroom with the real world outside the classroom. This helps them become responsible citizens who participate in the world in which they live.
- Students who work on projects with members of the community have a feeling of being an important part of the community. They carry the good feelings about their place in the community throughout their lives. The community benefits as these students become young adults who take pride in their community.
- The school becomes a focal point for the community, as people become involved in outdoor classroom projects with the students.
- Local businesses become partners with the students when they work on projects together in the outdoor classroom. As students develop successful projects, business people are eager to help.
- Outdoor classrooms can be used by other organizations, such as scouts. In fact, it becomes a valuable resource for the entire community.

What does an outdoor classroom look like?

Every school has an outdoor classroom, but every outdoor

"The students are encouraged to develop their own conclusions from the [project] results and openly discuss with the groups."

—A representative from a business-school partnership

classroom is different.

- It might be small and paved, or it might be large and primarily mowed grass. It might have puddles that form after a hard rain, or it might include a beautiful stream. It might include one tree, or it might include acres of forest.
- It might be located in the heart of a city, in the suburbs, on the edge of a small town, or in a rural area.
- The primary species of animal life might be ants, or there might be an abundance of various species of mammals, birds, and insects.
- There might be a playground with swings, a football stadium, or a basketball court. The outdoor classroom might include a greenhouse, a tool shed, or a flagpole.

In other words, outdoor classrooms come in a variety of sizes and shapes, and include many different features. **The important thing to remember is that your outdoor classroom is a valuable resource, right outside your door, that can provide you and your students with a unique learning experience.**

How can I use an outdoor classroom?

No matter what your school yard looks like, it becomes an outdoor classroom when it is used for discovery and learning. **The moment your students step outdoors and learn something, the school yard becomes an outdoor classroom.**

- All outdoor classrooms have features that your students can measure, record, and compare. For example, they can measure the height and diameter of a tree or a flagpole. They can measure a flower bed or a parking area. They can measure a shadow at different times of the day.
- All outdoor classrooms contain living organisms that your students can observe (sometimes only with a

hand lens), sketch, describe, and document. For example, they might see ants, butterflies, beetles, birds, or worms. They might see grass, clover, flowers, leaves, or twigs.

All outdoor classrooms contain living organisms that are producing their own food or eating food produced by another organism, growing, being eaten, reproducing, and dying. Students can find evidence of leaves that have been eaten, grass that has grown taller, baby squirrels that are finding their own food for the first time, or decaying material where last year's leaves have gathered.

All outdoor classrooms have sunshine and shadows that change at different times of the day, rain that falls in varying amounts and collects in puddles in the same places, and temperatures that change. All of these things can be measured, recorded, and compared.

Every day the temperature changes in different parts of the outdoor classroom, wind comes from different directions, and all of these differences result in microclimates that become the right places for some living things and not for others. These can be discovered and compared.

All outdoor classrooms have a history of change—from the time the Indians first walked the land until the present. Some teachers and their students learn about the history of the people who used to live there, the things they made, and the crops they grew. This kind of study connects the students with the heritage of their land.

All outdoor classrooms have a place where students can look up into trees or at clouds or at rooftops and try to imagine what it would be like if they were there. They can look down at plants that are growing in a crack of the driveway and wonder how it could possibly survive. Or they can look around at tree trunks or windows or birds and think about all the different kinds there are. They can express their

"The kids are so enthusiastic, they don't even know they're learning."

—A teacher talking about members of the Environmental Club at Southwestern High School in Somerset, who work with professionals from the community and the state, and act as mentors to younger students

thoughts and feelings in prose, poetry, sketches, paintings, songs, or dance.

- All outdoor classrooms contain subject matter for scientific inquiry, with students asking the questions and no one knowing the answer until the research is completed. They can choose what question they want to ask, and then set about finding the answer.
- All outdoor classrooms can be used to learn more about the environment in which you and your students live. How is it the same all year long, and how is it different? How is it the same where you live, and how is it different? What living creatures call your outdoor classroom "home"?

Sometimes we can think of only one way to use a paved area, or a stream, or a mowed lawn for discovery and learning. But after you and your students become involved, new ideas will come.

In other words, ideas about how to use your outdoor classroom—in any discipline or subject area or grade level—will come from you and your students as you learn more about your valuable resource.

How can an outdoor classroom improve student performance?

Students have a natural interest in and curiosity about the outdoor world. Students can help you develop a few ground rules about going outside to explore and learn, Once they begin to explore, they thrive in an environment that includes opportunities for discovery.

In this environment, students can use their best method of learning—by listening, by seeing and touching, or by doing. By using their most effective learning style, they acquire new skills and knowledge. This leads to success in achievement, which leads to more interest in learning. They are excited about learning, and you are enthusiastic about introducing new skills in this learning environment.

"According to the 1993-1994 KIRIS Science Assessment, the number of students scoring Distinguished raised from 0% to 1%; Proficient from 2% to 6%; Apprentice from 45% to 77%; and, best of all, the number of students scoring Novice (the lowest level of Performance) decreased from 53% to only 16%."

—A teacher talking about the improved performance of students involved in a multifaceted Environmental Research Center developed at Clay County High School

As you and your students explore your outdoor classroom, you will continue to find new ways to help students improve their skills in areas that will meet expectations of education in Kentucky.

Learning Goal 1: Communication

1.1 When students have hands-on, direct experiences in the outdoor environment, they will have many questions about what they see. This experience will motivate them to use reference tools to find the answers.

... For example, when they see a butterfly, or an ant or a flower they don't recognize, students learn that they can look it up in a field guide or use a key. Or, they might know the common name, but not the scientific (Latin) name. They can learn where to get this kind of information. Or, if they see a problem in the environment, they can learn how to contact an agency about it.

1.5-9 Students have opportunities to use mathematical ideas and procedures to communicate their research findings, or problems they encounter, or solutions to problems they encounter.

... For example, they can count the number of a particular species in three different square meters of the outdoor classroom, chart the populations, and compare them. If the size of population is different in each area, they can look more closely at the three habitats to discover some reasons why the size of population varies from place to place. Or, they can find the average population of the three areas, and, on the basis of that sample, estimate the population in a larger area.

1.10 Students have many opportunities to organize data when they classify living and nonliving features of an outdoor classroom.

... For example, they can classify soils, rocks,

"Moving the learning environment from the classroom to nature is a 'turn on' for the students!"

—A teacher talking about the Rivers Curriculum Project in which students study the health of a stream near the Daviess County High School

plant communities, trees, herbaceous plants (not woody), or microclimates that become habitats for different kinds of animals.

1.11-16 Students are eager to share their discoveries in an outdoor classroom with others through various forms of communication.

For example, after students observe the interaction of an insect and a plant, they can communicate that experience to others in a variety of ways, depending on their skill level and the subject area.

... Students can write a technical paper or a creative piece; they can describe their observations orally to other members of the class; they can make a technical drawing or a creative sketch; they can compose a song, or choreograph a dance, or produce a play; they can enter the data on the computer, or take a photograph.

... Students can communicate their findings to leaders of the community to help influence policy-making or to simply raise the level of awareness.

Goal 2: Core concepts and principles

2.1 The dynamic environment of an ever-changing outdoor classroom is the ready-made environment for primary research (research that the students design and conduct, rather than read about).

... For example, based on their own study, students can determine the best kind of bird feeder to use for a specific species of bird. Or, they can set up an experiment to determine whether or not vegetative cover impacts soil erosion.

2.2 The outdoor classroom is an excellent place to study, first-hand, patterns of cycles, design, or change in the environment.

... For example, students collect data on the water cycle as rain falls and as water vapor

"Our garden influenced our learning environment in many ways."

—A teacher talking about a vegetable garden developed by students, parents, faculty and members of the community at Whitney Young Elementary School in Louisville

rises from puddles or through transpiration of green plants. Students study the pattern of a flower or the arrangement of leaves on a twig. Year after year, students add to the compilation of data collected about the pattern of seasonal change—temperature, humidity, bird populations, dormancy, or wind direction.

In outdoor classrooms, students analyze systems and the way in which their components work together or affect one another.

For example, students can analyze the ecological system that is in one square meter on their site. They can change one part of the system—light, moisture, insect, plant—to observe the change in the ecological system.

2.4-6 The outdoor classroom is a good place to study living and nonliving features in terms of change over time, constancy, and scale.

... For example, year after year students add to the compilation of data on the erosion of soil in a one-square meter of land. Students study the relationship of predator and prey, and the way this works to maintain a balance. Students compare one square meter that has hot, dry, sunny conditions with information about hot, dry, sunny regions in the temperate zone—or in Kentucky—to see if their microclimate is a small-scale version of the larger region.

2.7-13 Students have many opportunities to use numbers, apply mathematical procedures, space and dimensionality, and measuring skills, in addition to collecting data.

... For example, students use mathematical skills in research activity, in tabulations of living and nonliving things, in activities that require a measurement, and in gathering information about the outdoor environment.

The outdoor setting lends itself well to the study of

"Students, having limited resources, explored creative solutions to preserving this valuable bit of space."

—A teacher talking about a habitat improvement program for wildlife in a the courtyard at Potter-Gray Elementary School in Bowling Green

38 diversity, geography and human activity, historical perspective, study of fine arts and aesthetics, the analysis of forms, and career paths.

... In other words, all subject areas are enriched when tied to the setting of your outdoor classroom. In some cases, you can use your outdoor classroom "as is"; in some cases, you and your students will look for ways to improve the setting. For ideas, see the section "Taking the Next Step," beginning on page 19.

Goals 3: Self-sufficiency

3.1-3 Students have fun, are excited about opportunities to succeed, and feel good about themselves when they take part in real-world experiences of an outdoor classroom.

They also have opportunities to work independently and in small groups as they work on projects. The relaxed atmosphere of the sometimes unpredictable outdoors is a change for them; they learn to be flexible and adaptable.

3.4-6 Students have opportunities to be resourceful and creative as they plan and execute such plans as growing food in their outdoor classroom or improving habitat for wildlife. By initiating ideas and being responsible for projects, they learn self-control, self-discipline, ethical values and independent learning.

Goal 4: Productive group member

4.1-6 Students work together to accomplish goals that they set. This process helps them develop the skills they need for being successful in that activity.

Goal 5: Thinking and problem solving

5.1-2 In an outdoor classroom, students use critical thinking skills, such as analyzing, prioritizing, categorizing, evaluating, and comparing, to solve a variety of problems they encounter, and they use creative thinking skills to develop constructive

"Students leave the greenhouse with a feeling of excitement, achievement, and accomplishment."

—A principal at Tully Elementary School in Louisville talking about the recipients of a Learning Choice Grant to open a greenhouse where students apply skills as individuals and as members of teams

ideas or products.

... For example, students use critical thinking skills when studying a map of the site and creative thinking skills when creating their own maps of their outdoor classroom.

5.3-5 Students have opportunities to organize information they gather in order to understand a concept, use decision-making processes to act on the information, and use problem-solving processes to find solutions to relatively complex problems they encounter in the real-world setting in which they are working.

Goal 6: Making connections

6.1 Knowledge and experiences from different subject areas come together in the environment of an outdoor classroom.

... For example, making a map of the outdoor classroom requires the use of mathematics (measuring, estimating, proportion), science process skills (observing, collecting data, recording), social studies (human activity that changes the land at a given point in time), and language (visual and verbal communication).

6.2 In an outdoor classroom, students have a place to bring together, in context, the knowledge, skills, and experiences they use to construct understanding. In other words, all the bits and pieces come together in a way that helps students find relevance to the different pieces of information.

6.3 Students use what they already know as a foundation for adding new information they learn in the outdoor classroom setting.

... For example, students begin with classification skills they have and develop new skills, like using a key to identify a flower.

... Students have opportunities to encounter new situations in which the information they have

"...the individual is a part of a community of interdependent parts."

—Aldo Leopold
A Sand County Almanac, 1966

is not adequate. Then they must try to interpret these new experiences in such a way that they can decide what new information they need.

See pages 46-49 for more ideas about how you can integrate the curriculum and the outdoor classroom.

In summary, the most effective learning takes place in diverse settings and makes use of a variety of approaches. The outdoor classroom is a learning environment that enables you and your students to change the setting. **The outdoor classroom provides you and your students with the opportunity to use different approaches—making it more effective and exciting for the students and more interesting for you.**

Outdoor classrooms are not meant to be just an adventure of going outside. They are used as dynamic learning environments that are easily linked to your teaching strategies, the students' learning styles, and to curricula.

As students with different learning styles and skills achieve success, you will find that opening the door to the outdoor classroom opens the door to improved student performance.

Fifth-grade students at E.B. Terrry Elementary school in Glassgow represent the roots, stems and leaves of a plant in the activity "Raise Your Leaves: It's a Hold Up," from the PRISM unit *A Plant as a System.*

Taking the Next Step

What do I do now?

Some teachers and their students would like to use their school yards as outdoor classrooms. They are looking for *ideas about how to use the outdoor classroom "as is."*

Some teachers and their students have been using their school yards as outdoor classrooms. They are looking for ways to enhance habitat for a wider variety of species, for ways to increase learning opportunities, for ways to include the community, and for ways to broaden the base of support. In other words, they are looking for *ways to help the outdoor classroom become more effective.*

The following are **idea-starters** for using the outdoor classroom "as is" and for making the outdoor classroom more effective.

NOTES:
IDEAS ABOUT THE NEXT STEPS WE MIGHT TAKE WITH OUR OUTDOOR CLASSROOM

How can outdoor classrooms be used "as is"?

Your school yard can become an outdoor classroom just as it is by using it for discovery and learning. You only have to open the door and invite your students to explore the possibilities with you.

- You and your students can use mapping skills to make a picture of this valuable resource (see page 24). This activity can be used in conjunction with developing mapping skills at all levels.
- You and your students can take an inventory of features in your outdoor classroom (see page 27). This activity stimulates thinking about the environment in new ways. For example, maybe students have never thought about a rock as being part of their environment.

  You and your students can use county, regional,

state, national, and/or global maps to find the location of your outdoor classroom, as a way of understanding the connection between the physical characteristics of your site and another part of the country or state.

Given the subject area of your lessons and the skills you have targeted for improvement, *you and your students* can discover ways to use this resource to improve student performance, and have fun in the process. For example,

... What questions are the students asking when they are outside? Can the students design and conduct research to find the answers?

... Ask students to find three things that can be measured, recorded, and compared. For example, trees, flower beds, and puddles after a rain.

... Have students find two things that can be organized into a classification system. For example, leaves or rocks.

... Have each student find something interesting that can be described and then communicated (orally or visually) to others. For example, the direction the flag is flying in the wind or the song of a bird.

... Have students find one example of a system and one example of a pattern, in the natural environment and in the built environment. How are they alike and different? For example, food chain and clouds, sprinkler and windows.

... Ask students to vote on the feature of the outdoor classroom that is most exciting to them. Have them think of ways to use that in the "topic, principle, or concept of the day."

... Have students find as many different kinds of habitats for wildlife as they can in your outdoor classroom.

. Ask students what connections they can make between their observations or findings in one part of the outdoor classroom and in another part. In nature. Where they live. In the community. In

"...to the degree that we come to understand other organisms, we will place a greater value on them, and on ourselves."

—Edward O. Wilson
Biophilia, 1984

other parts of the world.

... Find out what the outdoor classroom looked like before the school was built. What did it look like 100 years ago? 200 years ago?

... How did cultural change in this place impact physical change?

... What might the outdoor classroom look like next year? In 20 years? In 100 years?

How can the outdoor classroom become more effective?

The process of using an outdoor classroom is not linear; that is, it does not begin on Page 1 and finish with the end of the book—like a textbook. Rather, **it is like a web that enables the traveler to move in many directions, depending on the desired outcome.** The following steps for making the outdoor classroom more effective are steps that will help the student learn to effect change in this and in other real-life situations, but **at any point you may digress to meet the needs of *you* and *your* students.**

If you and your students have been using the outdoor classroom and you are looking for ways to enhance it, work in partnership with your students to generate ideas about the kinds of improvements that could be made. Some outdoor classrooms are more limited in possibilities than others, but all outdoor classrooms can become more effective in one way or another.

- Make a class list of the things students like about the outdoor classroom and a list of changes they would like to make. The lists can include physical things, feelings, and/or learning opportunities. Add to the list the things you, as a teacher, like and things you would like to see changed. Post the lists, which can be amended as new ideas occur to the class.

  The purpose of this step is to give you and your students an opportunity to think critically and creatively about the effectiveness of the outdoor classroom as it is at this time.

"...life is not all about what is in the classroom, but especially what is outside of it."

—A student from Daviess County High School

Look at the class lists, and have students categorize the items in each list. Then have students prioritize the items in each category from most to least important.

... **The purpose of this step is to ensure the continuation of positive aspects while planning for change of other aspects.** Creating these categories will help students see the many faceted nature of the outdoor classroom as a learning environment. Setting priorities helps the class focus on the aspects most important to them.

Look at the top priorities on the list of changes the class would like to make, and have the students think about what might be needed to make those changes (e.g., information, tools, people, or other resources).

... The purpose of this step is to identify what it might take to make the desirable changes. Some changes might require only a change in approach and can be implemented right away. Some changes might require a lot of time, money, and labor; these changes require careful planning.

The loss of genetic and species diversity by the destruction of natural habitats can be reversed by thoughtfully planned and executed habitat improvement programs. If you have already taken an inventory of your outdoor classroom, look at your inventory again in terms of the plant and animal species you found. If you have not taken an inventory (see page 27), perhaps the school yard is large enough and complex enough that a comprehensive inventory of species would be better conducted as a multiple-class project.

... The purpose of an inventory of plant and animal species is to establish a baseline for research and to serve as a basis for a habitat improvement program. In addition to increasing the genetic base through diversity of species, biodiversity offers more opportunities for discovery, research, and learning.

"The one process now going on that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us."

—Edward O. Wilson
Biophilia, 1984

Look for partners (other classes, other grade levels, parents, administrators, support personnel, community members and organizations, agencies, and others) to help make the changes in items that are of highest priority to the class (see pages 36-37). You and your students can share the lists of ideas with potential partners; others can tell your students the ideas they have for projects in the outdoor classroom.

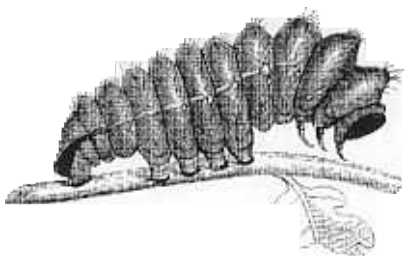
... **The purpose of this step is to ensure success of the projects by broadening the base of support and increasing the pool of ideas.**

After you and your students have identified potential partners, form a committee of representatives from each of the groups, *including students* (see pages 38-40). The planning committee establishes a plan for improving the outdoor classroom to enhance discovery and learning (see pages 41-46).

... The purposes of this step is two-fold: (1) to develop a more effective outdoor classroom for discovery and learning, and (2) to help students learn the process of effecting change.

Plan for an ongoing process of change, focused on developing a more effective outdoor classroom for discovery and learning. **The outdoor classroom is never "finished." It is always in a state of change.** Your students' use of many communication skills to document change in your outdoor classroom is an important activity (see pages 13-14 and page 45).

... There are several purposes of this step. They include giving each class of students an opportunity to engage in the process of change, giving each teacher an opportunity to gain ownership in the outdoor classroom, enhancing the use of the outdoor classroom as a part of the community, sustaining the outdoor classroom as a tool for meeting changing needs and expanded interests, and helping people learn to make decisions based on long-term consequences.



"The first rule of the tinkerer is to keep all the pieces."

—Aldo Leopold
A Sand County Almanac, 1949

Taking an Inventory

NOTES:
IDEAS ABOUT OUR OUTDOOR CLASSROOM INVENTORY

How do students map the outdoor classroom?

A map of your outdoor classroom provides a place for recording features of your outdoor classroom. Use mapping skills appropriate for the level of your students.

It is more important that students take part in the *process* of making the map than in producing a map that looks like someone else's. This is an opportunity for students to increase their map-making skills, observation skills, knowledge from many disciplines, as well as critical thinking and problem solving skills.

- Young children can make picture maps; older children can make bas-relief maps, other 3-dimensional maps, or maps drawn to scale; and upper level students can learn how to use professional survey instruments to accurately measure the site.
- Decide the final product: one large class map to be used as a classroom or school display; individual maps depicting different aspects of the the site, which are transportable and could be used in presentations to others; or another format to serve a different purpose. Regardless of the final product, each student or small group of students should have an individual *base map* that can be taken outside when they are collecting information.

Base maps

- Make a base map—that is, a simple map onto which other information is added. Information needed for a base map includes the dimensions of the site, location of the school building or buildings, and the compass directions north, east, south, and west.
- For younger students, a base map could be provided.

For older students, a base map can be made from a property line map.

... Obtain a property line map from **your county Property Valuation Administrator.** The cost is approximately $5-$10, depending on whether or not your county does its own mapping. Your school property line will be in a section map, so you will need to enlarge the part that includes the boundary of your school site. The location of your building will not be on this property line map.

... The Property Valuation Administrator is listed in the white pages of the phone book under the name of your county.

Making your maps to scale

Determine the scale that will be used—the proportion between the actual objects and the representation of those objects on the base map.

... For example, 1" on the map equals 4' in the actual outdoor space.

Add permanent features to your map, such as walkways, parking areas, and small buildings, as well as natural features that are easily depicted, such as large trees and ponds or streams. These features will give your students ways to relate the areas of the outdoor classroom to the map.

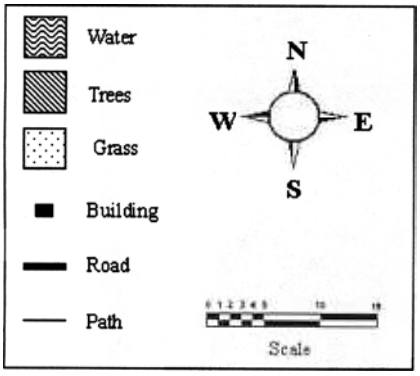
Making symbols and legends

- Establish the symbols that will be used in the legend of the map (the boxed-in area of symbols that appears in a corner of the map). The legend includes the scale of the map. The symbols represent every feature on the map, so people will understand the map. (See page 26.)

  ... For example, you will need symbols for the permanent structures, such as buildings, recreational facilities, and roads or driveways or parking areas.

"Ecology sees all species connected in such a mesh of interdependence that one hardly dares step on an ant."

—Sara Stein
Noah's Garden: Restoring the Ecology of Our Own Back Yards, 1993



Example of a Legend

... You might need symbols for natural features, such as streams, or ponds, and trees.

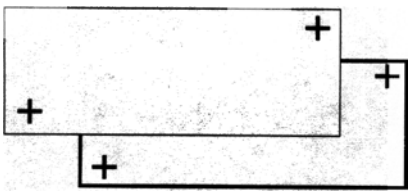
... You will need symbols for the property boundary lines and any walls or fences.

You and your students can add other symbols as you add features (e.g., a lawn area) when you take an inventory of features. The important thing is to design symbols that will help others understand the base map.

If your maps are to be in color, choose the best color for each symbol, and include the colors in the legend.

... For example, popular colors for symbols include
black — permanent structures
blue — water
green — trees
red — roads and driveways

After students have drawn their base maps, ask someone outside of the project to read and use the maps. Students want to be sure their base maps are correct before they begin adding information from their inventory of features.



Making map overlays

- Map overlays are used when you want to depict many different kinds of information that will be recorded in the same area, but you don't want the map to become cluttered.

  An overlay can be made from a sheet of clear acetate or tracing paper that is positioned directly over the base map. Registration marks (+) are placed in opposite corners on the base map and at the same positions on each overlay to make the repositioning of the overlays easy.

  Each overlay contains a different kind of information; for example, animals and their habitats could be on one overlay.

  ... If your students are showing the ants found in your

outdoor classroom, they might want to show all the places in which they found ants. If all the ants do not look the same, they might want to show that there are different kinds. They might also want to indicate the environmental conditions in which they found the ants (e.g., sunny or shady, wet or dry, sandy soil or soil rich in organic matter). In other words, they might want to show the ants' habitats.

Information like this can be placed on a separate overlay so it is not confused with other information. The students can decide how the information will be depicted on the overlay.

See the listing of outdoor classroom development material under Instructional Resources in the Appendices for a good resource on developing maps and suggested map activities.

How do students conduct a site inventory?

After a base map has been completed, students can find out more detailed information and place it on their maps—either directly or on overlays.

- Taking an inventory of the outdoor classroom is a valuable learning experience. Students learn simple surveying techniques; they apply mathematical skills to a real-world situation; and they learn about the interrelationships between people and their environment. In other words, they become more *aware* of their outdoor classroom.

  An inventory of site features and characteristics, as well as observations made about the site, can be conducted in a variety of ways, depending on the skills of the students.

  ... Each student or small group of students can be responsible for a different *section* of the site, and all maps can be displayed as a composite.

  ... Each student or small group of students can be

"It is neat when we can leave the teaching up to the kids."

—A teacher attending the Youth Conference in Louisville conducted by Youth Environmentally Aware

responsible for gathering information about a different *aspect* of the site; for example, one group can locate permanent structures; one group can locate such flora (plant life) as shrubs, grasses, trees, and garden areas; one group can focus on fauna (animal life), such as insects, birds, mammals, reptiles, and others.

Basic information

Establish the basic information that students will need to collect about each item on their inventory lists:

- What is the item? (Example: tree)
- What kind or type is it? (Example: maple)
- How big is it? (Example: 20')
- How many are there? (Example: one)
- Where is it located? (Example: right side of entrance)

Tools

Tools that students need to conduct an inventory depend on the kind of items you and your students decide to include in the inventory. The following are some tools commonly used for taking an inventory:

base maps
clipboards
paper
pencils
containers for collecting specimens
measuring devices
string or rope
thermometers
field guides and keys

- Field guides and keys are useful for identifying species of plants and animals. (See Instructional Resources in the Appendices for a listing of field guides and keys.) Depending on their developmental level, students will need to know how to identify plants, animals, soil types, rocks, and other features of your outdoor classroom. Plan to teach students how to use field guides and keys before they conduct an inventory of these features.

An extension activity: Following the inventory have students develop their own field guide and key for items they found in their outdoor classroom.

Selecting the information to gather

The kinds of items your students inventory in your outdoor classroom depend on the size of the property and how you are going to use the information. Use the following list as an idea-starter for your class.

- **Natural physical features**
  - ❑ Topography: high and low areas, major slopes, approximate degree of slope
  - ❑ Surface geology: rock exposures
  - ❑ Soil conditions: color, consistency, porosity, composition, acidity

    For assistance in obtaining soil testing equipment and instruction, contact the Natural Resources Conservation Service (formerly called the Soil Conservation Service) in your county. Look in the white pages of your telephone book under the name of your county, and then look for Conservation Service.

  - ❑ Surface water: ponds, lakes, streams, wetland areas
  - ❑ Climatic conditions: high and low temperatures, wind direction and speed, humidity, sunny and shady areas

Vegetation (flora) currently growing on the property

- ❑ Trees, shrubs, grasses, flowers, vines
- ❑ Plant communities: dry, sunny, open areas; wet, shady wooded areas; dry, shady, wooded areas; wetland areas

Wildlife (fauna) currently using the area

- ❑ Species observed: crawling insects, flying insects, birds, mammals, aquatic species

"...land as an energy circuit conveys three basic ideas:
(1) That land is not merely soil.
(2) That the native plants and animals kept the energy circuit open; others may or may not. (3) That man-made changes...have effects more comprehensive than is intended or foreseen.."

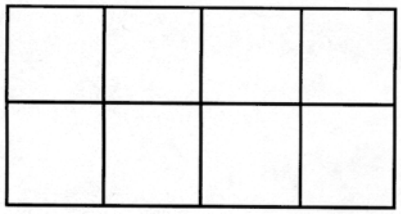
—Aldo Leopold
A Sand County Almanac, 1966

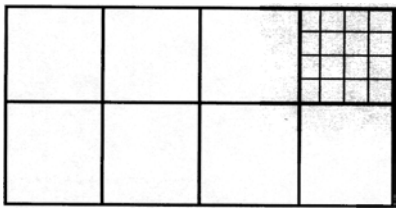
- ❑ Evidence of species: tracks, droppings (scat), partially consumed food, burrows

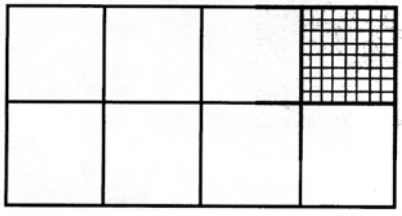
Current human use of the property

- ❑ Recreational: playground, football field, basketball courts, soccer field
- ❑ Utilitarian: service area for waste collection and removal, heating and air conditioning units, power lines
- ❑ Educational: nature trail, flower garden, special projects, or other features that were developed before this inventory
- ❑ Landscaped areas: entrance, building foundation plantings, flag poles, signs

Collecting information







One way to collect information is to use a grid system.

- On the working base maps, make a line grid. Students can do this by using the same increments along each side of the map to make the grid. Or, students can make a copy of the property line base map on a piece of tracing paper and place it over a sheet of grid paper.
- Choose the size of grid that is appropriate for the size of your property and the degree of detail your students will be checking.
  - ... Large-scale grids (e.g., 50 yard intervals) can be used to locate large objects, such as buildings, roads, trees, lakes, football fields, playgrounds, or dry, sunny, open areas.
  - ... Those grids can be furthered divided into grids (e.g., 5' intervals) to locate smaller objects, such as rocks, shrubs, or a flag pole.
  - ... Those grids can be furthered divided into grids (e.g., 1 meter intervals) to locate such things as species of ants, kinds of grasses, temperature readings, or water that forms puddles after a rain.

There are different ways to transfer your base map grid

to the school yard, and the inventoried items back to your base map. Basically, your students will need the following tools:

- base maps with large grid
- pencils
- rulers
- compasses
- string or rope knotted at measured intervals for easier measuring, depending on the scale you are using and the size of the area you are measuring
- dowel rods (to roll string or rope on)
- wooden stakes
- hammer

In the beginning, your students can transfer one column or one row of the grid, so they can become skilled at marking off the grid. The first part of the grid will be the outer line of the grid you want to make.

Roll the string or rope on a dowel rod. (1) Locate on the school yard one corner of the part of your grid that you want to identify. Fasten one end of the rope to a wooden stake and secure it in the ground. Use a compass to face the same direction as the first line of your grid. Measure the length needed to reach the next point on the grid you want to identify. Fasten the rope to a stake and secure it in the ground at that point.

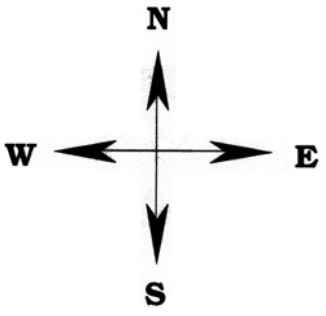
(2) Turn 90^{0} in the direction of your grid, measure the length of the line, fasten the rope to a stake and secure it in the ground at that point.

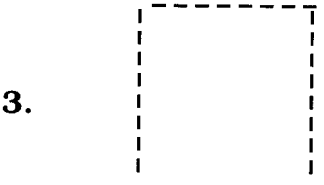
(3) & (4) Repeat the directions above two more times, which should bring you back to the starting point.

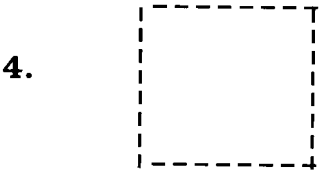
Interim points can be lined off as needed.

Have students record on their base maps what is within this grid. The knots in the rope or string will help students locate positions of objects at interim points.

Repeat the process until you have located and recorded the information about large objects on your







site. Continue with smaller sections of the grid until you have located and recorded the information you and your students have agreed to inventory. This process may take several days to complete, depending on the size of your site and the kind of information you are gathering.

Keeping good records

No matter what kind of information your students are gathering, keeping good records is an important part of the inventory. **They do not need to be complicated, but they will provide useful information for future development, for helping to tell others about your project, and for compiling information from year to year about the outdoor classroom.**

- Field notes become an important part of the permanent record. These notes include procedures and observations. An important learning process for students is how to make the notes clear, concise, and to the point.

  Sketches, diagrams, photographs, or video tapes are helpful in documenting the inventory. There are many uses for such documentation, as your students will see as they use the outdoor classroom.

  Document tools and equipment used, as well as expenses incurred.

Assessing the findings

Look at the information you have collected. Have students reflect on and list all the things they have learned.

For example:

... the process of making a map
... the process of taking an inventory of their outdoor classroom
... the diversity of things they found
... things they learned about themselves
... what they would like to know more about
... what they would like to do next

"As my knowledge of the place grew I began to have a sense of the meaning..."

—Wendell Berry
The Unforeseen Wilderness: Kentucky's Red River Gorge, 1991

How do students put their outdoor classroom in regional, national, and global context?

At some point, students will be ready to learn more about the environment around their outdoor classroom: the land or water just outside the property lines, the area they cannot see that lies just beyond the adjoining property, the land in your section of Kentucky compared with other sections of the state, and the place your outdoor classroom occupies on our continent, and on the Earth.

Looking at the land or water just outside the property lines

Look at the area on the other side of the property lines.

- Does it look just like your outdoor classroom? How is it the same or different?
- How do the features of that land impact the plants, animals, or human use of your outdoor classroom?
- How does the use of your outdoor classroom impact the use of the land adjacent to it?

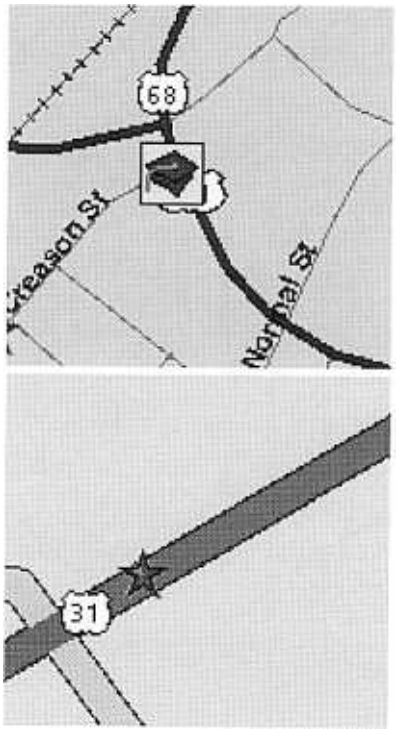
Looking at the land just beyond the adjoining property

Some schools are located on small properties within a highly developed urban area, surrounded by busy streets. Some schools are located on large properties within an undeveloped rural area. Some are surrounded by forests or by farmland.

- Locate your outdoor classroom on a map of your community.

  If you have access to the World Wide Web on the Internet, locate your school site on a street map at MapQuest.

  ... The MapQuest address is <www.mapquest.com>. Click on INTERACTIVE ATLAS, then click on FIND file folder. Enter only the street address, city, state, and zip code (do not enter the name of your



Two school sites reprinted with permission by GEOSYSTEMS

school). Scroll down to "Points of Interest," and click on EDUCATION. Then click on SEARCH. The resulting map will look like the maps on page 33.

If you do not have access to Internet, obtain a city or county map and locate your school on it.

- Locate your outdoor classroom on a map of your region.

  ... There are maps made from aerial photographs to show the soil conditions for your region. One for your county can be obtained from the **Natural Resources Conservation Service**. Look in the white pages of your telephone book under your county, then look under Conservation District.

You will want to get maps of streets and highways, as well as maps that include landforms, river basins or other physical features. The more information your students have about the area in which your school sits, the more they will understand about the possibilities and limitations of their outdoor classroom.

Looking at the land in your region of Kentucky

In addition to differences in urban, suburban, and rural settings, there are physical differences in the various parts of Kentucky. This diversity of rock formation, soil structure, and plant and animal life results in a richer, more dynamic environment with more exciting things to learn.

Look at a political map of Kentucky that shows county lines, highways, and cities. Locate your school on this map. How does the location of your school affect the size and features of your outdoor classroom?

Look at physical maps of Kentucky that show the river basins and landforms.

... There is a series of maps of Kentucky's major river basins in the ***Teacher's Guide to Kentucky's Environment,*** published in 1993 by The Kentucky

Environmental Quality Commission. For more information, look at Appendix: Instructional Resources, General References. Identify the river basin your school is in. Find out where the water goes that drains from your outdoor classroom.

Looking at the place your outdoor classroom occupies on our continent, and on the Earth

Learning about your outdoor classroom is learning about our Earth, our continent, our state, and your county, because your outdoor classroom is a part of all those places. And, learning how to care for your outdoor classroom, as well as learning *from* it, is learning how to care for, and learn from, the rest of our home.

- Look at political and physical maps of our continent, and locate your school on those maps.
  - ... How is your location the same as or different from other places on the continent?
  - ... What else would your students like to know?
- Look at a globe or world map—physical and political—and locate your school.
  - ... What other place is in a similar location on a continent? Are the landforms the same?
  - ... From what countries have your students' ancestors come? Are those countries at a similar latitude? How are they the same or different?
  - ... Find other locations on the globe or map that have similar plants or similar animals. Compare the locations.
- Find other places that have similar problems, such as poor air quality, or polluted water, or too much trash. What are they doing about it?
  - ... If you have access to Internet, find out if there is a way you can communicate with students who would like to share findings. Some students are comparing data electronically with students in other countries.

"If humans were to disappear from Earth, the other plants and animals would largely be unaffected; if the other plants and animals were to disappear, however, human beings would disappear as well."

—Bruce Wallace
Quoted in
A Guide to Curriculum Planning in Environmental Education, 1994

Building Partnerships and a Sense of Community

NOTES:
PEOPLE WHO ARE POSSIBLE PARTNERS IN OUR SCHOOL AND COMMUNITY

Why should there be a broad base of support?

Many teachers in Kentucky are using outdoor classrooms with their students. Sometimes they are the only teacher in their school who uses this rich resource. When that happens, problems can arise and there is no one to turn to: the teacher can come to school one day to find a native plant community mowed down; the students want a nature trail and there is no money to develop it; students move on to the next level or graduate and they cannot continue to be a part of the outdoor classroom discovery process; vandalism mars the site; or the teacher leaves the school and everything that had been developed is abandoned.

A strong base of support can be built so that projects undertaken by your students will have a good chance of lasting, and even growing. And, developing partnerships will strengthen a sense of community—a good model to take into the real world.

Students: developing leadership skills

The strongest projects in such areas as research, habitat improvement, or problem solving will be the ones that students themselves want to do. **In other words, successful projects are student driven.** When students are able to choose the use and development of a part of their learning environment, they get excited. When students are able to learn about things that are important to them, they want to learn. That enthusiasm is catching, and worth nourishing.

Teachers: providing guidance

The guidance needed to help students maintain their

enthusiasm and be successful comes from you the teacher. Teachers of other grade levels and subject areas can support you by listening to your students' ideas and making suggestions for guiding them to success. **In other words, if other teachers are not interested in using the outdoor classroom, begin to build a sense of community by asking for advice about your students' project.** As other teachers see how you are reaching educational goals with your students through fun, real-world learning experiences, they will become an important part of the experience.

Administrators: providing support

Administrators who see positive results from the use of outdoor classrooms will be supportive of projects that will make the site more effective. Students can help administrators understand these benefits by keeping them apprised of successes. They can invite administrators to join them in one of their activities, so they can see firsthand the effectiveness of the outdoor classroom in their learning process.

Service personnel: providing counsel

Service personnel, such as grounds staff and custodians, are good resources for the outdoor classroom. They know about the use and maintenance of the grounds, and can help guide students to the best locations for projects and activities. You and your students can invite them to observe, or participate in, one of your activities in the outdoor classroom. Have students keep them apprised of their findings and successes. A sense of community is strengthened when all members of a partnership are included.

Parents: providing support and resources

Parents are always glad when things are going well for their children. Parents will better understand their children's enthusiasm if they have an opportunity to see firsthand the place that generates this enthusiasm. You

"While they are providing new opportunities for curriculum enrichment outside of the classroom, they are building pride and unity into the student body, and learning about community resources and environmental design."

—Ellen VandeVisse and William B. Stapp, What Makes Education Environmental? 1975

and your students can invite the parents to learn right along with you, but it is important that the *children are the ones who are leading the learning experience*—not vice versa. As parents share their children's enthusiasm, they will become another important resource for the outdoor classroom.

Members of the community: providing opportunities

Other members of the community can become partners in this project—thus extending the sense of community to the community. Student presentations at a parent-teacher meeting can then be presented at civic organization meetings or at meetings of youth groups.

Invite a representative from the organizations or businesses to participate in a learning experience in the outdoor classroom. Give students the opportunity to lead the experience. Keep the organization apprised of research findings, successes, and ways in which the members of the community can use the resource.

Civic organizations often express interest in providing funds for outdoor classroom development.

Who should be part of planning and development?

As students express interest in making the outdoor classroom more effective (see page 21 for steps that will help this process), a committee comprised of representatives from the support groups can help ensure success. The following suggestions are offered as idea-starters for planning and developing the outdoor classroom. Each school has a different situation, and each teacher knows what works best in his or her school.

A planning committee

The committee can consist only of representatives from each of the support groups—always including students, of course—or it can also include resource people who will be needed to help with special projects. The important thing

is that each member of the planning committee should feel his or her contributions are important, leading to a sense of pride in the project.

Teachers

As the teacher, you will be an active participant who guides and facilitates the process. One of your main responsibilities is to ensure that the students' ideas are respected and supported by all members of the committee. If all participating teachers cannot attend all planning meetings, they can rotate on a scheduled basis. However, each participating teacher should receive a report of discussions and outcomes.

Students

Two students can represent each grade level or class involved in a project. If the representatives are rotated, include one "seasoned" representative with one new one. The representatives report back to the other students the plans discussed and results of the discussion. This process helps students develop leadership skills that increase as they participate from year to year.

Groundskeepers and custodians

Service personnel can help teach students important considerations in grounds maintenance. See page 62 for a detailed discussion. Students will want to take more responsibility for maintaining the learning areas that they plan and develop. If the maintenance staff cannot attend a meeting, they should be kept apprised of all plans for development of the site. As students and maintenance staff work to solve problems together, they develop the trust and respect necessary for a sense of community.

Administrators

The principal or other administrators may not be able to attend all the meetings, but they should be invited and reports of progress should be given to them after each meeting.

Parents and community leaders

Participation of parents and other members of the community extends the support of the projects beyond the

"The teacher and the program have made such a difference in my son's life."

—A parent talking about her son's involvement in the community projects of the Environmental Club at Southwestern High School in Somerset

resources of the school. The community is rich in expertise, ideas, and resources. Follow-up reports and letters of appreciation are always welcomed by people who volunteer their time and services to the community. The outdoor classroom is part of the community.

Agencies and organizations

Representatives from agencies and organizations who will be helping with a specific project related to their area of expertise, like soil, forestry, agriculture, wildlife, or native plants, should be invited to the initial planning meeting for that project. As students present their ideas, the consultants and potential supporters can offer guidance that will ensure success of the project. See the Human Resources listing in the Appendices for people to contact.

Meeting for planning and development

Two types of planning are suggested for outdoor classroom development: planning for special projects to meet the goals that have been established, and planning long-term policy and direction for the outdoor classroom. Representatives from the project planning committee should be on the long-term planning committee.

... Prior to each meeting, you and your students should set an agenda for the meeting, outlining the topics that will be discussed. Topics can include reports of student findings, ideas for improving the outdoor classroom, the need to raise funds for approved projects, or plans for implementing a project.

... Students should prepare an announcement of the meeting—date, place, time, and agenda—and give to each committee member prior to the meeting. Then, everyone can be prepared for the topics to be discussed.

... The meeting should begin and end on time, notes about the meeting should be kept, and any visit to a site should be photographed. Careful documentation of proceedings and progress is valuable to the success of the ongoing process.

Planning for Success

How do we develop an outdoor classroom enhancement plan?

There are many ways in which you and your students can improve your outdoor classroom (see page 21 for steps in this process). You might want to enhance the site to improve habitat for wildlife, or you might want to enhance the site so your students will have more opportunities for discovery and learning. What you plan will depend on the size of your outdoor classroom, its limitations or possibilities, whether or not this is your first project, the age of your students, and the extent of your resources.

The purpose of this section is to suggest some steps to take when planning to enhance your site, regardless of the size of your site or the purpose of your project. For ideas about enhancing habitat, see the Appendix: Improving Habitat.

Every plan should include a goal, the purpose for the goal, and objectives for achieving that goal; a time line for activities that accomplish those objectives, an estimated budget for the cost of those activities, and a plan for raising funds if needed; a maintenance plan, a plan for discovery and learning activities, for documenting the project, and a method for evaluating the project.

NOTES:
IDEAS ABOUT OUR PLANS TO DEVELOP OUR OUTDOOR CLASSROOM

Establishing goals, purpose and objectives

After conducting your inventory (see page 24 for step-by-step procedures) and analyzing the needs as your students perceive them (see page 21), establish and post the goal that you and your students would like to achieve, the reason for wanting the goal, and the objectives that will help you achieve that goal.

- The goal is a statement that reflects what you and your students want. For example,

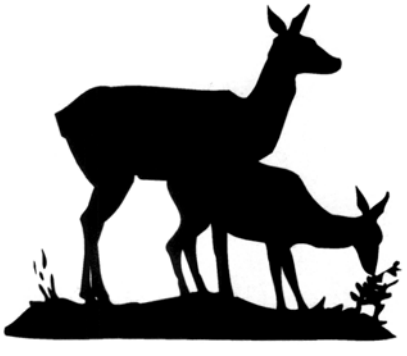
... To increase the diversity of native plants.

Add your purpose for wanting the project—that is, the anticipated benefits to the students and to the outdoor classroom. For example,

... Students will have more opportunities for research activity in plant science and in the study of ecosystems. The outdoor classroom will have more diversity of plants, which will attract more wildlife.

The objectives are statements that describe how you will accomplish the goals. Write them so they are specific and measurable. For example,

1. Review the site inventory to determine the best location for the enhancement project, given the current use of the site. Write the advantages and disadvantages for each site, and the reason for selecting the preferred location.
2. Use the site inventory to identify the current status of the selected location: topography, soil conditions, surface water, current species of plants and animals, and the temperature, and other items.
3. Use field guides (see Instructional Resources in the Appendices) and guidance from agencies (see Human Resources in the Appendices) to develop a list of plants and animals that lived in this place before humans altered the site, or those native plants that are still found in this region under the conditions of that plant community. (Those are the species that will be the easiest to reintroduce!)
4. Select the best plants to use, given the space, time and resources available.



Establishing a time line

After you, the students, and the support team have decided on a goal, the purpose for the goal, and the objectives needed to accomplish the goal, establish a workable time line for meeting the objectives. There should be two time lines: a one-year plan and a five-year plan.

One-year time lines list the activities needed to meet each objective. Each activity begins with an action verb, is brief and specific, includes who is responsible for the activity and the anticipated date of completion. The time line is reviewed at planning committee meetings, and adjustments are made as required. This is an example of a simple time line:

Objective 1. Review the site inventory to determine the best location for the enhancement project, given the current use of the site.

1.	List possible sunny locations	3rd-5th grades	Sept 1
2.	List advantages and disadvantages of possible locations	3rd-5th grades	Sept 3
3.	Select best location	Planning Comm.	Sept 5

Five-year time lines include such things as ongoing development, sources of funds needed for continuing the project, ongoing maintenance, use of the enhancement project for discovery and learning, and ways in which the project can be used by the community. The broader the base of support, the more positive the publicity, the more beneficial it is to the community, and the more it benefits the students' education, the better the chance for its continuance.

Preparing budgets and finding funds

After the time line of activities is completed, a cost for each activity can be estimated. Costs include such things as supplies, use of equipment, and labor. After each cost is estimated, a source for funds can be sought.

- Small, relatively inexpensive projects are easier to fund. People are more apt to donate supplies and labor, and even the use of equipment, if you are not asking for expensive items. Be sure that, when you receive donated time and supplies, you follow up with

a letter of thanks or an invitation to a celebration at the completion of the project. When small projects are carefully planned and successfully implemented, they attract more funds for larger projects.

... Grant funds are frequently available for outdoor classroom projects. This will require writing a proposal. But some proposals are not lengthy.

... Local civic organizations, garden clubs, and businesses are often able to help fund an outdoor classroom enhancement project.

... Fundraising events can be profitable; try connecting them to the project if possible. Part of the event should be educating people about your project.

... Parents sometimes know of sources of funds, or they may be willing to help raise funds for the project. They can contribute time, materials, and encouragement.

... Award money is often available for completed projects that have improved student learning, or improved habitat, or both. Areas of success should be well documented.

Keep a record of all actual costs of a project. These records can be used for preparing future budgets.

Planning for maintenance

Include a plan for maintaining your outdoor classroom enhancement project, throughout the school year and during vacation periods. The plan should be a part of your list of objectives for the one-year plan. Activities to meet this objective include "who will do what and when will they do it." One suggestion is to prepare a chart of needs and rotate responsibility. The school yard maintenance person can help guide the plan. There is a more detailed discussion of maintenance beginning on page 62.

Planning for discovery and learning

Your project idea was probably generated by the need for developing a more effective outdoor classroom. As you and your students begin to use a newly developed area, you will find more ways in which it can help the learning process in many subject areas.

For **idea-starters**, look again at page 10, pages 13-17, pages 20-21, and see pages 46-49. For other suggestions, see page 50 and the listing of Instructional Resources in the Appendices.

But remember, the process of developing an area of the outdoor classroom itself includes important learning experiences for you and your students.

Documenting and talking about the project

It is helpful to document every step of the project. At the beginning of the project, decide how it will be documented and who will be responsible for that.

... Maps and diagrams are good visuals for displays and scrapbooks.

... More detailed but concisely written descriptions are also important. You may need to refer to them later.

... A scrapbook can include photographs (both before and after), drawings, and publicity notices about the project.

... Slides and video tapes (also before and after) are useful for making presentations to larger groups.

... Provide newspapers with news releases and photographs. The publicity will help gain community support, as well as serve as an educational tool for the community.

Keep everyone informed about your project. Use public announcements at school, parent-teacher meetings, posters in the hall, presentations in other classrooms, presentations to civic groups, and tours of the project site.

Evaluating the project

In your list of objectives, include the procedures you will use to see how well you met your objectives. In other words, decide how you will measure the plan's success. For example,

... The time line of activities can be used as a means of keeping track of activities, and the proposed budget can be used to see if actual costs have been kept in line with estimated costs.

... Students can list the things they learned in the process of planning and developing the project, as well as the things they learned as a result of using the area.

Determine how you will know if the overall goal has been achieved.

An evaluation should also include the things that you would do differently the next time, the problems you had, and the ways in which you solved the problems.

How do we integrate the curriculum and the outdoor classroom?

It is essential for your outdoor classroom to be tied to the learning goals of education reform in Kentucky. Beginning on page 13, there is a listing of some of the possibilities for achieving these goals in the outdoor classroom setting. In the Appendices, there is a listing of activity guides in Instructional Resources and a sample activity from several of these guides in Sample Activities.

In addition to the listed resources, the following are **idea-starters** for integrating the curriculum and the outdoor classroom. In all areas, you and your students will start from what you know.

- For younger students, the outdoor setting is the ideal place to use a thematic approach and bring together all disciplines—science, mathematics, social studies, language arts, visual arts, and performing arts.
- For all students, the outdoor classroom provides real-world opportunities for research, problem solving,

critical thinking, communication, and discovery. For all students, the outdoor classroom provides opportunities for expressing ideas about their learning environment.

In the sciences

Observe, compare, and record plant communities and animal habitats in a one-meter square.

Conduct primary research in the areas of fluctuating populations, plant succession, and ecological systems.

See patterns in predator-prey relationships, in adaptation, and in food chains.

Record sounds made by insects or birds.

Choose a spot; record the plants in that area and its use by an animal.

Collect leaves and press them; produce a catalog of plants in the outdoor classroom. Find out how botanists prepare specimens and learn to do it the professional way.

Select a tree to document. Record everything you can about the tree during the school year (e.g., its height, when the leaves appear in the spring, when the leaves drop in the fall or winter, the animals that use the tree, or how long a branch has grown in one year). Include photographs of the tree and of the students who monitored the specimen. Continue the data collection each year with the same specimen—and new students.

Observe and identify the species of birds, mammals, or insects. Record patterns of habits, such as feeding, and flight during the different seasons—migratory and nesting.

Improve the habitat for an animal species that has been sighted in your region. Find out its habitat needs and plan to provide for them. See Improving Habitat in the Appendices.

Conduct research on the food preferences for species who share your habitat. Provide different kinds of food and see which ones are preferred.

Study soil structure, erosion, and the cycle of nutrients.

Observe and experiment with water cycles and the properties of water.

Record weather conditions, climatic changes, and seasonal patterns of change.

In mathematics

Measure shadows, heights of trees, heights of built structures, and growth of vegetation.

Estimate populations through sampling.

Estimate heights of tall structures through the use of special tools.

Make charts and graphs of different species populations, rainfall, and temperature changes.

Count things, and weigh things, and interpret data as part of research procedures in a dynamic environment.

In language arts

Write plans for projects.

Write detailed, concise descriptions.

Document research procedures and findings.

Write articles and make oral presentations about studies you conducted and your findings.

Organize thoughts and synthesize experiences.

In social studies

Investigate and document historical uses of a site.

Look for evidence of earlier use of the site—last year, 10 years ago, 50 years ago.

Find out who owned the property before the school was built. Find evidence of the use of property at that time.

Work with leaders of the community in making the outdoor classroom a valuable resource for members of the community.

Organize efforts to effect change if you find undesirable features for the environment of your outdoor classroom.

In visual arts

Sketch, paint or draw a plant (or a part of a plant) or an animal.

Draw a species for scientific purposes.

Draw a detail of a building or a feature of the built environment.

Compare the work of a wildlife artist with the work of an artist who produces botanical or zoological drawings.

Make a sculpture of a plant or animal species observed in the outdoor classroom. Do not use a picture in a book to use as a model.

In performing arts

Use the environment to inspire the creation of a song, a dance, or a play.

Choose a spot in the outdoor classroom as a place to perform a song, a dance, or a play. Invite another class and/or members of the support team to watch. Explain the source of inspiration.

Read an original poem in the outdoor classroom.

Education reform in Kentucky

See pages 13-18 for additional ways in which activities can be tied to Kentucky's learning goals.

Daviess County High School students learn to conduct water monitoring activities.

Stories About Successful Outdoor Classrooms

REFERENCES TO OTHER SECTIONS IN THIS GUIDE

Throughout this guide, there are suggestions and recommendations for using, developing, and maintaining successful outdoor classrooms. However, most teachers will probably not begin with Page One and move systematically through the guide: each teacher will probably find one section of the guide more helpful than another. That's because each teacher has a different situation, and each teacher is at a different point in his or her use of an outdoor classroom.

Many teachers in Kentucky have already been using an outdoor classroom with their students. The story of each outdoor classroom is unique, reflecting the interest and experience of the teacher, the event that triggers excitement and relevance for the students, and the resources available to the school.

Each of the following scenarios represents a composite of stories from real schools in Kentucky: one is about an elementary school experience; one is about a high school. The stories illustrate both the differences in situations and the similarities that lead to success.

Weaving a spider's web: An elementary teacher uses a child's discovery to expand the classroom experience

Carol teaches fourth grade in northern Kentucky. She has been an elementary teacher for eleven years. Her special interest as a teacher is language arts and communication. In her personal life she only spends time in the outdoors when she attends her son's soccer games. So, it was not unusual that she was unaware of the possibilities of using the school yard as a part of her classroom.

Carol's school is forty years old and, despite remodeling,

shows the signs of age. The building itself occupies nearly the entire property on which it sits, leaving a grassy space of only 55 by 80 feet for a play area. The school's small play area is the site of many imaginative games, because most of the students in the school live in apartments or in modest homes with very small lots.

Last September, during recess, three of Carol's more adventurous boys came running to her side and asked her to come see something "neat." She followed the three around the corner to a little-used entrance on a shady side of the building. There, sitting right in the middle of a thick zigzag web, was a beautiful spider. It was almost four inches across, and its black and yellow body was supported by eight spindly, graceful legs that were half beige and half black. Its head contained eight large eyes that seemed to watch her every move. Taking a deep breath, and trying not to show her fear, Carol talked with the boys about how amazing the spider was and how she had never seen one quite like it before. She cautioned them not to touch it.

At the end of the day, while Carol was preparing for the next day, Mr. Schaeffer, the custodian, came in to empty the trash cans. She asked if he had seen the spider. He replied that he had not, but that he would make sure and "take care of it" at the first opportunity. Carol, who routinely sprayed for bugs at home, felt a twinge of regret and asked Mr. Schaeffer if he would leave the spider for a few days until she and the children could talk a little more about it.

The next day was the third Saturday of the month, Carol's day to work at the food bank. While stocking shelves with Mrs. Hunter, a fellow volunteer, Carol described the spider as some rare jungle spider that had probably come into the country in a shipping crate. Mrs. Hunter, a lifelong gardener, laughed and said that it was probably a common garden spider. She suggested Carol contact the biology department at the nearby university for more information.

SEE, LEARNING GOAL 1.1 — PAGE 13

On Monday morning, before going to her classroom, Carol walked around to the side entrance, fully expecting the spider to be gone. But, it was still there, big and beautiful

as ever, and still watching Carol's every move. The next day most of the class had heard about the spider and begged Carol to take them out to see it. She explained that they were scheduled to do a writing exercise, but she would take them out for just a few minutes to see the spider before beginning the day's work.

SEE, WHAT ARE THE BENEFITS OF AN OUTDOOR CLASSROOM? — PAGE 7

When the class gathered under the spider's web, some of the children were frightened by the spider; others made jokes about it eating them up; and others just stared at it. Regardless of the reaction the spider had everyone's undivided attention. Even the most distracted children remained fixed on the creature and her zigzag web. Carol looked around at the eager faces and made a decision: she asked, "What if we spend the day trying to find out more about the spider, and then writing about what we discover?" They loved the idea.

SEE, HOW CAN I USE AN OUTDOOR CLASSROOM? – 3RD ITEM. — PAGE 8

When they got back into class, Carol gathered the children in a circle and asked them what they wanted to know about the spider. The children were full of questions: What kind of spider is it? Will it bite? Will it have babies? Should we kill it? Is it a boy or girl spider? Can it jump on us? Are there other spiders in the schoolyard? Carol wrote down all the questions, divided the students into groups, and assigned each group a question to research. Then, leaving the children to discuss their questions for a minute, she walked down the hall to the library. She asked the librarian if students could come, one group at a time, to do research on spiders. The librarian agreed to help them. By the end of the day, the class had many of the answers to their questions, and Carol had a copy of *Charlotte's Web* to read to the class.

Carol told the class she would call a biologist at the university to get more information. Later when she talked with the professor, he promised to send her information about the spider, but he assured her the spider was harmless. He suggested that, if left undisturbed, the spider would probably stay in its web for several weeks.

During the following weeks, the class often visited the spider, who they named Suzy. Carol began to notice how the creature often appeared in students' writing and

conversations. She also noticed how children who had been quiet and shy became animated when they explained what they were learning about Suzy. As the weeks passed, Suzy spun two egg sacks. She also captured insects and wrapped them in silk to hang about the web.

Each morning brought some new web event, and Carol began to see how the children were learning such concepts as change over time and the interrelationships of living things—just by observing Suzy. Children who had been squeamish about spiders became protective of Suzy and her egg sacks. Parents who brought their children to school were taken around the building and given lessons on spiders by children who had become junior entomologists.

SEE, BENEFITS FOR STUDENTS – ITEM 4 —PAGE 8

SEE, BENEFITS FOR TEACHERS – ITEM 7 —PAGE 9

Carol finished reading *Charlotte's Web* to the children. The children were concerned about whether or not Suzy would die like the spider in the story. Carol, too, dreaded the day when Suzy would be gone; Suzy had become such a motivating factor for her students, Carol began thinking about how she could sustain the excitement generated by the spider's timely appearance.

Carol's class was not the only one excited about Suzy, many of the other classes had observed her as well. At a faculty meeting, Carol mentioned that the spider would soon die and joked that she wished she could have a spider every month. Another teacher mentioned that if their school were in a rural area, they would have more opportunities for observing spiders. However, with so little space, it did not seem likely they could have such opportunities. Carol agreed, but the thought nagged at her.

The next time she worked at the food pantry, Carol mentioned the idea of an outdoor study area to Mrs. Hunter. Mrs. Hunter explained that it really takes very little space to have a few plants. She suggested that her garden club might be willing to help plan such an area. She also suggested that Carol contact her county extension agent to see if he could provide ideas.

SEE, APPENDIX: HUMAN RESOURCES

The county extension agent had a number of ideas,

including the creation of a butterfly garden. The garden would provide a home for a number of different insect populations, and perhaps a spider. He suggested that Carol contact the Kentucky Department of Fish and Wildlife Resources about their Habitat Enhancement Program. He explained that the habitat program could provide information about growing native plants, which would attract the butterflies. Finally, Mrs. Hunter's garden club voted to provide both expertise and funds to develop the garden.

SEE, APPENDIX: HABITAT IMPROVEMENT PROGRAM IN KENTUCKY

Armed with all these resources, Carol again raised the idea of an outdoor classroom at a faculty meeting. Although some teachers felt they did not have the time to develop an outdoor classroom, Carol convinced a number of her fellow teachers that the rewards were more than worth any extra effort. She also talked with them about how studying Suzy enhanced teaching and learning in all subject areas; it helped her integrate such diverse subjects as math and art. She described one project in which students counted the cocoons in Suzy's web and noted their placement, so they could draw the web more accurately. The teachers agreed to form a committee to plan their outdoor classroom. They each invited one student to meet with them, and began meeting every week.

SEE, TEACHERS: PROVIDING GUIDANCE —PAGES 36-37

SEE, LEARNING GOAL 2.7-13 —PAGE 15

One day in late October, Suzy disappeared from her web, never to return. The children were very sad, but they talked about how they knew this would happen. Carol allowed the class time to discuss their feelings and to write poems and stories about Suzy. She also reminded the class that, in the spring, Suzy's babies would be born. Would the children like to help her plan a place where the little spiders could live?

SEE, LEARNING GOAL 1.11-16 —PAGE 14

Over the next several months, the classes planned a butterfly garden. Parents were informed that the garden was being developed, and several volunteered to help. One student's father, a contractor, offered to build borders for the plant beds, and one mother who worked for Wal-Mart managed to get garden implements donated to the school. The children were involved in both the planning and the actual work of developing the garden and many reported

SEE, PARENTS: PROVIDING SUPPORT AND RESOURCES —PAGE 37 AND MEMBERS OF THE COMMUNITY: PROVIDING OPPORTUNITIES —PAGE 38

that they were building their own garden plots at home.

During the winter months, Carol attended workshops for *Project WILD* and *Ag and the Environment in the Classroom.* Both workshops provided her with many new ideas and skills that helped her integrate outdoor learning into the subjects she already taught. She was able to share much of this information with other teachers in the school. She also helped her principal to understand that outdoor learning is not a separate subject, but a tool that enhances the rest of the curriculum.

SEE, ADMINISTRATORS: PROVIDING SUPPORT —PAGE 37

Today, Carol's school has a butterfly garden and plans for a weather station. Carol is enjoying teaching more than she has in years. Through this experience, she feels she has grown both as a teacher and as a person. Several other classes are using the outdoors, and the principal has asked the committee to help students design a new landscape plan for the front of the building.

Carol has a new group of fourth graders this year who are excited about the fun things her students do. Yesterday, while pulling weeds in the butterfly garden, one little girl found a big yellow and black spider.

Environmentalizing the science curriculum: A high school science teacher uses environmental problems as a focus for scientific exploration

Mark lives in a small rural county in central Kentucky. He has taught science at the county high school for eighteen years. Last year, a long-awaited new high school was completed; now both students and faculty enjoy the new gym, football field, and computer lab. However, Mark, who helps raise corn and hay on his father's farm, recently noticed a problem; soil on a steep hillside behind the football field was washing away, leaving deep gullies in the slope.

Soil was washing into the stream that runs along the bottom of the hillside. Mark mentioned this one day to the

principal, Mr. Whiteside, as they passed in the hall. Mr. Whiteside said he knew about the problem and had already put it on the list of needed repairs. However, because their school was so new, other schools would probably be higher on the District's list for repairs.

The eroding hillside continued to concern Mark, because he knew how quickly erosion could wash away a hillside. One day, he discussed the problem with his sixth-hour class. A student asked if there was anything they could do to help. Then, the class became animated as they discussed possible solutions. Brian, one of the students, said his uncle was on the local Soil Conservation Board. He offered to ask his uncle to meet with the class about this issue. A date was set for Brian's uncle, Bill Cleavinger, to visit the class the next week.

Everyone was excited. But when Mark told Mr. Whiteside that the students were talking about finding solutions to the bank erosion problem, Mr. Whiteside wrinkled his brow. He explained to Mark that students could not walk around steep hillsides; they might be hurt and then the school would be liable. He approved the visit by Brian's uncle, but warned Mark that the students must not plan any action in which they might be hurt. Mark felt torn. Keeping students from walking on the site seemed a perfect way to dampen their excitement.

On the day Brian's uncle was scheduled to come to school, it had been raining heavily for two days. Mr. Cleavinger had asked the Soil Conservation officer from the Natural Resources Conservation Service, to visit the site the day before and had several pieces of information to relay to the students. First, he noted that grass seed had been planted on the site when the football field was first completed, but apparently it had never sprouted. He explained that planting some sort of vegetation on hillsides was, indeed, the best way to prevent erosion. He also explained, however, that the gullies in this particular hillside were so deep, the area would probably need to be bulldozed before anything was planted.

Mr. Cleavinger pointed out another problem; there was a sinkhole at the bottom of the hillside and much of the soil

that washed off the football field and the hillside was going into the sinkhole. Several jokes were made about footballs and quarterbacks falling into the sinkhole, and then the discussion turned more serious. What could the students do to help solve the problem?

Mr. Cleavinger suggested that, once the site was smoothed out, the students could plant grass and seedlings on the hillside to help prevent further erosion. Mr. Cleavinger told them that technical assistance was available through the Natural Resources Conservation Service (NRCS). He gave the students the name of a staff member at the closest NRCS office. So, perhaps there were things that students could do in the classroom to help solve the problem. Mark suggested that while the class waited to get an appointment with the NRCS staff person, they could find more information on their own.

The students were eager to get started. During the next class period, the students decided what they needed to know and how they would go about finding the information. The class was divided into several groups, and each group looked for information about erosion and sinkholes. They looked in the library and on the Internet; and they also spoke with their families, who lived on farms.

SEE, LEARNING GOAL 5.1-2
—PAGE 16

In the process of gathering information on erosion and sinkholes, the students learned a great deal about other topics, such as nonpoint source pollution, karst systems, contour plowing, and terracing. Soon they had their own plan for a solution to the erosion problem, complete with written description and sketches. When they met with the NRCS staff member, they merely fine tuned the plan.

Throughout the process, Mark served as "cheerleader and guide," rather than lecturer. He was pleased with the leadership shown by many of the young people, especially some of the more rural students to whom this was a familiar topic. He was also pleased to see students from a variety of backgrounds working together so well.

SEE, BENEFITS FOR STUDENTS
– ITEM 3
—PAGE 8

As with many other real-life problems, this problem had

more than one solution: an easy one and a more complicated one. The easy solution was to sow hardy grass seed on the hillside and cover the seed with straw, as had been done before. The students rejected this idea, because it did not work the first time and the deep gullies would probably continue to erode. Also, they worried that the run-off from the fertilizers and pesticides used on the football field would make its way into the sinkhole and eventually into the groundwater system; they hoped to prevent that.

SEE, HOW CAN THE CLASSROOM BECOME MORE EFFECTIVE? – ITEM 3 —PAGE 22

The solution the students chose involved terracing and planting both grass seed and tree seedlings. However, that solution was very expensive. They decided they would have to raise money for that project. At this point, Mark became concerned that fund-raising would interfere with learning science concepts. He suggested that perhaps they should back off the complicated erosion project and return to the simple solution.

That evening, when Mark mentioned this to his wife, she asked, "Don't real scientists have to raise money for their research?" Mark thought about it and decided to allow his students to continue with their project. But, Mark was also concerned that many students were going to the site on their own after school hours. One student admitted that indeed she had gone to the site to see what it was really like, but she had taken her dad with her and he did not seem to think it was dangerous. Students asked if they could go, if their parents were with them. Mark said he would talk with Mr. Whiteside about it.

Meanwhile, the students talked about holding bake sales and car washes to help raise the money, but they dismissed the ideas as impractical for raising such a large sum. One of the students said that her parents had a cousin who owned a small construction business. He had offered to do the necessary grading, if it could be done on a Saturday. She said he would need an exact description of how they wanted the site to look after the grading was complete. Other students thought about who their families might know.

Little by little, Mark and the students began to realize that their project might actually become a reality. Now there was pressure from the students to get it right. They began working with their math teachers and the NRCS staff to determine the correct slope of the terraces and how many terraces there should be. They also worked with their English and social studies teachers to draft letters to the Board of Education, requesting permission to undertake the project. At first, the Board was reticent to approve the project, but when the students' presentation included detailed charts, maps and a video tape of the hillside, they granted the permission.

SEE, LEARNING GOAL 6 —PAGES 17 AND 18

The local paper heard about the project and printed a story about the class presentation to the Board of Education; Brian's uncle saw the article. He called Brian and asked how the project was going. Brian told him they were ready except for raising the money for the seedlings. Mr. Cleavinger told Brian that the Conservation District had some funds for conservation education, which might apply to this project. At the next Conservation District Board meeting, the students made their presentation to Mr. Cleavinger and the Board. The students were rewarded; they were given the necessary money to buy seedlings for their project.

SEE, APPENDIX: HUMAN RESOURCES IN KENTUCKY

By this time, the students were very eager to plant the seedlings themselves, so again Mark went to Mr. Whiteside. By this time, a good deal of positive publicity had appeared in the local media. Mark assured the principal that the newly terraced land would be much less steep and, therefore, safer for the students. Mr. Whiteside agreed that students could work on the site, if they had their parents' written permission. Two weeks later, the hillside was terraced. The following Saturday, students, parents, and even Mr. Whiteside spent the afternoon planting seedlings across the hillside.

On the Monday following planting day, students from several of Mark's classes began asking how they could get involved in projects to improve the environment around the school. And the sixth-hour class had specific ideas for other projects, including cleaning up the creek below the

SEE, STUDENTS: DEVELOPING LEADERSHIP SKILLS —PAGE 36

hillside, and trying to get an idea of where the groundwater under the school ended up. Mark told all the students that he could certainly help them with monitoring water quality, but that geologic formations were out of his area of expertise. He suggested they contact the Kentucky Geologic Survey and ask for help with that project.

While Mark continued to encourage the students to pursue their own research projects in the outdoor setting, he cautioned them that there were also basic concepts and skills they needed to know in order to do well on their assessments. He told them that they must master those skills if they were to continue working on the outdoor projects. He suggested that the students work with a group of teachers to plan ways they could achieve their own research goals while learning basic concepts at the same time. This group of teachers and students formed the core of what would eventually become the outdoor classroom planning committee

SEE, LEARNING GOAL 2.1 —PAGE 14

One of the first things the planning committee did was to ask the librarian to help them find information on outdoor classrooms. Along with several nature guides, she gave them a brochure she had received from the Kentucky Environmental Education Council (KEEC).

SEE, APPENDIX: HUMAN RESOURCES IN KENTUCKY

A call to KEEC provided many ideas and resources. They got names and telephone numbers of people in their own county and surrounding counties who could provide technical assistance in outdoor classroom development. KEEC also provided the names and telephone numbers of people in state agencies who could help answer technical questions and provide materials on many environmental issues.

KEEC staff gave them a listing of available environmental teacher training programs, such as *Project Wet, Project Learning Tree* and *Project NEED.* (Several teachers on the planning committee went to those training workshops and received in-service credit for it.) The teachers also learned about the centers for environmental education at Murray State University, Western Kentucky University and the University of Louisville. They learned that these centers

SEE, APPENDIX: INSTRUCTIONAL RESOURCES

SEE, APPENDIX: HUMAN RESOURCES IN KENTUCKY

are excellent resources for schools that are planning outdoor classrooms. But perhaps most important of all, KEEC staff helped put the planning committee in touch with other teachers and students at schools in nearby counties, which had already developed outdoor classrooms.

Now, three years later, Mark's school has a nature trail, a weather station, and, of course, the erosion prevention program. They are involved with the Kentucky Water Watch program, they have plans for a wildlife viewing area and a pioneer garden. The majority of teachers in Mark's school still do not use the outdoor classroom, but those that do use it share the responsibility for the program. These teachers have learned to turn more of the responsibility for planning and maintenance of the site over to the students. The majority of funds and materials for the outdoor classroom are donated by businesses and civic groups in the community, which has come to think of the outdoor classroom as its own nature education center.

Last year, the school's science scores improved significantly; Mark and other teachers believe this is largely due to the outdoor classroom experiences. They also see a new self-confidence in their students, as well as a vast improvement in problem solving and communication skills. And, Mr. Whiteside—although he still cautions students to be careful on the site—proudly shows every visitor "his" outdoor classroom.

Planning for the Future

NOTES:
OUR PLANS FOR MAINTAINING THE OUTDOOR CLASSROOM

Excitement and enthusiasm generated by the use of an outdoor classroom, and the development of projects within the outdoor classroom, can be sustained by keeping everyone informed about the project, considering long-term maintenance of the physical environment, and increasing opportunities for discovery and learning.

How can we maintain the outdoor classroom?

You will find that the dynamic natural environment of native plants and wildlife holds more opportunities for discovery and learning than the static manicured landscape of non-native species.

The goal of the maintenance of traditional school grounds is to keep things looking the same: lawns are mowed, trees are pruned, leaves are raked, and shrubs are pruned. However, the natural native environment has diverse plant and animal life that is always changing. The totally natural area—rich with diversity and discovery—appears to some people to be too wild and unkempt. There is often resistance from members of the community, and even from some school personnel, to let the environment be too natural.

Anticipating the resistance will help you and your students find ways to enhance your outdoor classroom with native plants and wonderful places for wildlife—even in otherwise manicured outdoor classrooms—that is acceptable to everyone. The process of both developing the site and planning the maintenance is a learning experience for students, as is each task.

The value of establishing a maintenance program for your projects right from the start cannot be over emphasized.

For any site you are using, develop a monthly calendar of maintenance tasks, such as putting bird seed in feeders, weeding the herb garden, or putting grass clippings in a compost pile. With each task, plan who will be responsible for the task and provide a place to record the completion of that the task.

Example:

SEPTEMBER	WHO	DONE
Clean bird feeder	4th grade class	*9/4/96*
		9/11/96
Fill bird feeder	3rd grade class	*9/1/96*
		9/3/96
		9/5/96

Rotate responsibility, so everyone has an opportunity to learn about caring for the environment.

Include the maintenance personnel in planning the maintenance program. See pages 37 and 39 for other ideas about including the maintenance personnel.

Be sure that each student understands why each maintenance task is important.

... Sometimes the task helps the environment (e.g., collecting fallen leaves for a compost pile).

... Sometimes the task helps the maintenance crew (e.g., contributing the extra labor needed for weeding a native plant area).

... Sometimes the maintenance task helps the area look attractive, so the public will be pleased.

Keep the plan simple. If the maintenance plan is

included in the initial planning of a project, you can see if maintenance will be a problem. If it is, adjust your enhancement plan.

Include a maintenance program in your 5-year plan. As students move on to other grade levels, they can become mentors for the younger students.

How can we sustain discovery and learning in an outdoor classroom?

When your students are using the outdoor classroom for discovery and learning, new ideas for more learning experiences will appear, and new ideas for enhancing habitat and plant communities will be expressed.

It is this student-driven process that will continue to make the outdoor classroom more effective.

Students learn to

Begin each project with simple ideas for taking the next step. Honor those ideas.

Use the idea development process that begins on page 21, taking each step that is recommended for developing the plan. Even if the project itself is not accomplished, the process is a valuable learning experience.

Refer to the student map and inventory of the outdoor classroom. The map and the inventory will need to be updated each year as new projects for improvement—even small ones—are completed.

Work with their partners—in the school, in the community, and in Kentucky—to help guide the enhancement projects. Some of these partners will be learning from you and your students, and some will be good resources and support for your students' ideas.

You can

- Broaden the base of those who benefit from, or who have ownership in, the outdoor classroom. The

outdoor classroom is a dynamic place for integrated studies and for interaction among all grade levels; but people need to see how it benefits them. The more people who benefit from it, the more likely it will be supported as an integral part of the school program.

- Document improved performance of students using the outdoor classroom.

  Develop and maintain the outdoor classroom in such a way that it is aesthetically pleasing to a wide audience.

  Integrate the outdoor classroom into the fabric of the community.

  Look at the ways in which Kentucky's Learning Goals can be supported and reinforced (beginning on page 13), taking care to include the skills and concepts in all learning activities. Your students can help you do this, and tell others about it!

  Review the list of ideas for integrating the curriculum with the outdoor classroom (see page 46). You and your students can select the idea that is exciting to them and supports the skills and concepts you want to reinforce.

  Consider ideas for enhancing habitat, which are found in the Appendix: Improving Habitat in Kentucky. These are **idea-starters**. You and your students know what will work best for your site.

  Refer to the listing of supplemental activity guides in the Appendix: Instructional Resources. Sample activities from several of the guides are included in the Appendix: Sample Activities.

  Talk to other teachers who have successful outdoor classrooms at their schools. Share ideas. Visit them.

  Look for opportunities to attend workshops related to developing and using outdoor classrooms.

  Use as many resources available as possible. Develop a classroom library of books related to different aspects of outdoor classrooms, such as attracting birds or making a compost pile.

Use the Kentucky Environmental Education Council Hotline in Kentucky: 1-800/882-5271. Ask for help.

Reflect on the things you remember from your school days; are they things you read, or are they the things you experienced?

...How can I create a psychological climate in which that child will feel free to be curious, will feel free to make mistakes, will feel free to learn from the environment, from fellow students, from me, from experience? How can I help him recapture the excitement of learning that was natural in infancy?

—Carl Rogers
Quoted in
A Guide to Curriculum Planning in Environmental Education, 1994

Appendix: Instructional Resources

 Kentucky authors

Activity Guides Available Through Training Workshops

* Sample activity included in the Appendices

Aquatic Project WILD
Western Regional Environmental Education Council (1987, 1992).
The *Aquatic* guide focuses on aquatic life. For information about training workshop sites in Kentucky, contact Jay Webb, Project WILD Coordinator, KY Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort, KY 40601. Or call 502/564-7109 x436.

Project Wet (Water Education for Teachers) *
Western Regional Environmental Education Council (1995).
A collection of hands-on activities promotes stewardship of water resources. Includes the chemical and physical properties of water, quantity and quality issues, aquatic wildlife, ecosystems, and management strategies. In Kentucky, contact Jennifer Lynn, North Central 4-H Center, 260 Camp Drive, Carlisle, KY 40311. Or call 606/289-5308.

Project WILD *
Western Regional Environmental Education Council (1983, 1985, 1992).
Includes K-12 activities designed to increase awareness of and appreciation for wildlife and responsible human action. For information about training workshop sites in Kentucky, contact Jay Webb, Project WILD Coordinator, KY Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort, KY 40601. Or call 502/564-7109 x436.

Project Learning Tree (PLT) Activity Guide
American Forest Council (Second Edition 1993).
Revised edition is designed for students PreK-8, using trees and the forest as a "window" to the natural world, helping students learn about the world around them, their place within that world, and their responsibility for it. A set of high school modules is being completed. For information about training workshop sites, contact Kentucky PLT, P.O. Box 408, Wickliffe, KY 42087; or call 502/335-3151.

Activity Guides Available

* Sample activity included in the Appendices

AIMS (Activities Integrating Mathematics and Science) *
AIMS Education Foundation (Dates vary with publication).
A series of highly visual activity books, including such topics as plants, water, the sky, and the climate. Available from AIMS Education Foundation, P.O. Box 8120, Fresno, CA 93747. Or call 209/255-4094.

Hands-On Nature *

Vermont Institute of Natural Science (1986).

A book of information and activities for exploring the environment with children focuses on adaptations, habitats, cycles, and designs of nature. Available from VINS, RR 2, Box 532, Woodstock, VT 05091. Or call 802/457-2779.

OBIS (Outdoor Biology Instructional Strategies) *

Delta Education (1982).

A collection of modules includes hands-on, direct investigation of the out of doors for students of all ages. Categories of topics include adaptations, animal behavior, pavement and parks, and backyard investigation. Available from Delta Education, Inc., 5 Hudson Park Drive, Box 915, Hudson, NH 03051. Or call 1-800-258-1302.

Legacy Trees *

Louisville Gas & Electric Company (1994).

A project that promotes trees, the environment, and history. Legacy Trees also helps students appreciate the value of trees. For information on the *Legacy Trees* program, contact Phyllis Fitzgerald at LG&E, P. O. Box 32010, Louisville, KY 40232, or call (502) 627-3772.

NatureScope *

National Wildlife Federation (NWF) (Dates vary with publication).

A series of activity guides on topics that include weather, trees, mammals, birds, and endangered species. Available from NWF at 1400 16th St. NW, Washington, DC 20036-2266.

PRISM (Partnership for Reform Initiatives in Science and Mathematics) *

A collection of integrated science units developed by teachers in Kentucky as part of a statewide science education improvement project. Units, many of which are related to the outdoor classroom, are available for primary, intermediate, and middle school students. For a listing of units available, contact your Kentucky Department of Education Regional Service Center.

Integrating Environmental Education and Science: Using and Developing Learning Episodes

Ohio Environmental Education Fund (1995).

Supports education reform through environmental topics, using higher level thinking skills, to help students construct and use knowledge. Available from ERIC Clearinghouse for Science, Mathematics and Environmental Education at 614/292-6717 or e.mail <ericse@osu.edu>.

Solar Energy

KyNEED Project, P.O. Box 176055, Covington, KY 41017-6055.

An activity to show how to collect the energy from the sun to make a solar cooker.

The School Ground Classroom

Environmental Education Association of Oregon (1980, 1983: not copyrighted).

A curriculum to teach K-6 subjects outdoors. Interdisciplinary approach to supporting "things that have to be taught anyway." Available from the Environmental Education Association of Oregon, P.O. Box 40047, Portland, OR 97240.

What Tree Is That?
The National Arbor Day Foundation (nd).
A guide to common trees found in the Eastern and Central United States. Available from The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE, 68410.

Wildflowers & Ferns of Kentucky
Barbour, R. W., & Wharton, M. E. (1971). Lexington, KY: The University Press of Kentucky.
A unique guide to the herbaceous wildflowers and ferns of Kentucky's fields and forests contains over 500 full-color illustrations of nearly 500 species. Available from The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE, 68410.

Outdoor Classroom Development

Developing a Common Vision and a Unified Voice for Environmental Education in Kentucky
Kentucky Environmental Education Council (KEEC) (1995, no copyright).
A report on 27 successful environmental education programs in Kentucky. Available from KEEC, 663 Teton Trail, Frankfort, KY 40601. Or call 502/564-5937. In Kentucky, call 1-800-882-5271 toll free.

Greenways: A Guide to Planning, Design, and Development
Fink, C. A., & Searns, R. M. (1994). Washington, DC: Island Press.
A book that provides community organizations with practical and specific recommendations for creating and preserving natural "green" spaces.

Habitats for Learning
Ohio Environmental Education Fund, Ohio Environmental Protection Agency (1995).
A planning guide for using and developing outdoor classrooms. Available from Ohio Department of Natural Resources, Division of Soil & Water Conservation, Environmental Education Section, 1939 Fountain Square Court, Bldg. E-2, Columbus, OH 43224. Or call 614/265-6878.

Homes for Wildlife
New Hampshire Fish & Game Department (NHF&GD) (1995).
A comprehensive planning guide for habitat enhancement on school grounds. Available from NHF&GD, 2 Hazen Drive, Concord, NH 03301. Or call 603/271-3211.

Just Beyond the Classroom
ERIC Clearinghouse on Rural Education and Small Schools, Appalachia Education Laboratory (1996).
Community adventures for interdisciplinary learning, addressing educational reform and outdoor education, planning for outdoor learning, and activities for twelve outdoor themes. Available from the publisher at P.O. Box 1348, Charleston, WV 25325.

So you want to start an Outdoor Classroom...
The Oklahoma Conservation Commission (OCC) and The Oklahoma Department of Wildlife Conservation (ODWC) (n.d., no copyright).

A compilation of ideas for developing an outdoor site for primary and intermediate students. Contact the OCC at 2800 North Lincoln, Oklahoma City, OK 73105. Contact the ODWC at 1801 North Lincoln, Oklahoma City, OK 73105.

WILD School Sites
Western Regional Environmental Education Council, Inc. (1993).

A guide to preparing for habitat improvement projects on school grounds. For information, contact Project WILD, 5430 Grosvenor Lane, Bethesda, MD 20814. Or call 301/493-5447.

General References

Backyard Composting
Harmonious Technologies. (1992). Ojai, CA: Harmonious Press. Or call 805/646-8030.

A complete guide to recycling yard clippings.

The Backyard Naturalist
Tufts, C. (1988). Washington, DC: National Wildlife Federation.

An easy-to-read book that blends know-how, common sense, and environmental awareness.

Biodiversity
Wilson, E. O. (Ed). (1988). Washington, DC: National Academy Press.

A collection of presentations made at the National Forum on biodiversity, held in Washington, DC on September 21-24, 1986. This in-depth discussion addresses our dependence of biodiversity, its value, and ways in which we can help restore biodiversity.

The Bluebird Book
Stokes, D., & Stokes, L. (1991). New York, NY: Little, Brown & Company.

The Bluebird Book explains how to build a bluebird nest box, how to start a bluebird trail, how to attract bluebirds with appropriate landscaping, and all about bluebird feeders.

Going Native: Biodiversity in Our Own Backyards
Marinelli, J. (Ed). (1994). Brooklyn, NY: Brooklyn Botanic Garden.

An easy-to-read, colorfully illustrated small book that addresses the need for biodiversity, how to make a garden natural—and yet attractive, and the best plants for our region.

How to Attract Birds
Burke, K., Wood, J., & McKinley, M. (1983). San Francisco: Ortho.

A beautifully illustrated, easy-to-read book that addresses basic needs, selection of plants, providing nesting sites, and descriptions of commonly found birds.

Kentucky Alive!
Taylor, D. J. (Ed). (1995). Frankfort: Commonwealth of Kentucky.
This report of the Kentucky Biodiversity Task Force addresses the status of biodiversity and factors affecting biodiversity in Kentucky, biodiversity education in Kentucky, and recommendations for the future.

Landscape Restoration Handbook
Harker, D., Evans, S., Evans, M., & Harker, K. (1993). Boca Raton, FL: Lewis Pub.
An in-depth guide to naturalizing the managed landscape, maintaining and restoring natural diversity, ecological restoration, and extensive lists of native plants. (Out of print. Contact Sherri Evans, 502/564-4762.)

The Natural History of the Oak Tree
Lewington, R., & Streeter, D. (1993). New York: Dorling Kindersley.
A high quality, beautifully and lavishly illustrated visual exploration of the oak, the organisms that call it "home," and its environment.

Soil Survey Series
National Cooperative Soil Survey. (Dates vary with publication).
Books published for each county in Kentucky include topographical maps for all sections of the county and descriptions of the soil found in each county. Available from the Natural Resources Conservation Service (formerly called the Soil Conservation Service) in your county. Look in the White Pages under US GOVERNMENT, the DEPARTMENT OF AGRICULTURE, then either SOIL CONSERVATION SERVICE (former name) or NATURAL RESOURCES CONSERVATION SERVICE (new name).

The State of Kentucky's Environment: 1994 Status Report
Cole, L. A., Pauley, P., Richards, S., & Nye, P. (1995). Frankfort, KY: The Kentucky Environmental Quality Commission.
A detailed report on Kentucky's water resources, air quality, waste management, toxics, natural resources, resource extraction, and energy. Illustrated with numerous charts and graphs.

Teacher's Guide to Kentucky's Environment
Kentucky Environmental Quality Commission. (1993). Frankfort, KY: Author.
A companion to the "State of Kentucky's Environment: A Report of Progress and Problems." Addresses water resources, air quality, waste management, natural resources, and toxics.

Catalogs

Common Ground Distributors
An extensive listing of books, audio tapes, and video tapes on nature and the environment for children and adults. Call 1-800-654-0626, 9:30 am - 4:30 pm ET.

Field Guides and Keys

Bluebirds and Their Survival
Davis, W., Roca, P. (1995). Lexington, KY: University Press of Kentucky.

The Audubon Society Field Guide Series
New York: Alfred A. Knopf. (Dates vary).
Available in most bookstores. (All color, all photographic format)
North American Rocks and Minerals
Birds (Eastern Region volume)
Butterflies
Insects and Spiders
Mammals
Reptiles and Amphibians
Trees (Eastern Region volume)
Wildflowers (Eastern Region volume)

The Field Guide to Wildlife Habitats of the Eastern United States
Benyes, J. M. (1989). New York: Simon & Schuster.
Chapters include: What Is a Habitat? Observation Tips, River and Stream, Grassy Field, Transition Forest, and more. Each chapter includes characteristic plants and wildlife that live there.

Important Forest Trees of the Eastern United States
U.S. Department of Agriculture, Forest Service. (1991, 1995). Racine, WI: Western Pub.
A Golden Field Guide that is out of print. Contact the KY Division of Forestry for information about obtaining a copy on loan, 502/564-4496.

A Guide to Mammals in Kentucky
University Press of KY, (1974). Lexington, KY: University Press of KY.

Nature Study Guild Keys
Nature Study Guild, Box 10489, Rochester, NY 14610.
Flower Finder—spring wildflowers and flower families
Tree Finder—all native and introduced trees
Winter Tree Finder—leafless winter trees
Fern Finder—native northeastern and midwestern ferns
Track Finder—tracks and footprints of mammals
Berry Finder—native plants with fleshy fruits
Winter Weed Finder—dry plant structures in winter
Bird Finder—some common birds and how they live

Peterson Field Guides
Boston: Houghton Mifflin. (Dates vary). Available in most bookstores.
An extensive listing (40) on birds, insects, plants, and more!

Trees & Shrubs of Kentucky
Barbour, R. W., & Wharton, M. E. (1973). Lexington, KY: The University Press of Kentucky.
An extensive listing of trees and shrubs in Kentucky.

Weeds of Kentucky and Adjacent States
Haragan, P. D. (1991). Lexington, KY: The University Press of Kentucky.
A description of plant structures and a guide to native plants by flower color.

Videos

Exploring School Nature Areas
Bethesda, MD: *Project WILD.* 301/493-5447.
For teachers, it encourages the development of wildlife habitat in school yards.

Habitats for Learning: Ohio Takes a New Look at Land Labs
Columbus, OH: Ohio Department of Natural Resources.
Walks teachers through the process of using and enhancing outdoor learning.

Life in the City Habitat
St. Louis, MO: Missouri Botanical Garden. 1-800-927-9229.
For intermediate grade students. Explores organisms that have adapted to life in the city. (14 minutes).

Outdoor Classrooms in Kentucky
KET and Kentucky Environmental Education Council. (1996).
For teachers, a series of three programs produced as a companion to this guide. The first segment explores the benefits of using outdoor classrooms; the second describes ways to develop features of the outdoor classroom; and the third, ways in which activities align with the KERA Learning Goals.

The Puzzle of the Rotting Log
Missouri Botanical Garden 1-800-927-9229.
For intermediate grade students. Investigates the process of decomposition of a rotting log in the forest. (12 minutes).

Appendix: Sample Activities

Seeds Travel

I. **Topic Area**
Biological Science: Seed Dispersal

II. **Introductory Statement**
Students will observe many ways that seeds travel from the parent plant.

III. **Math Skills**
a. Measuring
b. Identifying Attributes

Science Processes
a. Observing
b. Recording Data
c. Sorting and Classifying

IV. **Materials**
Assorted seeds that travel by wind (dandelion, milkweed, maple, sycamore, pine), by water (cranberry, coconut), by animal fur (cocklebur, crabgrass, beggar-ticks, thistle)
Magnifying glass

V. **Key Question**
How many ways can seed be dispersed by a parent plant?

VI. **Background Information**
Most plants produce a large number of seeds. This is because so few seeds survive. In order to ensure survival many seeds are modified in various ways so they can be carried away from their parent plant.

Some fruit and seeds simply drop from a parent plant. They take root there, but have competition for space and light.

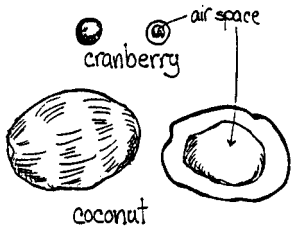
Many seeds have developed wings or silky hairs that allow them to be carried by the winds for miles. The dandelion seed, for example, has a little parachute which helps it to be carried by the wind.

Plants that grow along the banks of streams and rivers often have seeds that will float on water. The seeds usually have tough husks and air spaces in the seed to help them float. The best known seed that floats many miles is the coconut.

Many seeds have sharp hooks or barbs which stick to animals with furry coats like sheep or dogs. They drop off some distance from where they grew.

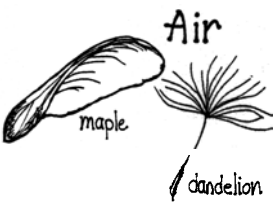
Seed dispersal helps to prevent too many seedlings from growing in a small area near the parent plant. Those plant species that are able to spread their seeds widely have a better chance of surviving.

VII. **Management Suggestions**
1. This lesson will use only three of the many ways that seeds are dispersed. These three are ones that students enjoy and can observe best.
2. Collect seeds from the different ways of seed travel—wind, water or animal fur. Or use other categories that suit your environment.



3. This lesson needs to be taught in the fall season when many seeds can be collected, or the seeds can be collected to use later in the year.
4. To find seeds look around your school. The trees planted along the streets near the school will produce seeds. Weeds often survive along the edges of the playground, or find a wild environment or vacant lot.

VIII. **Procedure**
1. Read the information sheet "Seed Travels" with the students.
2. Collect seeds that are carried by animals' fur. With a magnifying glass have the students look at the tiny hooks or barbs on the seed pod. See if the students can imagine how these tiny fruits hook a ride with animals with fur. Each hooked bract has a seed at the bottom.



3. Collect seeds that produce a "parachute"; bull thistle, milkweed, dandelion are some. The students should use a magnifying glass to examine the seed at the bottom of the parachute. Encourage the students to let the seeds blow in the wind to see how far they will go before landing. You might encourage a race.

4. The maple, linden, ash, and pine tree seeds have wings. These will resemble helicopters as they travel towards the ground. If your school has a second story, drop the seeds from an upper window and watch the miniature "helicopter". See how far it travels. Otherwise, just toss the seed in the air and watch it land. Open the helicopter to see where the seeds are held.
5. The best known floating seed is the coconut; however, a smaller floating seed is the cranberry. Look at the waxy waterproof coat of the cranberry. Cut it open and examine the four air pockets, each of which contains a seed. Some seeds if they land on moving water will be carried quite a distance; however, this is not the primary means of dispersal for most seeds.
6. Have the students record what they see when they study these seeds on the worksheet "Seeds Travel".

IX. Discussion Questions

1. How far can winged seeds fly? Do they need a strong wind?
2. Why do the seed cases (fruit) differ with the various dispersal methods?
3. Which do you think is the most efficient mode of travel for the seeds?
4. What is the best kind of weather for airborne seeds to disperse?
5. Can you find some other way in which seeds are dispersed than the ways that have been studied?

X. Extension

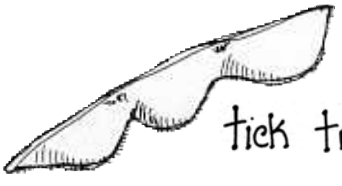
1. Have the students collect as many kinds of seed as possible and classify them into various ways of travel.
2. Write a story about a seed that travels far from the parent plant.
3. Make collages with the seeds that have been collected.
4. Make paper helicopters. Do they fly the same way that nature's seed helicopters do?
5. Choose some flowering plant in the spring. Watch it carefully. What happens when the petals fade? Where does the fruit form? What happens to the seeds? Go back in the fall. How are the seeds scattered, by the wind, by animals, or by water?
6. Invent a seed that has an unusual way of traveling from the parent plant.
7. Use "Helicopters and Parachutes" worksheet as an extension to the section on seeds carried by air.

Seeds Travel

Seeds cannot move by themselves. They must be carried away from the parent plant so they have enough light and space to grow.

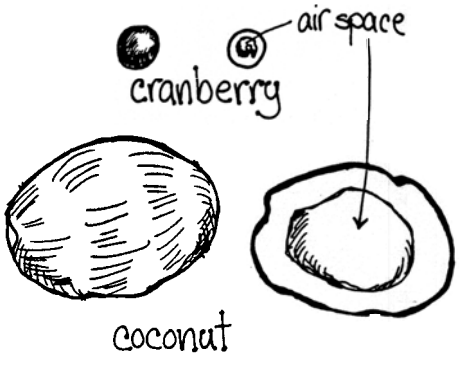
Hitchhikers

Some seeds have hooks or hairs that catch on people's clothes or animals' fur. These seeds "hitchhike" a ride far from the parent plant.

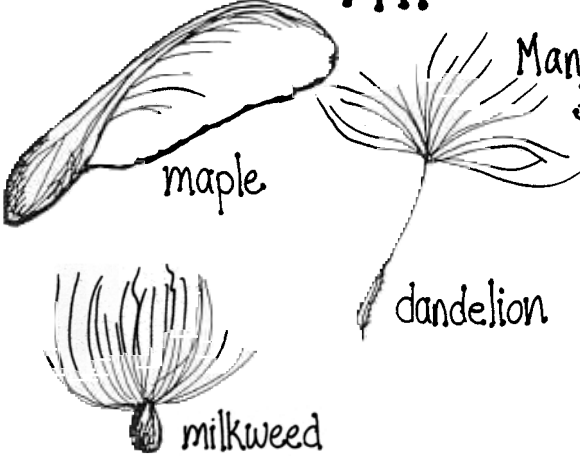


Water

Some plants that live near water have seeds that float. The seeds drop into the water and float away from the parent plant. Some have spaces inside to help them float. Any seed that floats can be carried by water.



Air



Many light seeds have wings or silky hairs that help them to be carried by the wind. The hairs catch the wind like a parachute. The ones with wings turn like a helicopter as the seeds ride the wind away from the parent plant.

The Great Producers

Leaves come in a variety of sizes and shapes, but all share a common function; they manufacture food using a process called **photosynthesis**, which is unique to green plants.

This is how the process of photosynthesis works. Plants obtain water through their roots, from which it rises to the leaves. Here, in the presence of a green pigment called chlorophyll, and with energy provided by the sun, water is split into hydrogen and oxygen. At the same time, carbon dioxide is entering the leaf through leaf pores called **stomates**. Next, through some chemistry not yet fully understood, the hydrogen gas available from the splitting of the water is combined with the carbon dioxide. The result is sugar, a compound containing carbon, hydrogen, and oxygen. The leftover oxygen is released to the air, and helps replenish what we and all other animals need for breathing.

There are many adaptive designs that lend themselves to the efficiency of this photosynthetic process. Leaf size, even on the same plant, varies considerably. In general, leaves exposed to the full rays of the sun are smaller than those in the shade. The arrangement of leaves on a twig or stem usually takes advantage of the available sunlight.

Leaf shape varies considerably, from the needle-like leaves of the pines to the broad leaves of the maple. They can be nearly round, star-shaped or linear, but whatever their specific shape, the primary objective of leaves is to capture as much sunlight as possible in order to carry out photosynthesis as efficiently as possible. The total leaf surface exposed for light absorption is often amazing. An American beech tree fifteen inches in diameter was found to have 119,000 leaves with a total surface of about 3,000 square feet.

In addition, different shapes help to retain or remove water. Much of the water taken up by a plant for photosynthesis and for mineral nourishment is eventually **transpired** through the leaves of the plant. Some leaves, such as those of the American elm tree, are asymmetrical, in that the two sides are unequal. It is thought that this causes the leaves to tilt sideways in the rain allowing water to drain off quickly, which prevents bacterial infection. A majority of leaves have sharp points at their outer ends or along their margins. These "drip tips" also cause the water to flow off the leaf quickly. Rain water in drier areas evaporates rapidly, making these sharp tips unnecessary. Many leaves are lobed or divided, as are those of strawberry plants and ash trees. Divided leaves not only allow wind to pass through them without injuring them, but allow the leaf to transpire more water and take in carbon dioxide more efficiently. The fine teeth along the margins of many leaves act as emergency water pores allowing excess water to flow out of the leaf.

While green plants must have sunlight to live and manufacture food, the heat of the sun often causes them to lose too much moisture for proper functioning. They compensate for this with great efficiency. Leaves have many stomates, through which air passes inward, and water and gases escape. Most occur on the undersides of leaves. Cells on either side of each stomate expand and contract, controlling the water loss of the leaf. Desert plants have few stomates as they have to conserve what water is available. Willows on the other hand, thrive in moist habitats because they are unable to close their stomates completely, and thus cannot control moisture loss. Other adaptations that effectively conserve the water supply of plants include leaves turning on edge to avoid the hot sun, a thick outer leaf covering and temporary wilting.

Palmate Veining Pattern

Parallel Veining Pattern

Pinnate Veining Pattern

Leaves are well designed for survival. Stems, or **petioles**, allow leaf blades to twist in the wind and rain, preventing the leaves from being torn to shreds. This movement also allows light to penetrate into the darker interior of the tree.

The design of leaves is not complete without mentioning the veins that extend through each leaf. Inside these veins are the ducts that carry water and minerals to the various parts of the leaf and carry manufactured sugars away. There are three common patterns — parallel, pinnate and palmate. Each species of plant has its own distinctive pattern of veins; most fit into one of the three categories.

Deciduous tree leaves demonstrate the ultimate efficiency of design, in that their very life span is determined by their usefulness to the tree. Chlorophyll, essential to photosynthesis, starts to disintegrate with shorter days and cooler temperatures in late summer, which allows hidden pigments such as xanthophyll (yellow) or carotene (orange or red) to be seen. Anthocyanin, another red pigment, is produced by the leaves when nights are cold and days are sunny. Brilliant fall foliage is the result. As the chlorophyll disappears, the leaves are no longer able to manufacture food for the tree. At this time about 90 percent of the minerals in the leaves are transported out of them and stored in the tree's tissues. A layer of corklike cells, the **abscission layer**, then gradually forms across the base of the leaf stem. The leaf soon breaks away and falls, exposing buds that, with the warmth of spring, will unfurl into next year's leaves.

Suggested References:

Brockman, Zim, Merlees. *Trees of North America*. New York: Golden Press, 1968.

Knobel, Edward. *Identify Trees and Shrubs by Their Leaves*. New York: Dover Publications, 1972.

Symonds, George W. D. *The Tree Identification Book*. New York: William Morrow, 1958.

Tolmie, Dr. Ghillean. Photos by Kjell Sandved. *Leaves*. New York: Crown, 1985.

VARIATIONS ON A LEAF

Season: Sp S F

Focus: *Leaves may vary in appearance and texture, but they are all designed to function as food producers for their plants.*

ACTIVITIES	MATERIALS
Initial Question: Why do plants have leaves?	
TO EACH HIS OWN **Objective:** To illustrate some differences among leaves Give each child a leaf to look at and study. Use hand lenses. After getting to know their leaves, all the children should put them in a pile, then find their own. After everyone has found the correct leaf, ask what were the unique characteristics of each. Point out the variety of shapes, sizes, textures, and patterns, and explain that these help serve important functions. Ask the children to look at their leaves and hold up the ones that: 1. catch the most sunlight — some trees have bigger leaves than others. When the leaves are small there are usually more of them. 2. are best protected from the wind — some leaves have flat stems (poplars) so they move easily in the wind rather than break; some have short stems, which hold them close to the twigs. 3. are designed so they won't become either too wet or too dry — some leaves have points on them or waxy coatings (oak leaves, pond lily leaves) so the water will drip off; others have rough or fuzzy coats to help keep moisture in.	• *leaves* a few different kinds, 3 or 4 of each kind 1 per each child • *hand lenses*
LEAF RUBBING **Objective:** To notice that the veins in different kinds of leaves look different. Have each child keep the leaf from the previous activity. With the underside of the leaf up, place a piece of paper over the leaf and rub gently with a crayon to get a leaf rubbing. The most noticeable structures will be the veins. Try this again with other leaves. Discuss the three common veining patterns: parallel, palmate, and pinnate. Ask the children which kind they illustrated in their rubbings.	• *paper* • *crayons* • *leaves* • *diagram of 3 patterns*

FOLLOW-UP ACTIVITIES

1. Spatter Prints
Have the children place leaves on paper and either shake paint off a paint brush or scratch paint with a toothbrush through window screening over them.

2. Celery Magic
Place fresh celery stalks upright in water that has been dyed different colors. Notice what happens to the celery. How long does it take?

3. Identification
Ask the children to choose 4 or 5 favorite, common tree leaves and look them up in a Tree Guide to find out what kind of tree they come from. Make a rubbing of each and write its name along with some of its special features beside the rubbing.

Skills

Science Process: Observing, Inferring, Communicating, Comparing, Sorting and Classifying

Integrated Curriculum: Art, Drama, Music, Social Studies, Reading, Writing, Language Arts, Math

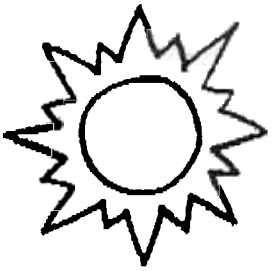
Suggested Reading for Children:

Bancroft, Henrietta. *Down Come The Leaves.* New York: Crowell, 1961. (y — shapes, colors, purpose)

Caulfield, Peggy. *Leaves.* New York: Coward, 1962. (o — photographs, details, adult text)

Davis, Burke. *Biography of a Leaf.* New York: G. P. Putnam's Sons, 1972. (o — ecological role and life cycle)

Selsam, Millicent E. *First Look at Leaves.* New York: Walker, 1972. (y — questions to encourage observation)



Solar Energy

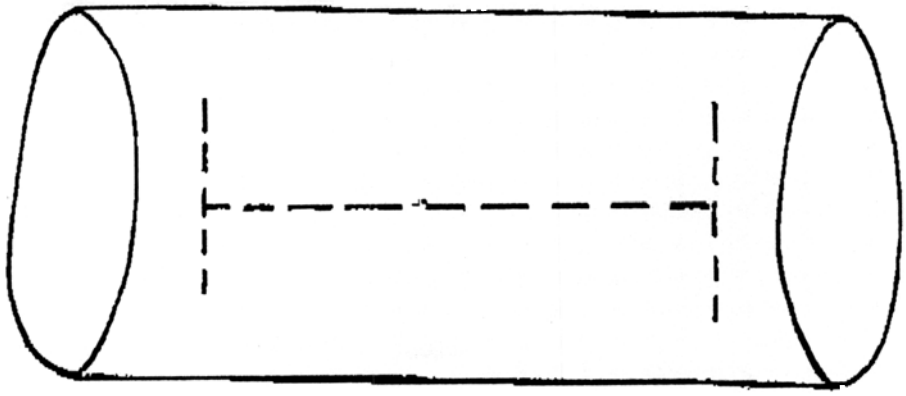
Solar energy is energy that comes from the sun. Every day the sun radiates, or sends out, an enormous amount of energy. People have harnessed solar energy for centuries.

A solar collector is one way to collect heat from the sun. An activity to show how to collect the energy from the sun and change it to heat for cooking is to make a *solar cooker.*

Special note: You will need an adult to help you prepare your solar cooker.

Supplies needed:
empty, clean, foil lined cardboard snack container
nail
hammer
knife
unpainted coat hanger
hot dog or marshmallow

Directions:
Use the nail to punch a hole in the center of each end of the snack container.
Use the knife to cut the side of the container, stopping about 1/2 each from each end.
Use the knife to cut a line parallel to the ends about 1 inch above and below the previous cut.
Fold the flaps out.
Cut the coat hanger about 3 inches longer than your container.
Hot pad



cut on dotted lines

fold flaps outward

Procedure:

Insert the coat hanger through one end of the container.
Place the hot dog or marshmallow on the coat hanger.
Push the coat hanger through the other end of the container.
Place the container in a sunny location with the open side facing the sun.
When food is cooked - enjoy!

Caution: Be careful of high temperatures. The coat hanger and the food will get quite hot.

Extension:

- Place containers in various locations. Have each student track the length of time it takes their hot dog/marshmallow to cook.
- Place containers in the same general area. Face some towards the sun and some away from the sun. Does this make a difference?
- Cover the hot dog with black foil. Does this make a difference in the cooking time?

For more information about Solar Energy and other energy sources contact:

Karen Reagor, Coordinator
KyNEED Project
P.O. Box 176055
Covington, KY 41017-6055

A Hot Contest

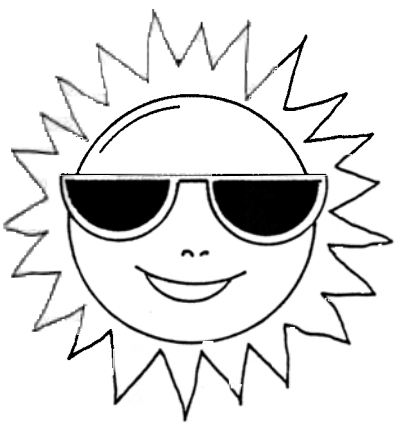
Compare temperatures over different surfaces.

Objective:
Compare how different surfaces absorb sunlight.

Ages:
Primary

Materials:
- ***6 thermometers***
- ***6 Styrofoam cups***

Subject:
Science



Mountains, valleys, glaciers, forests, oceans, lakes, buildings, highways, ponds, lawns, and beaches are just a few of the features of the earth's surface. And each one absorbs different amounts of sunlight. Generally, darker surfaces absorb more sunlight than lighter ones. Different textures and shapes also influence the amount of sunlight absorbed.

The more sunlight a surface absorbs, the hotter it will get and the more the air just above the surface will heat up. In this activity, your group will find out how different surfaces affect the air temperatures above them.

Make a list of six different surfaces on the chalkboard or on a large piece of paper. For example, you might list blacktop, sand, soil, concrete, water, and grass. Tell the group that they will get to go outside to measure the air temperature over each surface. But first they have to guess which surface they think will be the warmest and which will be the coolest. Have each person write his or her guesses on a piece of paper.

Then divide them into six teams (one for each surface). Give each team a thermometer and a Styrofoam cup. If the thermometer has a backing, have them push the backing and the thermometer through the bottom of the cup. (If your thermometers don't have backings, have the kids poke pencils through the bottoms of their cups and then push the thermometers in from the bottom.) To take a measurement, have them set their cups on the ground, topside down.

Tell the teams they'll be taking two measurements, one in the sunlight and one in the shade. Have each team set a cup, topside down, over each of these surfaces. They should leave the cups in place for about five minutes, then write down the temperature readings of both thermometers.

When all the teams are finished, write the temperatures next to the list of surfaces. How well did the kids guess which were the warmest and which were the coolest surfaces? Explain that dark colors get warmer because they absorb more sunlight. That's why many people wear dark-colored clothes in winter and light-colored clothes in summer.

PLANTS AROUND A BUILDING

BIO KEY

Observation
Comparison
Analysis

ACTION

1. Read the challenge to the youngsters.

2. Divide the group into teams of three or four, and give a small outline map to each team. Help everyone understand the orientation of the map to the building.

3. Give a set of Action Cards to each team, and tell them to find as many examples of the situations described on the Action Cards as they can. The teams should mark the locations on their outline maps.

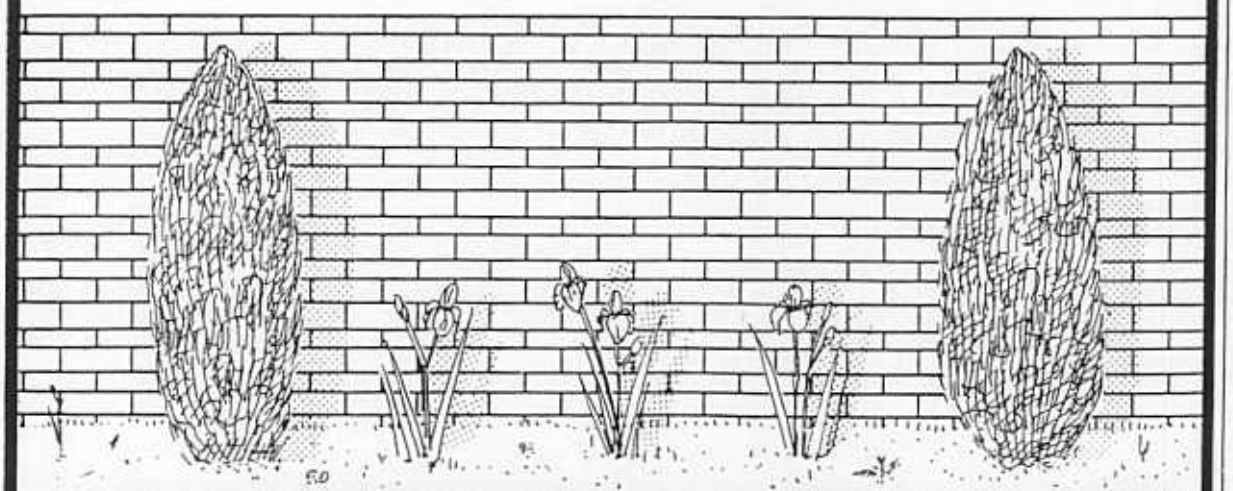
4. We have listed the Action Cards here for your convenience. *Don't read them to the youngsters!*

- Where are the biggest (largest or tallest) plants? Mark their positions on your map with a "B."
- Where are the smallest or shortest plants? Mark their positions on your map with an "S." Why do you suppose these plants are short?
- Where are there lots of plants? Mark their positions on your map with an "L." Why do you suppose there are so many plants in this spot?
- Do weeds or moss grow well in one place and not in another? On your map, mark the place where they grow with a "W" or an "M." Why do you think the weeds or moss grow well here?
- Where do plants not grow or seem to grow poorly? Mark those spots on your map with a "P." What do you think may be causing this?
- Which plants are helped or damaged by humans? (Hint: Look for broken branches or places that are watered regularly.) On your map, mark those plants with a "Help" or "Hurt."

5. After fifteen or twenty minutes, have the teams transfer their data to the large outline map.

BUILDING IDEAS

Referring to the large outline map, discuss what might be responsible for the growth patterns recorded. (If the youngsters need help, mention a couple of the environmental factors noted in the "Background" section.) Use the children's suggestions as examples of ***environmental factors,*** and explain that these factors make up the environment, which affects plants. Environmental factors include physical conditions, the presence of plants and animals, and non-living objects. Discuss a few of these factors and how each may be affecting the plants at different parts of the building. If possible, compare the same kinds of plants at different locations.

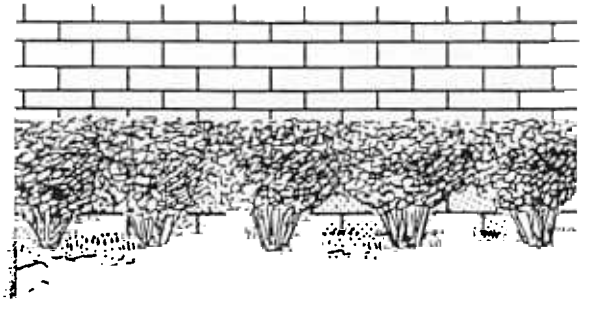


BACKGROUND

Plants are affected by the environment. The environment is everything that surrounds an organism: physical conditions such as temperature, moisture, light, and wind; the presence of other plants and animals; and non-living objects such as rocks, metal, and plastic. All of these factors that make up an environment and affect the growth of plants and animals are called ***environmental factors.***

Plants around buildings are often put there by humans. We do this to make the buildings look better, to provide shade and protection, to prevent soil erosion, and for other such reasons. The location of plants in relation to the building can determine how well the plants grow. Rain from roof gutters can flood plants. A building can protect plants from the wind, or the building might create destructive wind patterns that damage the plants. Buildings can prevent light from reaching plants, and surrounding sidewalks can create so much foot traffic that plant branches are broken. If there are no sidewalks, people walking by can compact the soil, thus preventing the plants from growing. These are just a few of the environmental factors affecting plants around a building.

CHALLENGE: DISCOVER HOW THE ENVIRONMENT AROUND A BUILDING AFFECTS THE GROWTH OF PLANTS.

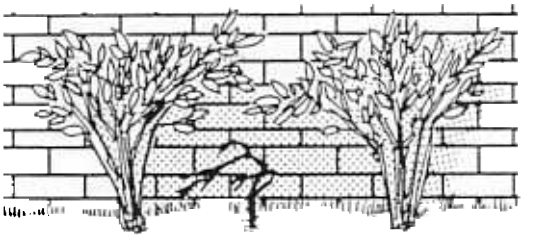


MATERIALS

For each team of three or four:
1 outline map of a building and the area around the building†
1 set of Action Cards

For the group:
1 set of crayons*
1 large outline map†
1 sheet of Action Cards*

† See the "Preparation" section.
* Available from Delta Education.



PREPARATION

Group Size. This activity is suitable for any size group.

Time. Allow thirty to forty minutes for this activity.

Site. Select a building with many plants around or near it.

Materials

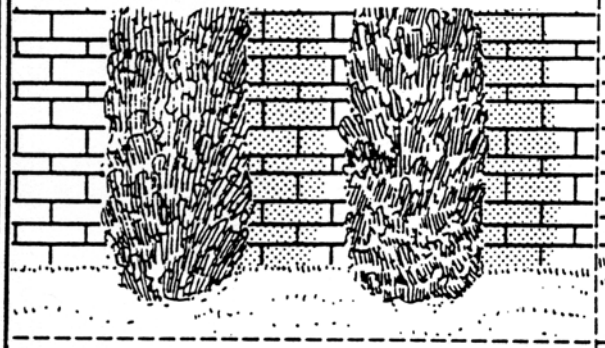
1. For each team of three or four participants, make one outline map of the building and the land around it, including significant nearby structures. This map should be about 30 cm x 22 cm.

2. Prepare one large outline map about 100 cm x 60 cm in size so the entire group can easily see and work on it.

3. Make one set of Action Cards for each team. If you want, include some cards of your own that reflect features of the particular building you have chosen.

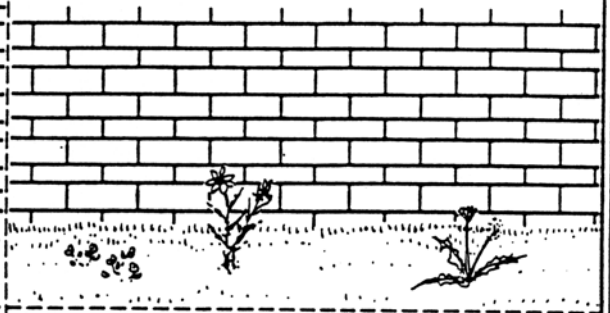
Plants Around a Building
Action Card

Where are the biggest (largest or tallest) plants? Mark their positions on your map with a "B."



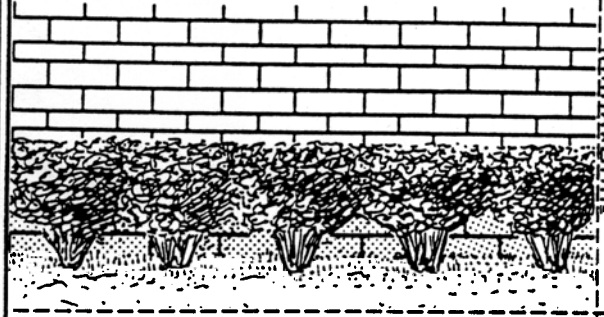
Plants Around a Building
Action Card

Where are the smallest or shortest plants? Mark their positions on your map with an "S." Why do you suppose these plants are short?



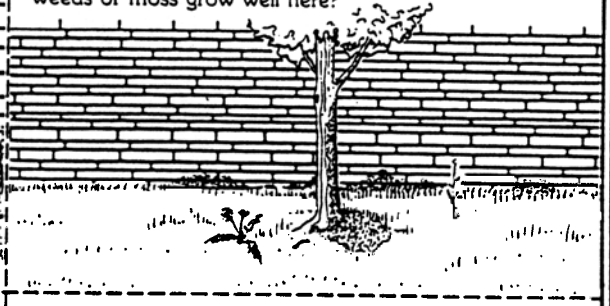
Plants Around a Building
Action Card

Where are there lots of plants? Mark their positions on your map with an "L." Why do you suppose there are so many plants in this spot?



Plants Around a Building
Action Card

Do weeds or moss grow well in one place and not in another? On your map, mark the place where they grow with a "W" or an "M." Why do you think the weeds or moss grow well here?

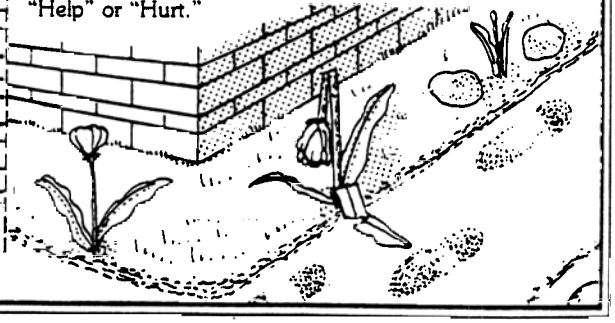


Plants Around a Building
Action Card

Where do plants not grow or seem to grow poorly? Mark those spots on your map with a "P." What do you think may be causing this?

Plants Around a Building
Action Card

Which plants are helped or damaged by humans? (Hint: Look for broken branches or places that are watered regularly.) On your map, mark those plants with a "Help" or "Hurt."



Activity 6: Search for Food

Students will do the following (KERA goals in parentheses):

examine the school grounds for sources of food for insects, beetles, butterflies, birds, squirrels, etc. (1.3)
brainstorm ideas about how food sources could be added to the school yard (5.2)
evaluate added sources of food to select the more successful ones (5.1)
add a symbol for food to the model of a habitat (2.4)

Materials needed

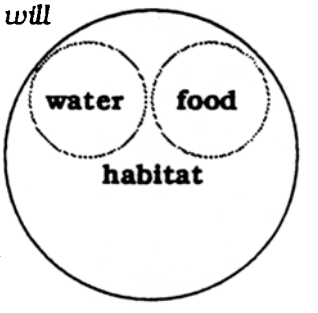
food for a bird, squirrel or other animal
crayon or marker
the model of a habitat from Activity 3

Procedure

1. Have students examine the school grounds for plants that animals eat (e.g., nectar in flowers, seeds, leaves, etc.). Record findings. *What insects or birds or other animals might eat them? What food source is not there?*

2. Brainstorm ideas about how a food source could be made available for such animals as insects, butterflies, birds, or squirrels in your school yard so they won't have to go somewhere else to find it. List all responses. *Why do we want to provide a source of food for them?*

3. Evaluate the list of suggestions: *What food can we add now? What would be easy to do?* (Suggestion: Several kinds of seeds, such as corn, sunflower and thistle, could be placed in shallow containers to see which seeds were eaten.) *What can we continue doing so that the animal will be able to stay?* Select two or three of the ideas that the students think are best, and set them up in the school yard. Check each day. Observe for evidence of use by insects, birds or animals. Record observations. *Which foods are the most successful? How do you know?*



4. Add the word "food," or a symbol for food, to the model of a wildlife habitat.

5. The next step in providing a suitable habitat for insects, birds or animals on your school grounds is adding a feeding station. Use the results of your investigation to determine the best approach. Later, you might change the location of the feeding station, but it will remain an important part of the wildlife habitat system. Make a plan for regularly replenishing the food supply.

6. Reflect on experience: *What did we do?* (List all responses.) *What did we learn about the role that food plays in habitats?* (List all responses, or use as an open response question for a portfolio entry.)

Extension ideas

Language Arts: Have students write an entry about the need for food in their habitat notebook.

Movement, Science: Play "Food Chain Tag." Divide the class into three groups. Assign to each group a different color of card. On the card is the name or picture of the animal the color represents. For example, eagles (orange), lizards (green), crickets (brown). Eagles eat only lizards. Lizards eat only crickets. Crickets eat only grass, represented by popcorn. Give each student a bag that represents the animal's stomach. Each animal must hunt for food and "eat it" by putting the card in the bag. If an animal (prey) is "eaten," it must empty its bag into the bag of the animal (predator) that has "eaten" it. But each animal must also try to avoid being eaten. Play the game outdoors in a specified area. Designate a free zone, in which dead animals wait and live animals can be safe from predators. Spread popcorn over the game area. At the signal to begin, crickets have 20 seconds to begin eating (putting popcorn in bag). Then, lizards enter the game and have 20 seconds to feed. Then eagles enter the game. The game ends when all prey are eaten, or are dead because they didn't have food in their stomachs (bags). *What did we learn? What would happen if there was no popcorn?*

Music: Write a song about how every living thing needs food, and we all prefer different food.

Science, Language Arts: Set up an ant farm. Use different kinds of food for the ants. Observe which food they prefer. Have students record their observations. *What did we learn?*

Literature: Read *The Tale of Two Bad Ants* by Chris Van Allsburg, 1988. Houghton-Mifflin, Boston. This story is about two wayward ants and their search for food.

Play "How Many Bears Can Live in This Forest?" 1992, *Project WILD*, Western Regional Environmental Education Council, Boulder, CO.

Science, Language Arts: Have students research an animal native to their region. Include in the report the food the animal eats and what would happen if there was not enough food, or it disappeared.

SUGGESTED SCORING RUBRIC			
Emerging	Developing	Competent	Proficient
The student chooses an animal native to the region.	Emerging level, plus lists one food that the animal consumes in order to survive.	Developing level, plus the student says that the animal would die if the food supply was not enough or disappeared.	Competent level, plus the student includes the impact of the animal loss on other animals, or in plants.

Rainy-Day Hike

■ **Grade Level:**
Upper Elementary, Middle School

■ **Subject Areas:**
Earth Science, Environmental Science, Geography

■ **Duration:**
Preparation time:
Part I: 30 minutes
Part II: 30 minutes

Activity time:
Part I: 50 minutes
Part II: 50 minutes

■ **Setting:**
Classroom, schoolyard

■ **Skills:**
Gathering information (collecting, observing); Organizing (mapping); Analyzing; Interpreting

■ **Charting the Course**
This activity provides a good introduction to watersheds. Students make a model of a watershed in "Branching Out!" Students can investigate the possible effects of the run-off from their schoolyard in "A-maze-ing Water." Following this activity, students can explore aspects of nonpoint source pollution in "Sum of the Parts."

■ **Vocabulary**
watershed, nonpoint source pollution

What do a puddle on your playground and a nearby lake or stream have in common?

Summary

Students are introduced to the concept of watersheds by collecting data about water flowing over school grounds.

Objectives

Students will:

- identify the watershed in which their school is located.
- explain the role the schoolyard plays in the watershed.

Materials

- *Maps of the local community, showing streams, lakes, and topography*
- *Drawing paper*
- *2 sets of copies of the Legend*
- *Waterproof outerwear*
- *Clipboards or sturdy cardboard with rubber band to secure paper* (Tape 2 pieces of cardboard to form a book; students can close map inside cardboard to keep it dry.)
- *Plastic wrap*
- *Pencils*

Making Connections

Students may be familiar with the idea of a watershed, but unaware that they live and attend school within one. Observing water flowing through and collecting on their school grounds provides students with direct experience in their watershed.

Background

Puddles, streams, and lakes all have something in common. They collect water that has drained from watersheds. Watersheds are like funnels; they are drainage basins where surface water runs off and drains into a common collection site. Watersheds are separated from each other by land forms (ridge lines or mountain divides). Water falling on each side of the divide drains into different watersheds and collection sites.

Surface runoff flows over a school's grounds on its way to the collection site (e.g., a river); therefore, schoolyards are part of a watershed. (Puddles are the collection sites of mini-watersheds: land surrounding puddles are the mini-drainage basins that empty into the puddle.) When the puddles overflow or the soil becomes saturated, water is released.

Often, materials carried by water to the school grounds (e.g., litter, twigs, leaves, oil) are left behind. Surface water leaving the school grounds may carry materials to the collection site of the watershed. These materials include soil, leaves, and twigs; litter; oil and gasoline from parking lots; and fertilizer from lawns.

As water flows from the school grounds, it combines with runoff from other land areas within the drainage basin. Materials from these other places are added to the water. While some substances decompose, settle out, or are filtered by soil, other matter continues to travel long distances downstream. Organic materials carried by the water nourish aquatic life. Some substances are toxic, however, and can endanger organisms consuming or living in the water.

Contaminants whose entry point into the watershed is difficult to locate are classified as nonpoint source pollutants. Along with residential areas, agricultural fields, and paved parking lots, school grounds can contribute nonpoint source pollutants. The schoolyard contributes point source pollution when the source of the pollutant can be traced back to a specific location on the school grounds (e.g., sewer, ditch, pipe).

Warm Up

Show students a map of the community and identify local rivers or lakes Ask the class if they think a connection exists between their schoolyard and these bodies of water. Tell the class they will take a fair-weather and a rainy-day hike, to study what happens to the water that falls on and flows over their school property.

Although plans for a rainy-day hike will generate student excitement, the wait for a wet day may prove discouraging. The lack of rain offers the opportunity to discuss with students the idea that people do not control the rain or other aspects of the weather. Remind students that even if people cannot "control" the weather, they can often predict it.

Have students listen to, watch, or read weather reports. When is rain predicted? Students can mark the calendar with the date and continue "preparations" for the hike.

The Activity

1. **In planning for the rainy day, have students create a map of the school grounds. Divide the grounds into sections and assign groups to map each area.** Orient students to which direction is north so all maps face the same direction.

2. **Remind groups to include the following: school buildings, parking lots, designated playgrounds, natural areas (trees, grass, flower gardens), with emphasis on water features like streams, temporary and permanent ponds, and constructed water features like bird baths and fountains.**

3. **After students have completed their initial mapping, if there is a school building in their area, have them consider the following questions.** Can they determine where the water that falls on the roofs goes? Does it flow off the roof into gutters that lead to waterspouts or does it fall directly onto the ground? Have students place an "X" on the buildings to indicate the location of waterspouts.

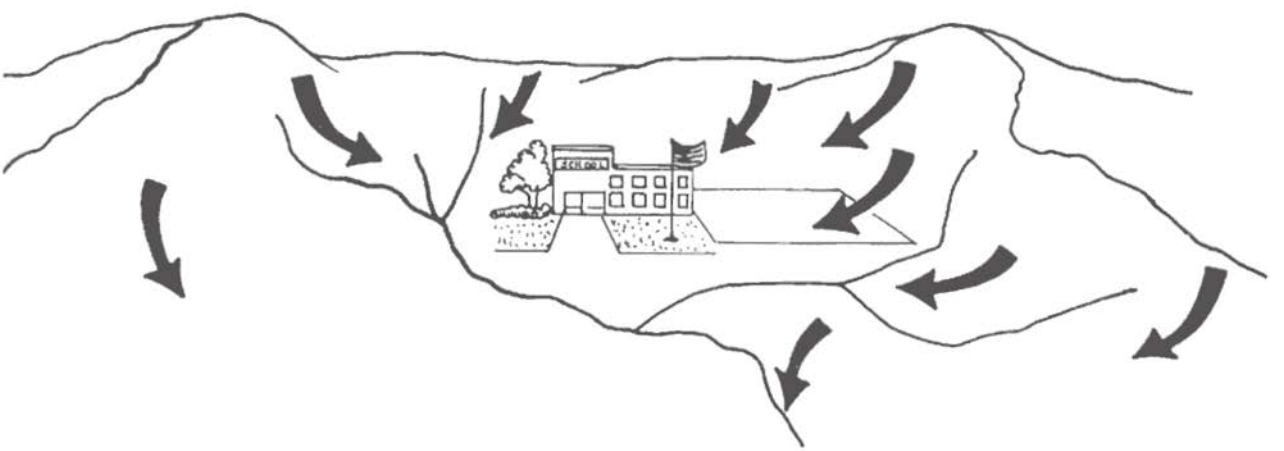
4. **Make two copies of student maps, one for the fair-weather hike where students make predictions of water flow and one for the rainy-day hike when students check their predictions.**

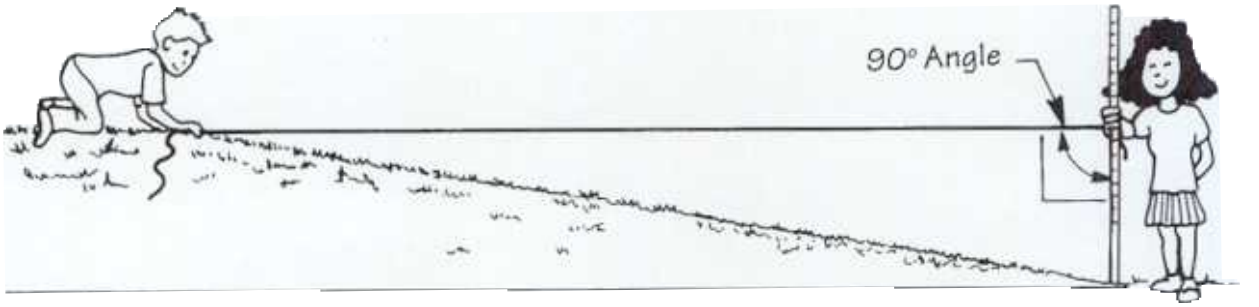
5. **For the fair-weather hike, give each group a copy of their mapped section and the *Legend*. Have each group predict the direction water will flow through their section.** Where do students think water will be stored? Are there ponds or low spots?

6. **Have students survey the ground area of their section for possible sources of point and nonpoint contamination (oil stains on parking lots, trash, tainted soil near the school dumpster). What materials could be on the roof of the school building that could be washed off during a rain (bird and rodent droppings, insects, dirt, roofing materials, leaves, twigs, etc.)?**

7. **Assemble the map sections from the groups and post in the classroom. Have them summarize their predictions.** How do the predictions of individual groups relate to each other? Where do students think water flows onto the school grounds? Where will it flow off the school grounds?

1. **On a rainy day, have students dress properly; take them outside and begin a simple tour of the school grounds. Have students identify patterns of water flow.** Discuss what influences the direction water moves. Have students:





- note slopes, depressions, cracks in the sidewalk, erosion trails, rocks, buildings, gardens, trees, etc.
- compare how fast or slow water flows in different places.
- identify ways water affects the surface of the school grounds (e.g., watering plants, eroding soil, piling up litter, washing away litter).
- note water flowing from the roofs of buildings and waterspouts.

2. **Divide the class into their original groups and give each group a copy of their unmarked map section and the *Legend*.** Have students indicate the following on their maps: direction and patterns of flowing water; natural and unnatural materials being carried onto and off their study area; and areas of standing water. Remind students to use pencils—ink runs. They can cover their note pads with plastic wrap or cardboard when they are not writing.

3. **When students have completed their investigations, assemble the map sections and post.** Arrows of adjacent map sections should line up. If they don't, discuss reasons for discrepancies.

▼ *Wrap Up and Action*

Have students summarize the general pattern of surface water as it flows across the school property. They should identify areas where the flow of water is slowed by landforms and vegetation, collects in depressions, and flows off school property. Have them compare the completed map on the rainy-day hike to the map indicating their predictions. How accurate were their predictions?

Referring to a community map, discuss the school's location within a watershed. Trace the likely course of runoff from the school grounds into a local lake or river.

City engineers or planners have information on storm drainage systems, or can identify destinations of storm water runoff from streets and parking lots.

Have the class list uses of water in local lakes or rivers (e.g., drinking water, animal habitat, irrigation, swimming, fishing, etc.). Do any activities occurring on your school grounds affect, positively or negatively, the water moving across it?

Some school property plans incorporate surface water treatment systems, such as detention ponds, to reduce materials carried by runoff. Ask the principal for a copy of the school site plan. Does the plan show the surface water management system for the school?

If students believe their school grounds contribute to erosion or to point or nonpoint source pollution, they may want to develop a plan to improve the area. They can plant trees or a garden, encourage parking lot patrons to keep their cars in tune, promote wise use of fertilizers and pesticides, etc.

Assessment

Have students:

- predict the movement of water and possible contaminants across their school grounds (***Part I***, steps 5 through 7).
- identify the school's location within a watershed or in relation to a body of water (***Wrap Up***).
- list ways the school grounds positively affect water passing through the watershed (***Wrap Up***).
- locate sources of point and nonpoint source pollution on the school grounds (***Wrap Up***).

Extensions

To increase the detail of their study area maps, students may include measurements of slope. Slopes can be classified as level, gentle, moderate, or steep. How does steepness of slope affect rates of water flow, erosion, and sediment load? To measure slope, one student stands at the top of the study area (top of the slope) and another student, holding a meter stick, stands at the bottom. The run or distance between the two students is measured. The student at the top holds one end of a string at his ground level and the other end is

extended to the student at the bottom of the slope. A level is needed to ensure the string is held straight. The point at which the string intersects the meter stick held by the second student is the rise. Slope gradient is calculated by dividing the rise by the run.

$$\frac{\text{rise}}{\text{run}} = \text{slope gradient (expressed as a percentage)}$$

On a community map, have students use pins to locate the school and their homes. Do students share the same watershed address as the school? They can observe surface runoff to see where the water goes. Topographic maps may help locate ridge lines within the community.

K-2 Option

Have students work in small groups to investigate sites of flowing water on the school grounds. They should observe what is in the water. Caution them not to touch the water, especially if the water is running off a parking lot. Children can search the area for natural materials with which to construct tiny boats. Have boat races to see how far and where the boats travel. Students can draw pictures describing what the tiny boat might encounter if it flowed off the school grounds. Discuss reasons why the school grounds must be kept clean.

Resources:

Doppelt, Bob. 1993. *Entering the Watershed: A New Approach to Save America's River Ecosystems.* Washington, D.C.: Island Press.

Dorros, Arthur. 1991. *Follow the Water From Brook to Ocean.* New York, N.Y.: Harper Collins.

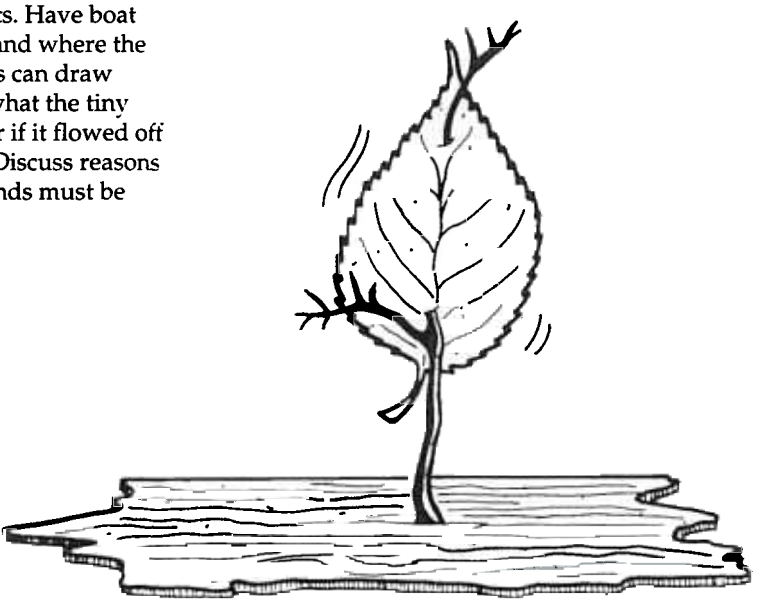
Holling, Clancy. 1941. *Paddle to the Sea.* Boston, Mass.: Houghton Mifflin Company.

Locker, Thomas. *Where the River Begins.* New York, N.Y.: Dial Books.

Miller, G. Tyler, Jr. 1990. *Resource Conservation and Management.* Belmont, Calif.: Wadsworth Publishing Company.

Project WILD. 1992. Activities "Puddle Wonders," "Where Does Water Run Off After School?" and "Watershed." *Aquatic Project WILD.* Bethesda, Md.: Western Regional Environmental Education Council.

Notes ▼



Legend

arrows indicate direction of water flowing onto and away from study area

a leaf indicates natural materials, such as leaves, soil, and twigs, that might have been carried onto study area from another location

a puddle shows where water collects in the study area

a crumpled ball of paper indicates unnatural materials, such as litter, oil, and chemicals, that might have been carried onto the study area from another location

a flower shows things that help slow the flow of water

a shaded leaf indicates natural materials that are being or could be carried away from the study area

a shaded, crumpled ball of paper indicates unnatural materials that are being or could be carried away from the study area

BIRD SONG SURVEY

OBJECTIVE

Students will identify and describe the importance of bird counting as one means of inventorying wildlife populations.

METHOD

Students investigate an area and use bird-counting techniques.

BACKGROUND

People interested in wildlife and its habitat use a variety of techniques to learn about it and to assist in management for its conservation and protection. Some techniques are used to acquire information and some to apply knowledge. Inventory is a technique that is used to acquire information about the number and kinds of wildlife in a given area.

This activity is designed to give students some experience in the use of inventory. Birds are the subject of study. The variety of species and the number of individual birds in an area are good indicators of the quality of that particular environment. Their presence indicates food, water, shelter and space in an appropriate arrangement to suit their needs. "Bird watching" can be a valuable research tool, as well as an aesthetically pleasing activity that brings the student into touch with intangible values.

Age: Grades 9-12
Subjects: Mathematics, Science (Biology, Zoology), Language Arts
Skills: application, classification, comparing similarities and differences, description, discussion, mapping, media construction, observation
Duration: minimum of three 45-minutes periods, not including transportation to bird inventory site
Group Size: up to 30, with need to break into smaller groups for bird watching
Setting: indoors and outdoors
Conceptual Framework Reference: I.D., II.A., II.A.3., II.B., II.B.1., II.B.2., II.B.3., II.B.4., II.D., II.E., II.E.1., II.E.3., II.F., III.A., III.B., III.D., III.D.1., III.D.2., III.D.3., III.D.4., III.D.5., IV.A., IV.A.1., IV.C., IV.C.1., IV.C.2., IV.C.3., IV.C.4., IV.D.2., IV.D.4., IV.D.5., IV.E., IV.E.2., IV.E.3., IV.E.4., IV.E.5., IV.E.10., VI.A., VI.A.2., VI.A.3., VI.A.4., VI.A.5.
Key Vocabulary: inventory, population, management, habitat
Appendices: Outdoors, Field Ethics, Animals in the Classroom

One means of identifying a bird species is by sight, another by sound or song. Male birds of most species sing from conspicuous perches to mark territory, except during the nesting period. With practice, identification of many bird songs can be learned easily.

The major purpose of this activity is for students to recognize the importance of inventory as one technique by which to learn more about wildlife, people and our shared environments. The activity also enhances students' appreciation of wildlife's aesthetic values.

MATERIALS

paper and pencil for note-taking; bird books as reference materials; drawing paper or magazine photos to illustrate final written project
OPTIONAL: binoculars; tapes of bird call recordings and battery-operated player

PROCEDURE

1. This can be an annual project—or a one-time project during a single school year. Offered each year for several years, the students who participate can be contributing to a meaningful record of the natural history of their area.
2. Establish a suitable tract of land and an optimal season for conducting this activity. Check to find out which time of year in your area there would be the greatest variety and number of birds. (Local members of the National Audubon Society are often happy to assist.) Find an area that is most apt to offer a variety of habitats and thus more likely to offer variety in birds as well. Transition areas between differing ecosystems—like pond, woods and meadow areas—are apt to be good locations. Watering sites in desert areas, and city sites with vegetation and water, may serve. If the students are assisting in identifying the most suitable site, remind them of the basic habitat needs of animals, including birds—food, water, shelter and space in an appropriate arrangement. They can use these components as working criteria. (If there is no way to travel except by foot, however, find the best and closest available site.)
3. Invite a member or members of a local bird club (e.g., affiliate chapter of the National Audubon Society) to instruct the class on field study techniques for

bird watching. These people can help the class determine what bird species are common to the area, which most easily identified, which most difficult to spot, any precautions to take in order not to disturb the birds or other wildlife in the area to be studied, etc. As part of the students' preparation for their guests from the local bird club, ask them to bring in bird guides from home (if possible) or from school and local libraries or natural history museums.

4. Try to get recordings of bird songs of selected species. Practice identifying the birds by their songs.

5. Now it is time to visit the site to apply the knowledge and skills the students have been working to acquire. Select a trail, path or road to walk in the area that has an easily discernible starting and ending point. If possible, the students should walk the trail in the early morning, using techniques they were taught by the bird club members in making and recording their observations. Ideally, members of the bird club, parents or other community members can come along to assist as well. OPTIONAL: Take along the recorded tapes of bird songs with a battery-operated recorder. This reference "in the field" is a big help in identification.

6. Repeat the inventory one or more times that morning to try to account for all breeding pairs. The number of singing males identified on each walk should be consistent.

7. Once back in class, have the students compile the results of their observations. Map the site and mark the locations of bird sightings, e.g., using colored dots for birds with an explanatory key. Encourage the students to discuss their observations as well as the feelings they experienced in the process of watching the birds. Also talk about any difficulties they feel they might have experienced in getting an accurate count.

8. As an option—a small group of students might volunteer to compile all the findings in a written format, including magazine photos or sketches of the birds, etc. This booklet could serve as the beginning of a year-to-year record of the inventory of birds in that location at that time of year, and thus could be used by students conducting this project in subsequent years. As a new group of students repeats the inventory each year, the results could be graphed, showing year-to-year changes, if any. Trends could be analyzed, etc. Additional information can be included in this report format, including a map of the area selected for the inventory with the trail and other notable landmarks identified.

EXTENSIONS AND VARIATIONS

1. In one school year, conduct several counts throughout the migration period, checking to see what happens in the area selected. Take counts seasonally, noticing similarities and differences.

2. One or two singing male birds could be followed closely to determine the size of their respective territories. Be sure that students are following rather than chasing the bird. This could be a mapping and mathematics project, using geometry to calculate the area of the bird's territory. Map each location where the bird perches to sing his song and try to determine where he comes into conflict with a neighboring, singing male.

3. Compare the class results with those of statistical count experts, if such research data are available.

4. Send for inventory techniques, counts, trends and management implications for other species of animals from the state or province wildlife agency, etc. Make comparisons with class techniques and data.

CAUTION: Do not disturb the birds; make sure not to disrupt mating, nest-building and nesting activities. Check with local authorities (e.g., the bird club members, state wildlife personnel) for precautions.

EVALUATION

1. Summarize the findings from your study. Why is it important to be able to inventory wildlife populations?

2. Design a wildlife survey plan for conducting a butterfly census.

DRAWING ON NATURE

OBJECTIVES

Students will generalize that wildlife and other animals are important inspiration for art and science.

METHOD

Students use techniques of observation and visualiza tion to record wildlife by drawing.

BACKGROUND

Some significant breakthroughs have been made in recent years with respect to teaching drawing to young people and adults. Betty Edward's *Drawing on the Right Side of the Brain* and Robert McKim's *Experiences in Visual Thinking* are classics in this area, filled with actual instructional activities for use by oneself or with others.

Much of our understanding of science comes from interpreting visual images. The language of science is precise. The images that accompany scientific writing can enhance our knowledge of a subject and add more precision to our perception. Drawings that accompany field notes offer researchers several paths through which to interpret their experiences. The subject is the same, but the information is different. Incorporating drawing into research improves one's observation skills. Good science requires keen observation skills.

Wildlife has been an inspiration for artwork of varying kinds throughout human history. Skills for observation of wildlife are also important to the poet and scientist.

Age: Grades 7-12
Subjects: Science, Art, Social Studies, Language Arts
Skills: application, observation, drawing (visual-spatial skills, motor development), discussion, generalization, invention, kinesthetic concept development, media construction, synthesis, visualization
Duration: one 45-minute period
Group Size: any; individual student project
Setting: outdoors
Conceptual Framework Reference: II.A., II.A.1., II.A.2., II.A.3., II.A.4., II.B., II.B.3., II.B.4., II.E., II.E.3., II.F., IV.D.2., IV.E., V.A.4.
Key Vocabulary: observation, visualization, inspiration, art, science
Appendices: Outdoors, Field Ethics

The major purpose of this activity is for students to recognize the value of wildlife as an inspiration for art and science as well as to develop personal skills.

MATERIALS

drawing materials

PROCEDURE

1. This activity is best done in an outdoor setting and requires students to be able to observe an animal, preferably wildlife.
2. Tell students that they are going to be able to try their drawing skills. After the groans which may follow—since so many people are sure they can't draw at all—insist that you're serious. Encourage them not to worry about drawing but simply to enjoy this activity as a process of observing and recording wildlife.
3. Provide each student with drawing materials. See "Wild Words" to use personal journals for this activity.
4. Take the students to a park, wooded area, natural desert or even an area of the school grounds—if there is some chance they can each see an animal at the site. More than one student may see the same animal. If sites are limited, the wildlife may be a line of ants, a cricket or grasshopper. If you can't find animals outside in a natural setting, then do the best you can—perhaps by going to a zoo or using an aquarium at school. You're looking for the animals in some kind of habitat. (Once the students are familiar with the technique, animals at home can provide opportunities to practice.)
5. Give the students their instructions:
   - Find an animal. Watch the animal as closely as you can. Look at its color, form and body shape as if it were an outline against the sky.
   - Close your eyes and try to reconstruct the animal in your mind. See its color, body shape, etc., again in your mind. Remember—this time your eyes are closed.
   - If, when you open your eyes, that animal is gone—find another animal and start over. Find an animal. Watch the animal as closely as you can, etc.

- After you've watched it very closely, paying particular attention to the shape of its body as if it were against the sky in an outline, close your eyes again and see the animal in your mind as clearly as you can.
- Now, try to draw just the body shape of the animal. Draw the outline of the animal as you would see it if it were surrounded by sky. Draw that outline of the animal's body on your sketching paper. Sometimes it helps to look at the animal—and not at the paper—when you are drawing the animal's outline.
- Now that you've got the body outlined, that's the hardest part! Now fill in some of the body parts, still working more on outlining shapes than in filling in any details.
- Now fill in some of the details of the animal's surroundings—still first closing your eyes to see the shape clearly before you outline it on your paper. You might outline the limb of a tree for a bird or the horizon line for an ant!
- Now fill in as many details as you like. Your drawings may remain a pencil sketch, or you may use a felt-tip black pen for a pencil-and-ink impression, or you could use chalks or crayons to add color.

NOTE TO TEACHER: Try to be supportive and encouraging of each of the students in this process, without being too evaluative and judgmental. A number of the students who have never been able to draw anything with any feeling of success will experience some real delight with this activity. All of the students should be able to come up with something on paper they can be proud of. Encourage the students to keep using this technique—keeping a journal of words and images, for example.

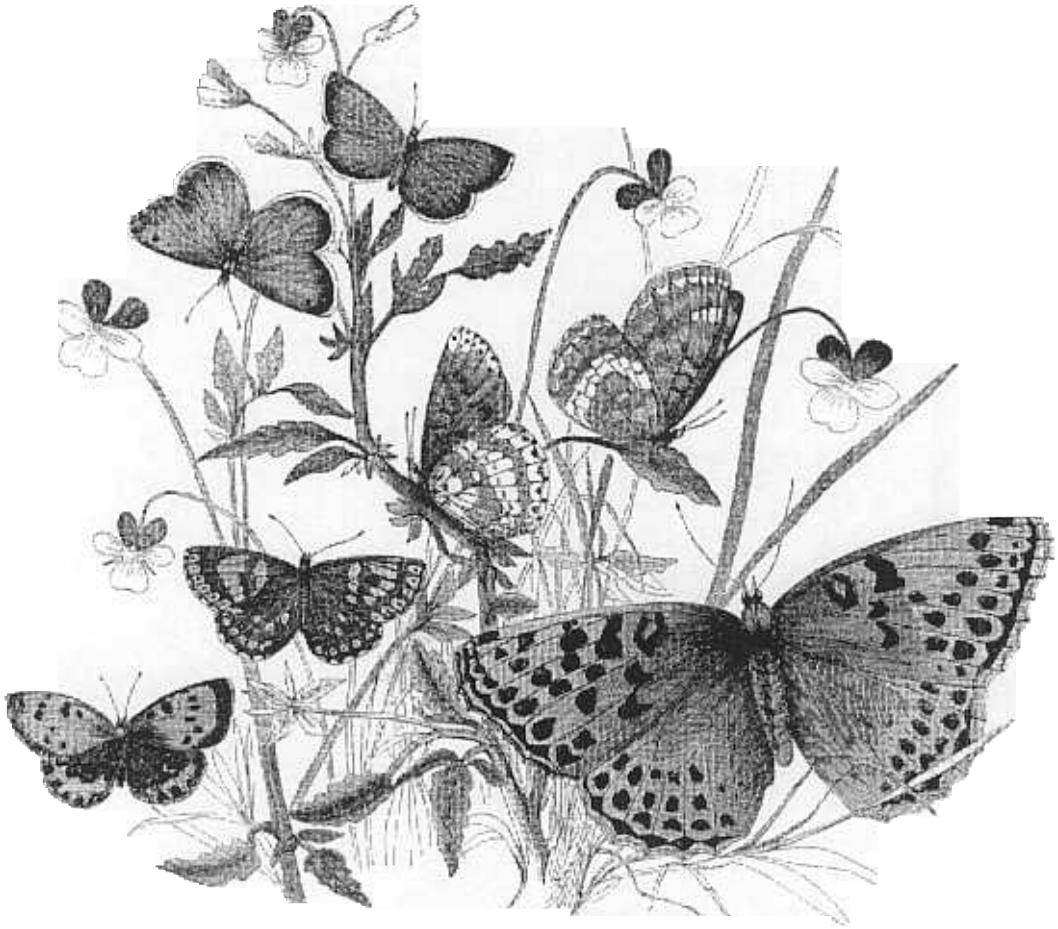
6. Once their work is completed, talk with the students about what happened while they were working on their projects—what they saw, how they felt, etc. Talk with them also about the importance of wildlife and all of nature as a source of inspiration for varying forms of art and science.

AQUATIC EXTENSIONS

1. Use these techniques for enhancing observations of aquatic wildlife and habitat. Include drawings of aquatic organisms in your own "Field Guide to Our School's Aquatic Wildlife" or "Field Guide to Our Community's Aquatic Wildlife."
2. If you have an aquarium, or can visit one, use these techniques to record your observations visually!
3. At an aquarium, pick one feature of aquatic organisms to investigate. Make drawings of this feature in several different organisms. For example, try features used for locomotion in underwater animals!

EVALUATION

A group of people were discussing endangered plants and animals—that is, those that are very close to becoming extinct. Some of the people felt that we should preserve and protect all kinds of plants and animals because we might learn that they could be very useful to us for chemicals, medicine, food and clothing, or that they are a necessary part of our ecosystem. Other people said that we did not need all those plants and animals and we should not worry about losing them. Suppose you are an artist in the group and you want to express your opinion about preserving plants and animals. What will you say?



Appendix: Habitat Improvement Program in Kentucky

There are many different kinds of habitat improvement and study projects in Kentucky. Some students build feeding stations for birds and small mammals like squirrels, clean or study a stream or creek, develop a pond or wetland, have an erosion control demonstration area, or provide brush piles for wildlife shelter.

In other outdoor classrooms, students increase the quantity and diversity of plants, compost leaves and grass clippings, establish native herbaceous wildlife plantings, care for existing trees, erect nest boxes and plant shrubs and trees for perch areas, establish a wildflower plot, or establish butterfly and hummingbird gardens.

Other ideas include having students set aside an area for natural plant succession, plant food beds using native species, use archeological techniques to study specific site characteristics, construct a habitat study area with Native American Indian themes represented, or design and develop an educational trail.

Recently, the Kentucky Department of Fish and Wildlife Resources initiated the Habitat Improvement Program. The name of this program is **Backyard Wildlife**. The purpose of the program is to help individuals and schools create habitat for wildlife in their yards and to recognize those who are successful. Those who participate in this program will receive a Habitat Kit and fact sheets as they are developed through this program. Currently included in the Habitat Kit are

- Establishing Wildflowers From Seed
- Nestbox Instructions
- Project Martinwatch
- Sample Plan for Butterfly Garden and Hummingbird Garden
- Outstanding Native Plants for Backyard Habitats in Kentucky:

  Berry-Producing Trees, Shrubs, and Woody Vines; Food Plants and Puddle Use of Kentucky Butterflies; Mast and Seed-Producing Plants; Native Evergreen Trees and Shrubs; Backyard Habitat for Butterflies; Butterfly Caterpillar Foods; Butterfly Nectar Flowers; Food Plants for Kentucky Moths; Hummingbird Plants; Native Grasses and Legumes; Invasive Exotic Plants in Kentucky; Habitat Niches Used for Nesting by Backyard Birds; and Water for Wildlife.

There is limited funding for schools that incorporate wildlife habitat into an outdoor classroom project. For criteria and available funding for school participation, contact ***Backyard Wildlife*** at 502-564-4336. Or write:

Backyard Wildlife
Kentucky Department of Fish & Wildlife Resources
#1 Game Farm Road
Frankfort, KY 40601

There are three sections of the Habitat Kit included in this Appendix. A Glossary of terms used in this material follows:

mast:	nuts, such as acorns, accumulated on the forest floor
predator:	an animal that kills and eats animals
vegetation:	plant life or total plant cover
cover:	something that protects or shelters an animal
overstory:	tall trees that form a canopy
understory:	medium-sized trees and shrubs between the canopy and the ground cover
herbaceous:	a plant that has little or no woody stems
mesophytic:	describing plants that grow in medium conditions of moisture
mixed mesophytic:	describing a variety of plants that grow in medium conditions of moisture (typical of much of Kentucky)
savanna:	grassland containing scattered trees and drought–resistant undergrowth
exotic:	not native to the place where found
invasive exotics:	non-native plants that spread out of control and replace other plants

Guidelines For Creating Backyard Habitat

The essential components of wildlife habitat are food, cover, and water. The way these components are arranged in the landscape will dictate the amount of space available for wildlife to raise their young and hide from predators. In natural habitats, vegetation supplies much of the food and cover used by wildlife. Overstory trees, understory trees, shrubs, vines and herbaceous plants all provide unique habitat "niches" used by different wildlife species.

Generally, a yard with a high diversity of plants arranged in in dense plantings will attract more wildlife than a yard having only a few kinds of plants scattered about. A yard with lawn grass and large shade trees will be used by fewer wildlife species than a yard that also has small trees, shrubs, tall grasses and wildflowers. A yard that has a diversity of vegetation arranged in borders, islands, clusters or other plantings that offer dense cover, will attract more wildlife than a yard with a few widely scattered plants.

Where you live will influence the type of habitat you will be able to create and the kinds of wildlife you might expect to attract to your yard. In nature, plants and animals live in "natural communities" that provide all of their life requirements. Examples of some natural communities in Kentucky are the tallgrass prairie, mixed mesophytic forest, Bluegrass savanna, and bottomland hardwood forest. Some communities are found throughout Kentucky, while others are restricted to certain regions of the state.Cypress swamp, a type of wetland community, occurs only in far western Kentucky, and many of the plant and animal species found in this habitat, such as the tupelo, bowfin, and green treefrog, occur nowhere else in the state. The mixed mesophytic forest occurs in eastern Kentucky where plants that require acid soils, such as rhododendrons, azaleas and mountain laurel, are common and easy to grow. Much of central Kentucky originally consisted of bur oak/blue ash savanna, while over three million acres of prairie ran in a loop from Louisville south to Bowling Green and west to Paducah. If you grow many of the plants native to your region of the state, you might expect to attract species of wildlife that normally use those plants.

Food and Feeding

Plants are a major staple in the diet of many wildlife species, from insects to deer. It seems that some part of every wild plant is found in the diet of one or more wildlife species or the prey they consume. Bark, stems, foliage, fruits, nuts, seeds, buds, nectar and even sap are all important wildlife foods.

Native plants are excellent choices for wildlife food plants. The term "native" refers to plants that occurred in Kentucky, to the best of our knowledge, prior to European settlement. Native plants are adapted to the local climate and soils, which makes them easy to grow with minimum maintenance. They are efficient at using naturally available amounts of water and nutrients, and well established plants rarely require watering or fertilizing. Native plants are naturally

serve water and eliminate the need for chemical fertilizers and pesticides that pollute the environment and kill beneficial as well as nuisance wildlife.

Native plants are important to the survival of many wildlife species. While some wildlife will eat almost anything that's available, others are very particular about what they eat. Some butterfly caterpillars, for example, will only feed on the leaves of a single species of native plant, and others on a specific group of plants, such as violets or milkweeds. The more native plants in the landscape, the more wildlife diversity is sustained.

Planting trees and shrubs that flower and fruit at different times of the year adds interest to the landscape and provides year-round food supplies. The tulip tree produces flowers that provide nectar for bees and hummingbirds, leaves that are eaten by the caterpillars of the fritillary butterfly, and buds and seeds that are relished by songbirds. Berries produced by elderberry, wild cherry and mulberry attract orioles and mockingbirds and those that fall to the ground are eaten by small mammals, turtles, and ants. Nuts, berries and seeds which remain on plants over winter are valuable survival foods for many resident wildlife species. Sumac, corralberry, and red cedar berries are good late winter emergency foods.

Herbaceous plants are also important wildlife foods and add color and texture to the landscape. Tender young greens are a nutritious salad for insects, rabbits and other mammals. Wildflowers attract many kinds of butterflies, moths and bees to their nectar and are an important food for caterpillars. The seeds of wildflowers and grasses are eaten by many kinds of birds and small mammals.

In addition to plant foods, wildlife can be enticed to the yard using artificial feeders. Feeding stations not only attract wildlife for close-up viewing, but can be a valuable food supplement when winter food becomes scarce or while landscape plantings are becoming established. There are many kinds of feeders on the market today, designed to hold different types of feed and attract different bird species. A combination of feeders of varying sizes and types will attract the greatest variety of birds. Feeders should be hung high enough above the ground to discourage predators and have a roof to keep the food dry and disease-free. Large platforms are preferred by blue jays, woodpeckers, grosbeaks and grackles, while smaller feeders are used by cardinals, finches, titmice and chickadees. Tube feeders designed to hold thistle, sunflower, or peanut seeds will attract goldfinches, purple finches and chickadees; Audubon makes one that is house finch-proof. There are also specially designed tube or "saucer" feeders for hummingbirds and orioles that can be filled with a sugar solution. Suet in a wire feeder attached to a tree limb or suspended in nylon netting will attract woodpeckers, nuthatches and even mammals (including neighborhood dogs if they aren't hung high enough).

Squirrels can be frequent visitors to bird feeders and may chase the birds away. Squirrel baffles on feeders and feeders designed to repel squirrels are one option. Another is to offer some favorite squirrel foods such as corn cobs, peanuts or peanut butter in a location distant from your bird feeders. Suspended feeders discourage raccoons and opossums, but even pesky wildlife need help sometimes, so consider setting up a mammal feeding station away from the house. In deer country, a salt block and corn may entice deer out of nearby woods for observation.

Although food supplies are often most critical in winter, most suburban areas do not provide enough food to sustain a diversity

of wildlife in all seasons, so consider feeding year-round. During warm weather, be sure to keep feeders clean using a weekly scrubbing with warm, soapy water. Hummingbird feeders should be emptied and cleaned out every 3-4 days.

Cover

The more types of cover you can provide in the backyard, the more kinds of wildlife will take up residency there. Plants that provide food can also provide cover. Trees and shrubs provide shelter from weather and predators, convenient perches for resting or roosting, and places to raise young. Loose (exfoliating) bark provides shelter for bats, butterflies and other insects. Large overstory trees are used by nesting tanagers, while mockingbirds and catbirds use smaller trees and shrubs. Some species, such as the wood thrush, nest on or near the ground beneath dense shrubbery. Evergreens are excellent winter cover and help block winter winds; when situated on the north or northwest side of the house they can help conserve home energy.

Natural cavities are valuable nesting and denning sites for many species of amphibians, birds, and mammals. Some species, most notably woodpeckers, excavate their own cavities in living, dead or dying trees. Other species, such as flying squirrels, chickadees and bluebirds, use abandoned cavities in trees, fenceposts or other structures. Different species require different size cavities and cavity openings. As can be expected, smaller bird species prefer small cavities with small entrance holes that prevent entry by predators, while larger species require large trees for their cavities. Fallen trees and debris piles afford additional types of cover for wrens, raccoons, foxes and other species.

In addition to plants, other types of cover are also important to wildlife. A number of bird and mammal species build their nests on rock ledges, and in the absence of such structures will often use porch rafters, window ledges or artificial shelves. Mammals, amphibians, reptiles and a great variety of insects seek shelter in log or rock piles, stone walls and depressions beneath fallen logs or rocks. Certain species of butterflies hibernate as adults or larvae beneath log piles, leaf litter or mulch piles. Some types of structural habitat components, notably sunny logs and rocks, are used not as cover but as body heaters: butterflies, turtles and lizards sun themselves on them to raise their body temperatures, enabling them to become active.

In the absence of natural cavities, cavity nesters will often use artificial nestboxes or ledges. Barn swallows commonly use barn and porch rafters, and peregrine falcons use ledges of city buildings. Plans are available for building nesting or roosting boxes for a variety of birds, bats and mammals. Your *Backyard Wildlife* **Habitat Kit** contains additional information on habitat niches and structures used by nesting birds.

Water

Another important component in the backyard habitat is water. Many kinds of wildlife, particularly fish, amphibians, and many kinds of insects, require an aquatic environment during all or part of their life cycle. Water attracts insects that are important summer foods for amphibians, reptiles, birds and mammals. Many kinds of wildlife also require a source of water for drinking and bathing. The more kinds of water available, the better. Misters, drippers, bird baths, ponds, lakes and streams

are all important water sources. Even a whiskey tub filled with water will be used by frogs and dragonflies. Areas of deeper, permanent water benefit fish, frogs and turtles, while shallow water is used by bathing birds. Certain species of butterflies will congregate around shallow puddles of water or damp sand, soil or mud to obtain minerals. Please refer to the *fact sheet*, "Water for Wildlife" (included in your Habitat Kit) for additional information.

Space

The size of your property will influence the kinds of wildlife you may expect to observe. Many wildlife species will defend an area around the nest or den from intruders. The size of this "territory depends on how much space is needed to provide life's basics: food, cover, water, nest or den sites, and places to romp and to hide from enemies. Some wildlife species (eg., purple martins and great blue herons) are colonial in habit, with many pairs nesting in close proximity to an abundant food supply. Others (eg., pileated woodpeckers and red-tailed hawks) are more solitary in nature. If you have the room, consider providing some secluded areas for the more solitary kinds of wildlife.

A small suburban lot may not attract as many wildlife species as a 5 acre lot. but by landscaping that space with wildlife in mind, you can provide optimum habitat per square foot of space. When neighbors cooperate as a community to provide habitat, even more species benefit. And, when developers plan for greenspace within a new housing development, an even higher diversity of wildlife will be able to live in the suburban environment.

On large sites, it may be possible to create or restore one or more natural communities. Even on a five-acre lot, it is possible to provide prairie habitat for secies such as the meadow vole, prairie kingsnake, bobwhite quail, prairie warbler, yellow-breasted chat, woodcock, grasshopper sparrow, and cottontail rabbit. Place a nestbox in the meadow and you might attract a pair of bluebirds. Predators such as the red-tailed hawk and red fox might visit your prairie in search of prey. If you have a sizable wetland on your property, you may be able to attract red-headed woodpeckers. prothonotary warblers, kingfishers, wood ducks, muskrat and beaver. Install a purple martin house near the water and you might attract a colony of these insect-eating friends. If you have mature forest on your property, you have valuable habitat for forest-dwelling species, many of which can be enticed into your yard with food plantings.

On smaller sites, you may not be able to create an entire community, but you can use some of the plants that grow in the natural communities in your region to attract local wildlife. Referred to as habitat gardens, these plantings can be important sources of food and cover for many wildlife species. A prairie habitat garden, for example, will attract many kinds of butterflies to its nectar and songbirds to the seeds, plus provide cut flowers and a colorful focal point in the yard. A water garden containing aquatic plants becomes a wetland home for insects, frogs, turtles and the birds and snakes that prey on them. In general, small or fragmented woodlands will not attract many of the migratory songbirds or large mammals, but a woodland border of trees, shrubs, ferns and wildflowers will often attract the cardinal, nuthatch, titmouse, chickadee, and flicker as well as squirrels, racoons, chipmunks and other forest wildlife. If there is a forest preserve nearby, you and your neighbors can increase wildlife use of your yards by planting a corridor of trees connecting your properties to the preserve. Natural drainages and streams provide excellent opportunities to create wooded wildlife corridors connecting small or isolated forestlands.

Backyard Wildlife

Checklist of Practices Used In Landscaping for Wildlife

When developing your backyard habitat landscape plan, try to include as many of the habitat components listed below as your space, budget and time will allow.

Increase vegetational diversity.

Plant many different species of flowering trees, shrubs, vines and herbaceous plants.
If your yard is mostly lawn with a few shrubs and shade trees, consider adding understory trees and shrubs of varying heights to increase vertical diversity and interest.
Select some species that bloom in each season -- spring, summer and fall.
Include species that produce nuts and berries in summer and fall and some that hold their fruits through the winter.
Plant a small grove of evergreens on the north side of the yard for winter cover, and tall, deciduous shade trees on the south and west sides of the house.
Leave fields and borders unmowed to provide tall grasses and weeds for food and cover.

- As a more attractive alternative, consider establishing a wildflower "meadow" along property edges or as a transition zone between trees and lawn.
- Consider making a small sign informing your neighbors and community that your "weedy" meadow is valuable wildlife habitat.

Try to provide some secluded space for wildlife away from human activities.

Feed your wild friends.

Plant a butterfly garden of nectar-producing plants in a sunny location. Use caterpillar host plants along the garden border. Add some rocks for sunning and a wet depression in soil, sand or gravel for puddling.
Plant annuals and perennials with tubular flowers for hummingbirds.
Establish a feeding station containing different sizes and styles of bird feeders.

- Locate feeders near tree and shrub cover.
- In addition to seed, supply fruit such as raisins and jelly to attract orioles, catbirds, and mockingbirds (especially during the breeding season).
- Entice problem birds away from feeding stations using cracked corn or coarse meal.

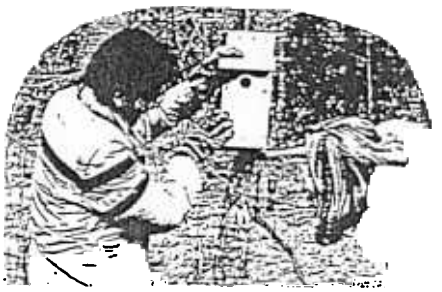
Provide different types of cover.

- Plant trees with exfoliating (peeling) bark to provide hibernation sites for bats and insects.
- Lawn areas provide little food or cover for wildlife. Try to reduce the amount of lawn in your yard by fifty percent.
  - Convert unused areas of lawn to habitat gardens using plants characteristic of Kentucky wetlands, forests, savannas or prairies.
  - Consider alternative ground covers that don't require mowing.

- In areas of lawn that are retained, follow these conservation guidelines:
  - Use lawn grass varieties that require the least amount of water and fertilizer.
  - Water early in the morning and allow your lawn to go dormant in the heat of the summer.
  - Use a mulching mower and cut to a proper height.

Retain old dead or dying trees that may provide homes for cavity-users; prune back dead branches if safety is a concern. If natural cavities are lacking, install nesting boxes in appropriate locations.

- If possible, place nestboxes for owls, woodpeckers, wood duck, chickadee, titmouse and other forest species within the cover of trees.
- Locate bluebird boxes next to a weedy field or meadow at least 20 feet from shrubbery.
- Locate martin houses in a weedy field near water.
- Locate bat houses high above ground in areas where feeding bats are observed.



Leave downed timber or logs in woodlands to decompose and provide additional cover Pile brush pruned from trees or shrubs or piles of rocks in an out-of-the-way corner.

Provide year-round water supplies.

Retain natural wetlands such as streams, ponds and marshes for wildlife.

- Protect water quality by retaining a buffer of unmowed vegetation along shorelines.
- Gradually sloping shorelines can be stabilized with wetland shrubs, grasses and wildflowers; steep shorelines are prone to erosion and sedimentation problems.
- Avoid using chemical fertilizers and pesticides near bodies of water. Dense algae growth indicates the water may be overly nutrient-rich.

If natural water sources are lacking or far from the house, construct an artificial pond or pool to attract wildlife for observation.

- Include both deep water areas for amphibians and aquatic organisms as well as shallow areas for wading and bathing by birds and butterflies.
- Running water is less likely to freeze in winter. Use drippers, misters, fountains, or circulating water devices. (The sound of running water also attracts migratory birds).
- Locate watering stations away from areas where predators might hide.

Conserve water and improve soils.

Turn grass clippings, leaves and other yard debris into compost and use it to improve the soil in your planting beds.

Use organic mulches to conserve moisture and eliminate the need to irrigate.

- In the shade garden, mulch with a top layer of leaves and incorporate the leaves into the soil in spring to increase organic content.
- In prairie and butterfly gardens, mulch lightly with a shredded pine or hardwood mulch.

Protect and restore existing wildlife habitats.

Enhance fencerows and shrubby borders by removing invasive exotics and encouraging a diversity of native species.

Maintain/restore trees and shrubs along streams of all sizes.

Fence livestock from woodlands and the shorelines of lakes, ponds and streams.

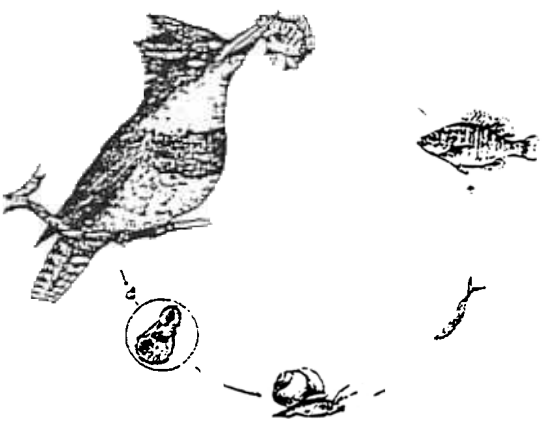
Avoid using pesticides that contain harmful chemicals. The same chemicals that kill aphids on your milkweeds will also kill the Monarch butterfly caterpillars!

- Insecticidal soaps and pyrethrums are least harmful. Washing pests off plants with a strong blast from the hose in the morning can reduce pest problems.
- Encourage insect-eating birds and other predators into the yard with lots of cover and food plants.
- Be careful about introducing exotic biological controls into your region (ie., ladybugs, wasps, worms, Asian praying mantis), as the long-term effects of most such species have not been well studied.

Restore woodlands degraded by logging or grazing.

- Replace invasive exotic plants with a diversity of trees and shrubs native to your region.
- Make a pathway through the woods and plant woodland wildflowers along it.

Protect existing wetlands on your property; there are many beautiful wetland plants you can use to enhance its value for wildlife. Wetlands include lakes and ponds, rivers, streams and other drainages, bottomland forests, marshes, and wet fields.



For more information, contact ***Backyard Wildlife***, Kentucky Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort KY 40601. 502-564-4336.

Backyard Wildlife

WILDLIFE HABITAT NOTES:
Food Plants and Puddle Use of Kentucky Butterflies

SPECIES	CATERPILLAR FOOD	ADULT FOOD	PUDDLES
Anglewings			
Comma	elm, hops, nettle, hackberry	sap, fruit, nectar	
Question mark	hackberry, elm, nettle	sap, fruit	Yes
Baltimore checkerspot	turtlehead, plantains	nectar	
Blues			
Eastern tailed	legumes	nectar	Yes
Spring azure	dogwood, wild cherry, spirea, New Jersey tea, viburnums	nectar	Yes
Buckeye	monkey flower, plantain, verbena	nectar	Yes
Copper, American	dock, sorrel	nectar	
Fritillaries			
Great spangled	violets	nectar	
Gulf	passion flower	nectar	Yes
Meadow	violets nectar		
Hackberry	hackberry	sap, fruit, nectar	
Hairstreaks			
Banded	hawthorn, hickory, oak	nectar	
Gray	hibiscus, legumes, strawberry	nectar	
Monarch	milkweed	nectar	
Mourning cloak	birch, cottonwood, elm, hackberry,	sap, fruit, nectar	Yes
Painted ladies			
American	sunflowers, pussytoes	nectar	Yes
Painted lady	sunflowers	nectar	Yes
Pearly crescent	asters	nectar	Yes
Red admiral	hops, nettle	sap, fruit, nectar	Yes
Red-spotted purple	hawthorn, hornbeam, oak, poplar, wild cherry, willow	sap, fruit, nectar	
Satyrs			
Wood nymph	grasses	nectar, plant juices	
Wood satyr	grasses	sap, rarely nectar	
Skippers			
European	grasses	nectar	
Fiery	grasses	nectar	
Silver-spotted	locust, woody legumes	fruit, nectar	Yes
,nout	hackberry	fruit, nectar	Yes
Sulphurs			
Alfalfa	legumes	nectar	Yes
Clouded	legumes	nectar	Yes

SPECIES	CATERPILLAR FOOD	ADULT FOOD	PUDDLES
Cloudless	legumes, senna	nectar	Yes
Dainty	sneezeweed	nectar	Yes
Dogface	legumes, indigo bush, prairie clover	nectar	Yes
Swallowtails			
Black	plants in the carrot family	nectar	Yes
Giant	hercule's club, prickly ash	nectar	Yes
Pipevine	pipevine	nectar, fruit	Yes
Spicebush	spicebush, sassafras, tulip poplar	nectar	Yes
Tiger	hornbeam, paw, paw, sassafras, spicebush, tulip poplar, wild cherry, wild plum	nectar	Yes
Zebra	hornbeam, paw paw, spicebush, tulip poplar	nectar	Yes
Tawny emperor	hackberry	sap, fruit, nectar	
Viceroy	apple, cottonwood, plum, wild cherry, willow	sap, fruit, nectar	Yes
Whites			
Cabbage	plants in the mustard family	nectar	
Checkered	plants in the mustard family	nectar	
Falcate Orange Tip	plants in the mustard family	nectar	

For more information, contact ***Backyard Wildlife***, Kennucky Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort KY 40601. 502-564-4336.

Appendix: Human Resources in Kentucky

Kentucky Environmental Education Council
663 Teton Trail
Frankfort KY 40601
502/564-5937
Toll-free in Kentucky: **1-800-882-5271**
e.mail: keec@mail.state.ky.us
Home Page: http://www.state.ky.us/agencies/enred/
Ask for local telephone numbers of agencies, such as Resource Conservation & Development offices, as well as schools in your area with outdoor classrooms

Kentucky Association for Environmental Education
c/o Blackacre State Nature Preserve
3200 Tucker Station Road
Louisville, KY 40299
502/473-3437
Home Page: http://www.louisville.edu/groups/kiesd-www/kaee96.html
A quarterly newsletter and annual environmental education conference keeps members in touch with news around the commonwealth.

Center for Environmental Education
Murray State University
Wells Hall
Murray, KY 42071
502/762-2747
The Center has an extensive library, conducts teacher workshops, and offers help with outdoor classrooms.

Center for Environmental Education
University of Louisville
School of Education
Louisville, KY 40292
502/588-0590
The Center offers workshops, has access to resources, and aids in outdoor classroom development and use.

Center for Mathematics, Science and Environmental Education
Western Kentucky University
179 Jones-Jaggers Hall
Bowling Green, KY 42101
502/745-4424
The Center offers workshops in outdoor classroom development and use, has a library of materials, and aids in outdoor classroom development and use.

Continue

Cooperative Extension Service
University of Kentucky
Thomas Poe Cooper Building
Lexington, KY 40546
606/257-4772
Also, contact your county office. They have fact sheets on topics related to outdoor classrooms.

Kentucky Coal Marketing and Export Council
302 Wilkinson Blvd.
Frankfort, KY 40601
502/564-2562
Schools can apply for grant funding for environmental and coal projects.

Kentucky Department of Agriculture
P.O. Box 814
Frankfort, KY 40602
502/564-4696
K-12 teacher workshops, a mobile unit, and a teacher's guide for classroom activities are available.

Kentucky Department of Fish & Wildlife Resources
#1 Game Farm Road
Frankfort, KY 40601
502/564-4762
Biologists may be available to provide technical assistance related to the development of outdoor classrooms. They also have a wildlife education center. Call for information.

Kentucky Department for Surface Mining Reclamation and Enforcement
#2 Hudson Hollow
Frankfort, KY 40601
502/564-6940

Kentucky Department of Transportation
State Office Building
Frankfort, KY 40622
502/564-4556
Packets of seeds are available for planting in public areas. Wildflowers are NOT to be planted along state rights-of-way.

Kentucky Division of Air Quality
803 Schenkel Lane
Frankfort, KY 40601
502/573-3382
Available are materials on air quality issues and teacher training programs.

Continue

Kentucky Division of Conservation
663 Teton Trail
Frankfort, KY 40601
502/564-3080
Many Conservation Districts sponsor teachers to allow them to attend environmental education programs sponsored by various agencies. Check with your local District Office.

Kentucky Division of Energy
691 Teton Trail
Frankfort, KY 40601
502/564-7192
They have a training program for high school teachers and students to conduct school energy audits and prepare reports for decision- makers recommending cost-effective improvements..

Kentucky Division of Forestry
627 Comanche Trail
Frankfort, KY 40601
502/564-4858
They have 20x30" posters on state trees, wildflowers, foods of forest, animal footprints, snakes, fish, butterflies, bird nests, leaves, fungi, wood products, lizards, insects, birds, and animals. They provide Arbor Day Celebration kits in April, educational materials for teachers, and grants to improve community forestry programs. They also have resource materials for teachers to use when preparing units on forests or forestry, as well as technical assistance and grants promoting the planning, planting, and maintenance of Kentucky's urban forests.

Kentucky Division of Recreation and Interpretation
500 Mero Street, 11th Floor
Frankfort, KY 40601-1974
502/564-2172
Environmental education camps are offered at each Kentucky State Resort Park. Activities range from canoeing to geology—all tied to conservation.

Kentucky Division of Waste Management
14 Reilly Road
Frankfort, KY 40601-1190
502/564-6716
Ask about the activity guide *Waste: A Hidden Resource in Kentucky*, which includes activities about solid waste, hazardous waste, municipal waste, a glossary, and resources in Kentucky. The guide is available to those attending a solid waste workshop. Also, ask about their extensive library of videos; subjects include composting, household hazardous waste, landfilling, population growth, recycling, waste reduction, and others.

Continue

Kentucky Division of Water
14 Reilly Road
Frankfort, KY 40601-1190
502/564-3410
*Ask about their pamphlet, "*Wetlands and Their Functions in Kentucky," *their factsheets on protection/preservation history, procedures for wetland habitat, and a free loan slide/video presentation,* "Every Time It Rains," *with accompanying brochure about nonpoint source pollution in Kentucky. See KY Water Watch Program.*

Kentucky Environmental Quality Commission
14 Reilly Road
Frankfort, KY 40601
502/564-2150
They publish reports on different topics updating the environmental condition of the Commonwealth. $10 for the set of 7 reports.

Kentucky Natural Resources Environmental Protection Cabinet
Capital Plaza Tower
Frankfort, KY 40601
502/564-3350
They have 2 maps—one that has the Salt Licks old growth forests and villages of 1792, and one of 1992. Ask about the availability of special events .

Kentucky Water Watch Program
Kentucky Division of Water
14 Reilly Road
Frankfort, KY 40601
502/564-3401
e.mail: kywwp@igc.org
Home Page: http://www.state.ky.us/nrepc/water/wwhomepg.htm
In addition to training teachers and students in the program, they can conduct water workshops to meet your needs.

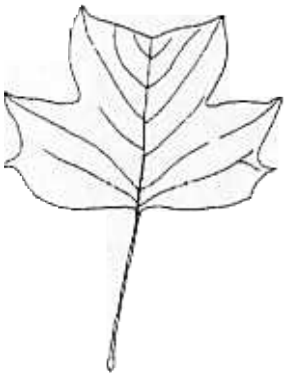
U.S. Forest Service
Daniel Boone National Forest
100 Vaught Road
Winchester, KY 40391
606/745-3100

U.S. Natural Resources Conservation Service
(Formerly Soil Conservation Service)
771 Corporate Drive, Suite 110
Lexington, KY 40503-5479
606/224-7350 (See County Conservation Districts below)
A Soil Survey for your county is available through their office. Contact them for technical advise. See County Conservation Districts on next page.

Continue

County Conservation Districts
Look in the White Pages under US GOVERNMENT, the DEPARTMENT OF AGRICULTURE, then either SOIL CONSERVATION SERVICE (former name) or NATURAL RESOURCES CONSERVATION SERVICE (new name) for the telephone number. then ask for the COUNTY CONSERVATION DISTRICT OFFICE.
They often provide assistance to schools that are developing outdoor classrooms.

Locally, look for garden clubs and service organizations.



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