SCHOOLYARD HABITAT DESIGN

School of Landscape Architecture
College of Architecture, Planning and Landscape Architecture
The University of Arizona

Sponsored by The Arizona Game and Fish Department

Creators

Lauri Macmillan Johnson
Associate Professor

Laura Mielcarek
Research Associate

Renee Tompkins
Julie Parizek
Graphic Layout

Gerardo Mayoral-Pena
Illustrations

with
Robin Jablonski
Robin Pinto
Research Assistants

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Judy Atkins, Scott Libby School, Phoenix, Arizona, Interview
Kerry Baldwin, Arizona Game and Fish Project Department, Project Review
Bob Barsch, Arizona Game and Fish Department, Project Review
Diana Bonney, Mountain View School, Phoenix, Arizona, Interview
Donna Chickering, School of Renewable Natural Resources, The University of Arizona, Environmental Education Resources
Laura DeWalb, Northern Arizona University, Plant Review
Nancy Emptage, School of Landscape Architecture, The University of Arizona, Administrative Support
Mark P. Frederickson, School of Landscape Architecture, The University of Arizona, Cover Graphics Contribution
Amy Johnson, Sonoita, Arizona, Graphics Contribution
Steven M. Johnson, Sonoita, Arizona, Editing of a First Draft
Margaret Livingston, School of Landscape Architecture, The University of Arizona, Plant Review
Carolyn Nielson, Coronado Elementary, St. John, Arizona, Interview
Scott Richardson, Arizona Game and Fish Department, Project Review
Faith Roeloff, Highland Center, Prescott, Arizona, Interview
Jean Searle, Sedona, Arizona, Plant Review
Karen K. Schedler, Heritage Environmental Education Program Manager, Arizona Game and Fish Department, Workshop Coordinator
Terry Seward, Sunnyside High School, Tucson, Arizona, Interview
William Shaw, Renewable Natural Resources, The University of Arizona, Wildlife Review
Nicole Trashell, Highland Center, Prescott, Arizona, Interview
Heidi Vasiloff, Arizona Game and Fish Department, Project Review
Carol Wakley, School of Renewable Natural Resources, The University of Arizona, Business Manager
Bob Wilson, Sinagua Nursery, Flagstaff, Arizona, Plant Review

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Preface

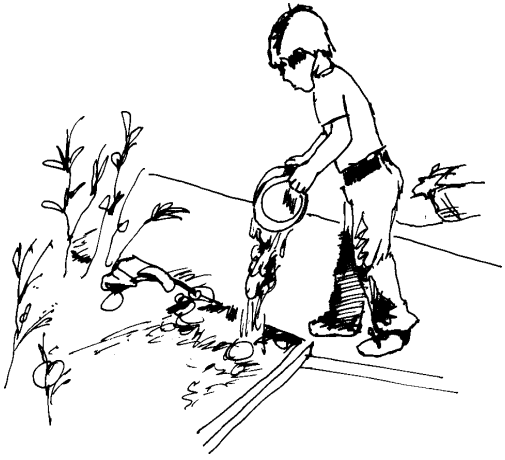
"Now, far away in the woods a bird called; another answered; presently the hammering of a woodpecker was heard. Gradually the cool dim gray morning whitened, and as gradually sounds multiplied and life manifested itself. The marvel of nature shaking off sleep unfolded itself to the musing boy. A little green worm came crawling over a dewy leaf, lifting two thirds of his body into the air from time to time and "sniffing around," then proceeding again—for he was measuring, . . ."
(Mark Twain, *The Adventures of Tom Sawyer)*

This project was funded through a Heritage Grant from the Arizona Game and Fish Department. The project goal was to provide educators with technical assistance for the design and implementation of environmentally sound schoolyard habitats or 'wild' places for learning about nature. The authors have a strong commitment to this concept as these natural areas help students develop high levels of self-esteem and values towards environmental protection through fun hands-on learning. Largely created through grass-roots efforts with shoestring budgets, schoolyard habitats are small miracles in our litigious and bureaucratic society. Participants, including administrators, teachers, students, parents, community members, and outside professionals, unite in this creative process, and in so doing, develop greater appreciation for one another, natural resources, and all living things on the earth.

"Natural environments are important for people of all ages but especially children. These wild places provide young people with opportunities to discover natural occurrences like those so sensitively described by Mark Twain. Brilliant colors held within streams of sunlight, rain water creating miniature drainageways in the mud, wind permanently bending trees, ant highways, and the endless sights, sounds, and tastes of the natural world are the mysteries of life that have inspired civilizations throughout the ages." —Lauri Macmillan Johnson

"Children's opportunities to explore nature are disappearing along with the natural environment. As adults we look back at our childhood and some of the fondest memories we possess are those of fields and streams, rocks and vacant lots, and the tiny creatures in the soil. Our children deserve the same opportunity to seek the experiences in nature that we hold onto so dearly." —Laura Mielcarek

How To Use This Handbook



This handbook is a general guide for the design and implementation of schoolyard habitats. Emphasis has been placed on the sensitive ecology and culture of Arizona in this source book of design methods, ideas, and resources. The design and implementation of your project will necessarily involve modification of this information since the parameters of your schoolyard habitat are unique.

Schoolyard habitat design is a large and complex undertaking that can be accomplished by any group of individuals with desire, persistence, and the talent for seeking outside assistance. Many professionals should be brought into the effort for advice and review. Such useful support might come from professional fund-raisers, landscape architects and designers, surveyors, construction and irrigation specialists, wildlife and plant experts, and outside educators.

Site planning does not imply one right solution. There are many possible schoolyard habitat layouts within the parameters of your site. This handbook is only the tip of the iceberg; it would be impossible to include all the facets of schoolyard habitat design. Information and ideas are presented herein as *examples* for consideration. There will be many more equally exciting and valid concepts that the readers and their school communities will generate as the creative process unfolds. We suggest that participants maintain open attitudes and involve many volunteers in their approach. We wish you success in the creative process and many years of satisfaction with your schoolyard habitat.

Chapter 1:
An Introduction to Schoolyard Habitats

History of Playground Design and the Emergence of Schoolyard Habitats

What is a Schoolyard Habitat?

Why Schoolyard Habitats?

Integrated Learning Within Schoolyard Habitats

Schoolyard Habitats in Arizona

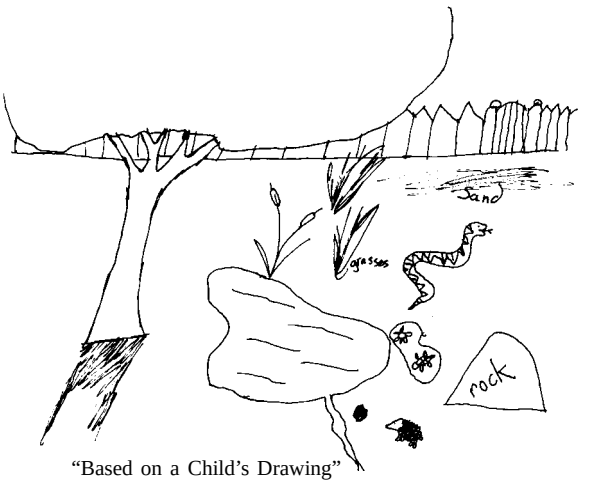
Additional Sources

History of Playground Design and the Emergence of Schoolyard Habitats

Schoolyards in the United States have typically been thought of as spaces that provide students with opportunities to "let off steam" through structured physical fitness and free play. This concept has been realized through the construction of athletic fields and playgrounds which help students develop physical, social, cognitive, and emotional skills. Natural outdoor areas within schools, however, have historically been overlooked and even eliminated as places necessary for play and learning. "A typical pattern wherever schools and child care centers are built is to destroy the natural features - trees, grass, topsoil". . . "and leave a barren, lifeless area where children are expected to play." (Frost, et.al. 1988, 24) Unfortunately, this pattern of extensive clearing for construction happens regularly and unnecessarily when, in fact, only the building sites, road and parking areas need to be cleared.

When the natural landscape is destroyed opportunities are lost. At some schools, the goal has now become reconstruction of natural systems including native plant communities, streams and ponds, hills and valleys, even rocks and twigs. These natural features provide habitat for insects, lizards, birds, and mammals. Through interaction with these creatures and the natural world, a young person's imagination will almost certainly be touched and stimulated.

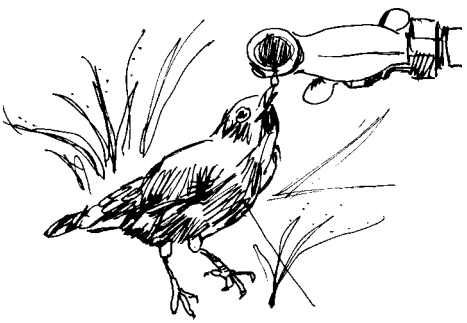
Natural elements including animals, plants, earth, water, and wind have been used as simple play objects throughout history. However, planned play environments often favor the use of manufactured playground equipment over natural materials. Not until recently has the schoolyard been widely thought of as a possible site for the study or enjoyment of nature. A brief overview of playgrounds in the United States from the 1950s to the present provides the context for the emergence of schoolyard habitats.



"Based on a Child's Drawing"

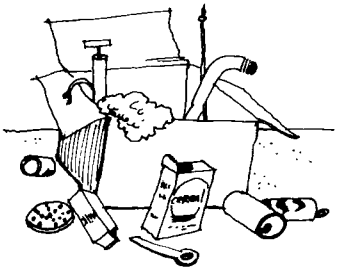
Playground design of the 1950s - 1960s was influenced by the physical fitness era initiated by John F. Kennedy's National Council on Youth Fitness on July 19, 1961 (Weston 1962, 103). The playground equipment included swings, monkey bars, flying rings, slides, and other metal climbing apparatus; these primarily addressed large-motor skill development. Comprised of a collection of isolated metal structures set within a flat paved surface, play yards, from this period, evoke images of prison yards. These environments reflected a stark industrial image typical of modern "machine-age" design. Today there is a movement to remove and discard these pieces. Although re-design of these playgrounds is warranted, the apparatus from this period could and should be recycled, if possible, and used in new contemporary design approaches.

For example, the monkey bars could be sited along a sandy hillside with shade trees planted tightly around the base of the structure. This arrangement would create a new identity and purpose for the metal structure which now becomes the framework for an enclosure; children might imagine a fort, house, boat, etc. Small places of "refuge" (Appleton 1975) like this are important for children. Branches, cardboard, rope, and other collected materials could be used for ongoing creative adaptations. Swing-sets of this era will always be popular; they provide places to sit, swing, and watch. These swinging benches, are enjoyed by all ages and should be included in every playground. The 1970s have been described as the "playground revolution" or "playground movement." That decade was a period of extensive research in the area of child development and play which led to innovations in playground design.



" The natural environment offers a wealth of play potential for young children, with trees and small patches of water the most valued elements. One tree can engage a child for days at a time or, periodically, over a span of years. Manufacturers of playground equipment have found it impossible to recreate such richness." (Roger Hart 1973, 69)

Playground designer Richard Dattner (1969, 137) wrote that, "the environment for play must be rich in experience, and it must be, to a significant extent, under the control of the child." Designers strived to create environments that would promote healthy childhood development through imaginative play, social cooperation, manipulation of the play environment, and problem-solving. Play environments became complex systems where equipment pieces were linked together to create space sequences and a variety of play settings and experiences. Design elements included wooden climbing structures, cobblestone covered earthen mounds, tire swings, cable bridges, and ground surfaces softer than pavement such as gravel, sand, or rubber. Abstract forms were used to promote imaginative play as the structures could become trees, rocket ships, houses or anything else the child wished. "Loose parts" (Nicholson, 1976) such as cardboard boxes, milk cartons, and other recycled household objects were used within the play setting in order to better facilitate creative play. By manipulating these toys children had control over their environments. Natural materials such as twigs, nonpoisonous berries and nuts, etc., also make good toys or "play props" for use within the play setting (Moore, 1993).



"Loose Parts"

On a reduced scale, this idea replicated the concept behind the "adventure playgrounds" of Europe. These were vacant lots where children built their own playgrounds out of discarded lumber, nails, fabric, and metal. An adult "play leader" coordinated the construction and regulated safety. Lady Allen of Hurtwood (1964) was an advocate of these innovative play environments and she wrote, "At its best, play is a kind of research, and like all research at the adult level, it should be an adventure and an experiment that are greatly enjoyed." (Bork 1964, 68). Many scholars and designers encouraged the use of adventure playgrounds in the United States. Although several were initiated the idea was not fully embraced and did not become popular. Perhaps this failure was due to liability issues, funding for the play leader, perceived health risks, or the unsightliness of the space.

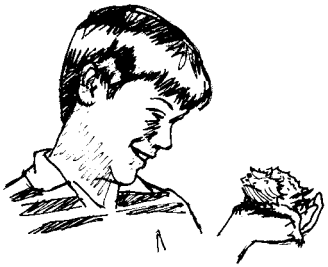
As the playground revolution matured, natural elements such as living trees (not imaginary ones), wildflower patches, and ponds were added to the plans. The most noteworthy example was the Washington Environmental Yard (WEY), an elementary school playground in Berkeley, California, designed by Robin Moore (1974). His design transformed the existing asphalt playground into an ecological garden for play and learning. Two decades later, the concept has become generally accepted and a variety of schoolyard gardens have emerged. These include vegetable, ethnobotanical (historic and traditional plantings that were used by native cultures), ecological, and habitat landscapes. This awareness of the social value of the natural landscape was due, to some extent, to the environmental movement which itself had been fueled by the earlier writings of Rachel Carson, Ian McHarg, Aldo Leopold and others.

Playgrounds today reflect continuing progress in the "playground revolution" of the previous era. One major difference is that play equipment is now made of brightly colored and more durable materials such as enameled metal and polyethylene. Wooden apparatus weathered poorly and splintered dangerously. Additional changes include legislative guidelines as directed by the Americans with Disabilities Act of 1990, which now requires accessibility for all people.

Schoolyard habitats are supervised outdoor classrooms which are often separated from play areas. The lessons about nature occur primarily through the guidance of teachers. It is important, however, to provide students of all ages with natural places where they can freely explore and play on their own. Sunrise Drive Elementary School in Tucson, Arizona, offers students a large natural desert area in which to play. Children sit in the low crotches of mesquite trees, arrange rocks in territorial circles, sweep the desert floor with desert broom, *Baccharis sarothroides*, create dirt tunnels, and engage in many other cooperative and individual play activities. Roger Hart (1973, 69), who has spent many years observing children at play, sites another school situation where children spontaneously built "Dams, bridges, tunnels, islands, and waterfalls [within] elaborate stream systems." Children place high value on these natural places for play and personal investigation, as revealed by Lisa Schicker (1987). In a study involving 39,000 children, she discovered that their least favorite play spots were, in fact, playgrounds. Her observations of children playing indicated that fifty percent of all outdoor activity directly involved collecting, observing, and experimenting with wildlife. Children are drawn to unkempt landscapes—ones that might include piles of dirt or sand, discarded materials, and overgrown plants. Places such as construction sites, alleyways, and empty lots offer attractive places for play.

> *"Children will not manipulate or modify an overtly cared for and guarded landscape. Manicured lawns, miniature trimmed trees, and the absence of dirt piles, surface water, and large trees all convey a strong message to a child—do not touch."*
> (Hart 1973, 67)

What is a Schoolyard Habitat?



Schoolyard habitats, as defined by Heidi Vasiloff (1997, 6), of the Arizona Game and Fish Department, "are places where young people and wildlife connect. Built and planted with native vegetation to provide a home for wildlife, they serve as outdoor classrooms where students learn about our natural environments. Schoolyard habitats are rooted in communities; in students, teachers, parents, and business people. They require work and commitment, and they establish a lifelong connection with wildlife." Within these interactive settings students gain knowledge and appreciation for ecology, plants, and wildlife. Through hands-on activities within these important environments, students explore and learn about the deep connections between one's inner self, man and nature, and the world around us. Our hope is that they come to appreciate the connectedness of all living things and work towards the protection of our environment.

Why Schoolyard Habitats?

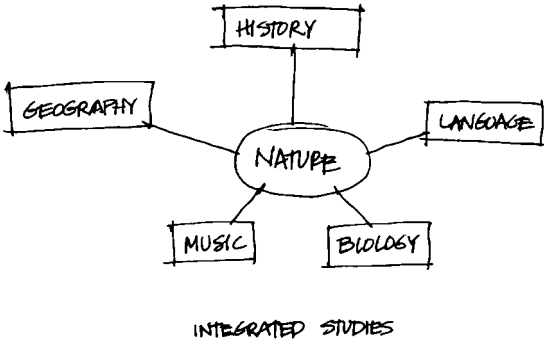
In 1993 the Arizona legislature passed into law, ARS (Arizona Revised Statute) 15-706, which states, "All school districts shall develop and implement programs which integrate environmental education into the general curriculum. The environmental education program shall include curricula to increase awareness of the environment and to promote knowledge of environmental concepts, develop positive attitudes and values toward the environment and encourage civic and social responsibility toward environmental issues." (Arizona Department of Education, 1993). While the law was repealed the following year, its brief existence represented a recognized need within the state to educate our youth about the natural world. Schoolyard habitats provide an ideal setting for this one-time legislative effort since they make these objectives real for students. Through the planning of and caring for these places young people can observe, first hand, issues which effect our environment and our lives. For many students, these places may become settings which provide the catalyst to inspire their budding curiosity and creative spirit.

When young people explore natural places, they gain a better understanding of the connections between humans, natural systems, and the world and universe at large. Young people and especially children have an instinctual need to interact with the environment; they gain self-confidence as they meet challenges such as hiking through the desert, climbing rocks or wading across streams. They come to respect the natural world and, in doing so, perhaps develop the belief that people must live in balance with nature.

"At our schools and learning centers, we have a chance, and perhaps an obligation, to put our youth in contact with the natural world"
Craig Tufts, Chief Naturalist, National Wildlife Federation.

Dr. Thomas Lickona (1975, 8) has written that, "schools should get back in the business of moral education." He sees "a clear and urgent need" and reminds us that, "Young people are increasingly hurting themselves and others, and decreasingly concerned about contribution to the welfare of their fellow human beings. In this they reflect the ills of our society in need of spiritual and moral renewal." Schoolyard habitats offers one opportunity to introduce ethics and values into the public school atmosphere. A spiritual awakening and sensitivity towards living creatures, including other people, could be facilitated through the experiences within the schoolyard habitat and the natural world at large. It is critical that these opportunities be made available to our youth, and especially those living in cities who are increasingly removed from daily contact with nature.

Integrated Learning within Schoolyard Habitats



INTEGRATED STUDIES

Howard Gardner (1993) offers the notion that individuals possess multiple intelligences. These "seven intelligences" include: (1) *linguistic*—exhibited by poets, (2) *logical/ mathematical*— indicative of ability in math and science, (3) *spatial*—possessed by artists and designers, (4) *musical*—"Leonard Bernstein had lots of it; Mozart, presumably, had even more" (Gardner 1993, 9), (5) *bodily-kinesthetic*—needed by surgeons, dancers, and craftspeople, (6) *interpersonal*—the ability to understand others, and, (7) *intra personal*—the capacity to understand one's self. Some teachers have become aware of Gardener's research and have adjusted their teaching methods to better facilitate and inspire learning within all these intelligence categories. One method, called the integrated studies approach,

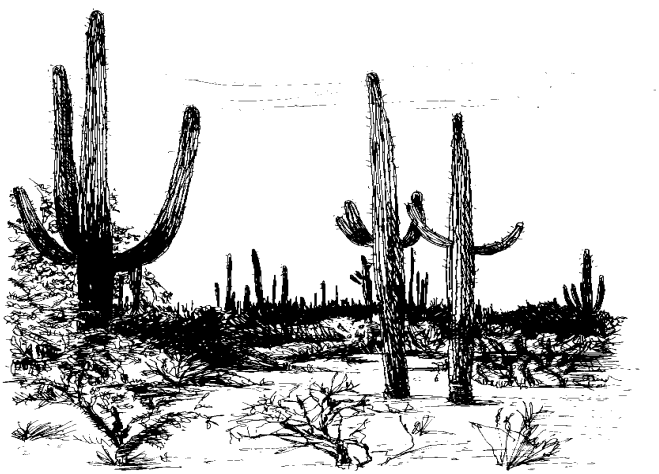
strives for balanced learning through the coordination of subjects such as science, math, history, geography, language arts, fine arts, music, and performing arts. Within the context of a theme or central topic, these various subjects are explored. This teaching method helps students relate various topics within broad contextual frameworks, perhaps the world at large. Their enthusiasm for school and learning increases as they excel within the structures of this interactive and hands-on teaching approach.

Judy F. Carr and Chris Stevenson (1993) illustrate how theme topics can be selected and curriculum frameworks developed for integrated studies. These educators often cite natural places such rivers or mountains as the overarching themes for curriculum development. A visual diagram or "web" is made with the theme at the center of the diagram. Related topics radiate from this main idea. Multi-disciplinary perspectives (science, art, music, etc.) are represented in these curriculum maps which are often generated through collaborative processes involving teachers and students.

The schoolyard habitat is a dynamic living system that is an ideal theme and setting for integrated learning. Nature has a direct tie to the sciences but it also inspires and becomes a great stage for the arts. Examples of applications seem endless as the habitat environment facilitates scientific experiments or math exercises, inspires nature writing, drawing or mural making, and provides the setting for story telling or dance performances. Using the schoolyard habitat for a variety of curriculum objectives, such as these, encourages greater use by teachers and students. When the habitat is not incorporated specifically into curriculum plans it runs the risk of becoming unused and neglected over time.

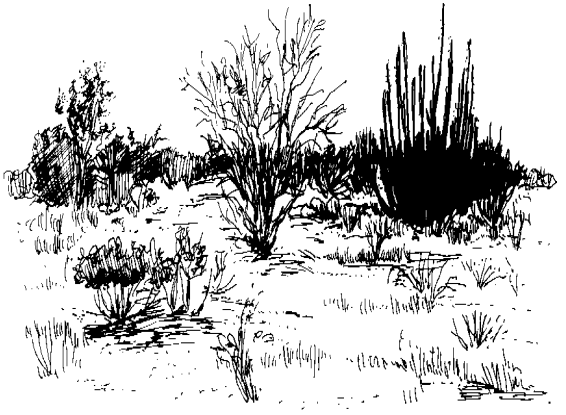
Schoolyard Habitats in Arizona

"A land ethic reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity." Aldo Leopold



Arizona is a beautiful and unusual place. It contains many ecosystems from pristine deserts to high alpine tundra. The collection of species found within these different environments makes Arizona a valuable laboratory for budding naturalists. This diversity of habitats as well as species is essential to our own well-being. We depend on the land, plants, and animals for our food, oxygen, and water. Due to the state's increasing population and urban and suburban development, large areas of native habitat within Arizona are being threatened.

The natural beauty of Arizona has contributed to more than a million people moving to the state within the last decade. Sprawl has occurred in the form of housing developments, industrial expansion, and shopping malls. A 1990 survey revealed that the population of Arizona grew by 35% in just the previous decade (Martin et. al. 1993). This population growth and subsequent development are now affecting the extraordinary environment that attracted many of these people to Arizona in the first place.



Indeed, widespread development throughout the world has had a direct effect on biodiversity through habitat elimination. The accelerated rate of habitat destruction is the "most important single factor affecting the fate of biodiversity on Earth." (National Research Council 1992, 18). On a global scale, species are, in fact, disappearing at shocking rates. "The causes for the loss of species are numerous but the most important is, without question, the loss and fragmentation of natural habitats." (Schucking et.al. 1991, 17). Although species extinction is a natural process, humans have caused the rate of extinction to accelerate through the exploitation of natural resources, habitat destruction, and pollution.

Conservation of habitats and their dependent organisms is a global responsibility that must be addressed on an international, community, and personal level. At the community level, schoolyard habitats offer hope as they replace lost and needed habitats and sensitize students and community members towards the protection of natural resources.

The scenic qualities and fragility of Arizona's diverse life zones have enlightened many state residents towards the protection of natural resources. Along these lines (and perhaps also as a result of our predominantly sunny days which make year round outdoor activities feasible), schoolyard habitats are becoming popular schoolyard additions.

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Moore, Robin C.; Goltsman, Susan M.; Iacofano, Daniel S. 1992. ***Play For All Guidelines.*** *Berkeley: MIG Communications.*

U.S. Federal Government American With Disabilities Act (ADA) *effective in 1990.*

Safety Guidelines 1991. *U.S. Consumer Product Safety Commission (CPSC)*

TimberForm and Pipeline Play Equipment *Catalog Publication No. PC-9210. For informtion call or write: 1975 S.W. Fifth Avenue, Portland, Oregon 97201-5293. 1-800-547-1940*

Chapter 2: Design Process

Introduction

Step One: Participants

- Administrators
- Teachers
- Students
- Parents and Community Members
- Landscape Architects and Designers
- Outside Professionals

Step Two: Written Program

- The Overarching Framework for Design - Goals and Objectives
- Requirements
- Activities and Activity Settings
- Design Features
- Curriculum Ideas

Step Three: Site Research and Preparatory Maps

- Site Selection
- Site Inventory
- Site Analysis

Step Four: Design Development

- Review and Evaluation
- Design Principles
- Conceptual Design
- Preliminary Design
- Final Design

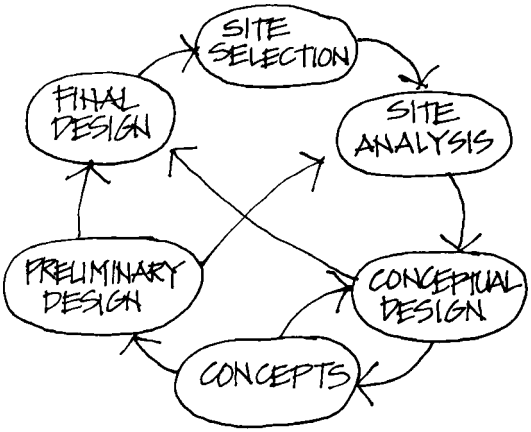
Additional Sources

Introduction

The architecture and landscape architecture (site layout) of schools should be designed as a whole and harmonious system guided by the parameters of an overarching conceptual framework. Ecological factors, socio-cultural conditions, artistic influences, and economic and functional requirements should lay the foundation for design decisions. Piecemeal and uninformed design can result in a hodgepodge collection of poorly sited and unrelated spaces. The array of potential problems including soil erosion, vehicular and pedestrian conflicts, and scorching hot play areas can be avoided through proper planning.

In creating school campuses, the indoor and outdoor spaces including classrooms, roads, athletic fields, and schoolyard habitats should be considered at the onset of the design. Instead, school buildings become the clear priority and are often designed as isolated units without regard for existing site conditions or possible outdoor functions. Schoolyard habitats and many other outdoor spaces are, therefore, eliminated from the "design programing" phase of school architectural proposals. The design and construction of these "less important" places occurs at later dates, if at all. This poor planning approach creates stifling limitations for these spaces which are, in fact, important for the development and well-being of students as well as faculty and administrators, who must spend long days within the school environs.

Site design methods or design processes (Lynch 1984, Rutledge 1971, Simonds 1983) are used by designers to create beautiful, satisfying, and appropriate design solutions. These various approaches involve a series of similar sequential steps which guide designers and community groups along a journey of discovery and creation. The information contained in this section has been presented as a linear sequence, that is, a process of collecting and organizing information, site selection and analysis, and design generation. In reality the sequence will be much more circular than linear and often designers will find that many of the later steps affect and alter decisions made earlier. Readjustments and modifications will have to be considered within this process. *Stay flexible and your goals will be realized.*

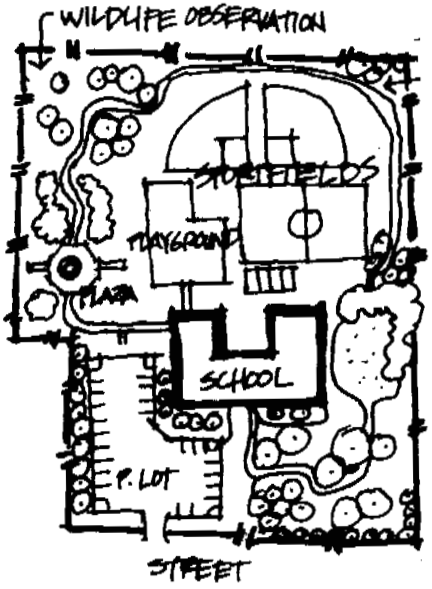


SEQUENTIAL STEPS

The terms “masterplan” or “site plan” are used to describe the finished design scheme which will become the record of the collective vision of all of the participants. This design solution is represented through drawings including plans, sections, elevations, perspectives, and also three-dimensional models. These products are usually colorfully rendered to clearly show spaces, pathways, design elements, and materials. This display becomes a useful communication tool for both fund-raising and construction of the project. Keep in mind that even after the completion of the masterplan, design adjustments during construction are likely to occur.

Legal construction drawings or working drawings, as they are often called, are the very detailed blueprints used for the construction of most public projects. These drawings are needed when the project is subject to the construction bidding process. It is advisable that your committee contact a licensed landscape architect for advice regarding the preparation of construction drawings. Most schoolyard habitat projects, however, are implemented through community volunteer efforts and, thereby, avoid the necessity for the public bidding process and the hiring of licensed contractors. In this case, illustrative masterplan drawings and models could suffice.

The following section outlines a possible design process for the development of schoolyard habitat masterplans. The students should participate in the completion of these steps which could be developed into useful classroom exercises within the curriculum. It is important to note that this process should be adjusted in order to accommodate the specific parameters of your habitat project.



SITE PLAN

A Design Process For Schoolyard Habitats

1 **Step One: Participants**

Be inclusive, not exclusive, and involve:
Administrators
Teachers
Students
Parents and Community Members
Landscape Architects and Designers
Outside Professionals

2 **Step Two: Written Program**

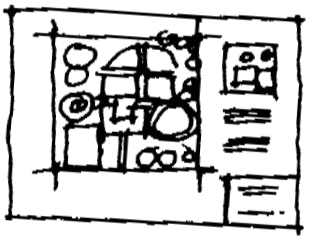
Brainstorming, research, and documentation of:
The Overarching Framework for Design—Goals and Objectives
Requirements
Activities and Activity Settings
Design Features
Curriculum Ideas

3 **Step Three: Site Research and Preparatory Maps**

Site Selection
Site Inventory
Site Analysis

4 **Step Four: Design Development**

Review and Evaluation
Design Principles
Conceptual Design
Preliminary Design
Final Master Plan



1 Step One: Participants

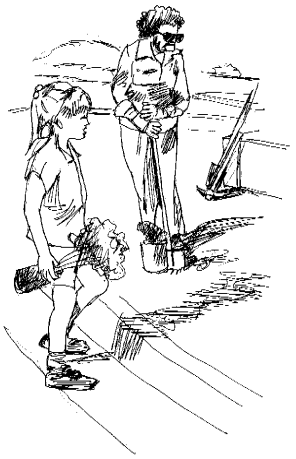
Schoolyard habitats are typically created through the collaborative efforts of many volunteers. Projects of this nature usually do not succeed when they are the proud creations of only a few individuals. Therefore, school administrators, teachers, students, parents, community members, landscape architects and designers, and a variety of outside professionals should be involved at the onset of the planning effort. The input from these diverse points of view will help to create a superior habitat project. In fact, everyone connected with the school should be invited and encouraged to participate.

Administrators

Administrators such as the school superintendent, principal, and school board members should be involved in the planning process. Projects will not be implemented without the support of these key individuals.

Teachers

Teachers from various specializations and grade levels should be represented. If the schoolyard habitat is to be used by students of all ages and become a school-wide theme for integrated studies, all disciplines must be represented. When schoolyard habitats are created by only a few teachers the use of these environment tends to become limited to the needs and desires of those individuals. Eventually the schoolyard habitat can become neglected as these teachers leave the school or lose interest in the project.



Students

Students of all ages should be involved in the planning and design of the schoolyard habitat. Many of the steps and tasks outlined within this section could be developed into special projects or areas of study. A visiting artist, landscape architect, biologist, or perhaps an interested teacher or parent might be willing to lead students through a series of lessons and workshops aimed at the generation of research and design ideas for the project. As a result of this creative effort, students develop a sense of pride and ownership for the schoolyard habitat. If the environment is a meaningful place for students, teachers, and community members, the risk of vandalism and neglect will probably be reduced.

Parents and Community Members

Parents and community members should be encouraged to join the effort. Their assistance will be diverse, often including strengths in fund-raising, design, and construction. Special-interest groups such as garden clubs, scouts, 4-H, and others might welcome the opportunity to participate in community projects such as this.

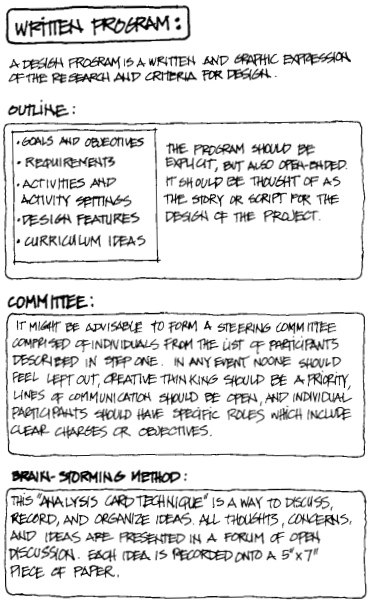
Landscape Architects and Designers

Landscape architects and designers play an important role in the facilitation of design processes and preparation of conceptual, preliminary, and final masterplans for the schoolyard habitat. A landscape architect or landscape designer from the community or parent population might be willing to volunteer his/her time.

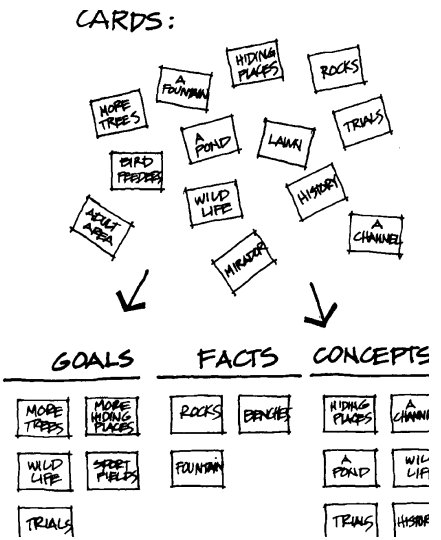
Outside Professionals

Outside professionals from various agencies including the USDA Forest Service, National Park Service, Natural Resource Conservation Service, Arizona Game and Fish Department, and Cooperative Extension Programs can be utilized for specialized input as needed. Local businesses from the construction industry will be valuable and appreciated participants. (See Appendices for a more detailed list of possible resources.)

2 Step Two: Written Program



There are many ways that participants can become involved in the creation of a program. It might be advisable to form a steering committee comprised of individuals from the list of participants described in Step One. This committee could develop a system of participation which would include classroom projects, sub-committee research groups, open-ended brain-storming sessions, and task oriented workshops. No one should feel left out, creative thinking should be a priority, lines of communication should be open, and individual participants should have specific roles which include clear charges or objectives.



A brain-storming method that can be used in this early stage of design was developed by the architect William W. Caudill, of Caudill, Rowlett, and Scott (CRS Inc.) of Houston, TX (1973). This "analysis card technique," as it is called, is a way to discuss, record, and organize ideas. All thoughts, concerns, and ideas are presented in a forum of open discussion. Each idea or piece of information is recorded with a short phrase and loose sketch onto a 5" x 7" piece of paper. Usually there are two people recording these comments and placing them on a large wall where everyone can see them. The ideas traditionally take the form of "goals" (statements of vision), "facts" (known problems, concerns, or information), and "concepts" (solutions or design ideas).

These categories (goals, facts, concepts) could be changed to match other topics of importance. This handbook outlines different topics as explained in subsequent text. In any event, it is sometimes better to simply allow people to say whatever comes to their minds. Later the collection of thoughts and ideas can be organized into a structure that makes sense. This information will becomes the basis for the written design program.

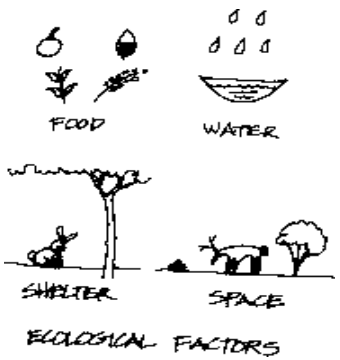
Not all of the ideas generated in brain-storming sessions, such as the one described, will be used in the habitat project. Eventually ideas will have to be prioritized. This can be achieved by forcing individual participants to select and discuss their most important concerns. Sometimes a voting system can help facilitate the establishment of priorities. Ongoing open dialogue will continue to help everyone understand the many unique points of view that should be represented within the schoolyard habitat.

The Overarching Framework for Design-Goals and Objectives

At the onset of the project it is important that an overarching conceptual framework for design be established. In the case of schoolyard habitats this framework will be a synthesis of ecological factors, socio-cultural conditions, and artistic principles. Economic and functional parameters will also play an important role in design. Functional aspects of design will be easy to identify. These include practical concerns for safety, accessibility, and ease in movement. Overall function will be explored frequently throughout this process.

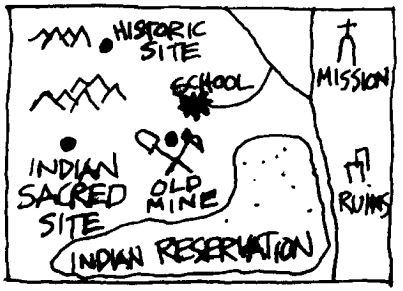
The economic limitations should not be emphasized greatly at this beginning stage in design. When communities develop ideal masterplans they are usually able to find funding sources. Outside donors are more likely to provide resources when they see a well articulated design plan. Project *phasing* is another possible way to resolve budget limitations. (See *Chapter 3: Design Implementation,* for more detailed information regarding ways to expand your construction budget.)

At this early stage in design it is important to think broadly and idealistically. Some discussion about the overarching framework for design as a reflection of ecological factors, socio-cultural conditions, and artistic principles is warranted as these will provide ongoing inspiration for design ideas and solutions.



The ecological factors of the site and region should be carefully understood and applied within your habitat project. In fact, ecological principles will probably become the main context of design as the site must provide a home for native wildlife. To attract these animals, the schoolyard habitat must offer four elements that are essential for their survival; food, water, shelter, and space. Provide only three of the four and animals will visit but will not stay for extended periods of time. The first elements, food and water, are critical on a daily basis. Shelter and space offer long-term comfort. The schoolyard habitat should provide

densely planted areas for animal protection and security. Wildlife will not expose themselves for long periods of time within open areas for fear of predation. Birds will not nest if human activities threaten their security. Therefore, the schoolyard habitat must provide secluded planted areas. These should include water sources and a diverse collection of plant species with a variety of sizes, shapes, and textures including trees, understory shrubs, and grasses. This diversity will assure provision of wildlife needs. In short, the success of the schoolyard habitat in attracting wildlife is largely dependent upon how well the site can mimic nature. (Refer to *Chapter 4, Ecological Principles* for more information.)



Socio-cultural conditions include two main categories: (1) the basic human needs and desires of the current school population (these are addressed throughout the sections to follow), and, (2) the larger cultural context of the region. This first category, the needs of all users, must be identified with sensitivity to the preferences, beliefs, and the specific backgrounds of the individual families of the school. The second category, the broader cultural context, requires research and interpretation regarding the historic cultures who once occupied the region, as well as the (perhaps even more difficult to interpret) recent past and present day aggregates of American culture. This challenging topic must consider the complexities of cultural constructs within societies which are not always readily apparent.

Various cultural groups and their cultural manifestations must be understood with respect to their relationship with the natural world. These cultural groups might include past and current American Indian tribes, early pioneers, ranchers, miners, and more recent cultural groups of modern day humans living within your region. The latter could lead to investigations within various time periods such as post-war (World War I or II), the population expansion of the 1950s (and persisting today) or present day culture which includes discussion about over-consumption, pollution, waste, and expanding technological advancement.

An understanding of cultures as they evolve and pass through time will set the stage for many discoveries related to mankind and man's relationship to the land. Their stories of survival, quest for territory, search for food and water, hunting practices, plant cultivation techniques, diseases and wars, travel advances, and the eventual diffusion of culture, could offer inspiration for the schoolyard habitat design. This may or may not result in physical expressions or actual forms within the site. In fact, past cultural design expressions often become trite if they are mimicked or replicated within the landscape. It is, however, our responsibility to remember and pay tribute to our past, celebrate those who walked before us, and acknowledge our own triumphs and failures.

Story-telling events, visits from old-timers, and other interpretative devices including signs, paintings, murals, and cultural landscape interpretations might become the devices from which past and current cultures are reflected and understood. This might include investiga-

tion into settlement patterns and dwellings; tools and technology; art forms; written and spoken languages; agricultural practices including water harvesting and plant use for food, medicine, and spiritual benefit; as well as man's relationship with wild and domesticated animals.

Landscape creations throughout history have been thought of as an application of the principles of fine art and are a form of cultural expression. Historically, man-made landscapes have been art works for celebration of the "spirit of place" which often included sacred rituals for the gifts nature provides. Three overarching components; ecology or nature, culture, and art have always been present as the intertwining strands for meaningful place creation. Artistic principles become the tools with which physical design layout is achieved. As these principles guide the shape and placement of spaces within this recreation of nature, unity and beauty can be achieved. Artistic principles are outlined in detail within this chapter (Step Four: *Design Development*, subheading *Design Principles*).

The overarching framework for design usually takes the form of a written statement of goals and objectives. *Goals* are broad in nature and have comprehensive results. They are the project aims, ideals, and intentions—the overarching framework for design. *Objectives* are specific and particular—the implementation of this overarching framework. These are the short term attainable means to the *goals*. What actions are to take place by whom with what purpose? Objectives should be planned in coordination with a time-line. An example might be as follows:

Project Goals: (1) To create an ecologically sustainable schoolyard habitat for small mammals, birds, lizards, and insects. (2) Additionally, to use this habitat project as a theme for integrated learning involving cultural and artistic aspects of design.

Project Objectives: (1) To form a planning committee with sub-committee special interest groups. (2) To develop a masterplan using native plant communities. (3) To actively involve students in the design process. (4) To have a neighborhood barbeque where each family plants a tree.

Requirements

The project requirements are basic physical needs of wildlife, students, teachers, and administrators. The specific needs will vary from school to school but include elements such as space, vegetation, water, storage, shade structures, etc. Each school should establish their own list of requirements. The specific wildlife requirements for your area will require additional research. A list at the end of Chapter Three offers possibilities that can be expanded in order to provide habitat diversity. The following chart shows how schoolyard habitat requirements might be organized to address the various needs of wildlife, students, teachers, and administrators.

Wildlife Needs

- Food (e.g. feeding stations, native plants)
- Water (e.g. ponds, drippers, bird baths, streams)
- Shelter (e.g. brush piles, bat houses, snags, nest boxes)
- Safe places for raising their young
- Connected open space "corridors"

Students' Needs

- Natural areas for play and learning
- A variety of experiences (e.g. science projects, creating art works, exploring, writing)
- A variety of spaces (e.g. private spaces, eating areas, trails/paths, active areas)
- Shade (e.g. big trees, ramadas, arbors)
- Places to sit (e.g. benches, retaining walls, under trees)

Teachers' Needs

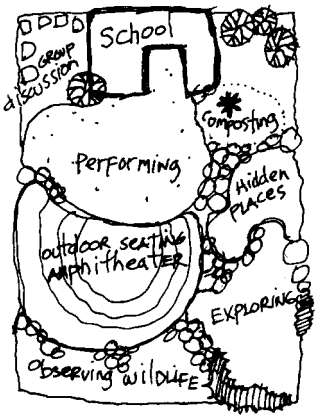
- Inspiring places to teach "learning stations"
- Outdoor seating/ amphitheater
- Overall site viability
- Storage of teaching materials (e.g. potting shed, composting area)
- Noise control

Administrators' Needs

- Ways to inspire and facilitate teachers
- Good management and maintenance of the habitat
- Workable budgets
- Liability issues addressed "meets the building codes"
- Volunteer support

Activities and Activity settings

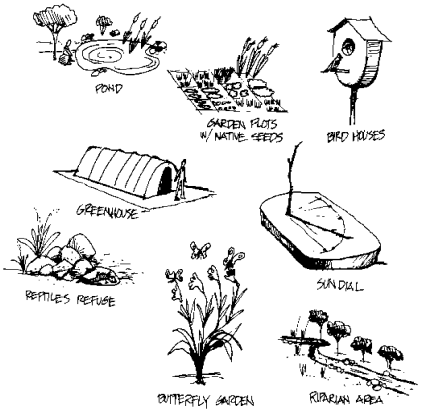
Students must be nurtured and inspired through the people and places of their daily lives. Our schools are the places where students spend much of their time. It is important that we provide our young people with a variety of structured and unstructured activities within appropriate activity settings. An activity setting is a place designed for specific types of activities such as reading, playing ball, sitting, running, or listening. The physical characteristics of the place should match the expected or planned activity(ies). The following list provides a few examples.



Activities and Activity Settings

Activities	**Activity Settings (a description of the possible places)**
Being alone	Place enclosed with vegetation (teachers can see over or under plants), tree houses
Composting	Easy access but screened and away from other activities, near storage areas
Performing	Multi-use stage area, open meadow where chairs can be set up
Group discussions	Tables and benches within a shaded area
Class time	Outdoor seating/amphitheater
Observing wildlife	Wildlife viewing blinds
Exploring	A real “wild” place

Design Features



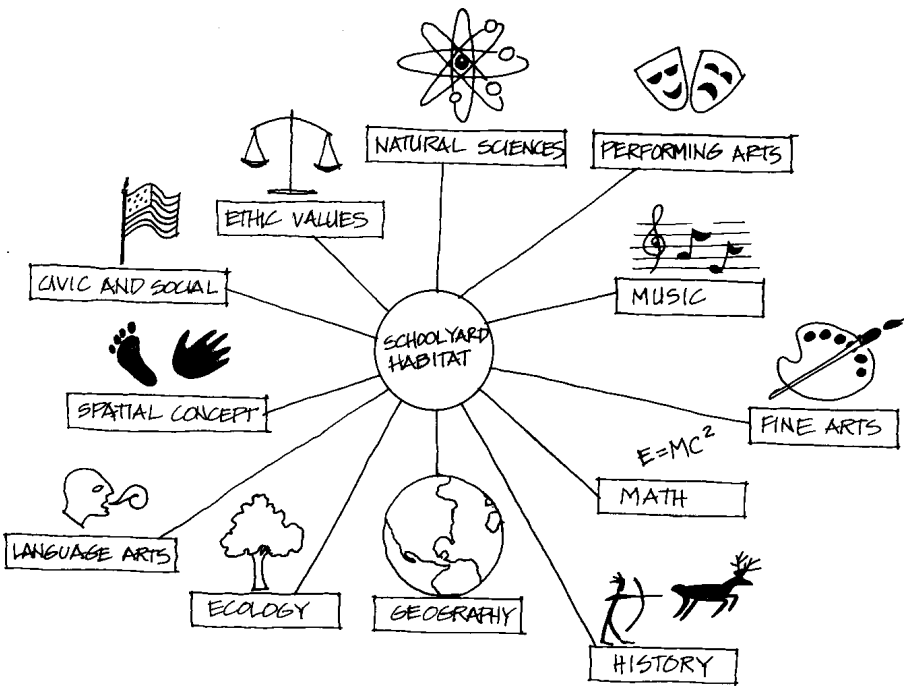
This category is simply another way to gather and organize design ideas. In fact, there will be considerable overlap within all the program areas (requirements, activities, activity settings, design features and curriculum ideas). Design features imply a list of desires or wishes. Your school should simply ask "What do we want in our schoolyard habitat?" These creative ideas seem to come to mind throughout the research and design process. Perhaps an "idea" wall at the school could be the repository for these creative thoughts. Students could also keep design journals. As mentioned earlier, not all the ideas generated will be used in the schoolyard habitat but it is important to keep a record all of them. *Early rejection of creative ideas could restrict potential avenues for ongoing innovation and discovery.* The following list of design features may offer clarification.

Design Features

Natural Elements	**Cultural Elements**	**Wildlife Elements**	**Man-Made Elements**	**Art Elements**
Pond	Garden plots using American Indian seeds	Bird houses	Greenhouse	Tile mural depicting the history of the area
Wildflower meadow	Tree-dedication area	Butterfly garden	Amphitheater	Clock tower
A "sacred" grove of trees	Educational trails with cultural themes	Rock piles for attracting reptiles	Ramadas and sun-protection structures	Animal track imprints in concrete
A look-out mound	Archeological dig site	Brush and litter piles for wildlife shelter	Soil-profile box, weather station	Sundial
Riparian area	Pioneer and ranching practices demonstration area	Diversity of plant species	Signs and directional arrows	Stone slate for a chalkboard

Curriculum Ideas

The curriculum ideas or specific educational goals and related topics for implementation within the schoolyard habitat must be discussed at the onset of the planning process. Habitat projects can be designed and built, but if they are not used for specific teaching purposes they can become neglected places of limited value. Therefore, the long-term success of the project will be strengthened through concrete ties with the curriculum. All teachers and students should be encouraged to develop curriculum ideas for use within the schoolyard habitat. The schoolyard habitat, as mentioned earlier, is an ideal theme for integrated learning. Multi-disciplinary design approaches are particularly rewarding.



CURRICULUM WEB

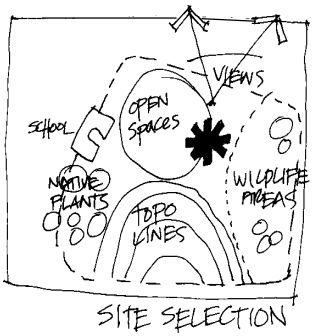
*The GLOBE program (Global Learning and Observations to Benefit the Environment) is a network of students, teachers, and scientists working together to study and understand the environment. Over 4,000 schools in over 55 countries are participating in this program. For more information, check out their website: http://www.globe.gov/

Curriculum Ideas

Subject	During the Design Process	After Schoolyard Habitat Construction
Natural Sciences	Plant and animal inventories on the site prior to construction.	Learn stages of life for butterflies and moths and what plants are needed for their life cycle; study ecosystems, extinction, plant succession and other ecology-related concepts; start an herbarium at school.
Math	Measure slope of the land, square footage, and plant counts for site inventory and analysis.	Determine water volume, water depth, and tree canopy.
English and Literature	Writing class writes to local businesses, seed companies, and funding sources for donations.	Nature poetry and literature; keeping a wildlife or nature journal.
Technology	Production of a video for all stages of the project.	Document wildlife observations by video and/or photography, then report to local media; GLOBE* project on the Internet.
Social Studies and History	Learn about prior land use of the site. It's possible there may be American Indian ruins on site.	Find out how plants were used by Americans Indian and pioneers.
Art and Music	Art class can design a brochure or logo promoting the schoolyard habitat.	Study the interrelationship of art, music, and nature; photography; sketching and painting.
Community Integration (Not a school subject, yet very relevant)	Students get involved with mentors from local businesses and professions.	Form environmental clubs for the students and parents; go on field trips; sell seeds to community to promote native planting practices; invite the elderly to participate perhaps read nature literature to the students; community can help with project maintenance and use facility for enjoyment e.g. hiking or cross-country skiing.

3 Step Three: Site Research and Preparatory Maps

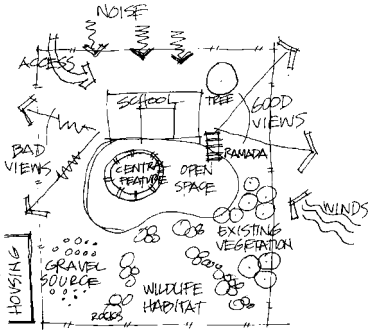
Site Selection



SITE SELECTION

The selection of a site for the schoolyard habitat, whether it is a part of an overall campus masterplan or an addition to the existing campus, should consider many factors such as site ecology, aspect, site size, and shape. If possible, select a site that is at least a half acre in size. Larger areas create greater opportunities for diversity of plants and animals. Schoolyard habitats can be created in smaller spaces with limited species inclusion. Linear sites or sites that weave throughout the campus offer possibilities for trail design and spacial sequences in combination with habitat design. Ecological interest is an important consideration. Look for topographic changes (hills and valleys), vegetation diversity, and washes or drainageways. The schoolyard habitat site should be protected from school activities that would create noise and interfere with wildlife needs, such as bus loading and unloading areas, cafeteria rooms, and garbage pick-up locations. Sites connected to public land or other large open spaces are particularly attractive as wildlife will use this "borrowed" landscape which expands the boundaries of their habitats. The schoolyard habitat should have some protection from harsh conditions such as the hot desert sun or cold winter winds.

Often the schoolyard habitat is added to an existing campus and the site selection will be limited to left-over, perhaps less attractive places. The absence of prime landscape opportunities can eventually be mitigated through the creation of land forms and the addition of trees, water, rocks, and other natural materials.



SITE INVENTORY

Site Inventory

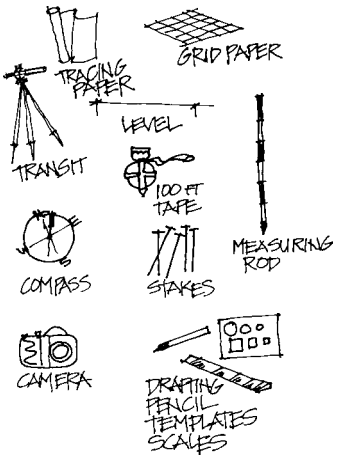
The site inventory or site survey is a record of existing conditions both natural and cultural or man-made. This information must be carefully researched, recorded onto a map, and understood before a masterplan can be created. This inventory of information is measured and recorded as a *base map* which provides underlying elements for the subsequent site analysis maps and site plans. The base map should include property boundaries, legal restrictions including setbacks and easements, orientation relative to north, topography, vegetation, utilities—above and below ground, and existing site features such as adjacent buildings and sidewalks.

The site inventory maps should be as accurate as possible. Individuals from the community who have surveying skills could oversee the production of these maps. Indeed, survey maps might already exist and the architect or landscape architect responsible for the original school plans could help obtain these.

Less accurate methods will have to be used if a site survey is not attainable. In this case, sites can be measured by pacing or with tape measures. The pace method is the least accurate but fastest means of locating site elements. It can be used to estimate sizes and locations of existing features. An adult or young person can determine their average pace by pacing a known 100 foot length. Divide the number of paces by 100 to determine the length of that person's average pace. More accurate measurement occurs when a measuring tape is used. The tape (100 foot metal tapes work best) is stretched the length of the site. Site elements are measured from positions along this baseline. Measurements can be recorded on grid paper in the field and later transferred to an appropriate "scale" on tracing paper. The architects or engineers scale can be used to locate site features on a map. The following scales will probable work best: 1 inch = 8 feet, 1 inch = 10 feet, or 1 inch = 20 feet. Photographic documentation should be used to supplement the mapped record of site conditions. Design professionals often photograph or sketch sites as a way to better see and therefore, understand the physical components and visual qualities of places.

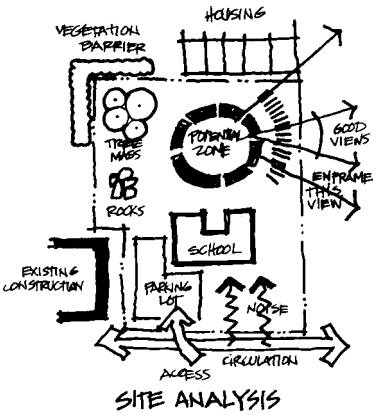
Site Inventory Materials

•Trained surveyor to oversee production (if possible)
•Transit (if possible)
•100 foot metal tape measure
•Compass
•Stakes
•Line level and string to determine slope and heights of objects
•Measuring rod (ruled post to use with line level)
•Large clip board
•Grid paper
•Tracing paper
•Drafting pencils, tape, circle templets for drawing trees and shrubs
•Camera and film



Site Analysis

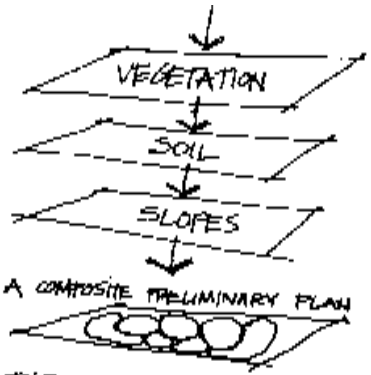
Every site has a unique set of conditions which creates the identity of the place. Natural and cultural factors such as wind, sun, topography, and land use exist in complex and dynamic interrelationships with one another. They can change daily and throughout the seasons. These conditions create the "genus loci" or "spirit of place." Just as people have personalities with good traits and bad ones, sites, too, have good conditions or *opportunities* and potential problems or *constraints*. The intended site use also affects analysis. For example, a steep hill creates an opportunity for certain activities such as rock climbing while the same land form presents a constraint for athletic field layout.



SITE ANALYSIS

*"Like individual human beings, landscapes and civilizations display distinctive characteristics. While they change in the course of time, they retain a uniqueness derived in large part from the set of conditions under which they emerged and also from the factors which influenced their subsequent evolution. The phrases "genius loci" and "spirit of place" symbolize the forces or structures generally hidden beneath the surface of things which determine the uniqueness of each place." (*Rene Dubos**,** *A God Within*, 1972, 22)

Good design maximizes opportunities and minimizes constraints in a series of *design trade offs*. This synthesis process relies on a comprehensive understanding and interpretation of site conditions. Each trait from the inventory (vegetation, wildlife, topography, etc.) can be recorded on a transparent map. Together these topical maps can be assembled into one composite map of all the site and cultural features. This *overlay analysis system*, as it has come to be called, was developed by Ian McHarg (1971) as a tool for design decision making. For example, ideal building locations and sensitive open space reserves are more readily seen through this cataloging of information. The overlay analysis process is currently generated through a computer application known as Geographic Information Systems (GIS).



THE OVERLAY SYSTEM

While analysis of schoolyard habitat projects may not employ the use of the overlay system it is important to evaluate existing site features before site plans are prepared. Detailed analysis notes can be made on copies of the inventory map. These notes, sometimes subjective evaluations of the site features, will lay the foundation for design decisions.

Here is an example of the thought process used in site analysis:
Imagine a native mesquite tree found within the proposed schoolyard habitat site. The inventory would locate the tree and identify its species and size. The analysis would describe the conditions of tree. Suppose the tree is mature, healthy and a good potential habitat opportunity for birds. Pretend also that the thorny tree is poorly located near an existing pathway. This condition is a constraint for safety. Future design recommendations might suggest tree pruning, relocation, or removal. Budget permitting, the path might be removed to allow the tree to flourish. As the design progresses into greater refinement perhaps it had been decided that the tree is more important than the path and should remain. Within this scenario, the area where the tree stands, could be enhanced with additional plantings.

This example illustrates the potential complexity of site analysis as both an informed and subjective process of interpretation. A single site feature can be both an opportunity and a constraint. The resulting design recommendations are generated through trade-offs based on this evaluation. An analogy which sometimes helps to further explain site inventory, analysis, and design is seen in a parallel medical process. The physical examination could be compared to the site survey; the conditions of the patient or site are measured and understood. The subsequent diagnostic evaluation of both the patient or site requires the evaluation of conditions within their respective contextual parameters. Medical treatment, like design solutions, are the prescribed plans of action. The charts to follow shows a check list of site inventory concerns and analysis possibilities for both natural and cultural conditions. Specific site analysis examples have been included to add clarity.

Check List For Site Inventory and Analysis Considerations

Natural Conditions

	Site Inventory—the facts, existing conditions	**Site Analysis—**interpretation of information
The Natural History	**Regional:** Use a regional map to show the location of and context for the site with respect to the area's natural features such as nearby mountains, rivers, forests, etc.; outline the natural history of the region including general ecology, plant and wildlife communities, etc.	**Regional:** Describe the unique characteristics of your region's natural conditions and the potential impact or benefit these have as a source of inspiration for design ideas; identify possible guest speakers and field trip locations. **Example:** The nearby pinyon/juniper forest could be represented in the schoolyard habitat.
Topography	**Site:** Identify contour lines at specific intervals; note degree of steepness through slope percentages; locate high and low spots, sink holes; establish spot grades for existing walks and grade changes between existing buildings and ground surfaces, tops and bottoms of walls, curbs, steps, etc.	**Site:** Identify potential problems such as erosion, poor drainage; identify slopes too steep for sheds, ramadas, walks, etc.; find possible locations for ponds; identify potential accessibility problems; determine topographic points of interest such as hills and valleys. **Example:** The northwest area of the site has slopes of 15% or greater. These areas should be avoided as locations for site structures.
Drainage	**Site:** Locate and note the direction of water flow for drainageways and surface run-off (away from and toward the site); note subsurface water, down spouts, standing water, and wet spots.	**Site:** Evaluate drainageways and low spots for potential habitats including planted areas and ponds (water is naturally directed to low spots which can become locations for ponds and plantings); identify drainage problems resulting in erosion, wet spots, muddy areas, etc. **Example:** Water from the building downspout creates a muddy area. This water could be collected and channeled into a proposed seasonal stream.

Soil	**Site:** Identify the soil classification of your site (i.e. sand, silt, clay, or loam) and the chemical nature of the soil (pH level and possible high salinity levels). In addition, find out the depth of topsoil and the depth to bedrock.	**Site:** Describe these conditions as opportunities or constraints; this might include potential problems with caliche, poorly drained soil, and soil fertility advantages or disadvantages. **Example:** A 2' layer of caliche exists below 3' of topsoil on the southern edge of the site. Tree plantings along this edge should be limited since hole digging would require a jack hammer.
Vegetation	**Site:** Locate all vegetation (trees, shrubs, and groundcovers including grasses and wildflowers) include plant species, size, form, color, texture, and other features.	**Site:** Determine condition and potential for wildlife, shade, beauty, etc.; identify problems in location and safety (thorns, poisonous fruits, etc.). **Example:** An old London plane tree (*Platanus acerifolia)* exists within the schoolyard. It is not native to the area but provides potential as bird habitat. The tree is appreciated by many children and teachers as its wind-twisted form gives it character. The tree is special and should remain.
Geology	**Regional:** Identify and describe the geological structure of the area: land formations including mountains, basins, streams, rock and mineral deposits. **Site:** Identify rock and mineral deposits, rock outcroppings, and soil layers.	**Regional:** Describe potential hazards such as landslides, groundwater pollution, flooding; identify regional sources of inspiration from natural sites of beauty or cultural alterations such as mining activities; identify view-sheds from the site towards points of geological interest. **Example:** The history of the nearby copper mine could be used as a display within the schoolyard habitat. **Site:** Describe geological features within the site such as streams, rock outcropping, or mineral deposits. **Example:** A sand deposit within the site provides a good “free” play area.

Climate	**Regional:** Identify average annual temperatures, precipitation (at different times of the year); determine depth of frost and plant hardiness zones. **Site:** Microclimate: chart the vertical and horizontal movement of the sun including rise, set, and high noon (at different periods in the year); identify year round sunny and shady areas, winter wind exposure, and summer cooling breezes.	**Regional:** Describe and document the limitations and benefits that these conditions create. **Example:** The project is in plant hardiness zone ten. Use plants that can survive in these conditions. **Site:** Locate the places that need protection from the sun and wind; determine naturally protected areas. **Example:** The strong winter winds from the northwest create severe limitations. Wind screens need to be provided. These same winds provide opportunities for creative dramatic effects and art-works (wind harps, chimes, sculptural sails).
Wildlife	**Site:** Identify existing habitats and corresponding animals using the site.	**Site:** Identify additional potential habitats for development or enhancement; locate those areas that have limitations for wildlife. **Example:** Along the western edge of the schoolyard habitat site there is a wash with mature vegetation. This area should be preserved and expanded through additional plantings.

Cultural Conditions

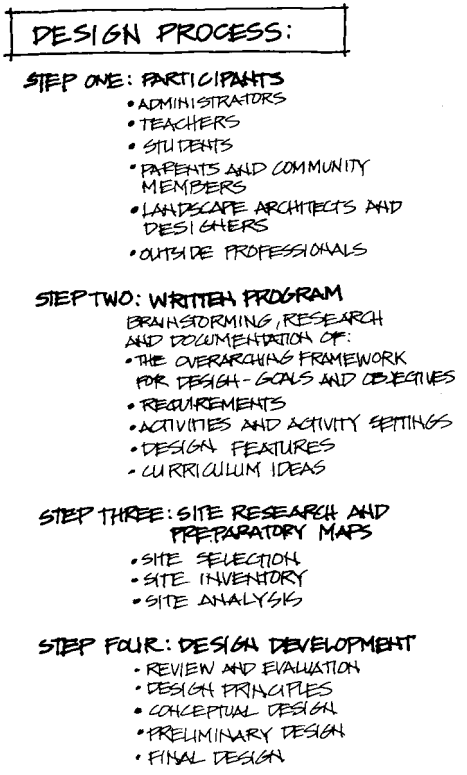
	Site Inventory—the facts, existing conditions	**Site Analysis—**interpretation of information
The Cultural History	**Regional:** Use a regional map to show the location of and context for the site with respect to the area's significant cultural features such as museums, sacred and historic sites; outline the cultural history of the region including American Indian influences and early pioneer and ranch life. **Site:** Indicate culturally significant or sensitive areas such as archeological areas, historic structures, etc.	**Regional:** Describe the unique characteristics of your region's cultural conditions and the potential impact or benefit these have as a source of inspiration for design ideas; identify possible guest speakers and field trip locations. **Example:** The nearby town was supposedly named for the large ball-shaped chunk of silver found there. This story, or others like it, could inspire design ideas (art-works such as sun dials, story mural, etc.) within the schoolyard habitat. **Site:** Document the potential impact the habitat would have on these cultural features, great impact warrants new site selection; determine features that should be incorporated in the design solution. **Example:** Evidence of primitive dwellings warrant protection and preservation. A schoolyard habitat will not be developed near these significant areas.
Legal Restrictions	**Site:** Setbacks, city/county building and landscape restrictions.	**Site:** Describe the impact of these restrictions for schoolyard habitat construction. **Example:** The regulations call for periodic design review by a review board. Early contact of this board will be made. Ongoing dialogue will occur.

Existing Land Use	**Regional:** Document surrounding land use (residential, commercial, recreational); note existing buildings, circulation patterns (roads, walks, trails), neighborhood character, and other features. **Site:** Document existing man-made uses within the habitat site such as walks, structures, and other man-made features.	**Regional:** Record conditions and potential assets or conflicts; suggest areas for screening. **Example:** The neighborhood is on the National Register of Historic Places. This contextual setting will be respected. The design of the proposed schoolyard habitat project should not disturb or be in conflict with the special character of the neighborhood. **Site:** Record conditions and describe features which benefit the schoolyard habitat and those that restrict use and should be removed or relocated. **Example:** The existing concrete walks are laid out in a linear fashion. These straight pathways might be removed, in part, in order to better satisfy the circulation needs of the schoolyard habitat.
Utilities	**Site:** Locate all electrical, gas, sewer, telephone, cable, and water lines, irrigation systems, septic tanks and leach fields, storm sewers, electrical boxes, and cooling system pumps; have a "blue stake" done by the utility company.	**Site:** Determine boundary easements, areas to avoid, hazards, places to screen. **Example:** An existing irrigation system is in good working condition and should remain.
Views	**Site:** Photograph views from all sides of the site looking from the site and into the site; label views "looking north from site"; observe daily and seasonal changes.	**Site:** Note good and bad views and view sheds; identify views for screening, preservation or enhancement. **Example:** The unsightly view of the adjacent property parking lot should be screened.

4 Step Four: Design Development

Review and Evaluation

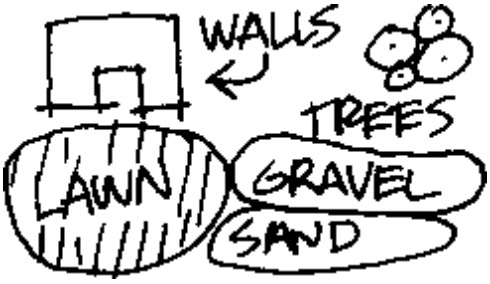
PARTICIPANTS (Step One) have created a WRITTEN PROGRAM (Step Two) which includes a statement of goals and objectives, a detailed list of requirements, proposed activities, activity settings, desired design features, and curriculum ideas. The SITE RESEARCH AND PREPATORY MAPS (Step Three) has lead to the selection of a site, documentation and mapping of existing site conditions (site inventory) and the evaluation of these conditions (site analysis). With these steps completed you will be ready to make informed design decisions as you proceed to the next phase in this design process known as DESIGN DEVELOPMENT (Step Four). As you move into this next phase of design, it is important to note, that the information gathered and generated within steps two and three must be reviewed and evaluated. Some of this material will be changed and adjusted as the design develops.



Design development is the creative synthesis of information and ideas into expressions of physical forms. This difficult endeavor requires an understanding of *design principles* for guidance in the creation of schoolyard habitats (these are presented within the section to follow). As the design develops or unfolds, three sequential progressions of site layout are used. These include *conceptual*, *preliminary*, and *final design*. *Conceptual design* is an experimental stage where the general relationships and locations of areas are explored and eventually determined through loose diagrams, sketches, and three-dimensional study models. *Preliminary design* is a schematic and more refined stage of ideation. Spaces are formed and generally defined. *Final design* is a well articulated more precise layout. Spaces, pathways and other design features as well as specific materials are clearly illustrated within a masterplan.

Design Principles

Landscapes are defined by many salient qualities; the sights, sounds, and smells that have the power to evoke strong feelings and emotions. This section focuses on visual aspects of design and the infinite possibilities that exist as one begins to create outdoor environments. An understanding of design principles will enhance the design experience. Traditionally these theories —"formal principles of design" (unity, balance, rhythm)—have guided the creation and critique of primarily two-dimensional artworks. Modifications have been made, through the ages, for application in three-dimensional works including sculpture, industrial design, architecture, and landscape architecture.



Principles of design are used in landscape expressions as the means to satisfy both functional needs as well as consideration for beauty. As these principles interact with one another within the environment, their combined effect will create harmony or discord. When they exist in balance with one another, functional, attractive, and meaningful places are created.

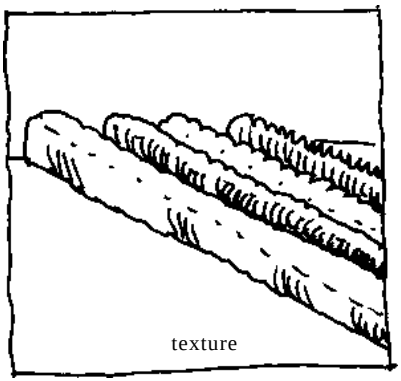
Schoolyard habitats are an explosion of colors, forms, and textures that change over time and through the seasons as the natural features grow and evolve. Man-made elements are also used for function and visual interest. These, too, could change over time as new students and teachers make creative adaptations to the spaces. The following design principles offer some ideas for the design of schoolyard habitats that are visually exciting compositions yet unified and harmonious places, well suited for both wildlife and people.

Focal Points or Emphasis

Focal points within the schoolyard habitat are special areas or elements of interest. These points of emphasis will attract the attention of both wildlife and people. Examples include unique wildlife features such as a pond or special bird houses, artworks including sun dials, animal track pathways, and drinking fountains (which could be brightly colored). There can be more than one focal point within the schoolyard habitat.

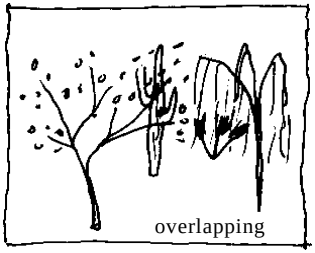
Texture

Texture is the surface characteristics of objects such as plants, rocks, water, walls, etc. The



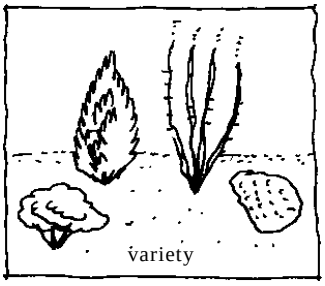
Overlapping

Overlapping is a layering of objects to create depth and visual interest. This layering is often exhibited in plant compositions. For example, large evergreen trees could be planted as the background for smaller flowering trees and shrubs. This overlapping effect creates a greater sense of depth, adds visual interest, and makes the plant mass denser which provides greater protection for wildlife.



Transparency

Partially transparent materials are used with overlapping techniques to create depth and frame views. This technique is exhibited as one can see through the bare winter branches of deciduous trees; the distant views are often accentuated. Additionally, lattice work structures and fences with openings, placed within the foreground, frame the "borrowed" landscape of the distance.

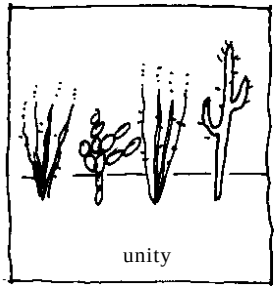


Variety

Variety in color selection, with contrasting textures and forms creates interest within the schoolyard habitat. This visual and functional liveliness is the "spice" of design. Designers of schoolyard habitats should consider variety in many ways including the size of spaces, spacial sequence, plant species, activity settings, artworks, and materials. While variety creates interest, too much variation will be visually chaotic and confusing.

Unity

Unity within the schoolyard habitat implies a sense of cohesiveness and harmony; the visual qualities and functional aspects of the design work as a whole system. Unity is the "glue" of design. This can be achieved through spacial layout, the repetition of similar or like materials such as plant species, and other ordering devices such as balance, rhythm, repetition, and progression.



Contrast

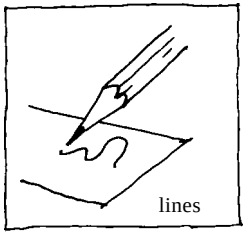
Contrast implies opposition or difference within the elements of design. This can be seen in the lightness and darkness of objects. Contrasting forms, colors, shapes, and textures will enhance the visual interest of the schoolyard habitat. A flowering desert shrub will be accented if it is placed against a wall of contrasting color. Contrast is used to create variety and visual impact.

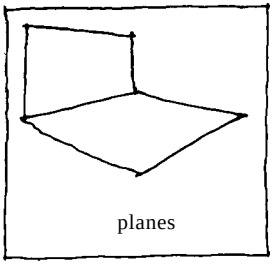
Light

The qualities of natural and introduced light will dramatically affect the feelings and experiences of a place. Changes in the characteristics of light during the day and throughout the seasons will greatly affect the visual qualities of the environment. Artificial lighting can be orchestrated to change according to the needs of users. The natural sky is a more appropriate source of light for habitat projects. The schoolyard habitat might try to enhance or accentuate the visual experiences of these occurrences. A sun plaza or sky viewing area might be created for watching and perhaps measuring the patterns of the sky and celestial objects.

Lines

Lines within the schoolyard habitat define edges or boundaries, suggest movement, and add interest. They might appear on the ground plane to create a winding pathway or along the edges of a dry wash. Lines of sight or view-sheds direct and frame the "borrowed" landscape of the distant mountain views or other focal points.


lines

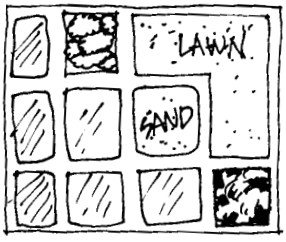

planes

Planes

Planes are the most important elements which create and define spaces within the schoolyard habitat. These include ground planes, vertical planes, and overhead planes. These "walls" of the landscape include both architectural structures and natural features. The plane orientations and their various combinations of treatments will provide unlimited opportunities for the designers of schoolyard habitats.

Ground planes

Ground planes can be hard, paved surfaces or soft, natural materials depending on the intended purpose. The degree of slope and topographic contour of the ground plane(s) offer additional variables with which to work. The ground plane offers designers a canvas of opportunity for expression in color, form, texture, and line with patterns of wildflowers, grasses, stones, tiles, and paint.

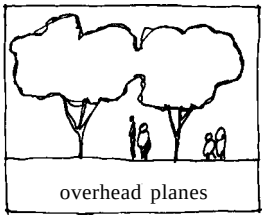


Vertical planes

Vertical planes are spacial dividers that might be made of earth berms, plant masses, solid walls of various heights, lattice or open air structures or single vertical elements such as a clock tower or a tree. Variations in texture, form, color, and size must also be considered.

Overhead planes

Overhead planes of landscape spaces create various degrees of enclosure which can be created through the open sky, tree canopies, overhead trellises, or solid roofs.



overhead planes

Volumes

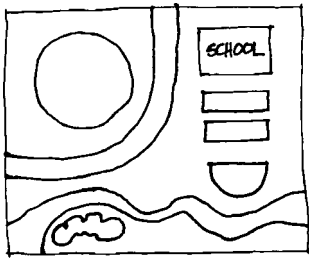
Volumes of spaces are created through man-made and natural materials. The volume of an outdoor space implies the form and mass of the air in enclosures made with vegetation and walls. Volumes of spaces within spacial sequences should change to create visual and functional variety and interest.

Mass

The mass or massing of design elements includes both architectural and natural materials. Plant massing is a term used to describe a grouping of plants, usually of similar species, to define space in a unified manner. Plant masses within the schoolyard habitat will screen views, define spaces, and provide specific habitat zones.

Shapes

Shapes imply two-dimensional patterns. Within the landscape they are the lines and edges that are most predominately observed on the ground plane as site plans are generated. These shapes could be amorphous and natural or derivations of geometric shapes including circles, squares, rectangles, or triangles. Shapes are manipulated and combined into patterns that begin to structure the site.



shapes

Forms

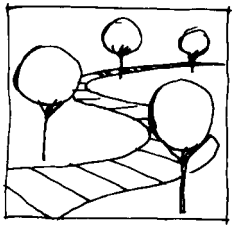
Forms imply three-dimensional objects or masses. Forms can be natural and organic—*informal*, or they can be symmetrical and highly ordered—*formal*. The schoolyard habitat will probably consist mainly of organic forms derived from nature. Refer to a topographic map for natural shapes that can become the basis for forms within the habitat project; it is difficult to replicate natural forms from memory and they tend to look like artificial 'peanut' shapes within the landscape. For example, berms should not be lumps of soil plopped on the land; they will look like "elephants under a carpet" (DeBoer 1972).

Scale

Scale is the relative size of spaces or objects with respect to the human body. Spaces can be large monumental, football field size spaces or tiny places like those created from hanging branches. The schoolyard habitat spaces must be designed with consideration for the scale appropriateness for all sizes of people and wildlife. Therefore, the habitat project should include a variety of space sizes. Small spaces are often ignored in public place design but these will be especially attractive for students and small wildlife.

Movement

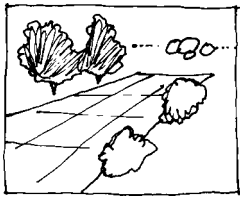
Movement in landscape design is a critical component that refers to visual movement of the eye and bodily movement through the outdoor spaces. The designer will orchestrate both of these types of movement through the composition of spacial layout. Views will be directed through site lines and framing and or screening devices. Circulation patterns will be determined and pathways created to move people through a series of spaces designed for a variety of visual and physical experiences.



movement

Balance

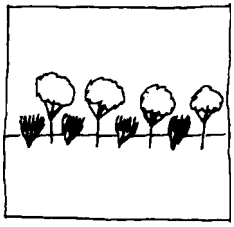
Balance is an ordering of elements in a composition. These ordering devices include symmetrical, radial, and asymmetrical patterns. The schoolyard habitat will probably be derived from natural landscapes which are asymmetrically balanced. Plant groupings of odd numbers will help achieve this effect.



balance

Rhythm

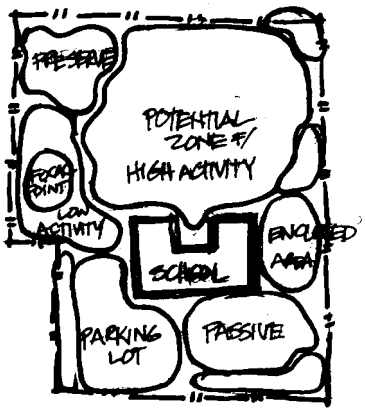
Rhythm is an ordering principle marked by expected recurrence; it is understood by ratios and organic forms in nature. Designs within the schoolyard habitat created on walls or with ground paving materials could repeat patterns according to various rhythms. Plant groupings can also appear in patterns which reflect a sense of rhythm. A music or art teacher might find ways to create rhythmical patterns that can be expressed within the schoolyard habitat.



rhythm

Conceptual Design

This stage of design is a loose arrangement of zones, spaces, spacial sequences, and other design features within the landscape. The size and relationship of elements are first determined first at a conceptual and general level. In order to achieve a good conceptual design a discussion of zones, spaces, and spacial sequence has been provided.

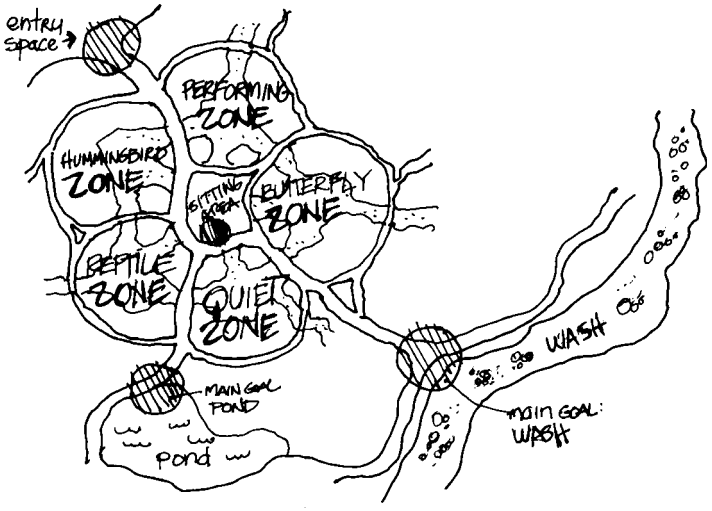


CONCEPTUAL PLAN

Zones

Zones are large areas within the landscape designed for a specific function or experience. These themes within the schoolyard habitat might reflect the following ideas: (1) an activity setting such as a large performance area or outdoor classroom, (2) ecological factors or life zone

demonstrations which might include a spruce-fir aspen community or desert scrub community, or, (3) specific wildlife habitats such as a bird habitat or butterfly garden. Zones are made of spaces, spacial sequences, and other design features. Circulation patterns and physical devices such as plantings, landforms, walls, and fences will link or separate zones within the schoolyard habitat and specific spaces within zones. This hierarchical division will help to organize the layout of the site.



Disneyland is an example of zone designations used to organize a landscape and produce a desired effect. Zones such as Frontier Town are carefully controlled to create an atmosphere reminiscent of the early West. Spaces and functions within this setting are isolated from other areas within the park; visitors become oblivious of the modern world nearby.

Spaces

Spaces within the landscape are sculptural compositions made from materials such as plants, earth, water, sky, sand, bricks, wood, concrete, iron, and plastic. Materials are artfully combined to enclose space through overhead structures, ground surfaces, and vertical elements or masses. These elements create the edges and physical or visual boundaries within the landscape. They are the walls of outdoor space. The volume, size, and form of the space, spacial linkages and sequences are other variables that affect the visual quality and function of the landscape.

Professor of landscape architecture Michael Laurie (1986) describes two basic styles of outdoor space—*formal* and *informal*. *Formal* space is primarily architectural and symmetrically balanced through mirror image repetition along an implied axis; the right side of the space is the same as the left side. *Informal* space is organic and asymmetrical; a "felt" order.

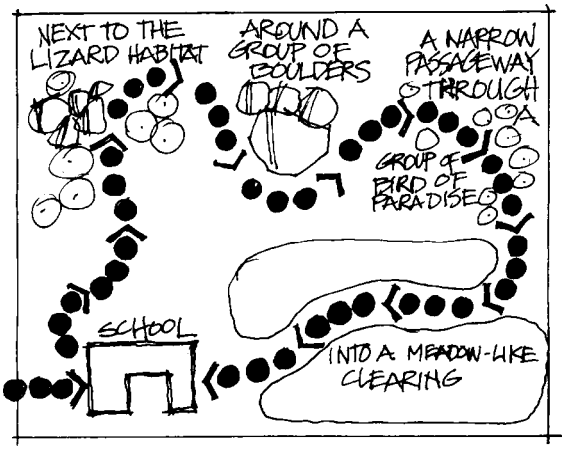
Schoolyard habitats will probably have informal styles with spaces that are derived, in part, from the natural landscape. Sensitivity to the ecology, culture, and art forms indicative of your region will guide design. Existing places, both natural and man-made, could be used as prototypes for the design of spaces within your schoolyard habitat. A design tool often

employed by both beginning and seasoned design professionals is the creation of a *story-board* of design possibilities. Photographs of attractive space possibilities are collected and displayed within a large montage format. This mural of ideas becomes the inspiration for design. A wall within the school could become the story-board for the evolution of possibilities as participants add images on a regular and ongoing basis. As the design progresses it could prove useful to actually measure and map a natural space; the landforms, plant species and groupings, or other features could be applied in your schoolyard habitat design.

Spacial Sequencing

Natural and man-made features will be coordinated in a composition of linked spaces designed to create spatial sequences. These sequences can be described through the visual and physical sensations that occur as one moves through the environment. This progression of unfolding images could be compared to those created by film-makers. For example, Spielberg leads us through a series of frames within the movie Star Wars in order to tell a story and produce a variety of visual experiences and related emotions. Landscape designers also create a series of settings that reveal themselves as one moves through the spaces. These settings create a variety of effects which, in turn, adds interest and stimulate feelings. The orchestration of spatial sequencing within the landscape is an art form of the highest level.

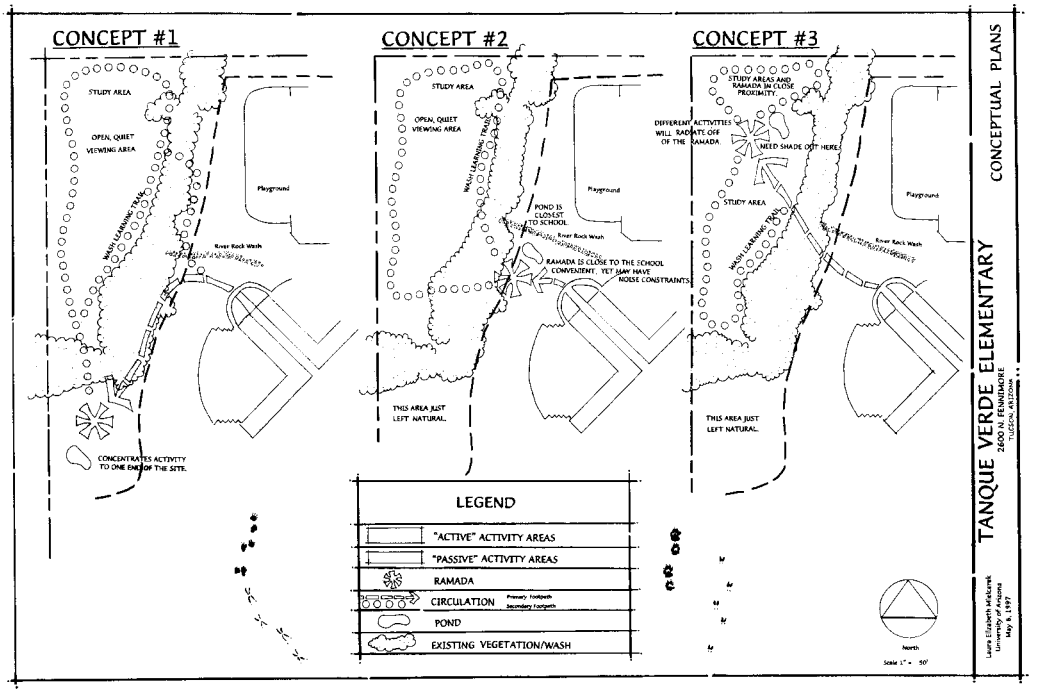
The father of landscape architecture, Frederick Law Olmsted, exhibited masterful control of spatial sequencing in his 1858 design for New York City's Central Park. Pedestrians and carriages (now cars) were separated both visually and physically through level changes, stone wall placement, and beautiful plant compositions. As people stroll through the "picturesque" romantic landscape, strong sight-lines direct views towards magnificent landscape features such as Bow Bridge or the naturalistic lake. These dramatic focal points are framed by vertical elements, predominantly plants, while undesirable views, now skyscrapers, are screened by hills planted with evergreens. The arrangement of spaces within the park including Bethesda Terrace with pond, the wooded natural area called the Ramble, and the open lawn or Great Meadow, attract both people and wildlife as the park has maintained its original concept as natural retreat within the urban surrounding.



Site layout

Site layout is the composite arrangement of zones, spacial sequences, and design elements (light fixtures, plants, walls) within an interlocking landscape composition. The size and relationship of zones, spaces, circulation pathways, and other design elements are first determined at a conceptual level. This can be achieved through functional relationship or "bubble diagrams." In this loose arrangement of spaces the ideas generated from the written program merge with the lay of the land in conceptual design plans. Revision of these ideas will naturally occur as you develop design alternatives.

Many conceptual designs should be generated before one is taken to a more refined stage. You should start by developing an ideal diagram for your schoolyard habitat. At this point disregard the specifics of your site and think only of the ideal functions and their relationships to one another. To begin, place each requirement, activity, activity setting, design feature, and curriculum idea on a single piece of paper. There will undoubtedly be overlap and repetition among these ideas. Group these pieces of paper in piles of likeness on a large table. For example, all of the items that relate to water or pond features would go in one pile. You may have to organize the ideas several times and in several ways before an appropriate pattern emerges. It is also possible that items from one pile will have to be duplicated for use in several of the other piles. For example the requirement, "shade," or the design features, "tables and benches," might need to be included in several of the groups. Begin to think of these groups as "zones" within the ideal schoolyard habitat.



The Schoolyard Habitat Site is broken down into Zones or Themes of Use

Zone Examples

Zone A	Entry area
Zone B	Hummingbird garden
Zone C	Lizard habitat
Zone D	Desert scrub
Zone E	Free play area

Zones are broken down into Spaces or Activity Settings

Example: Zone B Humming Bird Garden

Space 1	Shaded space for sitting
Space 2	Linear strolling space
Space 3	Hidden secret garden
Space 4	Open space for small group gatherings
Space 5	Planted space for viewing only

Design Features (Elements) are Added to Spaces

Example: Space 1: Shaded Space for Sitting

Design Features include:
Overhead trellis
Drinking fountain
Wooden benches
A cluster of shade trees
Signage explaining the hummingbird garden

The organization of design ideas within this hierarchical structure can be used to make conceptual diagrams of the ideal site. Make large cardboard rounded or circular shapes for each zone and smaller cardboard ones for related spaces and features. Arrange these on the table in a manner that places related or similar zones and spaces together and separates dissimilar ones. Try this a number of times until a few exceptional diagrams emerge.

This prepares you to move on to the same kind of exercise within the parameters of your site. This can be achieved easily through the use of a sandbox study model. First build a simple box proportioned to the dimensions of your site. (The box length should be at least three feet with a depth of 8 inches.) Add clean sand to the box. With cardboard, construct the existing

man-made and natural features including buildings, walls, walks, trees, and rock outcroppings. These should be scaled or proportionally correct in relationship to the box. Place these features in the their appropriate locations in the sandbox model.

Make alternative arrangements, within the sandbox model, with the cardboard zones, spaces, and features made previously. The size and shape of these cardboard pieces will have to be adjusted to better match the scale of the study model. As you manipulate the cardboard pieces you may discover that there are too many zones, spaces, and features, and that these various functions will not all fit within the boundaries of your site. Should this happen, you can expand your schoolyard habitat area, consolidate zones, spaces, and design features or eliminate some of your ideas. The size and location of zones will eventually be determined as you continue to manipulate these areas within the model. The cardboard shapes will need to be adjusted as you progress to better fit the site's constraints. Some zones will begin to take on an elongated shape while others twist to follow a drainageway. In fact, some zones might be doughnut shapes as they enclose smaller zones. These are the puzzle pieces of your habitat landscape. Some of the pieces will be interlocking and related, others will be separated with buffers.

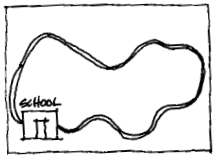
Add cardboard trees and shrubs to the sandbox to begin to enclose and define spaces as needed. Existing and proposed landforms can be easily created by adding water to the box and molding the sand. Circulation patterns can be made out of pieces of paper or fabric. The following section provides some ideas about pathway design as well as other site features including plantings, landforms, and waterforms.

Circulation Patterns

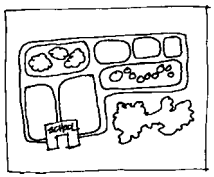
Circulation patterns are systems of path and trail layouts that offer people access from one place to another. This should happen in coordination with a variety of sights, sounds, and smells. Sometimes mysterious, or perhaps funny, a path within the schoolyard habitat should take people on journeys of experience through the sequence of zones and spaces. For example, the pathway might twist sharply around a boulder and become a narrow passageway through a tight thicket of Bird of paradise (*Caesalpinia*) plants. Suddenly, the same path widens and opens into a meadow-like clearing dotted with wildflowers. Experiences like these will make your habitat project meaningful and engaging for people while also satisfying wildlife needs for varied spaces and cover. Creative writing exercises could be used to describe possible pathway experiences. These, perhaps poetic descriptions, might help articulate and clarify ideas which could be incorporated in the design.

The layout of the pathways within the habitat project could be derived from adaptations of the following basic patterns.

"S" Curves
People tend to walk naturally in slight 'S' shapes. This pattern lends itself to a more natural approach.



Straight Systems
Straight patterns and grid systems could prove useful methods for organizing the spaces within the schoolyard habitat. These checkerboard patterns might enclose specific habitat zones. Straight and grid patterns tend to be geometric and formal. These patterns might need to be softened with asymmetrical planting arrangements.



Circular Loop Paths
Circular loop paths run along the perimeter of the site. This helps to lengthen the pathway while providing access throughout the entire site. This could be used within small schoolyard habitat sites as a way to maximize the experience of the journey.

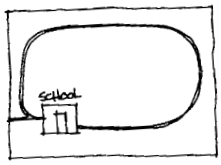
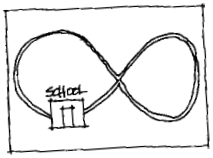
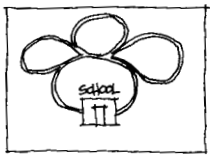


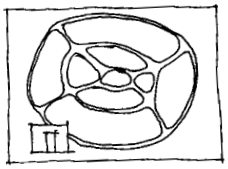
Figure Eight Patterns
Figure eight patterns consist of two loops that meet in the middle. This option creates several directions of movement which may be attractive within the schoolyard habitat site. It also provides a spot in the middle where the paths come together. This spot could be developed into a classroom, observation area or other gathering place which could provide seating and shade structures.

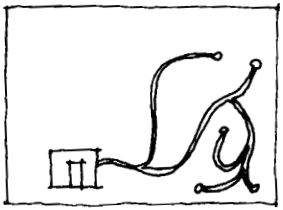


Clover Leaf Patterns
Clover leaf patterns resemble figure eight patterns except that there are three or four loops rather than two. These loops could serve to enclose specific zones within the schoolyard habitat project. This pattern works well with large sites that have plenty of space.



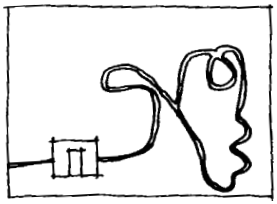
Spider Web Patterns
Spider web patterns are maze-like systems that offer variety and interest. Their complex pathways could become confusing; use dominant and subordinate paths if possible. Spider web patterns offer students many travel options and potential experiences. Their symmetrical nature might be softened with asymmetrical plantings.





Dead-end Patterns

Dead-end patterns should be avoided since pedestrians will have to back track the way they came. This can be frustrating and unappealing. More importantly, dead ends paths cause safety concerns as they become possible entrapment areas for intruders.

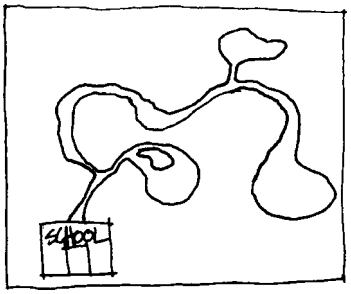


The "Let it Happen" Approach

Sometimes circulation patterns are not defined in the design plan. Rather, they are determined after the project has been constructed and people begin to carve paths on the ground as they move freely through the site.

Student Designs

Young students often draw unusual pathways which meander and have undulating forms. Their winding paths have varying widths which can be narrow and pinched in spots and wide bubble-like forms at other locations. As envisioned by these students, the wide spots are places for activities such as meeting, sitting, and watching. This pathway concept would be wonderful within the schoolyard habitat setting and could be applied within any of the above patterns.



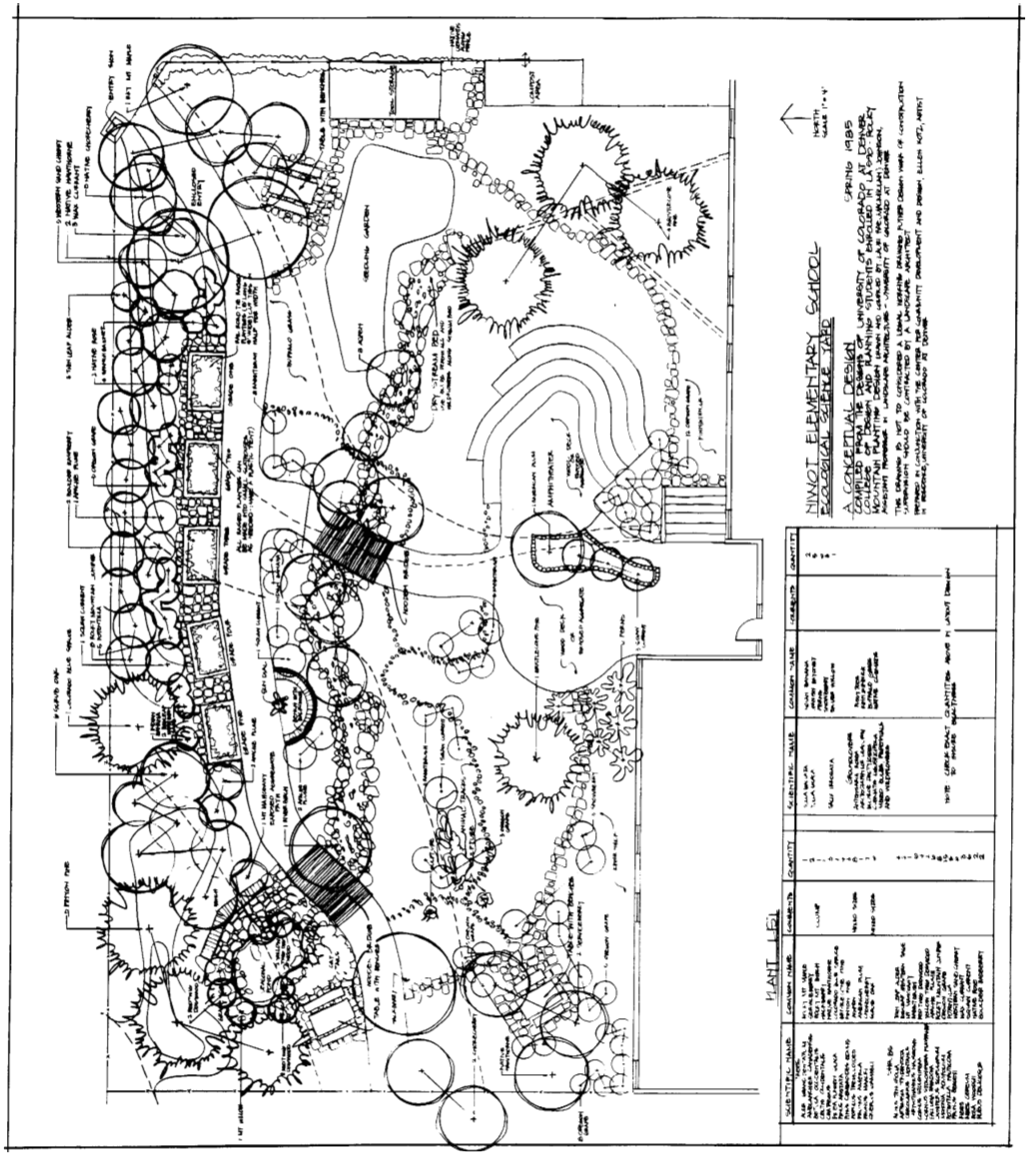
Preliminary Design

The conversion of loose ideas and diagrams developed in the conceptual design will become more specific through the preparation of preliminary designs. This stage in design development shows the general geometry of the site layout including zones, spaces, and features. Spacial composition and general forms are determined; actual plant names and other specific materials remain unnamed. Rather the drawings specify hard or soft surfaces and indicate general plant forms such as shade trees, shrubs, and ground covers. Within this stage the ideas and drawings are still open for revision and modification. Abstract symbols for views, buffers, and undecided elements such as focal points can be represented through abstract symbols while other elements are drawn as realistic forms. Ideas are illustrated through plan view drawings, sketches, and models. Usually a number of preliminary design alternatives are generated for review by the project users.

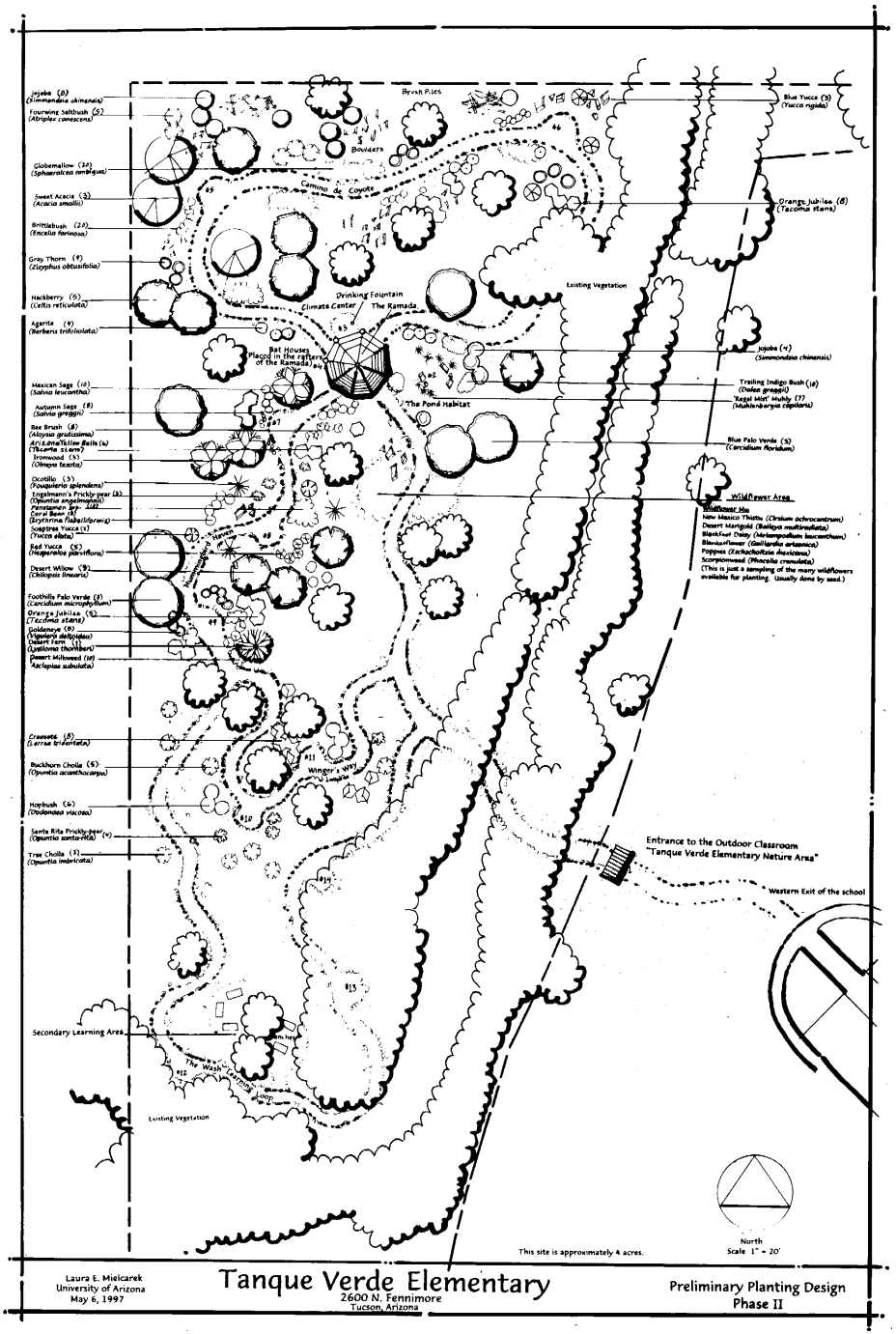
Final Masterplan

One or several of the preliminary design alternatives will be adopted for revision into the final masterplan . The final masterplan is a refined scheme that can be built through contractor assistance and community volunteer efforts. The final masterplan should be a clear set of drawings (plans and sketches) and perhaps a model. Accurate measurements are imperative. The drawings should be colorfully rendered and all zones, spaces, and features must be labeled. These final plan drawings, sketches, and site model will guide the construction process and help with fund-raising.

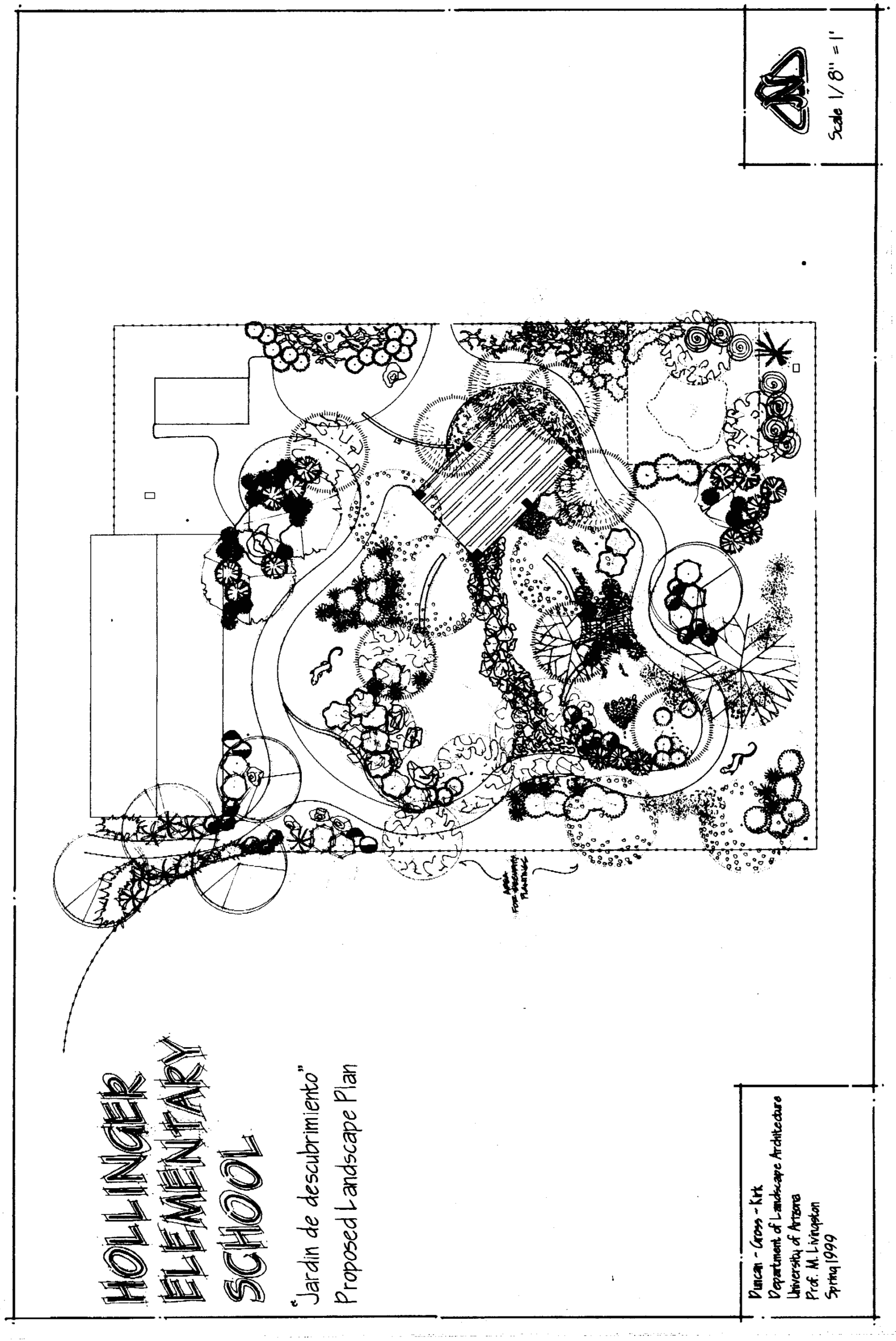
Examples of plan graphics are found on the following pages.



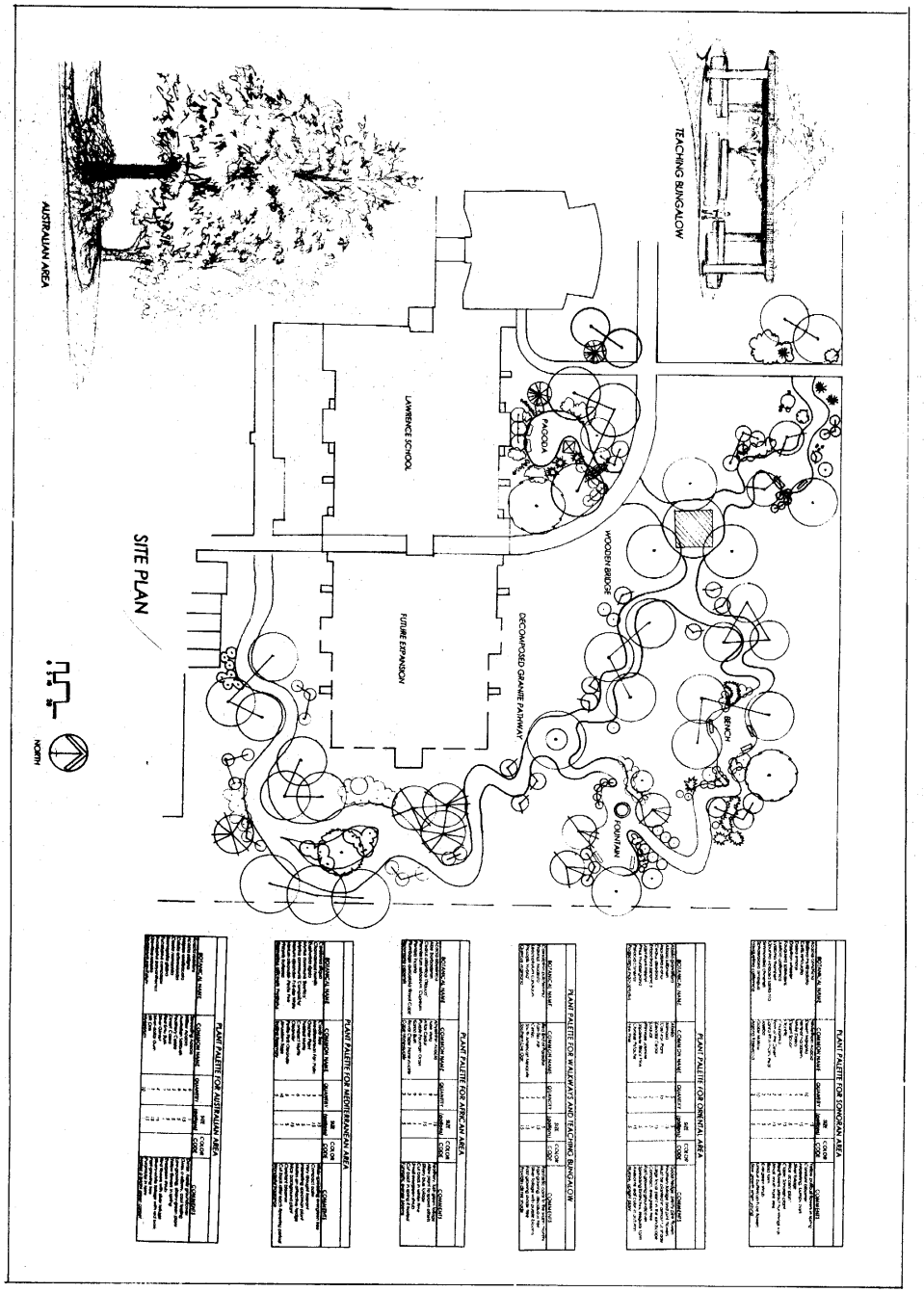
Masterplan



A Master Plan

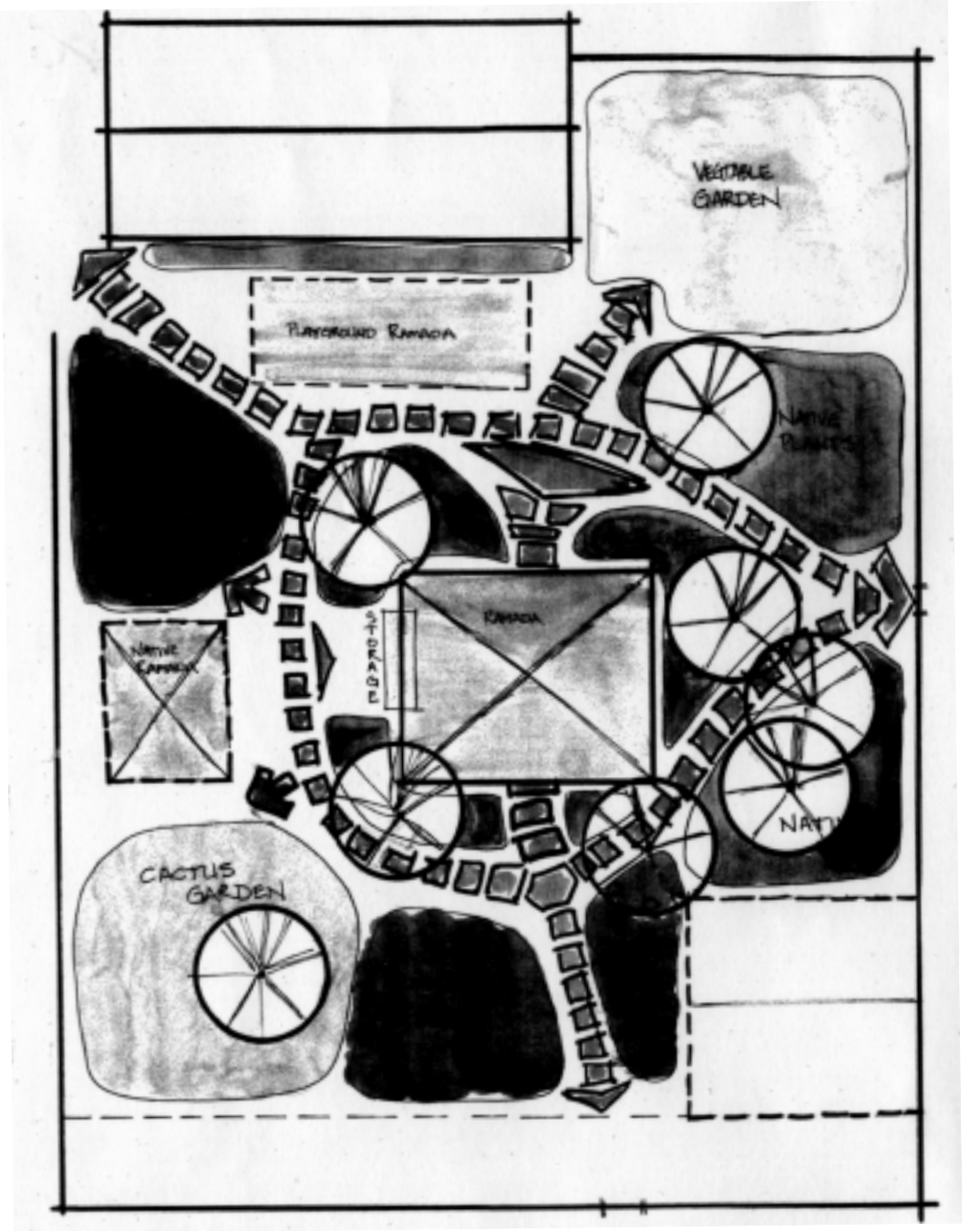

HOLLINGER
ELEMENTARY
SCHOOL
"Jardin de descubrimiento"
Proposed Landscape Plan
Duncan - Gross - Kirk
Department of Landscape Architecture
University of Arizona
Prof. M. Livingston
Spring 1999
Scale 1/8" = 1'

Masterplan



Renee Tompkins
Laura Mielcarek
Planting Design 538
Spring 1997
Professor Lauri Johnson

Lawrence School Site Plan



Concept Plan

Additional Sources

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Chapter 3:
Design Implementation

Introduction
Project Funding
- Grants and Cash Donations
- In-Kind Donations
- Organization of the Fund-raising Process

Constructed Elements of the Garden
- Natural Features
- Irrigation Systems
- Plants
- Man-made Features

Maintenance
- Weeding
- Watering
- Pruning
- Spring and Fall Debris Cleanup
- Pond Maintenance
- Bird Nests and Bird Baths
- Wildlife Houses

Accessibility
- Paths
- Ramps
- Seating
- Water Features and Safety

Project Evaluation
- Environment
- Structures
- Overall Stewardship

Revisions
Additional Sources

Introduction

Design implementation is the transformation of the schoolyard habitat masterplan into a physical reality. This requires three key components: (1) community support, (2) project funding, and, (3) the actual construction of the project. As discussed in *Chapter 2, Design Development*, community support and participation from a variety of individuals including: administrators, teachers, students, parents, community members, landscape architects, and other outside professionals is critical to the overall success and longevity of the project. Their contributions will be needed in design, fund-raising, and construction. This community support and dedication will foster a sense of stewardship in all involved. Acknowledgments of these valuable participants both publicly and with letters of appreciation should not be forgotten.

Project Funding

Two approaches will be helpful in obtaining funding for the project: searching for actual dollar contributions and obtaining "in kind" donations. To make the masterplans for your schoolyard habitat come to life, an hybrid approach to fund-raising might prove most successful. In short, schools will have to be creative in their search for resources.

Grants and Cash Donations

Grant applications are formal requests for funding through public and private agencies. *Appendix A: Resources*, subheading *Funding* provides a list of possible funding groups. Write to each agency separately to obtain their specific guidelines. Your request for funding should include a project description, a discussion of project benefits, masterplan drawings and photographs of models if possible. Student drawings and letters are compelling support materials.

Organizations including local businesses (for example, Target Stores, WalMarts, gas stations, IBM), and clubs (Rotary Club, Lions Club, garden clubs) might also be able and willing to offer cash donations. Additionally, various individuals from the community also become likely contributors. In all of these cases, the most persuasive fund-raising tool will be the completed masterplan since the idea is represented in a clear community vision. These plans might include possible construction phases which allow construction and fund-raising to occur over the span of several years. This approach is useful when resources are limited. As described in *Chapter 2, Design Process*, the masterplan will illustrate specific zones, spaces, and additional features or elements. These individual areas could be earmarked with respect to organization or individual donations. For example, an agency or person might want to fund one aspect to the masterplan—perhaps, if applicable, the tile signage for the humming-bird garden. Student presentations to these organizations or individuals would be a good

learning opportunity and an effective fund-raising device. Contact your local Chamber of Commerce for a list of potential businesses in your area.

In-Kind Donations

Many schoolyard habitats are created through a combination of actual dollars through grants, corporate and civic donations, and in-kind donations. In-kind donations are donations of goods and services. Some of the in-kind donation possibilities include landscape materials such as rock, gravel, soil, mulch, and fill to create berms and lumber (for planting beds, shade structures, and benches). Resources for these types of materials include local materials suppliers, local landscape contractors (they may have material scrap from various jobs), lumberyards, plant nurseries, and retailers.

In-kind donations can also be in the form of services; schools have been successful in receiving donations of services from contractors, plumbers, irrigation specialists, wildlife biologists, horticulturists, architects, landscape architects, artists, professional fund-raisers, and local civic groups.

Organization of the Fund-Raising Process

The funding aspect of the outdoor classroom has been most successful when it is viewed as an ongoing organized process. Be sure to start this process early and establish a funding/ resource plan. Designate one person to coordinate all the funding activities. Breaking down the project resources into grant funding, cash donations, and in-kind donations with one individual heading up each of these categories will simplify the tasks. Each of these respective groups should set goals, time lines, and establish a method for reaching their goals. For example, for grant funding, a list of grants, their deadlines and contact people will help to organize the task.

To make the fund-raising process more effective, set target dates for receipt of funds and commitments for goods and services. Track the funding and commitments as they come in; a large poster or bulletin board displaying successes in this area can lend energy to the project. Additionally, there may be some funding available in-house; check with school administration for availability of environmental education funds that could be used on the schoolyard habitat project.

Students can be a part of this process by adding their efforts and excitement. At one Arizona school, the students took charge of part of the funding with a penny drive. Simple activities like this can augment grant and in-kind donations and add the students' energy and ownership to the project.

Constructed Elements of a Garden

A wide variety of natural and man-made features can be found in a schoolyard habitat. In the following sections, constructed elements are discussed and conceptual drawings are added to offer possible suggestions. These ideas should be modified according to the building codes and landscape standards within your county. Contact a Landscape Architect and County Planning Representative for advice and review.

"Natural" Features

Natural features of the habitat include earthworks, water and drainage areas, and plants. These elements form part of the living conditions for wildlife within the habitat and add interest for human users.

Earthworks

Earthworks are the large-scale ground height variations within a habitat. Small hills create visual interest, different zones for plants, and emphasize places for people to walk. Hills can be used as viewing platforms or screens that partially block unpleasing elements. Hills create a sense of anticipation for what is unseen but just around the corner. Connected low-lying areas help to relocate rain water to a specific area or off the site. Earth works are used in a landscape to define or separate spaces. Creating changes in topography on a flat site can make that environment much more interesting.

Earthmoving

Soil from off the site can be brought in at additional expense. Soil can be removed from one area of the habitat to form a future pond and subsequently be relocated to create small hills. In the construction of both hills and low-lying areas, final slopes should be fairly shallow, less than 25%. Erosion becomes a continual maintenance problem on steeper slopes.

Ponds

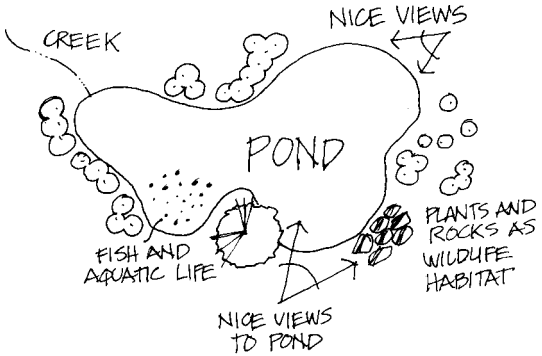
Choosing a Pond Site

When choosing a site for a pond, a key element is the location of water and electricity. Locate these utilities as a preliminary step in site selection. In general, site the pond in an area that receives shade during the hottest part of the day and is near trees and shrubs that wildlife may use for perching or cover. Locate the pond away from areas directly under high litter trees as debris will fill the pond. If the site must be in a windy location, provide wind breaks

for the wildlife. One of the greatest pleasures and learning opportunities is to observe wildlife at the pond; be sure to locate the pond where this is possible.

Construction of the Pond

There are many types of ponds including: a "kettle" structure for very small ponds; the liner method using a PVC, rubber, or GeoPond liner; concrete liners; formed fiberglass pool structures that range in sizes and shapes and Earthponds that are very large ponds lined with an organic liner. Essential to any type of pond is a water source, filtration system and electrical service to operate the filtration system. From an ecological viewpoint, the size of the pond is an issue. The surface area should be a minimum of 40 square feet to provide enough space to accommodate the basic elements of an ecological system.



Fish and Pond Organisms

Fish help in the overall balance of the pond. Insects, tadpoles and snails clean the bottom of the pond. A healthy pond has no more than 15 inches of fish per square yard of surface area.

Pond Filtration

A form of filtration is needed to keep the water clear in the pond. There are external and submersible types of filters. These will remove visible wastes and carbon dioxide that supports the growth of algae.

Adding Plants and Animals to the Pond

Prior to adding any living organism to the pond, a de-chlorinating agent must be added to the water; typical chlorinated public water is toxic to plants and fish. When you first introduce plants, fish, snails, and possibly soil, the pond will go through stages of murkiness as algae levels build and change. When a balance is achieved in pre-formed or concrete ponds, the water will eventually clear. Ponds with earth bottoms will retain murky water.

Irrigation Systems

An integral part of successful growth of vegetation in a habitat is the irrigation system. Regardless of the location of your habitat, all newly installed plants require some irrigation to assure establishment. For many desert-adapted plants, that irrigation may be eliminated after two to three years. The more water-needy species may require lifelong irrigation. A drip irrigation system is the most water efficient and can be used as a teaching tool for water conservation.

Components of an Irrigation System

Water source
Electrical source for controller (if system is automated)
Controller
Backflow preventer
Pressure regulator
Gate valve
Distribution system of valves, PVC pipe, poly tube, emitter tube, emitters and bubblers

A few general concepts are important to remember when designing and installing an irrigation system. Planning ahead will save much time, energy and money in your project. A drawing of the proposed irrigation system will be helpful for initial installation as well as any future repairs to the system. For simple layouts, irrigation parts suppliers can assist in an irrigation design. For more complex layouts we recommend consulting a landscape architect or designer for a complete plan.

Zoning the irrigation system allows you to customize the water provided to the different types of vegetation in the habitat. Trees typically have different watering needs than shrubs, grasses and ground covers. Also, some of the plants may have higher water needs than others. When designing the irrigation system, zone the trees on a separate line than other plant materials and zone the high water use shrubs, grasses and ground covers on a separate line than the low water use plant materials. In designing the overall system, remember Arizona has a diverse climate. Requirements for trenching and valve housing will vary from desert locations to mountain locations. Check with local landscape contractors for the regulations in your area.

Be sure to install the irrigation system prior to installation of plant materials; these plants will need immediate watering for the best chance of survival.

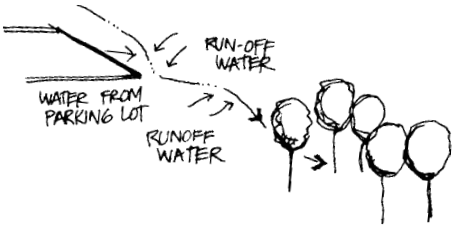
Sources of information include the local water company, the local branch of the cooperative extension service, local botanic gardens, local nurseries and irrigation system suppliers.

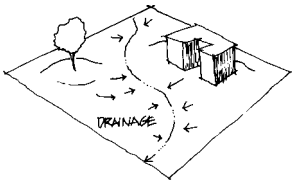
Natural Irrigation: Water Harvesting

Water harvesting is the capture of rain water and its subsequent use in sustaining the habitat.

Water harvesting systems can be as simple as collecting runoff from a roof through downspouts and extension hoses and redirecting it to plants. Complex systems involve catchment basins, ultra-violet treatment of stored water and recycling of water for landscape use. Water harvesting is a conservation method that provides ethical, environmental and scientific learning activities.

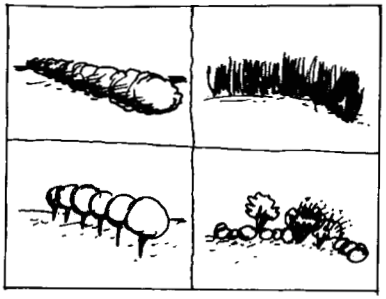
When designing a water harvesting system, consider a simple system. Run-off from parking lots, roofs and drinking fountains can be used to supply a portion of the water needs of the habitat area. Maintenance personnel are an excellent resource for assessing the possibilities of harvesting water from these areas. You may also want to consider cisterns and rain barrels; be sure to investigate the sanitary and safety requirements both at your school and locally.





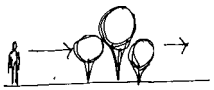
Plants

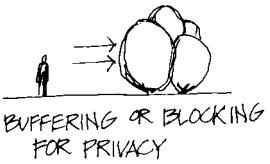
Plants are critical living materials define space, enhance views, and attract wildlife. Plants within schoolyard habitats will have a variety of uses, particularly as food and cover for wildlife. Additionally, plants can block unsightly views, frame good ones, retard soil erosion, retain soil moisture, direct circulation movement, clean the air, and offer protection from the desert sun and wind. Visual and functional considerations within your schoolyard habitat will include plant species, size, and form, branch and foliage shape and texture, type of fruits, flowering interest and color.



Soil Testing

Soil testing can provide baseline information on the type, acidity and drainage capabilities of your schoolyard habitat. The process and generated information provides an interesting learning opportunity for students involved in the project. Specific soil information for your area may be available through your local branch of the Natural Resource Conservation Service (formerly the Soil Conservation Service). For specific soil testing, nurseries, the local cooperative extension or environmental engineering firms are resources.





Xeriscape Design

Xeriscape *(zir'-I-skap)* is the conservation of water through creative landscape practices. The word comes from the Greek word *xeros*, which means dry. Here in Arizona, conserving water is an important ethic to understand and promote. In your design for the schoolyard habitat remember the seven principles below. They will help save water and money. For more information, contact irrigation specialists. See *Appendix A: Resources*. (from the Arizona Department of Water Resources.)

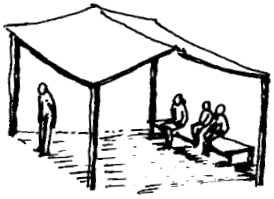
"Man-made" Features

Man-made features include shade structures, ramadas and trellises, storage areas for tools and seasonal supplies, weather stations, wildlife viewing blinds, wildlife houses, seating and table options, amphitheaters, signage, retaining walls, planters and pathways. When you're considering which structures to incorporate into your habitat area, you need to determine how the space will be used and what will be the long-term needs for the habitat area.

Many traditional and new materials are now available for building structures. Straw bale, recycled tires, adobe blocks, and stacked rock are among the options. Designing these structures offers great opportunities for creative, artistic and environmental experiences for the students.

Shade Structures, Ramadas and Trellises

Shade is a very important factor within the schoolyard for wildlife, plants and people. Different plant and animal species thrive in shady microclimates. Shade can be created from trees, large shrubs or built structures. Shade will be most prominent on the north-facing slope or side of an object. West- and south-facing structures will have the most exposure to sunlight. The eastern side of the building is exposed in the morning but offers shade benefits to nearby organisms during the late afternoon.



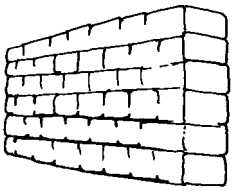
Heat and light exposure and the subsequent plant stress occur from reflected as well as direct sunlight. Reflected light comes from sunlight bouncing off of nearby bare walls and uncovered soil. Many plants are sensitive to these sun-exposed areas; your plant selection must accommodate these potentially hot, burning spots. The orientation of the surrounding buildings will determine the larger areas of shade and light. Such areas will vary according to the seasons of the year. This variation can have a significant effect on the types of flora and fauna that will survive in your habitat.

Storage Areas

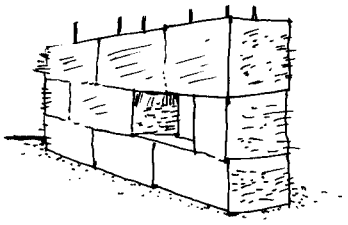
An often overlooked feature in the design of outdoor spaces is that of a storage facility. Tools, interpretive and project materials and supplies are all employed during the construction and subsequent use of the wildlife habitat. Items such as shovels, rakes, fertilizers, wheelbarrows, buckets, water testing kits, collection jars, butterfly nets, wildlife food, irrigation parts, and seating mats all require storage. The closer the storage location is to the habitat site, the easier and quicker it will be to make full use of that habitat. Storage structures can be built on site (a shop project) or purchased as a prefabricated entity.

Considerations for a storage area
Safe, securable door or entrance to the shed.
Adequate room for materials intended to be stored.
Lighting; a window or skylight will be sufficient.
If food supplies are stored inside, wildlife-proof the shed.
Proper drainage away from storage structure.

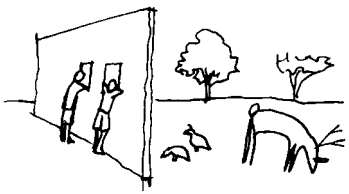
Walls



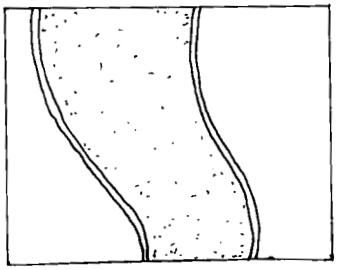
Opportunities for wall structures in your habitat include seat walls, retaining walls, raised planter walls, divisions of space and display space. Walls can be constructed of many materials including logs, formed concrete, concrete block, brick, rock, railroad ties, tires, straw bale, frame and stucco, wood board and rammed earth.



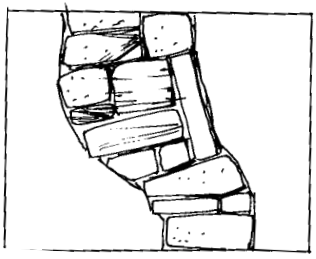
Select the type of wall that is most harmonious visually and functionally with your concept and envisioned uses of habitat. Cost is a large factor in creating walls; be sure to take this into account when creating your designs. Donated materials and labor or use of low-cost options such as railroad ties, straw bale or used tires can greatly mitigate the cost. Also, check safety regulations with the school administration and local authorities; there may be regulations regarding the height of walls as well as adjacent ground surfacing.

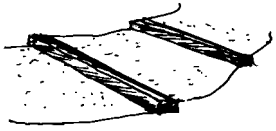


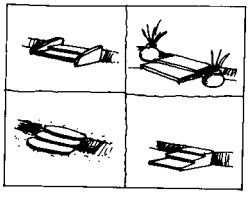
Pathways



A pathway is the vehicle for student explorations. It is a linear connection between a series of experiences that enhance discovery and learning. Edges of a path identify the limits of human access in wildlife areas. As a result, the routing of that pathway through a space is very important. A variety of paving materials can be used for surfacing pathways and gathering areas. These materials range from bare soil secured with a resinous stabilizer, to sand and decomposed granite, and finally to labor-intensive materials of stone, brick and concrete. The choice of material is dependent upon the budget, the availability of labor and the anticipated amount of use. Because of the aridity of Arizona climate, the use of uncoated wood should be considered a short-term solution.

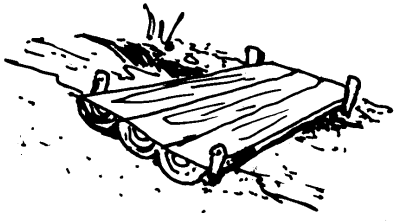






Considerations in Designing Pathways

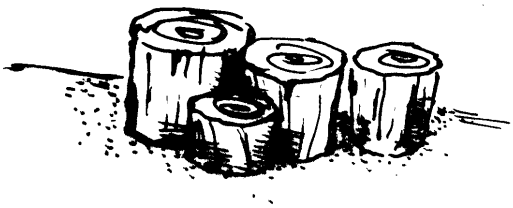
The most natural paths of travel for users between the areas are usually the best to implement. Pathways are more interesting when they contain curves and variations in width. Nodes or seating areas next to pathways become sites for student gatherings. Create pathways with widths, surfaces and slopes that are universally accessible even for disabled students (see reference for Americans with Disabilities Act Design Guidelines in Additional Sources).



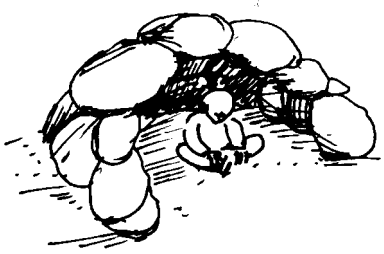
Seating Options

Seating is desireable for students and teachers alike. Accommodating users of the habitat area is the primary concern in developing seating options. If classroom groups of children will be gathering for group discussion or presentations, a group seating area is needed. This can be as simple as groups of logs or sitting rocks or as formal as benches or a concrete amphitheater. If the space will be used primarily by small groups, nodes with seating for three to eight children can be incorporated throughout the site. If

the area will be used for quiet individual observation, incorporate sufficient seating options in diverse areas of the habitat to accommodate a typical classroom of children.



When considering seating options, a hybrid of these seating concepts will produce an area conducive to both group and individual study, adding flexibility to types of study done in the habitat area. Another consideration when determining seating options is shade, especially in the desert locations of Arizona. Providing seating in comfortably shaded areas will increase the usability of the habitat as a study area.



Because the area is a designated wildlife habitat, the more natural designed sitting options seem appropriate. Consider boulders, logs, stumps, straw bale sitting walls, used filled-in tires, and tinted concrete pads with animal track impressions, natural objects or animal mosaics imbedded in them. If non-permanent seating seems to be the best option, consider portable "sit-upon" or sitting pads that the children make so they can sit anywhere in the habitat.

Wildlife Houses

Nesting areas and nest houses encourage wildlife to reside in your habitat for longer than a temporary period. (See Chapter 4:*Ecological Principles* for specifics on wildlife nesting areas and houses. The local Game and Fish office and Audubon Society have instruction pamphlets on how to construct various nesting boxes for wildlife. Botanical gardens, the local cooperative extension and the Arizona-Sonora Desert Museum are excellent resources to identify appropriate vegetation that provides nesting material and food sources for wildlife.

Maintenance

A schoolyard habitat is an excellent tool for involving students in the outdoors. The natural environment is dynamic and ever-changing. Maintenance of the schoolyard habitat should

reflect the natural development of the chosen inhabitants for your site. Plants should be allowed to retain and natural shapes except for those that provide shade or create a hazardous situation. The following list of maintenance tasks and tips will help to ensure a natural and save schoolyard habitat for students, teachers and wildlife that visit your site. Remember to include the students in any of these maintenance practices.

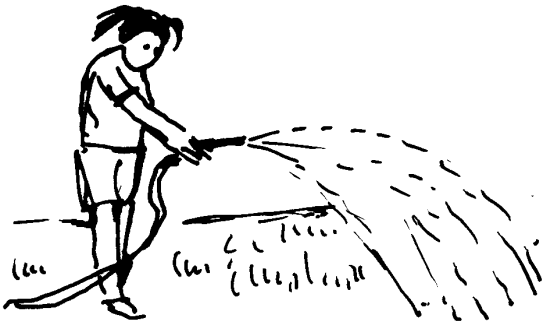
Weeding

Weeds are the species of plants that do not meet your needs or those of the wildlife in your habitat. Excess weeds compete with beneficial plants and, ultimately, can become a fire hazard. Because the entire habitat is vulnerable to herbicides, the safest method of controlling weeds is by hand-pulling. Although more time-consuming, this method is more selective than the blanket application of herbicides.

Watering

Regular maintenance of your irrigation system increases its longevity and decreases the waste

of a precious resource. Check for leaks, damage from rodents, and malfunctioning emitters or sprayers as part of a regular maintenance program. Adjust times and duration of watering according to the seasons of the year. During the hotter seasons, evening and morning are the most efficient times of the day to water.



Pruning

Heavy pruning is not appropriate in a wildlife habitat. This practice removes wildlife food and shelter. Since flowering and fruiting are curtailed by heavy pruning, it is best not to prune during these production periods. Pruning is appropriate for removal of diseased plant material or safety hazards, or the rejuvenation of shrubs with much dead material. When pruning, selectively remove specific branches rather than heading back growth. Try to maintain the natural shape of the tree or the shrub and allow branches to contact the ground to provide cover.

Spring and Fall Debris Clean-up

Moderation is the key in seasonal clean-up. Many fallen materials typically removed during these seasons are often beneficial to plants and animals in your habitat. Leave a portion of the organic debris in the habitat area. Clippings, leaves and branches provide good nesting and shelter locations as do dead trees and rotting logs. Allow flowers to re-seed; this re-seeding will enrich next year's crop and provide wildlife with food resources. Seedlings and volunteer plants add to the dynamic nature of the habitat. Diseased plant material should be removed as a should any safety hazards.

Pond Maintenance

Ponds require both periodic and annual maintenance. Water quality testing should be performed on a frequent basis to monitor the overall health of a pond. Remove any dead or diseased plants and fish regularly. A complete draining of the pond and removal of accumulated pond debris should be done every two years.

Bird Nests and Bird Baths

Nest boxes should be thoroughly cleaned once a year. Parasites buildup in old nesting material; all old nesting materials should be discarded after cleaning. Bird baths require regular cleaning, and daily during the summer. Remember to take health precautions when cleaning nest boxes and bird baths; at a minimum, wash with anti-bacterial soap after performing this task. Keep baths filled at all times; birds rely on your generosity.

Wildlife Houses

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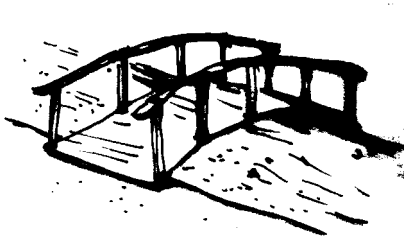
Accessibility

The schoolyard habitat provides rich opportunities for study and participation for all students. Be sure that <u>all</u> students can participate in the experience of the habitat. The Americans with Disabilities Act was established in 1992 to provide equal access for all individuals regardless of their differing levels of ability. The *Americans with Disabilities Act Design Guidelines* is available through the Americans with Disabilities Access Board in Washington, D.C. These guidelines provide helpful information on requirements for pathways, seating options, overhead obstructions, wheelchair ramps, accessibility issues and safety hazards.

Paths

The minimum width for any path of travel is 32"; yet, 48" is preferable. If the path is only 32", a wheelchair turning and passing zone is required every 200 linear feet. Surfacing of the path should be stabilized earth, asphalt or concrete. The slope of the path at any given point is optimally 2% with a maximum of 5%. Any slope greater than 5% requires a ramp.



Ramps

When the slope of the pathway exceeds 5% or at any sudden grade change, ramps are required. Design

guidelines for ramps are very specific and are available in the Americans With Disabilities Act Accessibility Guidelines (ADAAG).

Seating

Accommodation for parking of wheelchairs is necessary for any seating plan. Wheelchair parking areas should be interspersed in the general seating areas, not segregated from the group. Typically, a 3' by 4' pad is sufficient for wheelchair parking. Each wheelchair parking area should be accompanied by adjacent seating for peers and a special education teacher.

Water Features and Safety

When designing a pond or stream feature for the schoolyard habitat, the safety of disabled users must be considered. Wheel stops and railings mitigate the danger of a wheelchair or walker rolling into the water.

The design goal of any area is to be universally accessible to its users without segregtion due to ability. Bear this in mind as you design each feature of your habitat area. Ask questions as you develop the habitat area. Can an individual assisted by a wheelchair reach a ground level planter? A raised planter is a better solution. Is the pond study an accessible experience or is there a need for a transfer platform to make it accessibel? Do most of the features require visual interpretation or are there opportunities for the visually impaired? Give advance consideration to these and other access issues as you plan your schoolyard. Your local Access Board can also provide assistance in design.

Project Evaluation: Aspects and Questions

Environment

Are all plants healthy and growing? If not, they should be removed or relocated to a site which is more conducive to their needs. Is there an adequate diversity of plant forms, food and nesting sources to attract the desired wildlife? If not, what additions should be considered?

Structures

Buildings and other man-made structures should be regularly evaluated for their integrity and safety factors and reassessed as to whether or not they still meet the needs of the community.
Use and educational opportunities

Do students like studying and using the schoolyard habitat? Give them the opportunity to save what features or activities it would like to add. What do they like most or leased? Allow them to make creative revisions.

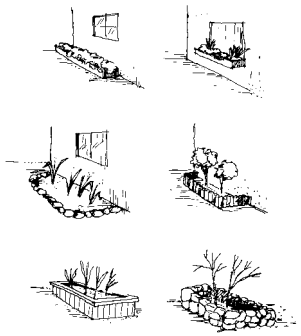
Do teachers find the habitat to be a resource and teaching asset? Are there are other ways the curriculum and habitat can overlap? Are there a few teachers using the site or many, and from what disciplines? Does everyone feel welcome to use the site?

Overall stewardship

Is someone or some group of people responsible for the maintenance and care of the facility? Do students, teachers and community members have a sense of ownership in the place? How can more people be included in this ongoing process?

Revisions

The schoolyard habitat is a living and evolving system; change occurs as the plants grow and the seasons change. Changes, other than these, should also be encouraged and incorporated into the long-term plan for the project. For example, site boundaries could expand, zones, spaces, and elements can be added or subtracted. New teachers, parents, and students can and should be involved in making design revisions and implementing new ideas. The schoolyard habitat should not be thought of as a fixed, rigid, and manicured landscape. Rather it should evolve over time and be modified in order to better reflect the needs of the current school population. New art-works should be added, plants moved, pathways adjusted, in order to constantly strive for a better learning environment. Changes such as these will make the schoolyard habitat meaningful for new users as they participate in the creation of new additions or revisions. This process of evolution will also help to hold the interest of returning students for longer periods of time.



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Chapter 4: Ecological Principles

Introduction

Habitat Requirements

Wildlife Habitat Zones for the Schoolyard

- Butterfly and Insect Zone
- Reptile and Amphibian Zone
- Bird Zone
- Hummingbird Zone
- Sharing a Wildlife Habitat

Arizona Life Zones

- Lower Sonoran Life Zone
- Upper Sonoran Life Zone
- Transition Life Zone
- Canadian Life Zone
- Hudsonian Life Zone

Additional Sources

Introduction

Every piece of land, no matter how large or small, has a series of stories to tell if we are only willing to sit still long enough and watch. Mountains speak of large-scale geologic processes, of inland seas and ancient marine organisms, continental collisions and terrible volcanic events. Riverbeds and valleys talk about the evolution of the land, of the force of water and erosion and the development of the soil. They can also speak of who has used the land in the past. Riverbeds often contain exposed fossils within their embankments and sometimes evidence of ancient human sites of habitation—arrowheads, pottery, and garbage middens. Even the climate of the land tells a story of how plants and animals live in a given region and with what they must cope to survive. Studying the natural history of the land teaches us about the environment and the elements contained within it that are needed to support local communities of plants and animals.

Habitat Requirements

A biological community is the result of continuing interactions between five principle players: plants, animals, insects, microbes and soils. In a complex system of give and take, they provide each other with most of the essential elements for survival. Plants, using only water, sunlight, and nutrients from the soil, produce most of the world's food. Animals and insects consume plants or other animals as food and defecate the excess. Microbes break apart any plant or animal material not already utilized and return it as nutrients to the soil. This incredibly efficient recycling process has operated for millions of years and has maintained an efficient balance between nutrients in the soil for plants and food for animals. A successful habitat must support all of these participants within it in order to continue to function for any extended period of time.

An attractive habitat for wildlife contains four important elements: **food, water, shelter** and **space**. As stated above, plants are the primary food source for most organisms; they produce this food in the form of seeds, fruit, nectar, leaves and twigs. For example, the native velvet mesquite attracts bees to its flowers, deer and rabbits to its leaves and twigs, and quail, squirrels and javelina to the seeds and pods. Mesquite also harbor in their bark and wood many insects which, in turn, bring bug-eaters like the Gila woodpecker and the cactus wren.

Providing Food for Wildlife

- Plant a variety of species with varying flower, fruit, and seed periods.
- Plant species of differing heights. Some animals forage on the ground; others in the tree canopy.
- Native plants are more attractive to native wildlife.
- Limit the use of gravel; seeds are lost when they fall between the spaces.

Equally critical in the arid climate of Arizona is the essential element of fresh water. Nearly all organisms require daily access to water for drinking and, in some cases, bathing. Indeed, some organisms, such as frogs and dragonflies, require immersion in water for short periods of their lives. Three quarters of all Arizona's bird population inhabit riparian areas—sites where water is available most of the year. One of the key goals in schoolyard habitats is to bring wildlife into the view of students for study and appreciation. Nothing does this quite as predictably as providing a water source. Water can be incorporated into the habitat as a small pond, a recirculating waterfall, a shallow dish with a dripper, or damp soil.

Providing Water for Wildlife

- Providing fresh, clean water is important to the health of birds and other wildlife.
- Moving water is most attractive to animals.
- Water can be a home to many organisms (e.g. fish, toads, and insects).
- Animals need shelter such as plants or rocks near water bodies.

The habitat must not only contain food and water but also provide living *space* and *shelter* in order to attract and retain wildlife. Space and shelter are both critical to an animal's decision to raise its young at a given site. Young animals are relatively helpless and require sufficient cover and camouflage to avoid becoming a predator's next meal. The cactus wren will often build its nest in the thorniest of environments like cholla where its offspring will be safe from snake encounters. Many organisms, even adults, venture out into open space as seldom as possible. Security from predation and dehydration requires a variety of covers. Plants provide the best shelter for wildlife. Shrubs or trees that retain low hanging branches create a protective "house," difficult for larger predators to see into or to penetrate. Other materials can act as shelter and escape venues such as snow, water, and burrows.

Providing Shelter and Space for Wildlife

- Plant vegetation in four layers (groundcover, shrub, midstory, and canopy) to create a variety of shelter and space.
- Provide some evergreens for year round cover.
- Use rock piles and brush piles to create sheltered areas for small animals.
- Add manmade alternative shelters.

Wildlife Habitat Zones for the Schoolyard

As mentioned in *Chapter 2, Design Process* the schoolyard habitat is broken down into different zones or themes of use. Some of these zones can function as a specific types of wildlife habitats, such as a butterfly or hummingbird garden. Below are some ideas and tips for creating several specific wildlife habitat zones. Please note that certain plants suggested in the following charts may not be suitable for your schoolyard. Check with a local plant specialist to find plant species that grow best in your location. In addition, contact the Arizona Game & Fish Department for more information on specific wildlife issues. Their phone number and address is located in Appendix

Sharing a Wildlife Habitat

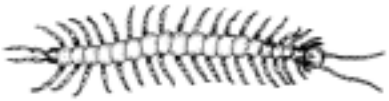
It is a thrill to see wildlife on your school grounds. It gives one a sense of pleasure and closeness with nature. Yet, some considerations need to be made when coexisting with wildlife:

- Trash cans need to be secured at all times.
- Compost should be contained in a wildlife-proof container.
- Gardens should be fenced off.
- Hanging shiny objects or mobiles that make noise might temporarily scare off certain unwanted wildlife. (Once they catch on to the locations of these noise-makers will need to be changed.)
- Contact the Arizona Game and Fish Department for further information.
- One can also contact a local ecologist to find out what species of plants are the "pesty" wildlife's least favorites.

Reptile and Amphibian Zone

Here are some tips in attracting reptiles and amphibians to your schoolyard:

- Snakes and lizards are attracted to wood and brush piles and also stone or masonry walls—places that absorb heat.
- Lizards eat insects. Insect-attractive plants will lure lizards seeking food.
- Dense, close to the ground foliage offers feeding and hiding areas for both lizards and snakes.
- Reptiles enjoy sunny environments with temperatures between 80 and 100 degrees.
- To attract amphibians, have a pond with two sides lined with grasses, leafy plants and rotten logs.



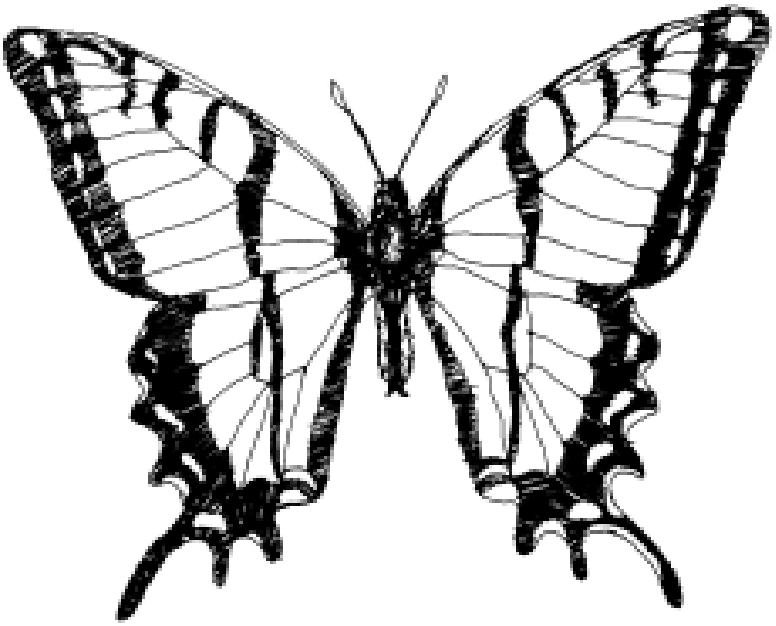
Sample of Plants that Attract Butterflies

Common Name	Botanical Name	Larval or Nectar Plant	Elevation Zone: Low, Middle, or High	Type of Plant
Asters	*Aster spp.*	Nectar	Depends on species	Perennial herbs
Buckbrush	*Ceanothus spp.*	Nectar	Middle to high	Shrub
Daleas	*Dalea spp.*	Larval	Low to middle	Shrubs
Desert lavender	*Hyptis emoryi*	Nectar	Low	Shrub
Desert hackberry	*Celtis pallida*	Larval	Low to middle	Shrub
Feather tree	*Lysiloma microphylla*	Larval	Low	Tree
Fern acacia	*Acacia angustissima*	Larval	Low to middle	Shrub
Fleabanes	*Eriogonum spp.*	Nectar	Middle to high	Perennial herbs
Golden dyssodia	*Dyssodia pentachaeta*	Nectar	Low	Perennial herb
Manzanita	*Arctostaphylos spp.*	Nectar	Middle	Shrub
Mesquite	*Prosopis velutina*	Both	Low to middle	Tree
Milkweeds	*Asclepias spp.*	Nectar	Depends on species	Perennial herbs
Rabbitbrush	*Chrysothamnus nauseosus*	Nectar	Middle to high	Shrub
Side-oats grama	*Bouteloua curtipendula*	Larval	Low to middle	Grass
Sweet bush	*Bebbia juncea*	Nectar	Low	Shrub
Thistles	*Cirsium spp.*	Nectar	Depends on species	Perennial herb
Verbena	*Verbena spp.*	Nectar	Low to middle	Groundcover
Western yarrow	*Achillea lanulosa*	Nectar	Middle to high	Perennial herb
Willows	*Salix spp.*	Larval	Depends on species	Shrub or tree
Wolfberry or Thornbush	*Lycium spp.*	Nectar	Low to middle	Shrubs
Zinnias	*Zinnia spp.*	Nectar	Low to middle	Perennial herbs

Butterfly and Insect Zone

Attracting butterflies and insects to a schoolyard habitat is fun, easy, and visually pleasing. Students love to see butterflies flittering through the air. Butterflies offer many lessons regarding the environment, such as plant and animal associations and seasonal changes. All insects, in general, are very important in the schoolyard habitat. Here are some tips on attracting butterflies and insects to your schoolyard:

- Avoid pesticides and insecticides.
- Ants, beetles, bugs, bees, and wasps all love flower nectar.
- Locate the garden in a sunny area, with some provision for shade.
- Have your butterfly garden protected by strong winds. A wind break is preferable.
- Butterflies like a water source; a birdbath or small pond is great. Remember to put stones which protrude above the water so the butterflies can land.
- Provide plants for butterfly larvae (caterpillars), as well as nectar for adults.
- Plant flowers in groups; butterflies are attracted to blocks of color.
- Plant fragrant plants. A butterfly's antennae respond to the aromatic nature of nectar-bearing flowers.



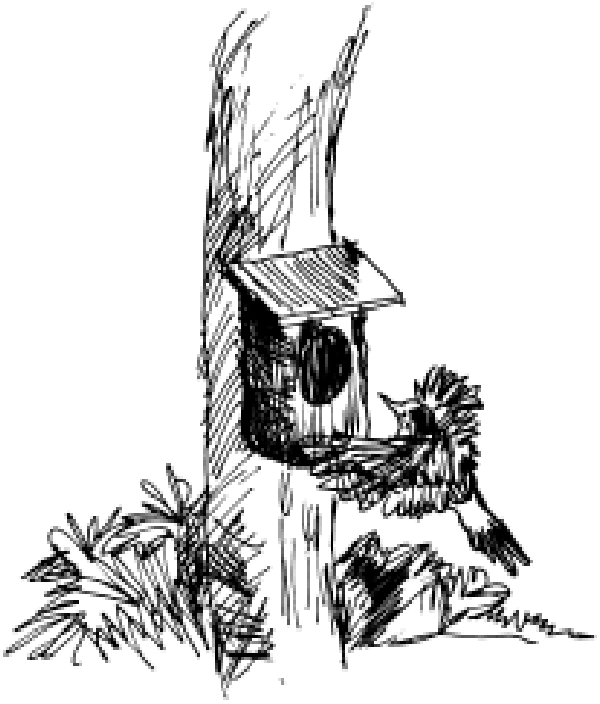
Sample of Plants that Attract Birds

Common Name	Botanical Name	Importance for Birds	Elevation Zone: Low, Middle, High	Type of Plant
Acacias	*Acacia spp.*	Provides lots of nest sites	Low to middle	Shrubs or trees
Arizona grape	*Vitis arizonica*	Provides nesting sites, shelter, and fruit	Low to high	Vine
Buffaloberry	*Shepherdia spp.*	Provides berries for food	High	Shrubs
Currants	*Ribes spp.*	Provides fruits as a food source	Middle to high	Shrubs
Douglas fir	*Pseudo-tsuga menziesii*	Provides shelter	High	Tree
Elders	*Sambucus spp.*	Provides a feast of summer fruit	Low or high; depends on species	Shrub or tree
Firs	*Abies spp.*	Provides shelter and seeds	High	Trees
Hackberries	*Celtis spp.*	Provides nesting sites and fruit	Low to middle	Shrub or tree
Ironwood	*Olneya tesota*	Provides nest sites	Low	Tree
Junipers	*Juniperus spp.*	Provides nest sites, shelter in winter, and fruits	Middle and high	Trees or shrub
Maples	*Acer spp.*	Provides nest sites, shelter, and seeds in the summer	Middle and high	Trees
Pines	*Pinus spp.*	Provides shelter in winter, nest sites, and edible seeds and sap	Middle and high	Trees
Saltbush	*Atriplex spp.*	Provides shelter	Low to middle	Shrubs
Serviceberries	*Amelanchier spp.*	Provides many, small fruits	Middle to high	Shrubs
Snowberry	*Symphoricarpos spp.*	Provides fruits as a food source	Middle to high	Shrubs
Sumacs	*Rhus spp.*	Provides fruit in the winter	Low to high; depends on species	Shrubs

Bird Zone

Schools (even in urban settings) can easily lure birds with great success. Birds provide the school grounds with music and entertainment for everyone. Here are some tips in attracting birds to your schoolyard:

- Plant an assortment of plant species to provide a year round food supply.
- Do not use chemicals.
- Incorporating the sound and sight of moving water will increase the number of birds.
- Provide water year round.
- Provide cover and nest sites.
- Provide bird feeders. To attract the widest variety of birds, use several models of feeders, placing them at different heights. The supply of bird seed should not be constant so that birds are not lured away from their natural food source.
- Provide nest boxes, platforms or nesting shelves. See below for some ideas of bird houses and feeders.



Sample of Plants that Attract Hummingbirds

Common Name	Botanical Name	Blooming Season	Elevation Zone: Low, Middle, High	Type of Plant
Agave or century plant	*Agave spp.*	When plant is mature	Low to middle	Succulent
Arizona honeysuckle	*Lonicera arizonica*	Summer	Middle to high	Vine
Chuparosa	*Justicia californica*	Spring	Low	Shrub
Coral bells	*Heuchera sanguinea*	Spring to fall	Middle to high	Perennial herb
Desert willow	*Chilopsis linearis*	Summer	Low and middle	Tree
Desert honeysuckle	*Anisacanthas thurberi*	Spring	Low to middle	Shrub
Hummingbird trumpet	*Zauschneria californica*	Summer to fall	Low to middle	Shrub
Morning glory	*Ipomoea spp.*	Summer to fall	Depends on species	Vine
Ocotillo	*Fouquieria splendens*	Spring	Low to middle	Cactus
Paintbrushes	*Castileja spp.*	Spring and summer	Depends on species	Herbs
Penstemon	*Penstemon spp.*	Depends on species	Depends on species	Perennial herbs
Southwestern coral bean	*Erythrina flabelliformis*	Spring into summer	Low to middle	Shrub
Tobacco	*Nicotiana spp.*	Spring to fall	Low to middle	Tree or shrub
Verbena	*Verbena spp.*	Spring to summer	Low to middle	Groundcover
Yellow bells	*Tecoma stans*	Summer	Low to middle	Shrub
Yucca	*Yucca spp.*	Spring to summer	Middle	Accent plant

*Check with a local nursery to find out which species will grow best at your school

Hummingbird Zone

Hummingbirds are one of nature's most captivating species. They can fly forward at speeds clocked as fast as 50 to 60 mph. They can fly straight up, straight down, and backwards. Hummingbirds must constantly eat in order to survive because of their fast metabolism.

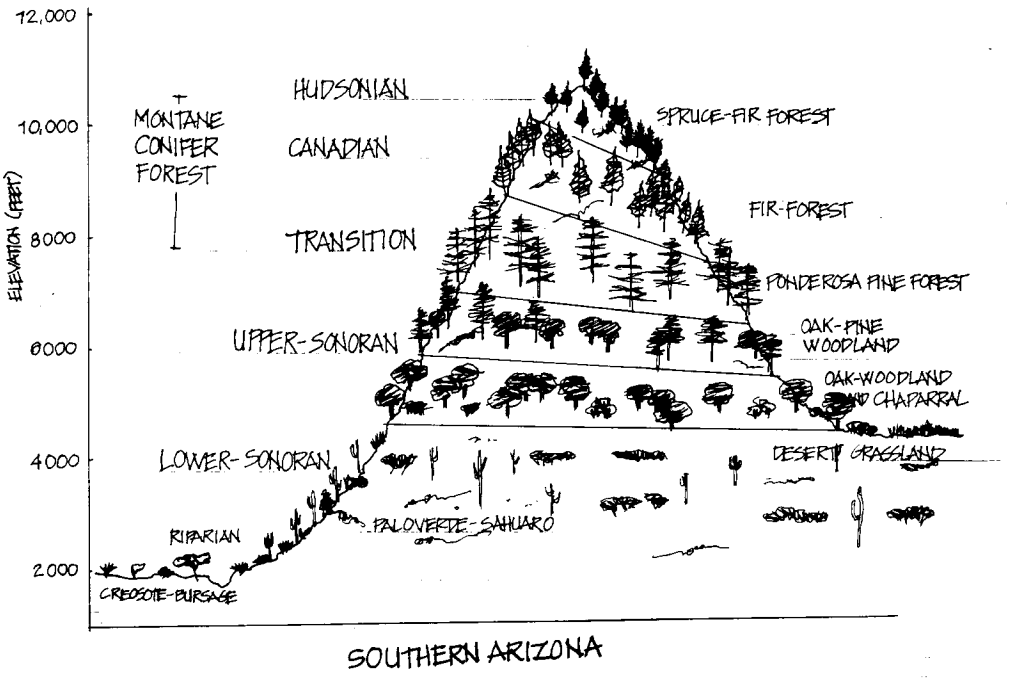
Their main food source is nectar from flowers. Each hummingbird needs to visit approximately 1,000 flowers a day to get enough to eat. It is always a treat to be able to see one in flight or sipping some nectar from a flower. Here are some tips to attract hummingbirds to your schoolyard:

- Plants with trumpet-shaped flowers in colors of red, orange, and pink are the best.
- Plan for a constant supply of blooms from early spring to late fall.
- Hummingbirds nest in shady areas and feed on plants in sunny areas.
- Do not use chemicals.
- Hummingbirds will bathe themselves in a water feature with fine or mist sprayer.

Arizona Life Zones

Arizona contains many different environments from the low deserts of Yuma to the high plains of Flagstaff. These diverse locations within the state have certain physical characteristics such as soil type, rainfall amounts, and temperature variations which dictate which plants will grow readily and what wildlife are found in that environment. Understanding and working within the physical ramifications of your site will improve the success and survival of plants included within the schoolyard habitat. This, in turn, affects the site's attraction for wildlife.

Changes in elevation across Arizona are dramatic and relatively abrupt; the city of Yuma is near sea level whereas San Francisco Peak, 250 miles away, is 12,600 feet at its peak. These changes in topography generate the differences in the plants and wildlife groupings throughout the state. The different groupings are known as **biological communities** and categorized by many scientists as **life zones**.



A life zone is the consistent pattern in plant life that occurs over changes in elevation and latitude. Temperature and moisture are two primary factors that dictate changes between life zones. These factors as well as the vegetation composition determine the kinds of wildlife that live within each life zone. Life zones in Arizona were first described on the San Francisco

Peaks near Flagstaff by C. Hart Merriam in 1889. He observed that changes in biological communities, seen as one moves higher in elevation, are identical to changes in communities experienced as one drives north toward Canada. He discovered that a 1,000 foot increase in elevation was approximately equivalent to a trip 600 miles northward. Merriam gave a name to each of the life zones present in Arizona. These include: (1) Lower Sonoran, (2) Upper Sonoran, (3) Transition, (4) Canadian, and (5) Hudsonian.

Another way to classify Arizona's biological communities is by the dominant type of vegetation present in the particular life zone. These classifications are divided into the following Communities: (1) Desert Scrub, (2) Desert Grassland, (3) Oak Woodland, (4) Oak-Pine Woodland, (5) Chaparral, (6) Pinyon-Juniper, (7) Ponderosa Pine, (8) Fir Forest, and (9) Spruce-Fir-aspen. Found within all the biological communities is the Riparian (i.e. streamside) Community. The Riparian Community is extremely diverse in plant and animal species. In addition, they are crucial for approximately 85% of Arizona's wildlife by providing food, water, shelter, and a natural migration pathways.

Localized climate changes, influenced by wind, soil, slope, exposure, and cold air drainage can affect the locality of a specific biological community. For example, at a site 6,000 feet in elevation on the south side of a mountain one might find the Oak-Woodland community. Yet, at the same elevation along the north side of the mountain, one would find the Ponderosa Pine community typically seen higher at elevations on the south side of the mountain. This is due to the fact that the north-facing slope of the mountain receives less sun and heat and retains more moisture, than the south-facing side of the same mountain, which receives nearly constant sunlight.

The biological communities and their characteristics are listed in this book using both methods of classification. A brief description of the life zones found in Arizona and the types of plant communities that they contain has been provided. If a schoolyard habitat is going to attract and maintain a wildlife populations, plants native to that particular environment should be used. The life zone descriptions allow the educator to identify, primarily by elevation and rainfall, his or her local environment. Armed with this information, the educator can then proceed to the charts and locate selected lists of native plants and wildlife for each biological community. Plants and wildlife listed are not comprehensive. They are merely a sampling of some of the species living in that particular community. At the end of this chapter additional book sources have been listed if more information is needed. Additionally, information can be obtained from local plant and wildlife experts and botanical gardens.

Benefits of Using Native Plants

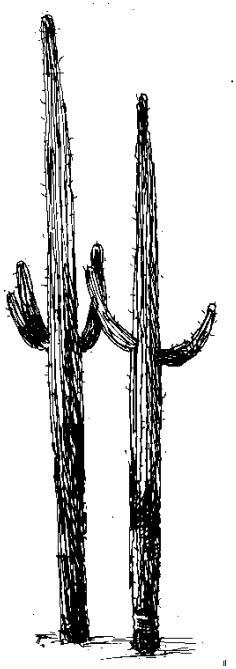
- Better food source for native wildlife
- Already accustomed to the soil and climate
- Beautiful and unusual in their form
- Require less irrigation
- Save money on maintenance, soil amendments, and water
- Less susceptible to disease

Lower Sonoran Life Zone

The lower Sonoran life zone includes the cities of greater Phoenix, Tucson, Yuma, Lake Havasu City, Safford, and Bullhead City. This life zone consists of the Desert Scrub Community.

The Desert Scrub Community

Desert scrub is found between 200-3,500 feet in elevation predominately in the southwest region of the state. This community, a subtropical desert, is rich in biological diversity. The Sonoran desert has a biseasonal pattern of rainfall and can receive up to 5-12 inches of rain per year.



Plants and animals found in the Desert Scrub Community have made certain adaptations in order to survive these harsh conditions of the lower Sonoran desert. Many animals are nocturnal, staying underground during the day. Some have protective devices, like hairy ears and flaps over their eyes and ears, to protect against blowing dust. Trees throughout the region are generally short and bushy with small leaves. Plants may have tough or waxy leaves to retard water loss. Dull gray-green leaf coloration helps to reflect sunlight. Other plants, like cacti and agaves, are succulents and have tissues that store water during periods of drought.

The Saguaro

The saguaro can grow to a height of 50 feet and weigh 6-7 tons! It is an important element to the Desert Scrub Community. The Harris hawk nests in the arms of the saguaro, while the Gila woodpecker, northern flicker and the elf owl nest inside. Longnose bats feed at night on the nectar and pollen that flowers provide. When the flowers turn to fruit, squirrels gobble them up when they fall to the ground.

Selected Plants of The Desert Scrub Community

This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
Acacias *Acacia spp.*	Varies	Mostly deciduous	Numerous seed pods eaten mammals and birds; flowers attract bees and other insects.
Desert palm *Washingtonia filifera*	50' x 15'	Evergreen	Roosting sites for birds and bats.
Ironwood *Olneya tesota*	20' x 20'	Evergreen to deciduous in colder areas	Provides nest sites, insect prey, and seeds for food; attracts bees.
Lysiloma *Lysiloma microphylla*	15' x 15'	Evergreen	Attracts butterflies.
Palo verde *Cercidium spp.*	25' x 25'	Deciduous	Provides nesting sites and insect prey; attracts bees. Mistletoe, a parasitic plant that grows on Palo Verdes, is a the favorite food for the phainopepla birds.
Velvet mesquite *Prosopis velutina*	25' x 25'	Deciduous	Seeds and pods eaten by birds and rodents; leaves and twigs browsed by deer and rabbits.
Shrubs			
Anderson thornbush *Lycuim andersonii*	6' x 6'	Evergreen	Attracts bees and butterflies; provides shelter; berries eaten by birds and mammals.

Creosote *Larrea tridentata*	10' x 10'	Sparsely evergreen	Makes a good shelter plant for birds, rodents, reptiles and amphibians.
Desert hackberry *Celtis pallida*	15' x 15'	Evergreen	Fruits are eaten by wildlife; provides shelter for birds and ground-dwelling animals; deer and jackrabbits eat the leaves.
Desert lavender *Hyptis emoryi*	10' x 8'	Evergreen	Attracts hummingbirds, bees, and butterflies.
Leafless milkweed *Asclepias subulata*	2' x 2'	Has very few leaves	Attracts butterflies.
Quailbush *Atriplex lentiformis*	8' x 12'	Deciduous	Provides good shelter; abundant fall seed source.
Accent Plants and Wildflowers			In these charts are only a few of the many wildflowers available. Check at your local nursery which species will grow at your school. Many times they will only be available as seed.
Barrel cactus *Ferocactus wislizenii*	6' x 2'	Cactus	Yellow fruits eaten by rodents and deer; flowers attract bees.
Cholla *Opuntia spp.*	Varies	Cactus	Provides nesting sites, especially for cactus wrens.
Desert marigold *Baileya multiradiata*	1' x 1'	Perennial	Seeds eaten by rodents, doves and finches.
Globemallow *Sphaeralcea ambigua*	3' x 3'	Herbaceous perennial	Birds eat the seeds.

Ocotillo *Fouquieria splendens*	20' x 8'	Sprouts leaves after rain	Attract hummingbirds.
Penstemons *Penstemon spp.*	Varies	Perennial	Attracts hummingbirds.
Prickly pear *Opuntia spp.*	Varies	Cactus	Juicy fruits are eaten by birds, mammals, and some reptiles; javelina eat the pads.
Saguaro *Carnegiea gigantea*	40' x 10'	Cactus	Nectar and pollen eaten by bats and birds; many birds nest in cavities of trunk; fruit and seeds eaten by many wildlife.
Verbena *Glandularia gooddingii*	1' x 2'	Herbaceous perennial	Good nectar source.

Selected Wildlife of the Desert Scrub Community

This is not a comprehensive list

Gila woodpecker	Tarantulas	Desert shrew
Cactus wren	Desert spiny lizard	White-throated woodrat
Verdins	Rattlesnakes	Packrats
House finches	Mice	Skunks
Hummingbirds	Desert cottontail	Gray fox
White-winged dove	Black-tailed jackrabbit	Ringtail cat
Mourning dove	Rock squirrel	Bobcat
Gambel's quail	Harris' antelope squirrel	Javelina
Roadrunner	Round-tailed ground squirrel	Coyote
Desert hairy scorpion	Kangaroo rats	Muledeer

Upper Sonoran Life Zone

The upper Sonoran life zone includes the cities of Globe, Sierra Vista, Nogales, Bisbee, and Wilcox, to name a few. This zone consists of the Desert Grassland Community, the Oak Woodland Community, the Oak-Pine Woodland Community, the Chaparral Community, and the Pinyon-Juniper Community. Elevations for this life zone range from 3,000 to 7,000 feet.

The Desert Grassland Community

Elevations of 3,500 to 5,500 feet in the southeastern portion of the state are where the Desert Grassland Community is located. Precipitation ranges from 10 to 15 inches annually. The Desert Grasslands Community is a transition community between the lower and upper Sonoran life zones, with areas of the desert grassland found in both. Desert grasslands are characterized by large expanses of open fields with trees scattered throughout. Many browsing and grazing animals depend upon the grasses and low shrubs for food. These animals, in turn, attract larger predators.

Selected Plants of The Desert Grassland Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
Desert willow *Chilopsis linearis*	20' x 15'	Deciduous	Hummingbirds and verdins eat nectar; seeds are good food source.
Velvet mesquite *Prosopis velutina*	25' x 25'	Deciduous	Provides lots of nesting sites; seeds and pods eaten by wildlife.
Netleaf hackberry *Celtis reticulata*	20' x 20'	Deciduous	Fruit eaten by birds and other wildlife; provides many nesting sites
Oak *Quercus spp.*	Varies	Mainly evergreen	Acorns are a good food source; provides nesting sites. Many species of oak in Arizona.
Junipers *Juniperus spp.*	Varies	Evergreen	Berries eaten by many wildlife. There are six species of juniper in Arizona. Check with your local nursery which species is suitable for your school.
Shrubs			
Jojoba *Simmondsia chinensis*	6' x 10'	Evergreen	Seeds provide food for javelina and squirrels; good shelter plant; provides nesting sites.
Turpentine bush *Ericameria laricifolia*	2' x 3'	Evergreen	Attracts bees and other insects.
Coral bean *Erythrina flabilliformis*	6' x 6'	Deciduous	Attracts hummingbirds.

Fairy duster *Calliandra eriophylla*	2' x 3'	Semi-deciduous	Attracts hummingbirds; seeds eaten by birds and rodents.
Desert sumac *Rhus microphylla*	5' x 5'	Deciduous	Fruits eaten by wildlife.
Algerita *Berberis trifoliolata*	6' x 6'	Evergreen	Berries eaten by wildlife.
Wildflowers, Grasses, and Accent Plants Prickly pear *Opuntia spp.*	Varies	Cactus	Fruits eaten by birds and mammals.
Soaptree yucca *Yucca elata*	15' x 10'	Evergreen	Attracts moths.
Agave *Agave spp.*	Varies	Succulent	Attracts nectar-feeding bats.
Ocotillo *Fouquieria splendens*	20' x 8'	Sprouts leaves after rain	Attracts hummingbirds.
Muhly *Muhlenbergia spp.*	Varies		Larval foodplant for butterflies.
Blue grama grass *Bouteloua gracilis*	2' x 2'		Seed heads eaten by rodents and birds; leaves grazed by rabbits.
Plains bristlegrass *Setaria macrostachya*	2' x 2'		Seeds and foliage used by birds and small mammals.
Thistles *Cirsium spp.*	3' x 3'	Perennial	Seeds eaten by birds; flowers attract butterflies and bees.
Tufted evening primrose *Oenothera caespitosa*	1' x 2'	Perennial	Seeds eaten by birds; attracts moths and bats.

Selected Wildlife from the Desert Grassland Community

This is not a comprehensive list

Meadowlark	Nectar-feeding bats	Raccoons
Kestrels	Pocket mouse	Kit fox
Roadrunners	Western harvest mouse	Gray fox
Mockingbirds	Merriam kangaroo rat	Badgers
Hummingbirds	Woodrats	Coyote
Mourning doves	Cottontails	Muledeer
Quail	Black-tailed jackrabbit	Javelina
Lizards	Squirrels	Whitetailed deer
	Skunks	Pronghorn

The Oak Woodland and Oak-Pine Community

The Oak Woodland Community is found between 4,000 and 6,000 feet in elevation with an annual precipitation of 12 to 24 inches of rain. Small areas of relatively dense stands of evergreen oaks are scattered in patches among the Desert Grassland Community. While often in very close proximity to each other, the Oak Woodland Community is usually located on the northern slopes of mountains. The Desert Grasslands Community and the Oak Woodland Community are found predominately in the southern half of the state.

Oak trees provide many organisms with a year round food source. American Indians and Spanish-Americans collected acorns which they ground up for flour. Many birds and animals eat acorns; mule deer and porcupines eat oak leaves. Acorn woodpeckers poke dime-sized holes into dead oak limbs, stuff them with acorns, and survive from this stored supply throughout the winter.

The Oak Woodland Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
New-Mexican locust *Robinia neomexicana*	20' x 15'	Deciduous	Seeds are eaten by quail and squirrels; mule deer like the blooms.
Oak *Quercus spp.*	Varies	Mostly evergreen	Acorns are eaten by wildlife; provides nesting sites.
Junipers *Juniperus spp.*	Varies	Evergreen	Berries are eaten by wildlife.
Desert willow *Chilopsis linearis*	20' x 15'	Deciduous	Hummingbirds and verdins eat the nectar; seeds are a good food source.
Pinyon pine *Pinus edulis*	35' x 30'	Evergreen	Pine nuts are especially enjoyed by pinyon jays. Javelina do not like to eat pine.

Shrubs Desert sumac *Rhus microphylla*	5' x 5'	Deciduous	Fruits eaten by birds.
Skunkbush *Rhus trilobata*	8' x 8'	Deciduous	Antelope and deer browse on the twigs and foliage; javelina do not prefer this one.
Wolfberry *Lycium pallidum*	4' x 6'	Semi-deciduous	Provides shelter for wildlife; fruits eaten by birds.
Silver buffaloberry *Shepherdia argentea*	10' x 10'	Evergreen	Fruits eaten by mammals and some bird species.
Mountain mahogany *Cercocarpus breviflorus*	12' x 12'	Evergreen	Provides shelter; javelina do not prefer this one.
Deerbrush *Ceanothus integerrimus*	8' x 8'		Wildlife feed on bark and seeds; browsed by deer.
Four-wing saltbush *Atriplex canescens*	5' x 5'	Evergreen	Seeds provide food for birds and small rodents; antelope and deer eat the leaves.
Accent Plants and Wildflowers Yucca *Yucca spp.*	Varies	Evergreen	Flowers attract moths.
Century plant *Agave parryi*	3' x 3'	Evergreen	Pollinated by bees, hummingbirds, and bats.
Evening primroses *Oenothera spp.*	Varies	Perennial	Some in this species attract moth.
Penstemons *Penstemon spp.*	Varies	Perennial	Attracts hummingbirds.
Gilias *Gilia spp.*	2' x 2'	Perennial	Attracts hummingbirds.

Selected Wildlife from the Oak Woodland Community

This is not a comprehensive list

Hummingbirds	Pocket gopher	Raccoons
Woodpeckers	Pocket mouse	Whitetail deer
Robins	Eastern cottontail	Muledeer
Grosbeaks	Squirrels	Coyote
Jays	Cliff chipmunks	Mountain lion
Rattlesnakes	Porcupines	Bobcat
Lizards	Gray fox	Javelina
	Skunk	

The Chaparral Community

The Chaparral Community occurs in Arizona in the central part of the state, usually between 4,000 and 6,000 feet in elevation, yet small stands may occur as low as 3,500 feet and up to 7,000 feet depending on localized conditions. Precipitation ranges from 13 to 23 inches annually.

Chaparral comes from the Spanish word 'chaparra' and refers to a shrub oak found in that environment. Yet because of its Spanish origin, the term is usually only used in the West. Chaparral is composed of dense stands of low-growing (3-7 feet)shrubby evergreen plants that are fairly uniform in height. These shrubs are accompanied by an occasional taller shrub or tree.

The Chaparral Community

This is not a comprehensive list

Common Name Botanical Name	Height x Width	Evergreen/ Deciduous	Wildlife Uses
Trees Oak *Quercus spp.*	Varies	Mostly evergreen	Acorns are eaten by wildlife. Check with your local nursery which varieties are suitable for your schoolyard.
Junipers *Juniperus spp.*	Varies	Evergreen	"Berries" are eaten by wildlife.
Shrubs Manzanita *Arctostaphylos spp.*	6' x 6'	Evergreen	Berries are eaten by rodents and birds. Attracts hummingbirds.
Cliffrose *Purshia stansburiana*	10' x 10'	Evergreen	Browsed by large mammals in winter.
Hollyleaf buckthorn *Rhamnus crocea*	10' x 10'	Evergreen	Browsed by large mammals.

Desert ceanothus Ceanothus greggii	6' x 6'		Provides good shelter; chipmunks, quail, and other smaller wildlife eat the small seeds.
Mountain mahogany Cercocarpus breviflorus	12' x 12'	Evergreen	Browsed by large mammals.
Wildflowers and Accent Plants Deergrass Muhlenbergia rigens	4' x 4'	Dormant in winter	Provides shelter for rodents, reptiles and amphibians.
Ocotillo Fouquieria splendens	20' x 8'	Sprouts leaves after rain	Attracts hummingbirds.
Yucca Yucca spp.	Varies	Evergreen	Attracts moths; provides nesting sites.
Agave Agave spp.	Varies	Evergreen	Pollinated by bees, hummingbirds, and bats.
Prickly pear Opuntia spp.	Varies	Cactus	Fruits are eaten by birds and mammals.
Mint family Lamiaceae	Varies	Most are perennial herbs	Many in this species attracts ummingbirds and are good forage plant.
Paintbrushes Castilleja spp.	Averages 16" x 16"	Perennial	Attracts hummingbirds.
Beargrass Nolina microcarpa	3' x 3'	Evergreen	Leaves browsed by wildlife in times of drought; provides shelter for small rodents.

Wildlife in the Chaparral Community

This is not a comprehensive list

Canyon wren	Arizona black rattlesnake	Jackrabbits
Sparrows	Western rattlesnake	Badger
Scrub jay	Glossy snake	Gray fox
Kestrels	Mountain kingsnake	Skunk
Quail	Cliff chipmunk	Raccoon
Hummingbirds	Rock squirrels	Coyote
Robins	Pocket gopher	Muleder
Bushtit	Rock mouse	Whitetail deer
Fence lizard	Woodrat	Bobcat
	Eastern cottontail	Mountain lion

The Pinyon-Juniper Community

The Pinyon-Juniper Community is found in the central and northern half of the state at elevations from 5,500-7,000 feet. Annual precipitation varies from 12 to 20 inches and, in winter, predominately in the form of snow. The Pinyon-Juniper Community is in close association with the Chaparral Community located at lower elevations and also, with the Ponderosa Pine Community found at higher elevations. The terrain of the Pinyon-Juniper Community is usually dry and rocky.

In Arizona, the Pinyon-Juniper Community is relatively simple in plant composition. Large stands of forest are dominated by a few tree species. Sometimes species are even in distribution, other times one species can occur in primarily solid stands within considerable areas. Junipers are more common at the lower elevations; Pinyons are abundant at the higher elevations. Pinyons are short trees in comparison to the trees of higher elevations. Large stands of Pinyon Pines are often referred to as "dwarf" or "pygmy" forests. If a Pinyon reaches the height of 30 feet it is likely to be 100 years old. Shrubs and grasses are dispersed throughout the understory.

The Pinyon-Juniper Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees Junipers *Juniperus spp.*	Varies	Evergreen	"Berries" are eaten by wildlife.
Pinyon pine *Pinus edulis*	35' x 30'	Evergreen	Pine nuts are eaten by turkeys, pinyon jays, and mammals.
Oak *Quercus spp.*	Varies	Mostly Evergreen	Acorns are eaten by wildlife.
Arizona cypress *Cupressus glabra*	40' x 30'	Evergreen	Provides good shelter and nesting sites.

Shrubs Apache plume *Fallugia paradoxa*	6' x 6'	Evergreen	Browsed by large mammals; good winter forage plant.
Rabbitbrush *Chrysothamnus nauseosus*	4' x 4'	Perennial shrub	Foliage and seeds browsed by rabbits and other small mammals.
Fernbush *Chamaebatiaria millefolium*	6' x 6'	Evergreen	Browsed by a variety of wildlife.
Fremont barberry *Berberis fremontii*	8' x 8'	Evergreen	Turkeys like this one.
Skunkbush *Rhus trilobata*	8' x 8'	Deciduous	Berries are eaten by birds and small mammals; browsed by deer and antelope.
Smooth sumac *Rhus glabra*	10' x 10'	Deciduous	Fruits are eaten by birds; fruits and twigs browsed by deer.
Winter-fat *Eurotia lanata*	2' x 2'	Evergreen	Good forage plant in the winter.
Silver buffaloberry *Shepherdia argentea*	10' x 10'	Evergreen	Fruits are eaten by ground squirrels, chipmunks, porcupines, bear, and some bird species.
Accent Plants and Grasses Yuccas *Yucca spp.*	Varies	Evergreen	Attracts moths; provides nesting sites.
Cholla *Opuntia spp.*	Varies	Cactus	Provides nesting sites; fruits eaten by birds and small mammals.

Cholla *Opuntia spp.*	Varies	Cactus	Provides nesting sites; fruits eaten by birds and small mammals.
Blue grama *Bouteloua gracilis*	2' x 2'		Seeds from native grasses make an excellant food source for birds.
Arizona fescue *Festuca arizonica*			Food source for birds; forage plant.
Muhly *Muhlenbergia spp.*	Varies		Provides shelter for small rodents.

Wildlife in the Pinyon-Juniper Community

This is not a comprehensive list

Western kingbird	Kestrels	Pocket gopher
Mockingbirds	Turkey vulture	Cottontails
Robins	Collared lizards	Black-tailed
Northern flickers	Fence lizard	jackrabbit
Black-headed grosbeak	Rock squirrels	Striped skunk
Mountain bluebirds	Arizona black rattlesnake	Raccoons
Gray flycatcher	Gopher snake	Coyote
Gray vireo	Woodrat	Muledeer
Pinyon jay	Pinyon mouse	Antelope

The Transition Life Zone

The Transition life zone includes the cities of Flagstaff, Williams, and Eagar to name a few. This life zone includes the Oak-Pine Woodland and the Ponderosa Pine Community.

The Oak-Pine Woodland and the Ponderosa Pine Community

The Oak-Pine Woodland is located just below the Ponderosa Pine Community. The two dominant tree sprecies there are the Gambel oak and the ponderosa pine. These two communitites are in very close association with each other. Similar plants and animals can be found in both. Therefore the lists below are a representaation of both communities.

The Ponderosa Pine Community is found generally at elevations between 6,000' and 8,000'. Annual precipitation is between 20 and 30 inches. Soils are relatively dry and sandy. The dominant tree is the Ponderosa pine with Gambel oaks scattered throughout. Ponderosas can live to be 400-500 years old. The Oak-Pine Woodland and the Ponderosa Pine Community can include a wide scattering of isolated individual Ponderosa pines or a dense stand which creates a dark environment through enclosed tree canopy. Many stands of Ponderosa pine are found throughout the state. Economically, this community is the most highly valued in the Southwest for its timber.

The Ponderosa-Pine Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees Ponderosa pine *Pinus ponderosa*	100' x 50'	Evergreen	Squirrels, chipmunks and birds eat seeds in the cones. There are nine species of pine in Arizona. Check at your local nursery which varieties are suitable for your schoolyard.
Pinyons and other pines *Pinus spp.*	Varies	Evergreen	Pine nuts eaten by turkeys, pinyon jays, and mammals. Seeds in the cones eaten by lots of wildlife.

Junipers *Juniperus spp.*	Varies	Evergreen	Berries eaten by wildlife. There are six species of Juniper in Arizona. Check at your local nursery which varieties are suitable for your schoolyard.
Arizona cypress *Cupressus glabra*	40'x 30'	Evergreen	Provides good shelter and nesting sites.
White fir *Abies concolor*	120' x 60'	Evergreen	Seeds in cones are eaten by grouse, chipmunks, squirrels, and deer.
Douglas fir *Pseudotsuga nenziesii*	100' x 40'	Evergreen	Provides shelter in the winter.
Bigtooth and Rocky Mountain maple *Acer grandidentatum and Acer glabrum*	40'x 25' and 25' x 15'	Deciduous	Squirrels and chipmunks eat the seeds; elk and deer browse on the foliage.
New Mexican locust *Robinia neomexicana*	20' x 15'	Deciduous	Quail and squirrels eat the seeds; mule deer like the blooms.
Gambel oak *Quercus gambelii* and Other types of oak *Quercus spp.*	Varies; can grow to 50'	Deciduous	Many types of mammals eat the acorns.
Shrubs Fendler rose *Rosa fendleri*	7' x 7'	Deciduous	Browsed by wildlife; rose hips eaten by birds and small mammals.
Gooseberries *Ribes spp.*	Varies	Deciduous	Berries eaten by birds.
Birchleaf buckthorn *Rhamnus betulaefolia*	7' x 7'	Deciduous	Many species of birds, black bear, and mule deer eat the fruits; foliage and twigs browsed by many types of wildlife.

Fendler ceanothus *Ceanothus fendleri*	4' x 4'		Browsed by porcupines and jackrabbits.
Utah serviceberry *Amelanchier utahensis*	12' x 12'		Berries and foliage eaten by many types of wildlife.
Creeping barberry *Berberis repens*	1' x 3'	Evergreen	Berries eaten by wildlife; good shelter plant for small rodents.
Vines and Wildflowers Arizona honeysuckle *Lonicera arizonica*	Trails out 3' or more		Berries eaten by birds and small mammals; attracts hummingbirds.
Arizona grape *Vitis arizonica*	Can sprawl out 20' or more	Deciduous	Fruits eaten by birds.
Hop *Humulus americanus*	Twining vine that can climbup trees	Perennial	Good shelter plant for birds and rodents.
White virgin's bower *Clematis ligusticifolia*	Woody vine sprawling to 20' or more	Perennial vine	Attracts bees.
Penstemons *Penstemons spp.*	Varies	Perennial	Attracts hummingbirds.
Coral bells *Heuchera sanguinea*	2' x 2'	Perennial herb	Attracts hummingbirds.
Butterfly weed *Asclepias tuberosa*	3' x 3'		Attracts butterflies.
Western yarrow *Achillea lanulosa*	3' x 3'	Perennial herb	Attracts butterflies.

Wildlife in the Ponderosa Pine Forest Community

This is not a comprehensive list

American kestrels	Osprey	Raccoon
Stellar's jay	Bald eagle	Gray fox
Mountain chickadee	Collared lizard	Bobcat
Western flycatcher	Red-spotted toad	Mountain lion
Acorn woodpeckers	Gopher snake	Muledeer
Northern flickers	Rattlesnakes	White-tailed
Robins	Abert's squirrel	deer
Western bluebird	Red squirrel	Elk
Pigmy nuthatch	Chipmunks	Bear
Wild Turkey	Striped skunk	Coyote

The Canadian Life Zone

The Canadian Life Zone includes the Fir Forest Community.

The Fir Forest Community

The Fir Forest Community is found from 7500 to 9000 feet in elevation. Precipitation, 25 to 30 inches annually, comes in the form of either snow or rain. Due to the increased precipitation, erosion has created richer soils that support more vegetation than in the lower communities. At higher elevations wind becomes a major factor. Trees grow close together and create a shady understory. Leaf debris, conifer needles and cones, and fungi are found on the forest floor.

The Fir Forest Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
Ponderosa pine *Pinus ponderosa*	100' x 50'	Evergreen	Wildlife eat seeds in the cones.
Limber pine *Pinus flexilis*	50' x 30'	Evergreen	Squirrels and birds feed on seeds in the cones.
Douglas-Fir *Pseudotsuga menziesii*	100' x 40'	Evergreen	Provides shelter in winter.
Blue spruce *Picea pungens*	80' x 40'	Evergreen	Provides nesting sites and winter shelter.
Quaking aspen *Populus tremuloides*	50'x 30'	Deciduous	Beavers eat the bark.
Rocky Mountain maple *Acer glabrum*	25' x 15'	Deciduous	Squirrels and chipmunks eat the seeds; birds eat seeds, buds and flowers.

Shrubs New Mexican raspberry *Rubus neomexicanus*	5' x 5'	Deciduous	Fruits eaten by birds and other wildlife.
Red elderberry *Sambucus microbotrys*	5'x 5'		Berries eaten by birds.
Bearberry honeysuckle *Lonicera involucrata*	7' x 7'		Bears, chipmunks, birds and small mammals eat the berries. Attracts hummingbirds.
Trumpet gooseberry *Ribes leptanthum*	5' x 5'	Deciduous	Berries eaten by birds.
Curlleaf mountain mahogany *Cercocarpus ledifolius*	15' x 15'	Evergreen	Thickets of this plant provides shelter for many types of wildlife.

The Hudsonian Life Zone

The Spruce-Fir-Aspen Community

The Spruce-Fir-Aspen Community is found from 8000 to 11500 feet around and on the summits of the highest mountain ranges of Arizona: the Chiricahua, Catalina, Santa Rita, Pinaleno, White, San Francisco Mountains, and the Kaibab Plateau. Precipitation is approximately 30 to 45 inches annually. The Hudsonian life zone receives more precipitation than any other zone in Arizona; twice as much snow falls here than the Canadian zone below. Appropriately enough, most of Arizona's ski areas are located in this community. A combination of dense forest shade and lower temperatures causes snow to stay on the ground well into spring and even into the summer season.

The Spruce-Fir-Aspen Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Width**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
Engelmann spruce *Picea engelmannii*	70' x 40'	Evergreen	Good shelter plant in the winter.
Quaking aspen *Populus tremuloides*	50' x 30'	Deciduous	Beavers eat the bark.
Bristlecone pine *Pinus aristata*	30' x 25'	Evergreen	Wildlife eat seeds in the cones.
Limber pine *Pinus flexilis*	50' x 30'	Evergreen	Good shelter plant in the winter.
Subalpine fir *Abies lasiocarpa*	70' x 30'	Evergreen	Birds and small mammals eat the seeds.
Shrubs			
Wolf currant *Ribes wolfii*	10' x 8'	Deciduous	Songbirds, chipmunks, squirrels, and other wildlife eat the berries.

Above the Spruce-Fir-Aspen community lies the alpine tundra. The alpine tundra is famous for its dwarfed trees due to the intense, high winds on top of the mountains. A few grasses and perennials cling to the rocky slopes. The only true alpine tundra in Arizona is found near the top of San Francisco Mountain.

The Riparian Community

Riparian communities are found at almost all elevations and in virtually every region in the state. Located along water courses with a sufficient year-round supply, good examples of these communities can be seen along the Gila, Salt, Hassayampa, San Pedro, Verde, and Colorado Rivers. Riparian areas are abundant in plant and animal species. Most of the plant species are broad-leaved, deciduous trees and shrubs but grasses, wildflowers, and annuals are also well represented. Riparian communities are magnets for most wildlife who visit these areas on a regular if not daily basis. They also act as corridors for movement of both animals and birds. Many birds use these riparian areas as migration pathways on their journeys between Mexico and the United States.

The Riparian Community
This is not a comprehensive list

Common Name **Botanical Name**	**Height x Spread**	**Evergreen/ Deciduous**	**Wildlife Uses**
Trees			
Arizona alder *Alnus oblongifolia*	50' x 40'	Deciduous	Rabbits eat the bark; birds eat the seeds.
Arizona sycamore *Platanus wrightii*	80' x 60'	Deciduous	Supplies food and shelter for birds.
Arizona walnut *Juglans major*	40' x 30'	Deciduous	Rodents eat the walnuts.

Bigtooth maple *Acer grandidentatum*	40' x 30'	Deciduous	Browsed by deer.
Bonpland willow *Salix bonplandiana*	30' x 30'	Semi-Evergreen	Provides nesting sites; bark is eaten by rabbits and other small rodents.
Coyote willow *Salix exigua*	15' x 10'	Semi-Evergreen	Provides a good nesting habitat for birds.
Fremont cottonwood *Populus fremontii*	80' x 50'	Deciduous	Provides lots of nesting sites.
Goodding willow *Salix gooddingii*	40' x 30'	Deciduous	Provides lots of nesting sites.
Quaking aspen *Populus tremuloides*	50' x 30'	Deciduous	Beavers love the bark.
Velvet ash *Fraxinus velutina*	40' x 30'	Deciduous	Provides food and shelter for birds; favorite food for beavers.

Arizona Wildlife living near Riparian Areas

This is not a comprehensive list.

Many species of birds Garter snakes Porcupines Muskrat Beaver Coati Raccoon Javelina	The list of riparian wildlife would be very long. This is due to the fact that approximately 75% of Arizona's wildlife live and/or depend on riparian habitats for survival. For our purposes here, we only listed a few of the riparian wildlife species.

*Please note: plants and animals listed in the charts above are not exhaustive. It is merely a sampling of plants and animals that live in each of the communities.

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Appendices

Appendix A: Resources

Public Agencies
Non-Profit and Private Organizations
Curriculum Support
Irrigation Support
Natural Resources Support
Funding Support

Appendix B: Sites of Inspiration

Appendix C: Arizona Schools with Wildlife Habitats

Appendix D: Wildlife Habitat Planning Guides

Appendix A

Resources

Public Agencies:

City and County Government

Parks and Recreation Centers

Libraries

State Government

Arizona Game and Fish Department

The Arizona Game and Fish Department has a variety of resources available such as publications, events and classes regarding wildlife regulations, and information on the Heritage Fund. If you have any questions about these resources, please call or visit their internet site at: www.gf.state.az.us

Flagstaff (520) 774-5045
Kingman (520) 692-7700
Mesa (602) 981-9400
Phoenix, Main Office (602) 789-3220
2221 W. Greenway Rd.
Phoenix, AZ 85023-4399
Pinetop (520) 367-4281
Tucson (520) 628-5376
Yuma (520) 342-0091

Arizona State Parks

Administrative Office
1300 W. Washington
Phoenix, AZ 85007
(602) 542-4174
Internet site: www.pr.state.az.us

Federal Government

The University of Arizona Cooperative Extension

This is a statewide system that links the Federal Government, Arizona counties and The University of Arizona. Its mission focuses on the enhancement of agriculture, the environment, our natural resource base, family and youth well-being, and the development of local communities. Call them with any related question or concern regarding these topics.

St. Johns, Apache Co., AZ (520) 337-2267
Willcox, Cochise Co., AZ (520) 384-3594
Sierra Vista, Cochise Co., AZ (520) 626-2422
Flagstaff , Coconino Co., AZ(520) 774-1868
Globe, Gila Co., AZ (520) 425-7179
Payson, Gila Co., AZ (520) 474-4160
San Carlos Indian Reservation, San Carlos, Coconino Co., AZ (520) 475-2359
Solomon, Graham Co., AZ (520) 428-2611
Duncan, Greenlee Co., AZ (520) 359-2261
Parker, La Paz Co., AZ (520) 669-9843
Phoenix, Maricopa Co., AZ (602) 470-8086
Kingman, Mohave Co., AZ (520) 753-3788
Holbrook, Navajo Co., AZ (520) 524-6271
Navajo Nation, St. Michaels,
Hopi Indian Reservation, Keams Canyon, (520) 734-3000
Tucson, Pima Co., AZ (520) 626-5161
Green Valley, Pima Co., AZ (520) 648-0808
Casa Grande, Pinal Co., AZ (520) 836-5221
Nogales, Santa Cruz Co., AZ (520) 761-7849
Prescott, Yavapai Co., AZ (520) 445-6590
Cottonwood, Yavapai Co., AZ (520) 646-9113
Yuma, Yuma Co., AZ (520) 329-2150
The Navajo Nation, Window Rock, AZ (520) 871-7406

The United States Forest Service

Apache-Sitgreaves National Forests
Springerville, AZ (520) 333-4301
Coconino National Forest
Flagstaff, AZ (520) 527-3600
Coronado National Forest
Tucson, AZ (520) 670-4552
Kaibab National Forest
Williams, AZ (520) 635-8200
Prescott National Forest
Prescott, AZ (520) 771-4700
Tonto National Forest

Phoenix, AZ (602) 225-5200

Natural Resources Conservation Service
The Natural Resources Conservation Service was formerly called the Soil Conservation Service. Their services include natural resources interpretation, pond and outdoor classroom design expertise, water quality tests, and other technical support. There is a district conservationist for each county that can give more specific information. Look in the blue section of the phone book.

Bureau of Reclamation
Fish and Wildlife Service
Geological Survey
Bureau of Land Management
National Biological Survey
National Wildlife Refuges
National Park Service
(phone numbers found in blue section of the phone book)

Non-Profit and Private Organizations:

Arizona

Arizona Clean & Beautiful, 1645 E. Missouri, Suite 230, Phoenix, AZ 85016, (602) 274-0494
Arizona Native Plant Society, P. O. Box 41206 Sun Station, Tucson, AZ 85717
Friends of the San Pedro River, Inc., 1763 Paseo San Luis, Sierra Vista, AZ 85635, (520) 459-2555
Huachuca Audubon Society, P.O. Box 63, Sierra Vista, AZ 85635
Maricopa Audubon Society, P.O. Box 15451, Phoenix, AZ 85060, (602) 967-9202
Native Seeds/Search, 526 North Fourth Avenue, Tucson, AZ, 85705, (520) 622-5561
Natural Resource Conservation Districts.
Southwest Center for Biological Diversity, P.O. Box 17839, Tucson, AZ 85731, (520) 733-1391
The Nature Conservancy-Arizona Chapter, 300 E. University Blvd., Suite #230, Tucson, AZ 85705, (520) 622-3861
Tucson Audubon Society, 300 E. University, Tucson, AZ 85705, (520) 629-0757

National

Backyard Wildlife Association, 4920 Liberty Lane, Allentown, PA 18106
National Wildlife Federation, 8925 Leesburg Pike, Vienna, VA 22184-0001
National Audubon Society, 950 Third Avenue, New York, NY 10022
National Wildflower Research Center, 2600 FM973, Austin, TX 78725
National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044-2831
Wildlife Habitat Enhancement Council, 1010 Wayne Avenue, Suite 1240, Silver Spring, MD 20910

Curriculum Support:

Arizona Association for Learning in and about the Environment (ALLE). This organization was founded in 1980. It is open to all persons or organizations with a commitment to the development of awareness, appreciation, understanding, and responsibility towards the environment. Their newsletter is published six times a year. Articles are about upcoming conferences and workshops, environmental education, and new books. Contact them for specific curriculum suggestions. For more information, write or call:
Arizona Association for Learning in and about the Environment, 179 W. Kent Drive, Chandler, AZ, 85224, (602) 786-9969, FAX (602) 963-0187.

North American Association for Environmental Education (NAAEE). Environmental Communicator. This organization's newsletter focuses on events and opportunities concerning environmental education, current political issues, national and international conferences, resource lists, book reviews and job opportunities. For more information, membership form or newsletter copies, contact:
North American Association for Environmental Education, P.O.Box 400, Troy, OH, 45373.

Project Learning Tree (PLT). Project Learning Tree is an award-winning environmental education program for teachers of grades K-12. It is a source of interdisplinary instructional activities and gives specific workshops and programs for teachers. It was produced through a grant from the American Forest Institute, and is cosponsored by Council for Environmental Education and the American Forest Foundation. It provides materials and support services. For more information, you can write or call:
Donna Chickering (contact person), School of Renewable Natural Resources, University of Arizona, 325 Biosciences East, Tucson, AZ, 85721, (520) 621-7263.

Project WILD and Aquatic WILD. Through the use of instructional workshops and additional curriculum materials, Project WILD and Aquatic WILD are excellent conservation and environmental education programs for teachers. They are co-sponsored by the Council on Environmental Education and the Western Association of Fish and Wildlife Agencies (WAFWA). Here in Arizona, the programs are through the Arizona Game and Fish Department. For additional information:
Arizona Game & Fish Department, 2221 W. Greenway Rd., Phoenix, AZ 85023, (602) 789-3220
Project WILD, 707 Conservation Lane, Gaithersburg, MD, 20878, (301) 527-8900

Ranger Rick's Nature Scope. This magazine is a creative education series dedicated to inspiring children and giving them a sincere understanding of the environment. They are fun, colorful activity booklets. For more information, contact:
National Wildlife Federation, 1400 16th Street, N.W., Washington DC, 20036-2266.

Project WET and Arizona WET. WET stands for Water Education for Teachers. Project WET is an education program on the national level. Arizona WET is an interdisciplinary,

supplementary water education program for Arizona educators. The program encourages appreciation of Arizona's precious water resources to our state's youth. For more information, contact:
Linda Stevens-Moore, Education Program Director, *Arizona WET*, University of Arizona, Water Resources Research Center, 350 North Campbell, Tucson, AZ, 85721, (520) 792-9591 ext. 22.

Agriculture in the Classroom Task Force. This task force is run by volunteers from the Farm Bureau of each county. They set up programs for the classroom on issues relating to ranching and farming. Counties may have different programs to offer. Contact:
Arizona Farm Bureau, Attn: Mike Lunt, 3401 E. Elwood, Phoenix, AZ, 85040, (602) 470-0088. They can direct you to your specific county contact person.

Northern Arizona Environmental Education Resource Center.
Their purpose is to assist environmental educators in Northern Arizona in developing environmental education programs. They conduct teacher workshops upon request and also, serve ten Navajo and Hopi schools. For more information, write or call:
Northern Arizona Environmental Education Resource Center, P.O. Box 5694, Center for Environmental Sciences and Education, Northern Arizona University, Flagstaff, AZ, 86011, (520) 523-1651, FAX (520) 523-7423.

SCENE. Southwest Center for Education and the Natural Environment. SCENE is a non-profit educational organization that provides the public with a scientific basis for understanding the environment. Their programs include a resource center, Science Connections Speakers Bureau, Super Science Saturday, and much more. Their Resource Center is a great place for teachers to obtain specific environmental information. For more information, contact:
Kathryn Kyle, Executive Administrator, *SCENE* c/o Arizona State University, Box 872512, 826 E. Apache Blvd. (location), Tempe, AZ, 85287-2512, (602) 965-4179.

NCEET's EE-Link: Environmental Education Materials on the Internet for Teacher
http://www.nceet.snre.umich.edu
National Consortium for Environmental Education and Training (NCEET), School of Natural Resources & Environment, University of Michigan, Ann Arbor, MI, 48109-1115
(313) 998-6726, FAX (313) 936-2195, e-mail: nceet-info@nceet.snre.umich.edu.

Arizona Environmental Education Resource Guides:
Environmental Education Resource Guide. Presented by the Arizona Advisory Council on Environmental Education; compiled by Kim Savage, 1995. This guide is a comprehensive listing of organizations providing environmental education opportunities in Arizona. For more information or to receive a copy, contact:
Arizona Advisory Council on Environmental Education, P.O. Box 64202, Phoenix, AZ, 85082-4202.

Environmental Education in Arizona. An Overview of Opportunities. United States Department of Agriculture, Forest Service, Southwestern Region, May 1996. This resource is very similar to resource above. Both are very important to see what environmental educaion resources are available for teachers in Arizona. For more information, contact:
Environmental Education Exchange, P.O. Box 2630, Tucson, AZ, 85702, (520) 670-1442,
E-Mail: nmarkowitz@eeexchange.org, http://www.eeexchange.org/fs.

The Internet. It's loaded with information on where and how to get educational materials.

Your district curriculum coordinator.

Irrigation Support:

Arizona Department of Water Resources
Tucson Office, 400 W. Congress, Suite 518, Tucson, AZ 85701, (520) 628-6758
Pinal County, 1000 East Racine Place, Casa Grande, AZ 85222, (520) 836-4857
Phoenix Office, 15 South 15th Avenue, Phoenix, AZ 85007, (602) 542-1512
Prescott Office, 2200 East Hillsdale Road, Suite A, Prescott, AZ 86301, (520) 778-7202

University of Arizona Cooperative Extension
Look under Public Agencies in this Appendix for phone numbers.

Water Conservation Offices
Tucson Office, P.O. Box 27210, Tucson, AZ 85726, (520) 791-4556
City of Phoenix Office, 200 W. Washington St., Suite 800, Phoenix, AZ 85003, (602) 261-8367
*Every city has their own Water Conservation Office; for example, City of Tempe, City of Glendale, and City of Prescott. Check your phone book for local phone numbers.

AMWUA
Arizona Municipal Water Users Association, 4041 N. Central Ave. Suite 900, Phoenix, AZ 85012-3309

Environmental Resources Support:

"Home Composting in the Desert" Video. This 25 minute video takes the viewer into actual preparation of a backyard composting operation in the Sonoran desert. The video is designed for homeowners, garden clubs, environmental classes, and youth group projects. If you would like a tape of this, send $15.00 (which includes shipping & handling) to:
Tucson Organic Gardeners, Compost Education Fund, P.O. Box 27763, Tucson, AZ 85726,
Checks should be made out to "T.O.G. Compost Ed. Fund."

Compost Assistance Line (520) 798-6215.

Arizona Environmental/Recycling Hotline, 2701 East Osborn Road, Phoenix, AZ 85016, (602) 253-2687 or (602)-C-L-E-A-N-U-P or (800)-94-REUSE.

Energy Education Resource Directory. A Guide to Energy Resource Materials for Arizona Educators. To receive a directory, write or call:
Arizona Department of Commerce, Energy Office, 3800 N. Central Avenue, Suite 1200, Phoenix, AZ 85012, (602) 280-1430 or toll free in Arizona (800) 352-5499.

Center for Desert Living. This program is part of the Desert Botanical Garden in Phoenix, Arizona. It provides the public with current information on energy and water conservation issues through the use of modern technologies. At the Desert Botanical Garden is the Center for Desert Living Trail. This trail shows how people can live comfortably in our desert environment by taking you through the Desert House and lush desert landscapes. For more information, visit, write, or call:
Desert Botanical Garden, Attn: Education Department, 1201 N. Galvin Parkway, Phoenix, AZ 85008, (602) 941-1217 (Recording) or (602) 941-1225.

Department of Environmental Quality, Waste Planning Section, 4th Floor, 2005 N. Central, Phoenix, AZ, 85012, (602) 257-2372.

Funding Support:

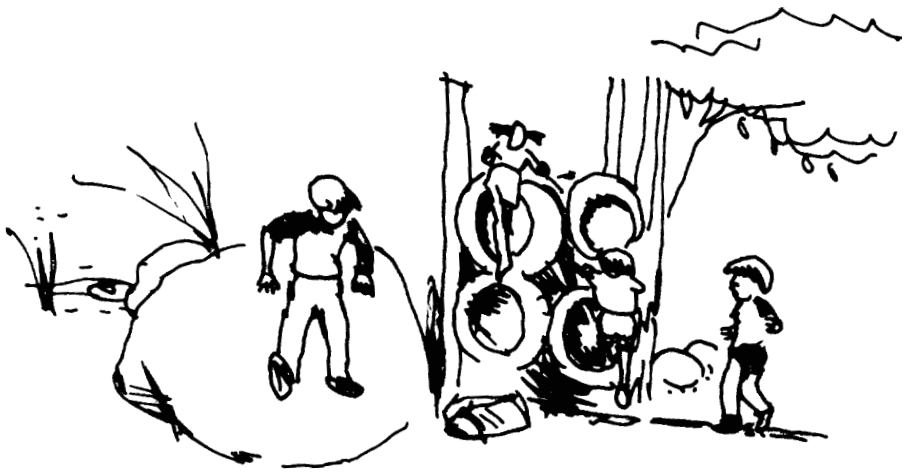
There are two major resources for cash donations—grant funding and solicited funding. Some of the major resources for grant funding in the state of Arizona include:

The Heritage Environmental Education and Schoolyard Program
Administered by the Education Branch of the Arizona Game and Fish Department
2221 W. Greenway Road
Phoenix, Arizona 85023, (602) 789-3238
Grant guidelines as well as applications and application workshops are provided by the Game and Fish Department throughout the state. (602) 789-3530
Environmental Education Program Grants

Administered by the Arizona Advisory Council on Environmental Education
c/o Arizona State Land Department
1616 W. Adams
Phoenix, Arizona 85007
(602) 542-4625
Grant guidelines for school-based field sites or facilities are available.

Research Support Office
Administered by the University of Arizona
1203 N. Mountain Ave.
Tucson, Arizona
(520) 621-1469
This is a database resource available to research grant funding opportunities.

Arizona Arts Commission
417 W Roosevelt
Phoenix, Arizona 85003
(602) 255-5882
and your local arts council
These organizations provide grant monies available for children and the arts, art education and environmental arts programs.



Appendix B

Sites of Inspiration

If you do not have a wildlife habitat/outdoor classroom at your school, visit places in the list below. Not only will they be great field trips for the students, but also they can give the teacher environmental education ideas, resources and materials. Also, these places can give inspiration needed for starting a wildlife habitat project at your school.

Desert Botanical Garden. The Desert Botanical Garden has a lot of great environmental education information—education packages for teachers focusing on grades K-6, Center for Desert Living information (energy & water conservation issues), and a gift shop filled with lots of books and resources. Walking through the Botanical Garden may give you design ideas and insight on what plants to use for your schoolyard habitat. For information:
Desert Botanical Garden, Attn: Education Department, 1201 N. Galvin Parkway, Phoenix, AZ 85008, (602) 941-1217 (recording), (602) 941-1225.

Boyce Thompson Southwestern Arboretum. This arboretum is full of habitat information with their plant displays, informative trails, demonstration gardens, interpretive ramadas, and gift shop. It's a great place to visit and get ideas or bring the students along for a field trip. Also, they have a selection of drought-tolerant plants for sale. For more information, write or call:
Boyce Thompson Southwestern Arboretum, 37615 Hwy. 60, Superior, AZ 85273, (520) 689-2811.

Tohono Chul Park. This 37-acre park features nature trails, demonstration gardens, and other informative ways to promote the conservation of fragile desert regions and educate the public about their uniqueness and importance. Information packets are available and teacher workshops are available by request. For more information, write or call:
Tohono Chul Park, 7366 North Paseo del Norte, Tucson, AZ 85704, (520) 742-6455 or FAX (520) 797-1213.

Tucson Botanical Garden. Besides being a great field trip opportunity, The Tucson Botanical Garden provides teacher training workshops on tropical rainforests and Sonoran ethnobotany for teachers of grades 3-8; teacher "check-out" kits; and outreach programs to schools. The gardens also provide design ideas and plant information for your schoolyard habitat. For more information, write or call:
Tucson Botanical Garden, 2150 N. Alvernon Way, Tucson, AZ 85712, (520) 326-9255 or FAX (520) 324-0166, Contact: Meg Quinn.

Arizona-Sonora Desert Museum. The Arizona-Sonora Desert Museum is truly a special place for learning about the Sonoran desert. One of its primary goals is teaching people about this unique region of the world. The gift shop is packed with environmental education activity materials, guides, and children's books. They offer a wide range of Education Programs for adults, young people, schools, and teachers. In addition, the education department at the Museum can send out specific, requested materials to enhance the classroom curruculum. For more information, contact:
Arizona-Sonora Desert Museum, Department of Education and Programs, Sonya Norman, Education Specialist, 2021 N. Kinney Road, Tucson, AZ 85743-8918, (520) 883-1380.

Red Rock State Park, Center for Environmental Education. Red Rock State Park serves as an environmental education center; including, exhibits, programs, and ranger-led hikes. The Connection Program is the park's environmental education school program developed for grades K-12. The park has a resource library, a mountain lion box for checking out, and educational support in supplementing the classroom curriculum. For more information, write or call:
Red Rock State Park, Center for Environmental Education, 4050 Red Rock Loop Road, Sedona, AZ, 86336, (520) 282-6907.

Oracle State Park, Center for Environmental Education. Oracle State Park is located in the northern foothills of the Santa Catalina Mountains. Currently, it is not open to the public. Yet, it offers educational programming to organized groups such as students and after-school groups by reservation. The park has a resource library with lots of books, curriculum materials, and audio and video tapes that can be checked out. For more information, write or call: Oracle State Park, Center for Environmental Education, P.O. Box 700, Oracle, AZ, 85623, (520) 896-2425 or FAX (520) 896-3215.

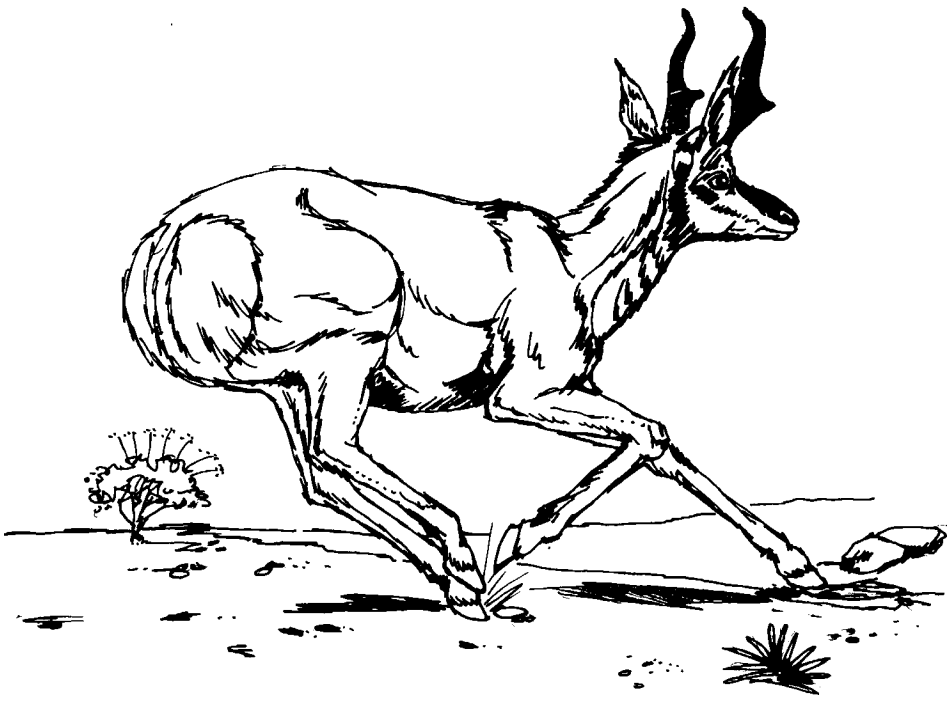
Highland Center for Natural History. Highland Center for Natural History, previously called the Community Nature Center of Prescott, gives the public an opportunity to appreciate and become aware of the unique bioregion of the Prescott area. They provide hands-on, creative educational experiences on a current 20-acre site of the Prescott Unified School District. They offer a variety of educational programs for multiple grade levels, families, and the community. For more information, contact:
Highlands Center for Natural History, P.O. Box 12828, Prescott, AZ 86304, (520) 445-5497, Nicole Trushell, Director, Faith Roelofs, Development Manager.

The Arboretum at Flagstaff. The Arboretum is located on 200 acres of ponderosa pine forest. Throughout the arboretum, there are many educational exhibits, trails, and theme gardens. There is also a pond, stream, and gift shop packed with books, informative extension bulletins, and displays. There are many educational programs available for children and adults including field trips, workshops, lectures, and guided tours. For more information, contact:
The Arboretum at Flagstaff, P.O. Box 670, Flagstaff, AZ 86002, (520) 774-1441, Administration: (520) 774-1442, http://www.flagguide.com/arboretum.

Appendix C

Arizona Schools with Wildlife Habitats

Many schools in Arizona have recieved grants from either the Arizona Game and Fish Department or other public and private organizations. The grants are used for the construction of wildlife habitat/outdoor classroom on the schoolgrounds. These schools are great resources and can provide information on how to get started on a habitat project. Give them a call and listen to their advice, or visit their habitat to get some ideas. There are a few case studies described on the following pages of schools in Arizona that have wildlife habitats. This is only a sampling of the many other schools undergoing similar projects. Feel free to call the Arizona Game and Fish Department for a current listing of Heritage Grant School Yard participants.



Coronado Elementary School
P.O. Box 3030
St. Johns, Arizona 85936
(520) 337-4435
Project Scale: 4 acres

Habitat Elements: Small lake, marsh, natural restoration area, trails, picnic benches & tables, amphitheater, bat houses, and grow boxes.

Community and Agency support: Salt River Project (SRP), City of St. John, Arizona Game & Fish Department Heritage Fund, University of Arizona Cooperative Extension, Natural Resources Conservation Service (NRCS), Bureau of Land Management (BLM), U.S. Forest Service, parents and students of Coronado Elementary, and many individuals from the community of St. Johns.

Description: Carolyn Nielson, a teacher at Coronado Elementary, took her childhood memories of trees, wildlife, and open space and used it as inspiration for the construction of a schoolyard habitat. Coronado School is located in the spot where Carolyn use to run and play outdoors. Instead of lamenting what use to be there, she and many community members are working together to build a 4-acre schoolyard habitat on the exact spot. She wants the kids in her community to be as lucky as she was and have a chance to be outdoors in nature and learn about the great mysteries of the environment that surrounds us.

This schoolyard habitat has been an on-going project for the last six years. With the constant flow of support, it is becoming one of the best in the state. The community donated lots of materials; yet, it's the students who have done most of the "hands-on" work. For example, the cultural inspection of the site, mapping of the site, and soil sampling were all done by students. Certainly, this enthusiasm is the key for a successful schoolyard habitat.

Sunnyside High School
1725 E. Bilby Rd.
Tucson, Arizona 85746
(520) 741-2400 ex.455
Project Scale: ½ acre

Habitat Elements: Wetlands, native vegetation berms, four watering holes, bird area, composting area, wildflower area, hummingbird and butterfly garden, and riparian area.

Community and Agency Support: WalMart, Arizona Game & Fish Department Heritage Fund, local nurseries, Alumi Association, lots of individuals, and the students.

Description: Terry Seward, a teacher at Sunnyside High for 26 years, took on this habitat project a few years ago. He has always loved the outdoors and felt bad for the his students because the natural desert was disappearing around them. Why not bring the desert into the school grounds? In starting the project, he also started a new class called Outdoor Education, an alternative replacement for physical education. These students, with Terry, helped get the habitat project underway.

The students helped out on all levels of the design process. They first went to the Desert Museum to study natural habitats. This helped them come up with a masterplan. They did all the planting, building of the berms, and wrote letters for donations. They had a competition who could receive the biggest donation.

Terry and the students get involved with a lot of habitat programs, such as the FeederWatch Program, World Wildlife Program, and GLOBE. These can be investigated on the Internet, which Terry says is loaded with free information on schoolyard habitats. They are proud to say that Sunnyside High has the largest outdoor classroom in the district and not a single act of vandalism has been committed at the site. They take pride in the hard work they have performed so far.

Scott L. Libby School
553 Plaza Cir, Ste A
Litchfield Park, Arizona 85340
(602) 935-0040
Project Scale: 20 acres
The Outdoor Classroom is called Project Preserve.

Habitat Elements: Insect garden, GLOBE Research site, cactus garden, small pond, stream, marsh, big pond, wildlife viewing blind, Native American area, archeology dig, Hohokam village, and the Gary Ewert Teaching Station.

Community and Agency Support: Arizona Public Service Company, Arizona Department of Commerce Energy, Arizona Game & Fish Department Heritage Fund, Natural Resources Conservation District (NRCD), Herpatology Society, Mountain View Nursery, Valley Forward Association, Telephone Pioneers of America, Quackenbush Construction, Eagle Scouts, Girl Scouts, a local landscape architect, and lots of community members and students. Iin 1992, Judy Atkins, a teacher at Scott L. Libby, recieved the Christa McAuliffe Fellowship.

Description: Judy Atkins, the motivation behind Project Preserve, went to a conference five years ago in Washington D.C. to learn how to improve science programs at school. She found out about wildlife habitats on the school grounds and how to use it as an outdoor classroom. What a great idea, she thought, and got started on what is one of the country's largest outdoor classrooms.

Project Preserve is not only for the students at Scott Libby. It serves as a local resource center for the entire surrounding community; such as field trips for other schools, student research, conferences, and a recreation area. During class time, the lessons are not only based on science. Teachers bring students out for integrated learning on math, literature, and even art. There are "activity tubs" designated for a specific lesson that takes place out in the

preserve. Sometimes the fifth and sixth graders use the tubs for teaching the younger students lessons about the preserve.
After interviewing Judy Atkins, she had a bit of advice for all of you about to dive into this kind of project. Make sure you have a plan before you get started, know who and how the maintenance of the site will be performed, think about how you will organize your volunteers, and take the risk. The awards that the kids get is worth all the hard work. Judy says, " When I walk across the campus, the kids always ask me, 'Are we going out to Project Preserve today?' That feels good to know they enjoy it so much."

Mountain View Elementary School
1502 W. Mountain View Rd. Phoenix, Arizona 85021
(602) 866-5232
Project Scale: 1/4 acre, includes two locations on the school grounds

Habitat Elements: Amphitheater, Pathways with plant signs along the way, ramada, benches, ethnobotany garden, and a Hohokam archeological site is in the process of being built.

Community and Agency Support: Salt River Project (SRP), Arizona Public Service (APS), Arizona Game & Fish Department Heritage Fund, a local plant nursery, a local construction company, and many students and community volunteers.

Description: Mountain View Elementary's schoolyard habitat may be small in size compared to other schools, but it contains all the necessary elements for a successful project in the center of the city. The school is surrounded by metropolitan Phoenix. The students there are not familiar with pristine desert areas. Diana Bonney, a teacher at Mountain View, wanted to bring nature back into their lives and have the students create a place of which they could be proud of. Their schoolyard habitat is a success because the students have been involved with the project from day one. After recieving the Heritage grant, they helped out in the planting of

trees and shrubs, laying out the walkways and spreading granite, and constructing the fences to the ethnobotany garden. The students practically did all the work. Second, the community uses the habitat for cook-outs, Cinco de Mayo festivals, and luminarios at Christmas time. Lastly, wildlife have found their small habitat and now call it home.

The project was such a success that ten "gifted ESL students" wrote another grant to the Arizona Public Service explaining that they need an outdoor classroom. It was completely the students idea. The grant came through and now Mountain View has an amphitheater and a 5000 square feet renovated cactus garden that the school utilizes. The students are very proud of their accomplishments.

Acacia Elementary School
13299 E. Colossal Cave Rd. Vail, Arizona 85641
(520) 762-5291
Project Scale: 3/4 acre

Habitat Elements: Trails, large outdoor classroom area, ramadas, cactus garden, plant identification signs, tables and benches, storage shed, stream, and pond.

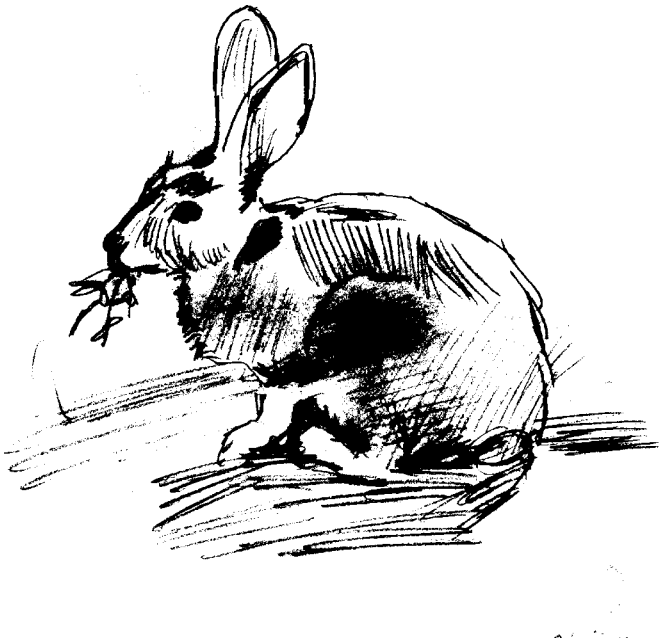
Community & Agency Support: Local nurseries, pool company, steel company, fence company, welder, Trees for Tucson, County Recreation Department, Arizona Game & Fish Department Heritage Fund, Sand & Gravel company, local Architect, Vail Education Foundation, local church, and many community members, parents, and students.

Description: This schoolyard habitat, otherwise known as the Acacia Outdoor Classroom and Environmental Research Park is a very important place for the students of the school. It is approximately six years old; therefore, many of students have been exposed to the habitat for

several years. They are fully aware of the plethera of wildlife that visit the site, such as javelina, bats, snakes, birds, and rodents. They even have longfin dace in the pond and stream in which the Arizona Game & Fish Department donated. Longfin dace are an endangered fish of Arizona. When the fish came to Acacia Elementary, the students and teachers performed a Native American ceremony welcoming the fish to their pond. The students were very moved from the whole experience and now feel they are stewards of the fish.

Throughout the years, the Acacia Outdoor Classroom and Environmental Research Park has recieved many donations. Currently, one way that the habitat will receive money is from benches covered with tiles. The tiles were individually painted from students and then cemented on top of the bench. The school is planning to sell the benches. These idea was also applied to Plant identification signs throughout the habitat. Students from the Middle School made the signs; each tile having a picture and name of a particular desert plant.

Peggy Gibson and Leslie Schecter, two teachers who were the motivators for the project, have a bit of advice for other schools undergoing this type of project. First, it is important to have good maintenance support. Second, do not overplan. If the plan is too elaborate, it will be harder to find volunteers who will know how to construct it.



Grijalva Elementary School
1795 W. Drexel Rd.
Tucson, Arizona 85746
(520) 578-4770
Project Scale: 1500 square feet

Habitat Elements: Ocotillo ramada, bird bath area, trails, native planting areas.

Community & Agency Support: Landscape designer, Trees for Tucson, Liason of the neighborhood community association, school district, Arizona Game & Fish Department Heritage Fund, students, parents, and even grandparents.

Description: The ground-breaking for Grijalva Elementary's schoolyard habitat was in January, 1997. Relatively young, yet deeply appreciated, this schoolyard habitat has become a favorite place for the students of the school. The students are out there during recess time placing rocks along the pathways and very excited when they get to use it for class time. "I live for this," one student says as they planted a tree for the habitat. One particular kindergarten student who is very quiet and didn't previously write, came out to the habitat, and began writing for the first time.

Mary Graham and Anna Childs, both teachers at Grijalva Elementary, began the schoolyard habitat project by organizing committees to plan the steps that are needed for a successful habitat. One of the committees was a children's committee. There was a group of ten students, who represented the student body. They attended all the planning meetings, toured other schools with schoolyard habitats, voiced their ideas, and helped in the decision-making process. The children's committee is a very important part of the planning process for all schoolyard habitats. It makes the students feel important, responsible, and an integral part of what is happening at their school.

Mary and Anna felt the key to success in schoolyard habitat projects is to connect with other schools who have undergone these similar types of projects, which includes visiting these schools to see how they designed their schoolyard habitat. Another important element for success is to have the support of the school district. "Be patient with the red tape," they said. It's all worth it in the end.

Appendix D

Wildlife Habitat Planning Guides

Notes on Benefiting the Biomes. Matt Nielson and the School Nature Area Project (SNAP), 1996. St. Olaf College, 1520 St. Olaf Avenue, Northfield, MN, 55057, (507) 646-3599, http://www.stolaf.edu/other/snap.

Guidelines and Features For Outdoor Classrooms. Compiled and edited by Sam Carmen, 1992. Indiana Department of Natural Resources, Division of Forestry, 402 W. Washington, Room 296, Indianapolis, IN, 46204, (317) 232-4105.

***Creating Landscapes for Wildlife...a guide for back yards in Utah*.** Sue Nordstrom, 1991. Cooperative project with Utah State University and Utah Department of Natural Resources. Project WILD, Utah Division of Wildlife Resources, 1596 West North Temple, Salt Lake City, UT, 84116-3195, (801) 538-4720.

***Schoolyard Ecosystems for Northeast Florida: A Guide for Planning, Installing, Maintaining, and Using*.** Joseph M. Schaefer, Dan W. Donelin, Lester L. Linscott, and Linda Cronin-Jones. Florida Game and Fresh Water Fish Commission, Office of Informational Services, NonGame Education Coordinator, 620 S. Meridian St., Tallahassee, FL, 32399-9969.

Habitats for Learning...a planning guide for using and developing school land labs. Developed by Ohio Department of Natural Resources, Environmental Education Council of Ohio, Natural Resources Conservation Service, Ohio Department of Education, Ohio Federation of Soil and Water Conservation Districts and Ohio State University Extension, 1995. Ohio Department of Natural Resources, Division of Soil & Water Conservation, Environmental Education Section, 1939 Fountain Square Court, Bldg. E-2, Columbus, OH, 43224, (614) 265-6878.

Naturescaping: A Place for Wildlife. Shann Weston. Oregon Department of Fish & Wildlife, Information and Education Office, Naturescaping Book, Oregon Department of Fish and Wildlife, P.O. Box 59, Portland, OR, 97207, (503) 872-5264 ext. 5528.

Schoolyard Habitats Planning Guide. National Wildlife Federation. Vienna, VA.

Success with School Gardens: How to Create a Learning Oasis in the Desert. Linda A. Guy, Cathy Cromell and Lucy K. Bradley, 1996. Arizona Master Gardener Press, 4341 E. Broadway Road, Box 112, Phoenix, AZ, 85040-8807, (602) 470-8086, ext. 312.

Handbook to Schoolyard Plants and Animals of North Central Florida. Peter Feinsinger and Maria Minno. Sponsered by Bingham E.E. Foundation, The NonGame Wildlife Program, and Florida Game and Fresh Water Fish Commission. Florida Game and Fresh Water Fish Commission, Office of Informational Services, NonGame Education Coordinator, 620 South Meridian Street, Tallahassee, FL, 32399-1600.

WILD School Sites. A Guide to Preparing for Habitat Improvement Projects on School Grounds.
Paul Schiff and Dr. Cindi Smith-Walters, 1994. Project WILD, 707 Conservation Lane, Gaithersburg, MD 20878, (301) 527-8900 or available through the Arizona Game & Fish Department, Heritage Schoolyard Program, 2221 W. Greenway Rd., Phoenix, AZ, 85023, (602) 789-3220

Homes for Wildlife. A Planning Guide for Habitat Enhancement on School Grounds.
Marilyn C. Wyzga. Developed by the New Hampshire Fish & Game Department, Attn: Business Division, 2 Hazen Drive, Concord, NH, 03301, (603) 271-3211.

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One Of My Mom's garden
- Observation