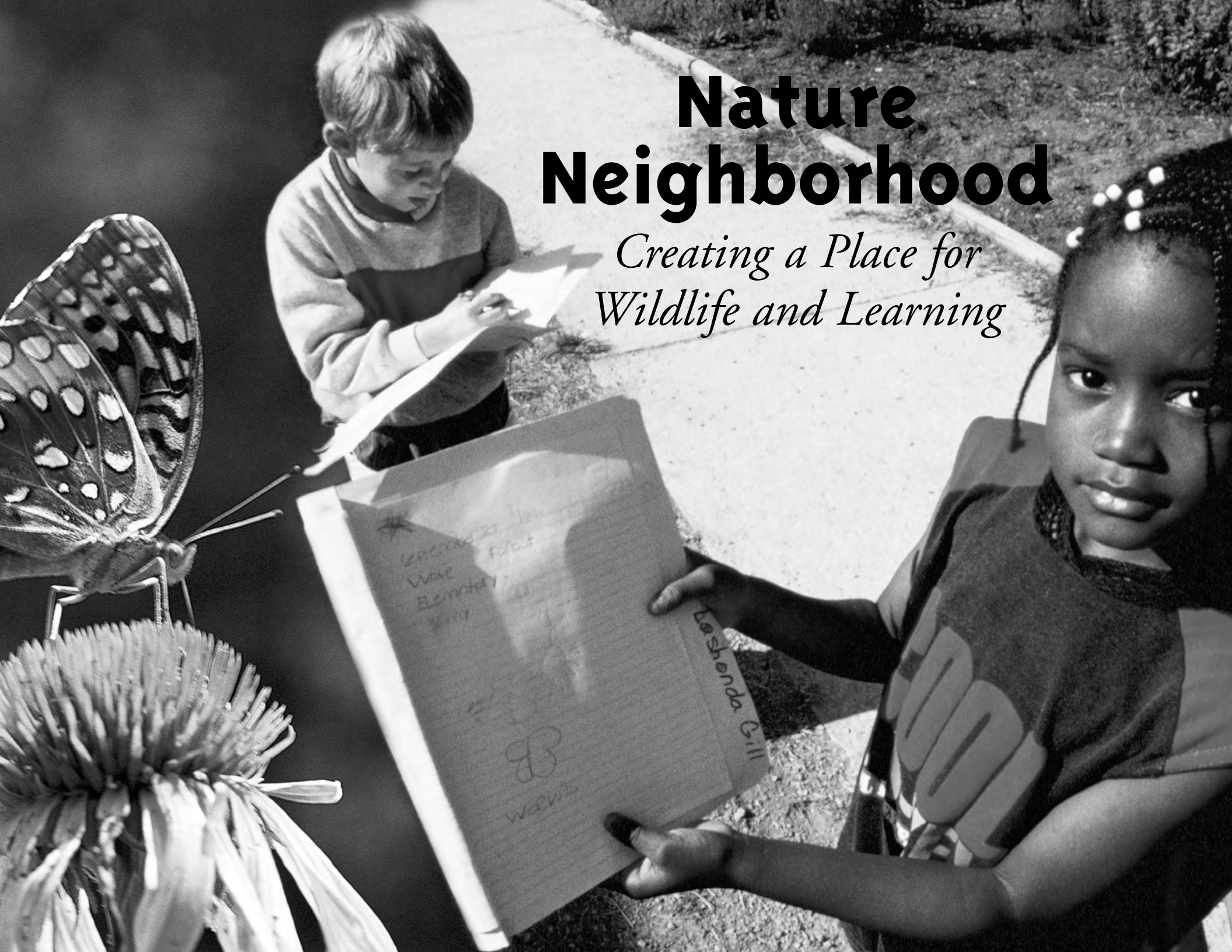


Nature Neighborhood

*Creating a Place for
Wildlife and Learning*



Nature Neighborhood

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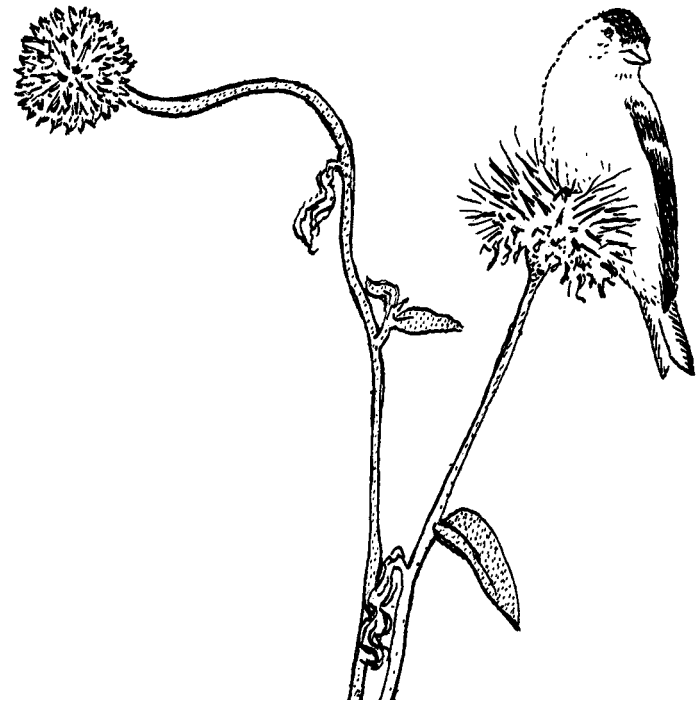
Edited by Christy Flint

*Strategies from the UTOTES program
Using The Outdoors To Teach Experiential Science*

Abbreviated Educators' Guide

North Carolina State Museum of Natural Sciences

Environmental Media Corporation
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Illustrations by Anne Runyon
Appendix illustrations by Brenda Wynne and Amme Maguire
Ant lion illustration by Brenda Wynne
Photography by Mike Dunn unless otherwise noted

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Page 28 American goldfinch photo by Chuck Gaul
Page 35 and 47 Student with binoculars and minipond photos by Liz Baird
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Foreward

*“The idea of **taking students outside** during the school day used to be frowned on as a departure from learning. Now we realize the outdoors can open doors to student learning that we had never dreamed of...”*

Renee Coward
K–8 teacher



Nature Neighborhood: Creating a Place for Wildlife and Learning is dedicated to elementary school teachers who want to extend the walls of their classrooms to include the natural world. This guide and its companion Nature Neighborhood video are based on an innovative program for teachers initiated by the North Carolina State Museum of Natural Sciences called Using The Outdoors to Teach Experiential Science (UTOTES). The UTOTES program arose from the Museum’s long-standing commitment to provide effective teaching strategies for teachers. The goals of the UTOTES program are to:

- increase the use of the outdoor environment in the teaching of all subjects
- positively impact attitudes of teachers and students toward living things

- enhance the value of the school grounds as a learning resource through native plantings and the creation of wildlife habitats
- develop site-based science leadership

Nearly every school has outdoor space that can be used for teaching. School grounds are familiar, safe, and convenient. They require no transportation to visit, and can be returned to again and again to observe changes over time. In many ways, they are the ideal place to practice observation skills and gain familiarity with living things. Enhancing school grounds is a cost-effective and efficient way to provide for hands-on learning, to motivate students, and to establish pride and ownership in the school facility.

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Getting Started

*“Many teachers were actually afraid to take their students outside, for who could assume to know how to answer all of the questions the children might ask? Now we understand that **we don’t have to know all of the answers**, it’s enough to marvel at all of the questions.”*

Renee Coward
K–8 teacher



With all the demands placed on school faculty these days, why should you spend the time and effort to transform your grounds into a more inviting place for wildlife? Because the environment is a powerful and accessible tool for motivating students and for integrating lessons across the curriculum. Unfortunately, many schools lack an inviting atmosphere once students walk out the doors. This is especially true for many new schools, where the landscape has been altered beyond recognition and little attention or money is focused on the environment outside the building. Creating nature neighborhoods can change the way a school looks and feels.

What is a nature neighborhood?

Nature neighborhoods are areas such as backyards and school grounds that are enhanced to attract wildlife and to provide for their needs. When built on schoolyards, nature neighborhoods give teachers a way to use their students’ natural fascination with living things to facilitate learning experiences. Nature neighborhoods can be designed specifically for integration into the curriculum and regular teaching schedule, and can be used to teach science, social studies, language arts, math, art, and music.

Establishing a nature neighborhood on your school grounds

Wildlife need four basic habitat elements: food, water, shelter, and a place to raise young. Most schools already have some or all of these elements. Creating a nature neighborhood is a matter of finding out what's already there, identifying what's missing, and determining what you want to build.

Adding wildlife habitats to your school grounds may seem daunting, but it need not be.

Creating a nature neighborhood is a long-term project, but the steps along the way consist of small projects and activities that can be done one at a time. A good plan can help phase in changes that will provide your school with long-lasting outdoor teaching resources.



Watauga County native plant garden at Hardin Park Elementary School

Planning your nature neighborhood

1. Talk to your principal, other teachers, students, parents, PTA officers, and maintenance staff about using the grounds for teaching.
2. Form a project team with individuals interested in creating nature neighborhoods on the school grounds. Involve the whole school community with school-wide projects that share the labor, fun, and learning.
3. Include maintenance staff in every step of the process and in all planning. If your maintenance staff has committed to your school's project, they can help to design areas for easy and convenient maintenance and can help to maintain the nature neighborhood, especially during summers and holidays.
4. Obtain a map of the school grounds. If none is available, sketch one yourself or get students to draw a map as a class activity.
5. Explore your school grounds and identify existing wildlife features. Record their locations on your map. (*Note: This is an excellent student activity.*) Look for the following essential elements: food sources (e.g., native plants and trees with berries, nuts, and seeds; nectar-producing flowers; existing bird feeders); water sources (e.g., ponds, streams, temporary pools, drainage ditches, puddles); and places that provide shelter for animals to live and/or raise



One of the first Nature Neighborhood gardens, at Brown Summit Elementary School

young (e.g., dead trees, natural meadows or other un-mowed areas, rock or brush piles, existing bird houses).

6. Discuss with your team what wildlife habitat improvements or additions should be made. This is a good time to involve your students in the project by having them generate ideas about what type of nature neighborhood to build, how to design it, and how to build and maintain it. See Appendix A for examples of projects or
7. Choose a site for your project that is easily accessible to students and staff and that can be seen from a number of different vantage points (e.g., classroom windows, walkways).
8. Whenever possible, use plants native to your region for wildlife habitat projects. Avoid using exotic species since their value

Chapters 2, 3, and 4 for detailed instructions on creating butterfly gardens, bird observation stations, and miniponds.



Perhaps the state's only "mud dauber preserve" at Brown Summit Elementary School

to wildlife is generally less than that of native species.

9. Begin a nature neighborhood notebook. Include the location of the project, a diagram of the project, a comprehensive list of materials, a description of how to build the project, and a schedule of maintenance requirements.
10. In your notebook, schedule in the necessary steps to build the project, from gathering materials to assigning work days.



Caterpillar and butterfly garden raised beds at East Clayton Elementary School

Why use native plants?

Native plants are species that can be found growing in natural habitats. Native plants do not include exotic or introduced species that have naturalized to an area (e.g., kudzu, dandelions, white clover). The Museum encourages the use of native plants because:

- Native plants generally provide better food and shelter for native wildlife.
- Native plants are adapted to local conditions and generally require less maintenance. They are also more likely to be resistant to local pest populations.

- Teaching children about local plants helps convey a sense of connection to the local environment. When children know and appreciate native wildflowers, trees, and shrubs, they are more likely to care about preserving them and their habitats.
- Native plants provide teachers with a wealth of teaching tools for topics from natural history to folklore and culture (e.g., edible and medicinal properties). It is also generally easier to locate resource information about native species.

- Planting native species is a good lesson in habitat conservation for students.
- Non-native species are often invasive and can create problems for native species.

Where to find native plants

- Seed catalogs
Many plants are easily grown from seed.
- Garden centers
Many nurseries specialize in the propagation of native plants and most garden centers sell some native species.
- Botanical gardens
Your area botanical garden or arboretum may have a native plant program. The N.C. Botanical Garden in Chapel Hill sells native wildflower seeds and plants and is a clearinghouse of information on sources for native species.
- Plant rescue
“Plant rescue” means saving desirable plants (with permission only!) in areas that are about to be disturbed for development.
- Agencies
N.C. Museum of Natural Sciences,
N.C. Cooperative Extension Service,
N.C. Division of Forest Resources

Maintaining your nature neighborhood

How your nature neighborhoods are maintained can make or break them. It's important to work with administration and maintenance staff at your school as you develop your plans and to keep them informed of changes. If you don't plan for future maintenance, a good idea one year can fall by the wayside the next.

- Design project areas for ease of maintenance. Raised beds with a mulched outside edge reduce the need for weed-eaters. One large raised bed is easier to mow around than several smaller ones. Space project areas to accommodate mowers between them.
- Clearly define your projects as natural areas. Raised beds help define an area and discourage cases of mistaken mowing or herbicide treatments. Labeling natural areas with signs helps define them and can be fun and educational. Students are proud of their nature neighborhoods and like to show them to parents and other visitors.
- Give students maintenance responsibilities such as weeding, watering, filling bird feeders, and checking areas regularly.
- Set up a schedule for daily and seasonal maintenance.
- If other teachers and groups will use these areas, make sure they know the rules and procedures.



Poison ivy vine

Keeping students and the nature neighborhood safe

Nature neighborhoods do not pose many hazards and, by being observant, you and your students can avoid most, if not all, potential problems.

- Teach your students proper handling for each type of animal (e.g., insects, turtles, frogs). Don't make students touch any animal if they are uncomfortable about it.
- Have students wash their hands before and after any activity with animals. Students

should not be allowed to eat or handle food until after the animal activity is completed and hands have been washed thoroughly.

- Teach students to identify and avoid poison ivy and poison oak. Keep learning centers free of it, or clearly label areas where these plants occur.
- Keep miniponds and other water gardens shallow (generally less than 18 inches) and avoid loose rocks and other tripping hazards around their edges.
- Identify students with allergies to insect stings, pollen, or other outdoor hazards, and make sure emergency medical treatment is available in case of allergic reaction.
- Most spiders and snakes are harmless, but be aware of venomous species in your area and alert students to be cautious when observing these animals.
- Do not let students taste any plants, berries, mushrooms, or anything else that may be poisonous.
- Instructors should scout out an area prior to taking groups to check for potential problems such as yellow jacket nests, poison ivy, etc.

Tips for teaching and learning

- Find points of interest ahead of time, such as mud dauber nests, spider webs, bird nests, insect galls, places where you see butterflies, caterpillars, insects, toads, etc.
- Learn to recognize a few common species of spiders, insects, and trees that your students will be likely to see.
- Before you go out, you may want to use collected specimens, field guides, or information sheets to familiarize students with creatures they are likely to see.
- When possible, divide your students into teams. Teams make learning more fun and students help each other observe.
- Teach students to be quiet and watchful when approaching an area and to be ready to observe.
- Have students keep a schoolyard field trip logbook or journal in which they regularly record observations, thoughts, feelings, learnings, and questions.

Bringing the outdoors in

After observing animals in your nature neighborhood, you may want to bring creatures into the classroom for short-term observation. *Always return animals to their original locations. Never release non-native organisms into the*

environment. The Museum does not recommend keeping wild animals captive in the classroom for extended periods.

Before bringing any animal into the classroom, consider these questions:

- Are any permits required to obtain it? Is it protected under State or Federal law? (In North Carolina, contact Wildlife Resources Commission for permit information.)
- Are there safety concerns for either the animal or the students?
- Is it appropriate to have this animal? Why keep it in the classroom?
- What is its diet? Is that food readily available? What will it cost to feed it?
- What are the maintenance needs (e.g., housing, lighting, temperature) of this animal?
- Who will care for it? How often does it require feeding or cleaning? What about care on weekends and vacations?
- What will you do with the animal when you no longer want it in your classroom?

Also useful for classroom study are habitat examples (e.g., rotten log box, minipond water aquaria) and organism artifacts (e.g., mud dauber nests, cocoons, praying mantis egg cases, galls, cicada exoskeletons).

Butterfly Gardens

*“Our butterfly gardens grace the windows along our corridor to the library, lunchroom, and auditorium. During those unexpected wait times due to back ups and class changes, I have found it is the best place to “park” my students. They are so busy **observing snatches of nature**—praying mantises, caterpillars, butterflies, chrysalises, garden spiders, hummingbirds, gorgeous flowers—they seldom misbehave!”*

Donna Collie
second grade teacher



Attracting and observing butterflies is one of the easiest ways to encourage students to use the outdoors for learning. Butterflies are common, colorful, and easy to attract. Even people that are uncomfortable with nature’s little “beasties” appreciate the beauty of butterflies. As an easy-to-observe bonus, the incredible transformation from egg to adult is captivating.

You probably already see butterflies on your school grounds, but you can attract even more by planting a butterfly garden. Butterfly gardens contain plants that are known to attract butterflies at all stages of their life. Butterfly

gardens can fit onto any school ground; they can be large or small, manicured or wild.

Students who participate in all aspects of planning and building the garden acquire a sense of ownership. Butterfly gardens have a variety of educational uses in addition to science. For example, they may be used for social studies (history of native plants, butterfly migrations that connect cultures), art (decorating the garden with sculpture or paving stones), and language arts (writing observations, keeping a journal of thoughts and feelings).

Butterfly gardens provide an accessible natural habitat where students can observe butterflies, moths, and caterpillars, learn about native flowering plants, and investigate the interdependence of plants and animals.



Students planting a butterfly garden at Merry Oaks Elementary School

Choosing a site

Your butterfly garden site should be:

- Visible to student traffic, so students, families, and teachers can see flowers and butterflies during the day.
- Accessible to deliveries of topsoil and mulch.

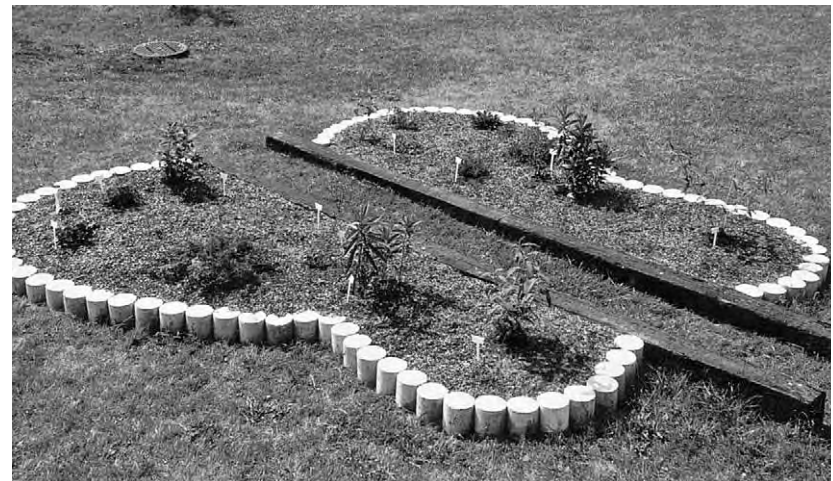
- Any size. Larger gardens are more likely to attract a variety of species, but even a container garden with the right plants can attract butterflies.
- In full sun (at least six hours of sunlight a day). Sun is important for both plants and butterflies. Many “butterfly” plants need full sun to grow and bloom. Butterflies need sun to keep their bodies warm enough to fly.
- Near a source of water so you can water the garden.

With a few sites in mind, check with your principal about the location of underground utilities and future building plans.

Planning your garden

1. Draw a diagram of your garden. Make it any shape you like, the more creative the better—a popular design is to lay out the garden in the shape of a butterfly. In general, curved designs are more appealing than square shapes. Include dimensions on the diagram.

2. Although not absolutely necessary, we recommend that you place a border around your garden to identify the area for easier maintenance and protect it from accidental mowing.
3. Decide what native plants you want in your garden and where you will put them. Remember to consider the growth habits and planting requirements of the plants when determining their location in your garden.
4. Incorporate walkways or stepping stones into your garden design so that students can explore the entire garden without damaging the plants.
5. You may want to include flat stones in sunny areas for butterflies to bask in the sun and a damp area and/or a puddle for butterflies to obtain mineral salts from the ground.



Butterfly-shaped butterfly garden at Brown Summit Elementary School

Choosing plants for your butterfly garden

To attract as many butterflies, moths, and other insects as possible, your garden will need to have nectar plants and host plants that are native to your area. Nectar plants provide butterflies with a source of food. Host plants provide butterflies with a place to lay eggs and are a source of food for caterpillars. Some species of plants serve as both nectar and host plants. Most of the plant recommendations below are native to North Carolina and many other Eastern states.



Great spangled fritillary on purple coneflower

PLANT SPECIES	SIZE	BLOOMS	FLOWER COLOR
black-eyed susan (<i>Rudbeckia sp.</i>)	24–30 inches	mid-summer thru fall	yellow
butterflyweed* (<i>Asclepias tuberosa</i>)	24–30 inches	mid to late summer	orange
cardinal flower (<i>Lobelia cardinalis</i>)	3–4 feet	summer into fall	red
swamp milkweed* (<i>Asclepias incarnata</i>)	30–40 inches	mid to late summer	pink
goldenrod (<i>Solidago sp.</i>)	28–60 inches	late summer, fall	yellow
purple coneflower (<i>Echinacea purpurea</i>)	18–30 inches	summer into fall	pink
New England aster* (<i>Aster novae-angliae</i>)	3 feet	mid to late summer	purple
joe-pye weed (<i>Eupatorium sp.</i>)	5–9 feet	summer into fall	pinkish purple
ironweed (<i>Vernonia sp.</i>)	3–7 feet	summer into fall	purple
coreopsis (<i>Coreopsis sp.</i>)	1–2 feet	spring into summer	yellow
phlox (<i>Phlox sp.</i>)	1–4 feet	spring	pink, purple, white
butterfly bush (<i>Buddleia sp.</i> non-native)	4–8 feet	summer into fall	blue, purple, pink, white

Table 2.1 Nectar plants. * indicates species that is both host and nectar plant.

While butterflies obtain nectar from many different plant species, they can be very particular about where they lay their eggs. For many species of butterflies, only certain plants will work as host plants for their eggs and larvae. Table 2.2 contains host plant suggestions.



Black swallowtail caterpillar

BUTTERFLY	PREFERRED HOST PLANTS
American lady	everlasting, pussytoes, cudweeds (all are plants common to grassy areas and disturbed sites)
black swallowtail	parsley family (dill, parsley, carrots, fennel, Queen Anne's lace)
buckeye	snapdragon, plantain, purple gerardia
cloudless sulphur	wild senna (<i>Cassia sp.</i>)
monarch	milkweed family
pearl crescent	aster species
red-spotted purple	black cherry*, willow*
silver-spotted skipper	black locust*, beggar's ticks (<i>Desmodium sp.</i>), wisteria
spicebush swallowtail	sassafras*, spicebush
Eastern tiger swallowtail	black cherry*, tulip poplar*

Table 2.2 Common butterflies and their preferred host plants. * indicates tree species

Planting your garden

Try to plant your garden in the fall. Plants put in the garden in the fall require less watering and have more time to establish roots before facing the heat of summer. If you plant in the spring, plant early and be prepared to water the plants frequently during the first few months.

Materials you may need

- shovels, hoes, garden carts
 - landscape cloth as a weed control cover (optional)
 - organic rich topsoil or organic matter
 - border material (optional)
 - organic mulch
 - stepping stones (optional)
 - seeds and/or plants
 - plant labels
1. Go to your site, outline the shape of your garden, and then use one of the methods described below to make the site as weed-free as possible. Select the method that best fits the time available to you and the type of ground cover present on the garden site. Either use a shovel or a tiller to turn the soil to a depth of at least six inches and remove clumps of grass and other plants; or cover the area with black plastic for about two months to kill the ground cover. *Note: The Museum discourages the use of herbicides, but if you find*

them necessary to eliminate particularly aggressive weed species, look for a product that breaks down rapidly in the environment.

2. Cover the garden area with at least six inches of organic rich topsoil or mix organic matter several inches into your existing soil. Remove all debris, sticks, rocks, litter, etc. from the soil. *Note: For large gardens, it is usually cheaper to buy topsoil and other organic matter by the truckload rather than in individual bags.*
3. Make narrow access walkways throughout the garden using stepping stones or mulch, then plant seeds or plants following the directions on the seed package or nursery information. If your plan calls for host trees, plant these near the garden, not in it.
4. Cover the entire garden with at least a two-inch layer of mulch to discourage weeds and keep moisture in the soil. *Note: Inexpensive or free sources of organic mulch may include your local power company or your city or county solid waste management department.*
5. Place plant labels next to each plant. Labels help prevent accidental weeding and are excellent educational tools.
6. If your butterfly garden is surrounded by lawn, put a six to twelve-inch-wide strip of mulch along the outside edge of the garden next to the grass to make mowing around the garden easier.

7. Water the plants frequently during the first few months.

Maintaining your garden

Make sure that you work with maintenance staff to work out the details of maintaining the garden year-round.

- Water plants as needed. Remember to arrange for watering during school vacations.
- Do not use pesticides. They are poisonous to caterpillars and butterflies.
- Manually weed as needed to keep the garden looking good and to keep aggressive weeds from crowding out young plants. Be sure to weed the garden prior to summer vacation and, ideally, a few times during the summer.
- Add mulch to your garden every year. Mulch helps inhibit the growth of weeds, conserves soil moisture and temperature, and adds organic material to the soil as it decomposes.
- If your garden has one, replenish the mulched mowing strip at the edge of the garden each year.
- If you plant a host tree near your butterfly garden, such as black cherry or sassafras, crop it back each year to keep it small and bushy.

Butterfly Garden Neighbors

1. To attract the greatest number and variety of butterfly species, be sure to provide both nectar plants like **asters** and **joe pye weed** and host plants like **milkweed** in your garden.

2. Look for **black swallowtail larvae** on parsley, dill, fennel, and **Queen Anne's lace**. Don't be fooled—like many caterpillars, these larvae undergo dramatic changes in appearance (e.g., size, color pattern) as they grow.

3. Caterpillars can be raised outdoors in a simple **homemade cage** made from wire (tomato cage works well) and window screen. Replenish host plant cuttings as needed.

4. A **mulched path** on the outside edge of raised beds reduces maintenance chores.

5. **Stepping stones** and/or paths make access easy for students and create ideal basking spots for lizards like the **five-lined skink**, butterflies, and other animals.

6. **Purple coneflowers** and **black-eyed Susans** provide nectar and pollen for insects and seeds for birds like the bright yellow **goldfinch**.

7. **Silver-spotted skippers**, a common sight on school grounds, are characterized by their rapid, darting flight, and by pointed or hooked knobs on their antennae.

8. Nectar sources planted in masses attract more butterflies and hummingbirds. Orange and red flowers like **cardinal flower** are particularly attractive to **hummingbirds**.

9. Nectaring **bumble bees** and wasps are generally non-aggressive and, if left alone, will not bother viewers. They also are important pollinators for the garden.

10. **Ladybugs** and lacewing larvae help control aphids on plants.

11. Butterflies (especially males) congregate at damp spots in the garden such as at the edge of **mud puddles**. This puddling behavior is believed to be important for the absorption of essential salts and minerals needed for reproduction.

12. **Plant labels** help students learn about different species and to avoid accidentally weeding desirable plants.

13. **Benches** provide places to make and record observations.

14. The **clearwing moth**, seen feeding on **coral honeysuckle**, is a day-flying moth that is often mistaken for a hummingbird.

15. **Goldenrod galls** are round swellings on the stems of goldenrod caused by the goldenrod gall fly. The female fly lays an egg in the stem, causing the plant cells to alter their growth and form the characteristic swelling. The gall serves as both shelter and food for the developing larva.

16. A rolled-up **sassafras** or spicebush leaf, usually indicates the presence of a **spicebush swallowtail caterpillar**. The larva's distinctive false eye spots may be a deterrent to predators.

17. Butterfly caterpillars form chrysalids which come in a variety of shapes, sizes, and colors. Most are camouflaged for protection from predators. Moth larvae like this **luna moth caterpillar** create cocoons in which to overwinter.





Butterfly garden teaching tips

Where to look

Look for butterflies near flowering plants, in fields, along woodland edges, on moist stream banks, or near rotten fruit. Look for caterpillars on their host plants. Chewed leaves and droppings (frass) are good clues to the presence of feeding caterpillars. Oftentimes, caterpillars found crawling on the ground have already completed their feeding stage and are searching for a place to pupate.

When to look

Many butterflies are seen April–October, and certain species, such as monarchs, are more likely to be seen during certain months. A few species overwinter as adults and may be seen on warm, sunny days even in December and January. The best times to look for butterflies are mid-morning to late afternoon on warm, sunny days. One of the best times to find a variety of caterpillars is August through September—a great activity for the beginning of the school year. Many species of caterpillars found in the fall may overwinter as pupae and emerge the following spring.

Materials you might use

- butterfly nets
- hand lenses, bug boxes
- field guides (see Resources and References for suggestions)

- containers for raising caterpillars: plastic box, paint strainer, indoor/outdoor caterpillar cage (see Appendix B for instructions)
- emergence cage (see Appendix B for instructions)
- monarch tagging kit (see Resources and References for source)

Suggested activities

1. Identify the butterflies that visit your garden. Have students make five observations such as color, patterns, wing shape, antennae, etc., before they refer to field guides to identify their butterfly.
2. Observe and record what butterfly species visit what type of flower. Do different species seem to have preferences?
3. Capture butterflies using a butterfly net. Use a sweeping motion and then flip the net to capture the specimen in the tip of the bag. Gently reach in and grasp the butterfly on the thorax or the leading edge of the wings and remove it from the net. After observing the butterfly or moth, return it to its habitat.
4. Have your students keep a checklist of butterflies and moths on your school grounds as a way of learning the common species.
5. Participate in Monarch Watch, an international program that tags monarch butterflies to monitor their southward migration.
6. Participate in Journey North, an international Internet-based project where students link to each other and to scientists to track migration of various animals including butterflies.
7. In the spring and fall, take compass readings to determine the flight paths of observed monarchs.
8. Preserve butterflies that you find dead from road kills, predators, or other causes. For safe storage and observation, place specimens in Riker mounts (available from biological supply houses).
9. Observe any caterpillars you see. Record what plants they are feeding on. Make illustrations of caterpillars and record their behaviors. Identify the species and find a picture of the adult butterfly or moth.



Study monarch migration by participating in the Monarch Watch tagging program.

10. To raise and observe a caterpillar in its natural environment, create an outdoor cage from screen (see Appendix B for instructions) or tie a mesh bag (e.g., latex paint strainer) around a host plant. While it is in the cage, you can quantify how much plant material is eaten each day by the caterpillar (e.g., number of leaves, weight, surface area), measure the growth of the caterpillar, record how long it takes to pupate, and watch it emerge as a butterfly.
11. To help with maintaining the garden, create a “weed book” for your students by making photocopies or digital images of known garden weeds. Instruct students (especially young children) to pull plants that look like the ones in the book. This will lessen the chances of pulling plants you want to keep.



Indoor/outdoor caterpillar cage (see Appendix B)



Emergence cage (see Appendix B)

Tips on raising caterpillars in your classroom

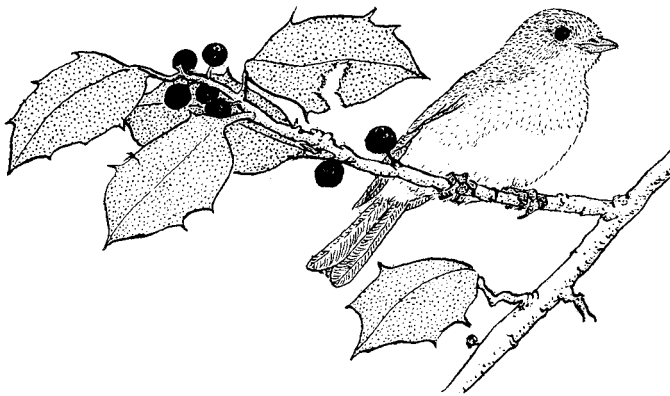
- Raise and release species that you collect from your garden or other local areas. Butterflies and caterpillars purchased from supply houses should not be released.
- Obtain the appropriate type of host plant for each species of caterpillar. Identify your caterpillar and find some leaves of its host plant. If you find a caterpillar feeding on a plant, take some leaves from the plant when you collect the caterpillar.
- Place the caterpillar in a ventilated container. This can be a plastic box with air holes cut in it, a glass aquarium with a screen top, or a net or screen cage.
- If the container is big enough, put cuttings of the host plant in a water-filled milk jug, vase, or jar. Otherwise, keep the leaves moist and replace with fresh leaves as needed. Protect caterpillars from drowning by covering the top of the jar with foil, crumpled paper, or some other lid.
- Have students record the date and time of each metamorphosis event in a log book.
- When the adult butterfly emerges from its pupa, release it in your butterfly garden.

Note: Species that pupate in the fall need to be kept outside to experience the correct temperature and humidity over the winter. Pupae brought indoors frequently dry out or emerge too early

Bird Observation Stations

*“My students looked forward to monitoring the bird boxes and were surprised how quickly the life cycle was displayed. On Monday mornings during the spring they were **particularly curious** to see what nesting activity and development had taken place over the weekend. A ‘bird update’ became a natural extension to our morning circle time.”*

Iris Meekins
Kindergarden teacher



Watching birds is one of the leading nature-oriented pastimes in America. And no wonder—birds are easy to attract to your yard or school ground, have interesting behaviors you can easily observe, and have unique and beautiful songs. Birds can be found almost anywhere—from urban settings to rolling countryside—and are present in all types of weather. Over the course of a school year, many bird species will remain (although they may change color with age and season), while others will come and go with seasonal migrations. Most birds are active during the day, which makes observing them during school hours possible. All you

need to do to enjoy them is to provide the right habitat.

Choosing a site

Bird observation can be done anywhere on most school grounds, but some locations are better suited than others. Since it is often difficult to approach birds closely with a group of students, your bird observation station should be located near classroom windows or should include a bird blind, both of which provide students the opportunity to observe the birds without disturbing them. To make the area attractive to birds, your station should have



Students at bird observation area, East Clayton Elementary School

bird feeders, native plants that provide food, a water source, and nearby cover such as a brush pile or evergreen plants. Often some of the best birding areas are at the edges of school grounds where open spaces meet woodland edges or brushy areas. These natural edge habitats attract a variety of bird life and can be ideal locations to create bird observation stations.



Northern cardinal



Red-bellied woodpecker feeding on sumac



Eastern bluebird

Food plants

It is essential to have native plants and trees in and around your bird observation station. Not only do plants and trees provide birds with nesting sites and cover from predators, but they also provide birds and other wildlife with a reliable food source. Plants and trees do not require much maintenance and, in the long term, will make the area look more natural.



Fruit of plants such as American holly provide excellent food for birds.

PLANT TYPE	SPECIES
vines	wild grapes (<i>Vitis</i> sp.), Virginia creeper (<i>Parthenocissus quinquefolia</i>), greenbriar (<i>Smilax</i> sp.)
evergreen shrubs	wax myrtle (<i>Myrica cerifera</i>), gallberry (<i>Ilex glabra</i>)
deciduous shrubs	viburnum (<i>Viburnum</i> sp.), elderberry (<i>Sambucus canadensis</i>), sumac (winged, smooth, and staghorn) (<i>Rhus</i> sp.), beautyberry (<i>Callicarpa americana</i>), blueberries (<i>Vaccinium</i> sp.), deciduous holly (<i>Ilex decidua</i>), strawberry bush (<i>Euonymus americanus</i>), blackberries (<i>Rubus</i> sp.), spicebush (<i>Lindera benzoin</i>)
evergreen small trees	yaupon (<i>Ilex vomitoria</i>), American holly (<i>Ilex opaca</i>), red cedar (<i>Juniperus virginiana</i>)
deciduous small trees	persimmon (<i>Diospyros virginiana</i>), serviceberry (<i>Amelanchier</i> sp.), flowering dogwood (<i>Cornus florida</i>), sassafras (<i>Sassafras albidum</i>), black cherry (<i>Prunus serotina</i>)
evergreen large trees	live oak (<i>Quercus virginiana</i>), pines (<i>Pinus</i> sp.)
deciduous large trees	American beech (<i>Fagus grandifolia</i>), oaks (<i>Quercus</i> sp.), hickories (<i>Carya</i> sp.), sweetgum (<i>Liquidambar styraciflua</i>), hackberries (<i>Celtis</i> sp.), red mulberry (<i>Morus rubra</i>), black gum and related species (<i>Nyssa</i> sp.)

Table 3.1 Native North Carolina plants that provide birds with food and shelter.

Bird feeders

One of the simplest ways to attract birds is to set up a variety of feeders. Different types of feeders and food attract different species of birds. Feeder placement can be used to concentrate birds in a particular area (e.g., in front of a bird blind or classroom window). If you include feeders in your station, remember to consider strategies for keeping the feeders filled and to include the cost of replacement seed in your budget.



Male goldfinch at tube feeder

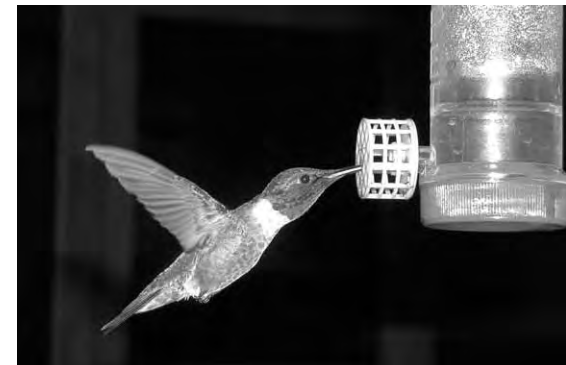
TYPE OF FEEDER	BIRDS ATTRACTED	TYPE OF SEED
tube feeders	small perching birds (e.g., chickadees, finches, titmice)	black oil sunflower seeds, thistle seeds
platform feeders	cardinals, finches, jays, sparrows, chickadees, titmice, and many others	any kind of seed, sunflower seeds, fruit
seed on the ground	sparrows, doves, juncos, towhees	millet, cracked corn, mixed seed
suet feeders	woodpeckers, nuthatches, wrens, chickadees, titmice, mockingbirds, pine warblers, yellow-rumped warblers	suet, peanut butter

Table 3.2 Different types of bird feeders and some of the birds they attract.

Attracting hummingbirds

One of the highlights of any wildlife garden is the appearance of the first hummingbird of the season. Ruby-throated hummingbirds are the most common species found throughout the Eastern United States. However, recent data shows occasional sightings of rufous hummingbirds and other wayward migrants. The peak period of ruby-throated hummingbird activity in North Carolina is from April through September. They are easy to attract by planting a variety of nectar plants (ones with red or orange tube-shaped flowers are preferred) and by setting up hummingbird feeders filled with a sugar-water solution. Feeders come in a variety of shapes and sizes and are also easy to construct from plastic drink bottles (see Appendix

B for instructions). Due to the aggressive territorial behavior displayed by hummingbirds at feeders, place feeders at various locations around your property.



Male ruby-throated hummingbird at feeder

Recipe for hummingbird food

1 part sugar

4 parts water

Boil sugar solution for two to four minutes. Stir to dissolve sugar. Cool solution. Fill feeder with sugar solution. Empty and refill feeder every few days in warm weather or as needed.

Water

A reliable water supply, especially in winter, can attract birds and other wildlife to schoolyards as effectively as food. A birdbath is an easy and inexpensive addition to your bird observation area.

- Birdbaths can be as simple as a flower pot saucer on the ground or a shallow depression lined with plastic. Other models hang from trees or sit on pedestals.
- Some birdbaths can be too deep for certain songbirds. An easy way to accommodate all potential bathers is to place flat rocks or bricks in the bath to create varied depths. An ideal depth range for most species is 3/4 inch to 1 1/2 inches.
- Place the birdbath two to three feet from cover. You want to provide the birds with a means to escape predators, not a means for predators to ambush the birds.
- Birds are attracted to moving water. Commercially available drip systems or misters can add motion to your birdbath.

PLANT SPECIES	HEIGHT	BLOOMS	FLOWER COLOR
columbine (<i>Aquilegia canadensis</i>)	1–3 feet	spring	reddish pink
fire pink (<i>Silene virginica</i>)	1–2 feet	spring	red
cross vine (<i>Bignonia capreolata</i>)	vine	spring	orange or maroon
red buckeye (<i>Aesculus pavia</i>)	small tree	spring	red
coral honeysuckle (<i>Lonicera sempervirens</i>)	vine	spring and fall	red
salvia (<i>Salvia</i> sp.)	2–4 feet	spring into fall	various
cardinal flower (<i>Lobelia cardinalis</i>)	3–4 feet	summer into fall	red
turtlehead (<i>Chelone</i> sp.)	2–3 feet	summer into fall	pink or white
bee-balm (<i>Monarda didyma</i>)	2–5 feet	summer	red
jewelweed (<i>Impatiens</i> sp.)	2–5 feet	summer into fall	orange or yellow

Table 3.3 Native North Carolina nectar plants that attract hummingbirds.

- During freezing weather, break up ice and replenish as needed with fresh water or install a commercially available birdbath heater. Some birdbaths have built-in heaters. You

can also paint the bowl of the birdbath with black latex paint to help it absorb heat from the sun's rays. *Note: Ceramic bird baths may crack during freezing weather.*

Shelter

Birds are vulnerable to attack when visiting bird feeders or birdbaths that are in the open. Make sure your bird observation station is a safe place for birds by planting cover and installing perches near feeders and baths. Examples of cover include clumps of thick vegetation, evergreen plants, and brush piles constructed of fallen branches. Structures on which birds can perch while they wait their turn at a feeder or bath are also very important. Poles with multiple horizontal branches, or for a more natural look, small dead trees make excellent perches.

Places to raise young

Bird nests are distinctive in their construction and placement and can be used to identify nesting species in your area. Some birds, such as killdeer, nest on the ground while many others, such as robins and hummingbirds, build their nests in trees, bushes, or shrubs. Tree cavities are used by birds such as bluebirds and woodpeckers. To attract and encourage birds to build nests and raise their young in or around your bird observation station, make sure it contains a variety of potential nesting areas, from trees, both alive and dead, to bird houses.

Many species of birds that normally nest in tree cavities can be enticed to use bird houses if the houses have the proper dimensions and are located in suitable habitat. Common birds that



A teacher and students carefully monitor a bluebird nest.

readily use bird houses include Eastern bluebirds, house wrens, Carolina chickadees, tufted titmice, tree swallows, Eastern screech owls, barred owls, great crested flycatchers, house sparrows, and European starlings. These last two are introduced species that can outcompete native species for nesting habitat. If house sparrows or European starlings occupy bird houses on your site, we recommend relocating the boxes further from buildings or removing the boxes altogether.

Here are some tips for effective bird houses:

- Bird house dimensions, from overall size to entrance hole diameter, can be very specific for different species. Small birds usually will not nest in boxes if the entrance hole can accommodate larger species. See Resources and References for references on bird house design.
- Put a few drainage holes in the floor to allow drainage of rain water that may enter.
- Ventilation holes at the top of the sides are important to keep birds from overheating.
- Put houses on metal poles to minimize risk of nest predation or use predator guards.

Bird blinds

An effective way to observe birds on your campus is to create a bird blind. Blinds provide a visual barrier that allows viewers to quietly observe bird behavior without disturbing the birds. Several designs are available from deck and walkway style construction to post and fencing options.

The following instructions describe how to build and install a single 6 ft x 8 ft blind, which can be used by five or six students at a time. To accommodate larger groups, install several sections side by side.

Materials:

- one 6-foot (H) × 8-foot (W) section of privacy fencing or five 1-foot × 8-foot planks
- wood screws or lag bolts
- two 8-foot long 4-inch × 4-inch treated posts
- post-hole digger
- bag cement
- carpenter's level
- drill with 1-inch bit or 1-inch hole saw

Procedure:

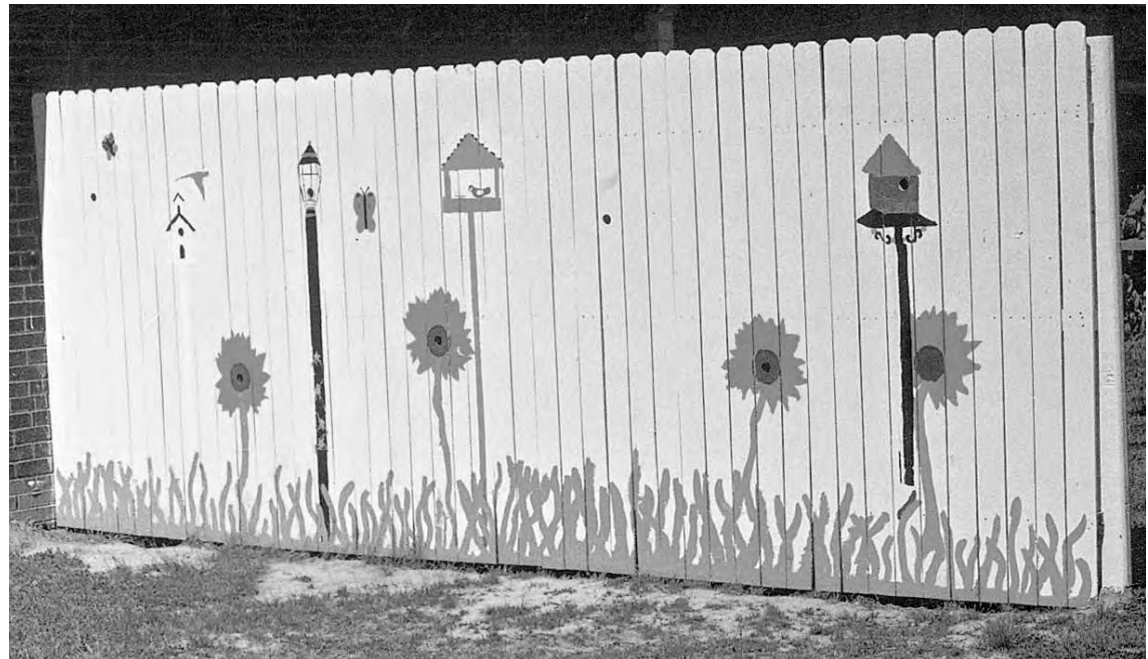
1. Depending on the materials you have chosen for your blind, do one of the following:
 - Secure a section of privacy fencing to the posts using wood screws, leaving 18–24 inches of the poles free on the bottom.-or-
 - Secure 1-foot × 8-foot planks horizontally to the posts, leaving a 2–3-inch gap between the planks at student eye level and leaving 18–24 inches of the poles free on the bottom.
2. Lay the assembled blind flat on the ground where the blind is to be located. Mark where the post holes should be dug.
3. Dig two 18–24-inch deep post holes. Lift the assembled section into place and put posts in the holes. Fill the holes with cement. Use a level to make sure the posts are upright and straight.

4. If using privacy fencing, when the cement is dry, drill several 1-inch diameter peep holes in the fencing at different heights suitable for student use.

Maintaining the station

Once birds discover the resources in your bird observation station, they will continue to visit the area throughout the entire year, as long as you and your students keep feeders and bird-baths filled. Here are some tips for maintaining your station:

- Change the water in birdbaths every two to three days. This will help prevent mosquito larvae from hatching and excessive algae from growing. If the birdbath becomes dirty, use a scrub brush to remove algae and debris.
- Establish a schedule for filling feeders. You may need to adjust the schedule during different seasons.
- Monitor bird houses and remove old nest material when baby birds fledge. This will encourage renesting.



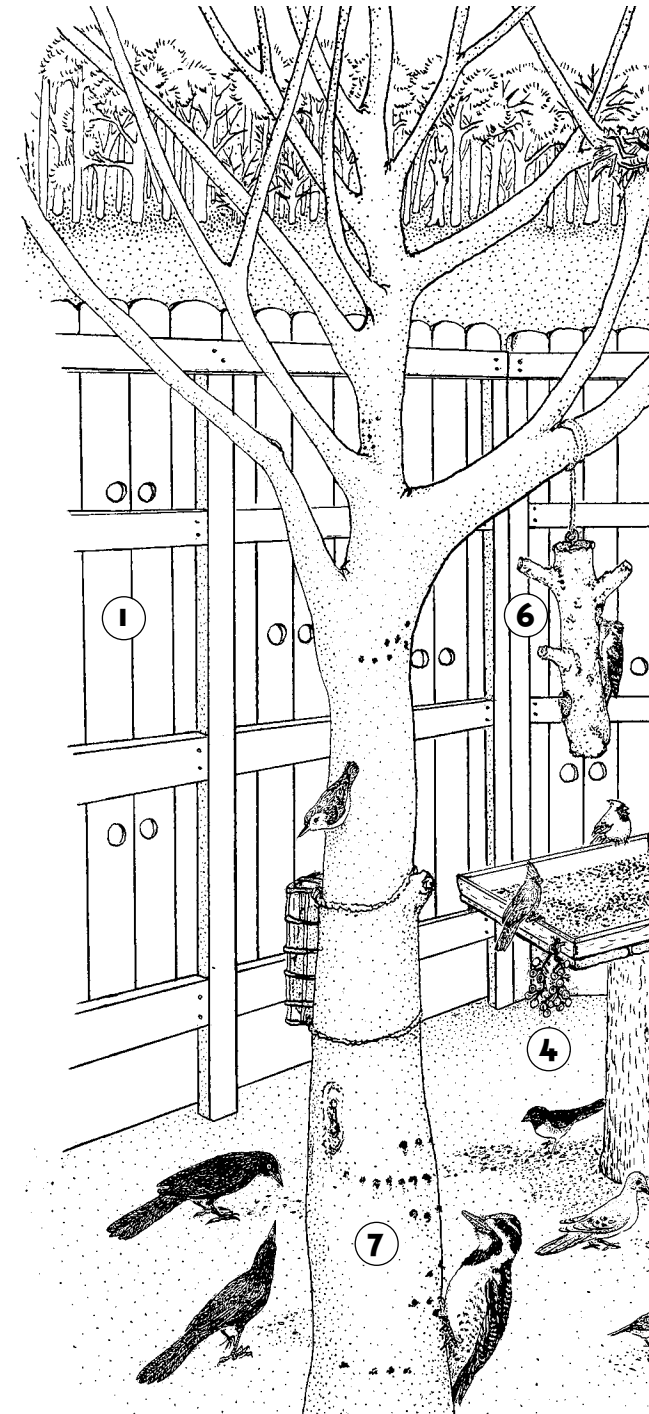
Bird observation blind at East Clayton Elementary School

Bird Observation Area Neighbors

1. A **bird blind** is a great help in making it easier to observe birds on your school grounds. Don't forget to create holes at different levels for easy viewing access.
2. To attract the greatest number of bird species, use a variety of feeder types (e.g., **platform feeders**, **hanging tubes**, **wire suet cages**, **suet logs**), food selections, and feeding station locations.
3. **Sparrows**, **mourning doves**, **juncos**, and several other species prefer to eat mixed seeds scattered directly on the ground or spread out on the tops of old **stumps**.
4. Increase the variety of food in your feeder by adding fruit like **grapes**, orange slices, and raisins to attract birds such as mockingbirds, orioles, and bluebirds.
5. Evergreens such as **wax myrtle**, **red cedar**, and **holly** provide excellent food and year-round shelter for birds and other wildlife. Deciduous species such as dogwoods, black cherry, and elderberry also provide nutritious fruit.

6. **Woodpeckers**, **nuthatches**, and several other insect-eaters are easy to attract using suet or peanut butter. A variety of feeder types can be used including wire cages, homemade suet logs, or pine cone feeders.
7. Look for the rows of feeding holes of the **yellow-bellied sapsucker** on trees. This woodpecker species is present throughout much of North Carolina from fall through early spring.
8. A small **dead tree** can be "planted" near feeding stations as a waiting station and as another "bird feeder." Drill a few shallow holes and fill them with peanut butter or suet.
9. Plastic **baffles** or **wire mesh cages** are two strategies to make feeders squirrel resistant.
10. Water is an essential component to any bird garden. It can be provided in simple **bird baths** (**flower pot saucers**) or miniponds. Water is particularly critical during freezing weather, so replenish supplies often.

11. Another way to increase the number of birds and other animals in your yard is to create or maintain a "**wildlife edge**", where one habitat type meets another.
12. **Brush piles** provide wildlife with needed cover and habitat especially in areas lacking sufficient natural vegetation.
13. **Bluebirds**, **screech owls**, and other bird species can be attracted with specific bird house designs.
14. Create simple seating (e.g., **wooden benches**, picnic tables) in natural areas to give students a place to journal, observe, or reflect
15. Leave **dead wildflower stalks** and **seed heads** in gardens during the winter to provide cover and seeds for birds such as **goldfinches**, juncos, and sparrows.





Bird observation station teaching tips

Birds tend to be most active early in the morning, late in the day, and before major weather changes. Look for increased activity at your feeders especially before the arrival of cold fronts and during blustery weather in winter. Good places to look for birds include feeders, water sources, prominent trees and dead branches, power poles and lines, fences, and natural edges (where different habitat types meet). Although the number of birds in a typical field guide may seem daunting to learn, only a small portion of the species listed in guides will be attracted to feeders.

When trying to identify a bird, look for a few key features. Think of it as being similar to identifying your students when viewed from across the school grounds—you can identify many of your students by their clothing, size, behavior, and voice, even at quite a distance. Bird identification uses the same principles—color and field marks, size, behavior, and song or call. Compare size with the size of a familiar bird (e.g., smaller than a robin or bigger than a chickadee). Be aware that colors may change over time as birds age or as a result of seasonal changes. Many birds, especially males, tend to be brighter during the breeding season.

Materials you may need

- *Golden Guide to Eastern Birds* and other field guides
- binoculars
- bird song tapes

Suggested activities

1. Watch birds feeding at feeders. Ask students to look for color, markings, beak shape, size, call, song, flight pattern, etc.
2. In early spring, fill wire suet feeders or plastic mesh produce bags with nesting material (e.g., straw, pieces of string, lichens, mosses, pet hair, feathers, bits of cotton, dryer lint) and hang from trees. Later, look for these materials in local nests.
3. Check bird houses periodically (no more than twice per day) and record observations on eggs and young. As nestlings approach fledging, reduce or eliminate observations so as not to cause them to leave the nest prematurely.
4. Observe bird behavior. Ask students to see who comes to the feeder first, who takes over, etc. Make a chart of observed feeding times (e.g., morning versus afternoon).
5. Put different kinds of seeds in different feeders and observe preferences. Keep a record of how many times a particular bird species comes to a feeder. Or use a stopwatch to see how long it feeds or how soon it comes again. Weigh or measure seed to determine preferences.



Students record observations at bird blind, Fairview Elementary School

6. Make your own video field guides by videotaping birds at bird feeders and include narration to identify them.
7. Make an audiotape of bird sounds. Have students write what they hear (e.g., a barred owl's call sounds like "who cooks for you").
8. Watch and record changes over time: which birds are seasonal, which live there the year around, what foods they eat at different times of the year, how their plumage changes, etc.



Using binoculars to observe birds at Fairview Elementary School

9. Make toilet paper tube binoculars by taping two tubes together and attaching a loop of string. This activity is a great way to practice looking for birds and to give a sense of adventure to young children.
10. Participate in national bird projects including:
 - Project FeederWatch
 - Journey North
 - International Migratory Bird Day
 - Audubon Society Christmas bird count

For information on getting involved in any of these projects, see Resources and References section.

Bringing the outdoors in

1. Set up bird feeders outside classroom windows and display student illustrations of common feeder birds inside classroom.
2. Study bird nests or other bird materials.
Note: An easily obtained permit from the North Carolina Wildlife Resources Commission is required to collect any bird material.
3. Examine owl pellets (available from several biological supply houses).
4. Keep a migration log book that tracks winter and spring arrivals and departures of species visiting your bird observation station.
5. Make life-sized bird silhouettes by projecting an image of a bird on the wall. Adjust the image until it is the approximate size given in a field guide. Trace the image onto a piece of paper and cut it out. The silhouette can be used as an identification aid or for other activities.
6. Make life-size color copies or drawings of common birds and mount to stiff backing. Place the “flat-birds” in appropriate habitat on school grounds and use as an identification activity.

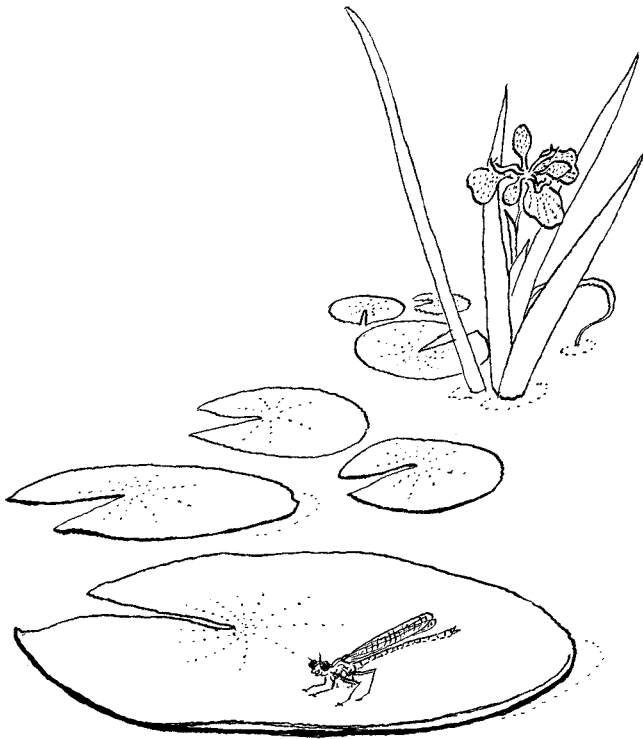


Students integrate art lessons into natural areas at Fairview Elementary School.

Miniponds

“My kids were fascinated by the wealth of life in our miniponds. After some close up observations and quiet reflection time around the pond, my students generated some of the most creative artwork they had produced all year.”

Donna Steigelman
first grade teacher



Reliable water sources are essential to wildlife and are often absent on school grounds. Miniponds provide drinking and bathing water for birds and mammals; offer critical habitat for amphibians, reptiles, and insects; and provide a place for a variety of aquatic plants to grow. Schoolyard miniponds provide accessible natural habitats where students can study the habits and life cycles of native aquatic plants and animals, and can explore the critical role of water for all living things.

Choosing a site

Your minipond site should be:

- Level.
- Visible to student traffic so students, parents, and teachers can see it during their daily activities.
- Within reach of a garden hose so the pond can be refilled periodically.
- Where it will receive at least four hours of sun daily.
- Not directly under trees to minimize the need for removing fallen leaves.
- Not where the land slopes down to it on all

sides. You do not want your pond to receive runoff from the surrounding ground, especially if the ground is mostly lawn that contains fertilizer and pesticides. Excessive amounts of fertilizer can lead to nuisance algae blooms.

With a few sites in mind, check with your principal about the location of existing underground utilities and future building plans. Also check local safety ordinances, which may regu-

late items such as fencing, maximum water depth, or other safety issues.

Choosing a type of pond

Miniponds can vary greatly in size and materials. The two most common materials used to create miniponds are preformed plastic pools and flexible pond liners. Both types of materials have advantages and disadvantages.



A diverse water garden habitat

Preformed plastic pools

Preformed pools designed specifically for miniponds are available at garden centers, but any plastic container such as a concrete mixing tub, a wading pool, or a cattle drinking trough will work.

Advantages:

- easy to install
- less likely to be punctured
- ideal for school grounds that do not have much room
- can use small containers that sit above ground

Disadvantages:

- tend to be more expensive
- more difficult to achieve a natural look
- limited design options

Flexible pond liners

Advantages:

- can make a pond just about any size and shape you want
- less expensive per unit area

Disadvantages:

- a little more complicated to install
- more likely to develop leaks over time (which can be patched with kits available where liners are sold)
- If your site's soil has a high clay content and does not drain well, water may get under the liner during heavy rainfall and raise the liner, emptying the pond.

Installing your minipond

After you have decided on the location of your minipond and what type of pond to build, you are ready to begin construction.

Installing a preformed plastic pool

Materials

- preformed plastic pool
- string, spray paint, or flour
- tools for digging
- sand
- large flat rocks for edging
- carpenter's level and long straight board

Procedure

1. Place the preformed plastic pool in the selected location and, using string, spray paint, or flour, outline the shape of the pool on the ground.
2. Remove the pool and dig a hole slightly larger than the outline. If your pool has multiple depths, be certain the hole you dig conforms to those depths.
3. When you reach the proper depth(s), remove any rocks or roots and level the bottom of the hole. Add a one to two inch layer of sand to the bottom of the hole to help make leveling the pool easier.
4. Place the pool in the hole and begin to fill in with soil around the outside edges.
5. Place a carpenter's level on a straight board

laid across the top of the pool to confirm that the sides are level. If the pool is not level, adjust the placement of the pool until the sides are level.

6. Finish filling in soil around the edges, checking frequently to be sure that the pool remains level.



A simple container water garden using preformed tubs

7. Place large flat rocks slightly over the edge of the pool to make your pond look more natural. Make sure all rocks are stable to avoid tripping students when they visit the pond.



Inexpensive water garden using multipurpose plastic tub, Hardin Park Elementary School

Installing a flexible pond liner

Materials

- commercial pond liner

Use the following formula to determine the amount of liner your pond will need:

width of liner = maximum pond width +
 $2(\text{maximum pond depth}) + 1$

length of liner = maximum pond length +
 $2(\text{maximum pond depth}) + 1$

example: A 4-foot \times 6-foot pond with a
maximum depth of 1.5 feet will require an
8-foot \times 10-foot pond liner.

width of liner = $4 + 2(1.5) + 1 = 8$ feet

length of liner = $6 + 2(1.5) + 1 = 10$ feet

- string, spray paint, or flour
- tools for digging
- carpenter's level and long straight board
- sand, newspaper, or old carpet
- bricks or small flat stones
- large flat rocks
- scissors

Procedure

1. Go to the site selected for your minipond and outline the pond's shape on the ground using string, spray paint, or flour.
2. Begin digging at the edges of the outline and work your way in toward the center.
3. As you dig, create a shallow shelf around the entire edge of the pond that is wide and

deep enough to hold a single layer of bricks or rocks. These bricks (or rocks) will be used to help hold the liner in place.

4. Continue digging until you reach the depth(s) you want. By creating different depths in your pond, you can increase the pond's habitat diversity.
5. Clear the bottom of the hole of anything that could puncture the liner.
6. Make sure the sides of the pond are level by placing a carpenter's level on a straight
7. Cover the bottom and sides of the hole with one to two inches of sand, several layers of newspaper, or an old carpet to cover any roots or rocks that may make their way to the surface and puncture the liner.
8. Place the pond liner in the hole.
9. Secure the liner by placing bricks or rocks on the shallow shelf around the inside



Water garden with a pond liner. An excellent border of large, flat stones provides sturdy, safe student access for aquatic studies at Knightdale Elementary School.

perimeter of the pond and then folding the liner back over the top of the bricks. Lay large flat rocks around the edge of the pond, making sure that these rocks cover the bricks. This system secures the liner, helps the pond look natural, and provides a surface where students can observe the pond. Make sure all rocks are stable and do not pose a tripping hazard.

10. Trim excess liner with scissors and discard.

Completing your minipond

1. To make your pond more useful to all forms of wildlife, be sure to provide access between the water and the land in the form of a large rock, a water-soaked log, or another kind of ramp. Access ramps can also help prevent the drowning of small creatures that might accidentally fall into the pond, such as baby birds.
2. Fill the pond with water. If necessary, chemically treat the water to remove chlorine or chloramines, which are added by some water treatment plants. These chemicals can harm aquatic animals. Your local aquarium, pet center, or garden store should have information on what treatment will be the most effective.

3. Allow the water to sit for a day before adding any living organisms.

4. It is not uncommon for new miniponds to experience algae blooms. As soon as some aquatic plants become established in your pond (see next section for planting suggestions), they will compete with algae for nutrients and help control algae.

5. A proper balance of plants and animals will maintain your pond's nutrient and oxygen levels. If your pond has this balance, it will not require additional filtration or aeration

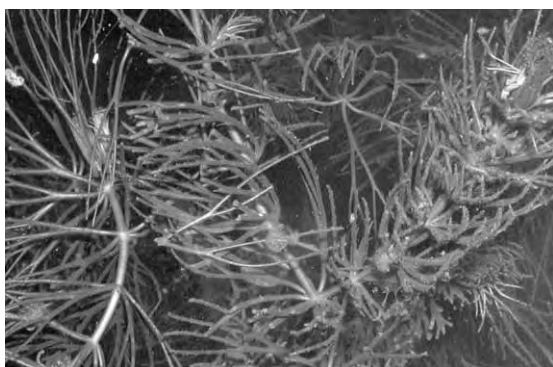
systems. However, if you decide to include either of these systems in your pond, you will need to provide a power source to the site (either electrical or solar) and plan for the additional maintenance that these systems require.



Water gardens can be incorporated into other learning areas, such as this butterfly garden at Wake Forest Elementary School.



Blue flag iris, an emergent aquatic plant



Hornwort, a submerged aquatic plant



White water lily, a surface aquatic plant

PLANT TYPE	EXAMPLES
emergent	blue flag iris (<i>Iris versicolor</i>), pickerel weed* (<i>Pontederia cordata</i>), duck potato (<i>Sagittaria</i> sp.), arrow arum (<i>Peltandra virginica</i>), cardinal flower (<i>Lobelia cardinalis</i>), horsetail* (<i>Equisetum</i> sp.)
surface	white water lily (<i>Nymphaea odorata</i>), water shield (<i>Brasenia schreberi</i>), yellow pond lily (<i>Nuphar</i> sp.), bladderwort* (<i>Utricularia</i> sp.)
submerged	hornwort (<i>Ceratophyllum</i> sp.), anacharis* (<i>Elodea</i> sp.)

Table 4.1 The examples listed are native to many areas. Plants marked with an asterisk (*) grow rapidly and need to be thinned regularly.

Minipond plants

Plants play an important role in maintaining a healthy minipond. They absorb carbon dioxide and excess nutrients, produce oxygen, and help regulate water temperature by providing shade. Plants help control nuisance algae blooms and provide hiding places for aquatic creatures.

There are three basic growth forms of aquatic plants: emergent, surface, and submerged. Emergent plants are rooted in a pot or in the bottom of a pond and have stems and leaves that stick out above the surface of the water. Surface plants have leaves that float on the surface of the water and may or may not have buried roots. Submerged plants are not rooted in any substrate and float in the water column.

Adding plants to your minipond

- To start a small pond use one or two emergent plants, some submerged plants, and at least one type of surface plant. Be sure to leave a third to a half of the water surface free of vegetation so that submerged plants receive sunlight and so that you can observe animals.
- Put emergent and surface plants into pots filled with good garden topsoil and topped with a layer of gravel or small rocks to keep the soil from dispersing into the water. To put pots in the pond, first saturate the soil with water to get rid of air pockets and then place them into the pond.
- Most emergent plants grow best if placed so that the tops of their pots are at or just below



Spotted salamander larva



Water strider



Green frog on lily pad

the water surface. Use objects such as bricks, rocks, or inverted flower pots under the plants to get them to the proper height. Pots for surface plants can sit on the bottom of the pond.

Minipond animals

“Build it and they will come” could be your motto if you start your minipond as a balanced system. Amphibians and aquatic insects will come to live or lay eggs in your pond. Your minipond may also be used as a drinking and bathing spot for birds and small mammals. Establishing a natural area nearby that includes cool, moist hiding places for amphibians such as salamanders and toads will allow these animals to utilize the habitat throughout all stages of their lives.

If you don’t want to wait around for animals to find your pond, you can add some.

You may want to add:

- pond water: Add a bucket of water from a local pond to help stock your minipond with all sorts of aquatic organisms such as insects, pond snails, tadpoles, and microscopic organisms.

You should not add:

- fish: Fish can create nutrient and algae problems for your pond, and they will eat many of the other interesting aquatic creatures. If you want a pond with fish, start a second pond. Keep one with fish and the other without. Have students compare the diversity of life supported by each pond.
- crayfish: Although crayfish are generally considered to be scavengers, in a small pond they may prey upon other animals and eat plants.
- turtles: Miniponds are usually too small to provide adequate turtle habitat.
- any animal not native to your county: This includes animals from pet stores, supply houses, or other sources.

Minipond neighbors

1. **Logs**, rocks, and native plants like **fire pink**, **green and gold**, and **Christmas fern** around your pond provide needed habitat for salamanders and other animals.

2. Emergent native plants like **blue flag iris** and **pickerelweed** contribute to the nutrient balance of your pond and provide vertical surfaces for emerging dragonflies, damselflies, and other aquatic insects.

3. Floating plants like the native **white water lily** provide shelter for aquatic animals and create shade, which helps inhibit the growth of algae.

4. Submerged plants like **hornwort** help maintain the balance of oxygen and nitrogen in your pond and provide cover for aquatic organisms.

5. **Water striders** are predatory insects that are often mistaken for spiders. They propel themselves on the surface of the pond with their long middle pair of legs.

6. New miniponds seem to magically attract **predaceous diving beetles** and other aquatic insects that fly in to colonize aquatic habitats.

7. **Fowler's toads** and other toad species lay eggs in jelly-covered strings that cling to vegetation.

8. **Damselflies** are smaller and more slender than dragonflies. When at rest, they hold their wings over their backs.

9. **Dragonflies** rest with their wings held at right angles to their body. They can be seen patrolling near ponds looking for prey. Males also patrol and guard sections of suitable mating territory.

10. **Dragonfly nymphs** have internal gills and breathe through their abdomens. They force water out of their abdomens to create a burst of "jet propulsion" as a means of escape.

11. One of the few salamander species that can coexist with fish is the **newt**. Newts are protected from predation by skin toxins.

12. **Aquatic snails** are important grazers of algae. Their numerous small clear **egg masses** are found attached to vegetation.

13. Always have a **ramp** (e.g., a water soaked log or flat rock) that leads from the water to the edge of the pond. This provides access to the water for birds like **blue jays** and may prevent other animals from being trapped in the water.

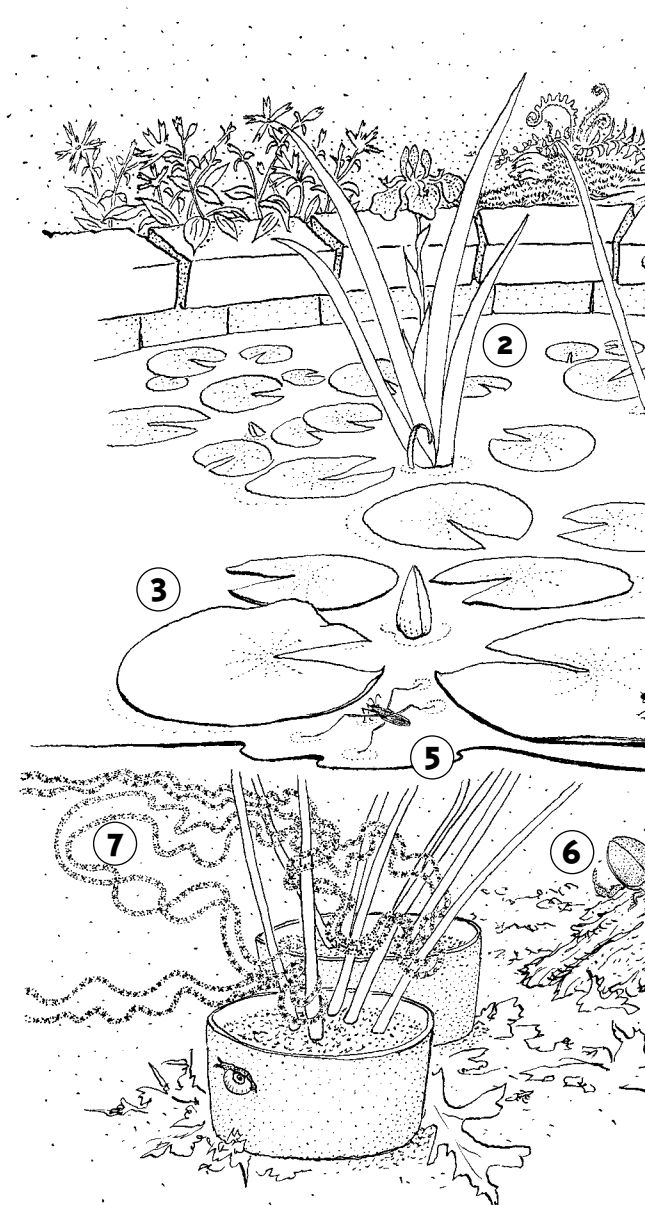
14. Miniponds should be designed with varying water depths for habitat diversity. Shallow **shelves** provide ideal places for aquatic plants.

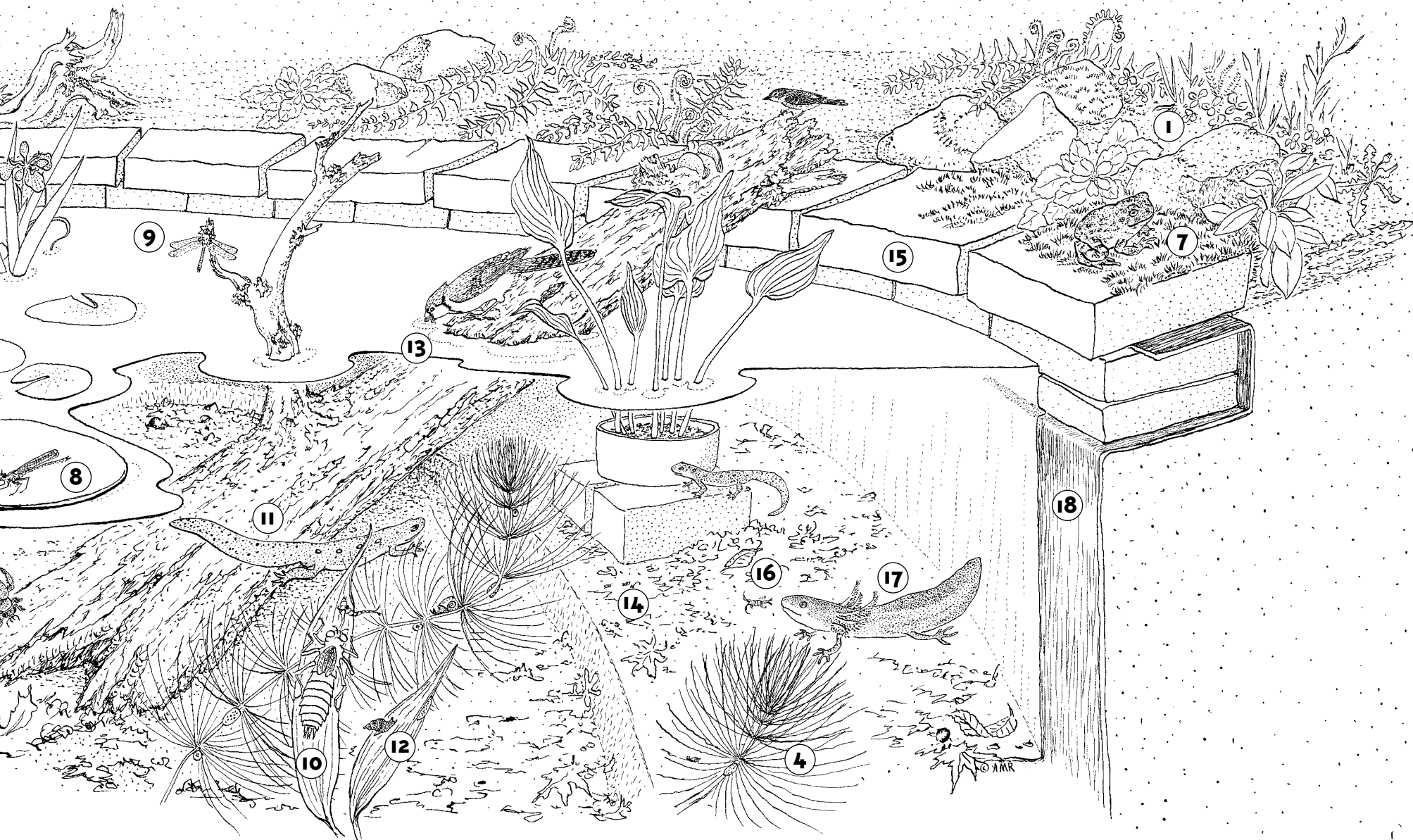
15. **Large flat rocks** around the pond provide easy and safe access for students.

16. Tiny invertebrates like **copepods** provide food for developing salamander larvae.

17. **Spotted salamander larvae** are sometimes mistaken for tadpoles. Salamander larvae have smaller heads in relation to body size, have external gills, and four small legs. They develop into terrestrial adults two to three months after hatching.

18. A thick **plastic liner** can be used to create a minipond. Fold the liner around a double layer of bricks and top with flat rocks to create a finished look.





Maintaining your minipond

Like any other nature neighborhood project, maintenance is important to keep your pond healthy, safe, and attractive.

- Maintain a log or inventory of what is in the pond, including any added plants or animals.
- In the fall, clean out most of the decomposing plant material. Be sure to leave a one- to two-inch layer of decomposing material on the bottom of the pond since this layer is important for overwintering aquatic life. Leaving too much decomposing organic matter in your pond may lead to the depletion of oxygen, which could kill animals in your pond.
- Periodically remove enough plants to keep a third to a half of the pond surface free of vegetation. Place the discarded plants in a compost pile. Do not dump them into streams or other bodies of water. Before composting, check removed plants for aquatic insects, amphibians, or other organisms.
- If necessary, control mosquitoes by using a commercially available bacteria mosquitoicide (available at most home and garden stores).
- If your pond develops a leak, empty the pond and locate the hole. Use a patch kit to fix the leak. Patch kits are available at garden centers and are easy to use.
- If a die-off of plants and animals occurs, drain your pond and start again. If possible, set the pool out to dry for a day or two and

scrub it out with a brush before refilling. Do not use detergents to clean the pool.

- Periodically divide aquatic plants by cutting through their root masses with a serrated knife. Repot the divisions and spread to other miniponds.

Minipond teaching tips

There is something magic about water.

Creating miniponds or other wetlands on your school grounds is one of the best ways to introduce your students to the wonders of the natural world. Part of the appeal is the surprises you find when you sweep a net through a pond and discover the teeming life beneath the water. Miniponds are great venues for teaching students about plant and animal life cycles and their interdependence.

Materials you might use

- log book
- dip nets (You and your students can make these with coat hangers and netting or sheer curtain fabric. Use dowels to make the handles longer.)
- *Golden Guide to Pond Life* and other field guides
- white plastic dishpans, styrofoam food trays, or other shallow white containers in which to observe organisms
- thermometers, pH test kit, measuring sticks



Preparing to set a potted pickerelweed into water garden

- underwater viewers (You and your students can make these using clear 2-liter plastic soft drink bottles. To make a viewer, cut the top off a clear soft drink bottle. Keeping the open end of the bottle above the surface of the water, place the bottom in the water and watch the pond life below.)



Students use homemade underwater viewers to observe pond life at Fairview Elementary School.



Using an aquarium net to sample aquatic organisms

Suggested pond activities

1. Observe aquatic animals on the surface of the water. To encourage observation, have your students answer questions such as, "What do you see?", "What is it doing?", "How does it move?", "What is it eating?", or "How does it breathe?" Have students or teams write or discuss three to five observations about a particular plant or animal before they use a field guide to identify it.
2. Observe, discuss, and record observations about underwater organisms using underwater viewers.
3. Catch and observe aquatic animals, such as insects, snails, and tadpoles, using dip nets and white plastic tubs. Before your students catch any organisms, make sure the tubs contain some water. Limit the amount of organic debris dumped into the observing tray to make it easier to see moving aquatic creatures. Have teams identify one of the animals in their tub and tell the group several interesting facts about it.
4. Have your students make a minipond field guide.
5. Compare water, air, and ground temperatures. Compare water temperature at the surface of the pond, at the bottom of the pond, and in the shade of a plant. Keep records and monitor temperature changes over the course of a day, a week, or a season.

6. Test and keep records of pH levels over a period of time. Because activities both in and out of the water can affect pH, keeping good records of what you do in and around the pond will help students develop hypotheses to explain any changes.
7. Make measurements of pond volume and surface area.
8. Study pond depth. Make measurements of pond depth over time. Relate changes in pond depth to rainfall and air temperature.
9. Study aquatic plants. Measure plant growth over time. Relate changes in plant growth rates to changes in pond temperature, pH, or depth. Observe and learn about aquatic plant reproduction and seed dispersal.
10. Look for amphibian eggs. Watch them daily to observe their changes as they grow into toads, frogs, or salamanders.
11. Observe toads and frogs that you find around your pond. Listen to their sounds, watch their behavior, and note their characteristics. Make an audiotape of frog and toad sounds.
12. Make a toad house by turning a flower pot upside down and using a rock or stick to prop up one side a few inches.

Bringing the outdoors in

1. Temporarily keep pond animals in an indoor aquarium. Record observations, draw pictures, and study life cycles.
2. Collect tadpoles from nearby ponds and raise them in an indoor aquarium. Be sure the aquarium has a lid and a place for emerging frogs to rest out of the water. Release them into your minipond when they have legs and begin to spend time out of the water.
3. Observe microorganisms from the pond under a microscope.
4. Place samples of pond water containing aquatic invertebrates in a clear dish on an overhead projector to view the invertebrates' silhouettes and observe their movements. Remove specimens after a minute or two so the heat from the lamp does not kill them.

Getting to Know Your Neighbors

*“Mrs. Williams and I were very surprised that this **lesson had spilled over to the students’ own yards.** They went home and came the next day so excited about the bugs they had found in their own back yard.”*

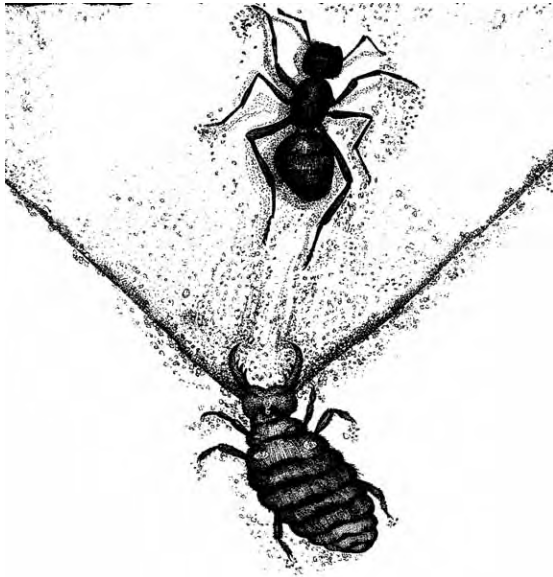
Betty Wiley
Elementary school curriculum coordinator



One of the benefits of creating a nature neighborhood is that you become more aware of the living things all around you. Once they start looking with eyes that are more in tune with the natural world, many teachers and students are surprised to discover what already lives on their school grounds. Every school ground has a variety of interesting plants and animals that can be used for teaching.

Ant lion

Ant lions are flying insects that resemble damselflies, but have distinctive, long, clubbed antennae. An adult's body measures about $\frac{13}{4}$ inches long with a wing span up to $2\frac{1}{2}$ inches. Ant lion larvae are $\frac{1}{4}$ to $\frac{1}{2}$ inch long, with stout, bristly bodies, slender necks, and small heads armed with large, sickle-shaped jaws.



An ant struggles to escape the waiting jaws of an ant lion larva.

Fun facts

- Ant lion larvae are sometimes called doodle-bugs because of the squiggly trails the insects make when they move around in the sand.
- The ant lion larva digs a conical pit in the sand by crawling backward in circles and flipping out sand with its jaws. It waits quietly at the bottom of the pit for its prey. When insects crawl into the pit they find it difficult to climb out because of loose sand and steep walls. The larva flicks sand at the struggling prey, causing it to slide down to the ant lion's waiting jaws.
- Like hypodermic needles, the jaws pierce the victim and suck fluids out of its body.

Activities/observations

- Ant lions are easiest to find in their larval stage. Look for their pits in the spring and summer in dry, fine-grained soil, usually in places protected from the rain. Ant lions may live on your school playground, under building eaves, or near building foundations. Their pits are circular, up to an inch deep, and up to two inches across. There are usually many pits located in the same area.
- To see how an ant lion captures prey, try using a small blade of grass or pine needle and make the tip of it act as if it were an ant trapped in the sand pit. You may see sand being flicked toward the pine needle. The ant lion may even grab the end of the grass or pine needle.
- To look at the larva, take a scoop of earth that includes the base of the pit. You should find the larva in the sand you collected. Remember to put the ant lion back where you found it when you finish your observations.
- Adult ant lions are harder to find. Look for them flying around after a midsummer rain or around lights at night.

Bagworm

Bagworm is the common name of bag-weaving moth larvae in the Psychidae family. The larvae construct small, spindle-shaped bags of silk about 1 1/2 to 2 1/2 inches long and camouflage them with plant material. The bags resemble



"Bag" of bagworm moth on cedar

small brownish Christmas tree ornaments hanging from the twigs of infested trees. Adult males are small, stout-bodied moths with thinly scaled or scaleless wings. Mature females are wingless, soft-bodied, and resemble maggots.

Fun facts

- The larva spins a bag made of plant material and silk and carries the bag attached to its abdomen. As the larva grows it enlarges the size of the bag. When the larva is ready to pupate, it attaches the bag to a branch and pupates inside.

- Bagworms feed on the leaves of a variety of plants, but prefer conifers such as cedars, juniper, and arborvitae.
- Female bagworms remain in their bags their entire lives.
- Males develop into adult moths and fly in search of females.
- Females attract mates by releasing pheromones. Males mate through the bottom opening in a female's bag. She lays several hundred eggs in her bag and dies shortly afterward.
- Bagworm eggs overwinter in the bags and hatch in late spring. Bagworms have a single generation of offspring per year.
- When the eggs hatch, the larvae crawl out of the bottom of the bag, lower themselves with a strand of silk, and are often picked up by the wind to rest on a nearby plant. A mature larva may even crawl to another plant. As soon as a suitable plant is found, the larva begins to construct a bag over its body.
- When disturbed a larva will go back inside its bag and close the opening.

Activities/observations

- Look for bags suspended from twigs camouflaged with plant material. Have your students examine a bag, draw what it looks like, and describe what they think the bags are used for.

- In winter you can open the bags (cut gently with scissors) and determine whether it contained a male or female moth. Bags of male moths will be empty or may have an empty pupal skin hanging partially out of the bottom of the bag. Male moths wriggle partially out of their bag while still in the pupal case and then emerge. Bags of female moths contain eggs and the remains of her pupal skin.

Common chickweed

Annual plant characterized by low growing creeping stems with opposite, oval leaves. It spreads by seed and by rooting at the joints of the long, slender stems. Chickweed flowers are deeply lobed with five white petals (appear to be ten petals). The flowers develop into papery capsules containing small seeds.



Common chickweed

Fun facts

- The name chickweed suggests that chickens (and other birds) feed on the seeds and plants.
- Chickweed is edible either raw or cooked. The greens reputedly are good in sandwiches or salads. Native Americans used the seeds to thicken soups and to make breads. It has also been used to settle a troubled stomach and as an ointment for skin problems.
- When gathered in the early spring, before flowering, chickweed is tender and is a good source of vitamins A and C.
- Chickweed grows well in cool weather and lies close to the ground. Because of this characteristic, the use of chickweed has been suggested as a good "living mulch" in gardens. If the gardener allows chickweed to grow in the bare ground in an early spring garden, the chickweed prevents the germination of other weeds, just as mulch would do. When the weather warms and most garden plants grow vigorously, chickweed dies back due to the heat, leaving a relatively weed-free garden. Because chickweed also has weak stems, it is easily pulled away from young garden plants if spreading becomes a problem.
- Chickweed was believed to be useful in predicting weather. If chickweed blooms fully, there will be no rain for at least four hours. If the blossoms shut, look out for rain.

Activities/observations

- The flower is very small and may appear to have ten petals. If you look closely at the flower with a hand lens, you will see that the five petals are paired and actually joined at the base.
- Look through a magnifying glass at the hairs on the stems. A row of hairs goes up one side of the stem to a pair of leaves, and then switches over and goes up the other side of the stem to the next pair of leaves and so on.

Cicadas

Cicadas are stout bodied insects with short, wide heads, large eyes, and bristlelike antennae. They have two pairs of large, transparent wings.



Annual cicada (adult)

Fun facts

- Cicadas are among the longest-lived insects in North America.
- Cicadas are not related to locusts, although in some areas that is their local name. They are actually members of the order Homoptera, which also includes aphids and leafhoppers.
- Males “sing” in order to attract females for mating. The vibration of the drumlike membranes on their abdomen produces the “song.”
- Each species of cicada has its own distinctive song.
- The female lays her eggs in the twigs of trees and shrubs. Before depositing her eggs, she slices the bark with a sharp ovipositor located at the end of her abdomen.
- Twigs that are punctured by the female cicada are damaged and often die as a result.
- After cicada nymphs hatch from the twigs, they drop and burrow into the ground. Cicada nymphs have piercing-sucking mouthparts, which they use to pierce tree roots and suck the sap.
- After a nymph has matured, it comes out of the ground, climbs up the trunk of a tree or other vertical surface, fastens itself to the surface, and emerges as a winged adult.
- Adult cicadas only live a few weeks.
- Cicadas mature slowly; the number of years depends on the species.
- Two common groups of cicadas found in North Carolina are the annual and the periodical. It takes four to seven years for annual cicadas to mature, while periodical cicadas take 13 or 17 years to develop.
- A synchronized population of cicadas is called a brood.



Annual cicada emerging from nymphal skin

Activities/observations

- When you hear cicadas singing (sounds like long, continuous buzzing), you can look for their nymphal sheddings on the trunks of trees or other vertical surfaces on your school grounds. The shed skin is light brown and about an inch long.
- Have your students examine the cicada shed. Notice the characteristics of the insect, look for clues of how the insect left its shed, and compare the physical characteristics of a cicada nymph and adult. You may need to refer to pictures if you cannot find adults.
- Look for holes in the ground where the cicada nymphs may have emerged. The holes should be about 5/8 inch in diameter.



Daddy-long-legs

SPIDERS	DADDY-LONG-LEGS
fangs	no fangs
body divided into two distinct regions by narrow waist	compact oval-shaped body
North American spiders do not have segmented abdomens	abdomen divided into visible segments
generally 6 or 8 eyes	2 eyes (may look like a black dot on top of head, but is actually two minute black eyes)
can spin silk	cannot spin silk

Table 5.1

Also look inside the nymphal shed for remnants of whitish thread-like tubes. These are part of the nymph's respiratory system.

Daddy-Long-Legs

Daddy-long-legs are neither insects nor spiders. They belong to the class Arachnida and the order Opiliones. They have four pair of long, slender legs which are bent so that their bodies hang close to the ground.

Fun facts

- They are harmless to humans.
- They are sometimes referred to as harvestmen because they were first documented in fall at harvest time.
- A daddy-long-legs' legs can be up to 30 times as long as its body. If humans had

similar proportions, our legs would be about 40 feet long.

- The second pair of legs helps the harvestman to sense its surroundings.
- Ways of protection: speed, foul odor secretions, and leg autotomy (a leg may detach when grabbed by a predator and continue to twitch while the daddy-long-legs escapes). They cannot regenerate lost limbs.
- Common foods: dead insects, ripe fruit

Activities/observations

- Look for them near tree trunks, wood piles, and around damp garden spaces.
- Let the daddy-long-legs crawl onto your hand.



Dandelion flower

- Have your students draw the daddy-long-legs and compare the daddy-long-legs to spiders (you may need a hand lens).

Dandelion

A low-growing perennial plant with a bright yellow flower at the top of a hollow stem. Leaves are dark green, grow next to the ground in a rosette fashion, and in most cases, are deeply toothed. Dandelions have long thick taproots which can grow up to five feet deep.

Fun facts

- The name dandelion comes from the French name “dents de lions” meaning “tooth of the lion.” The teeth refer to the deeply cut leaves.

- Dandelion is not native to North America. Early European settlers brought seeds with them.
- The dandelion is sometimes called the “shepherd’s clock” because of the way it opens and closes with the sun. Dandelion flowers close each afternoon and during rainy or cloudy weather, and reopen in the morning.
- Each flower head is actually a large group of tiny flowers that resemble small petals. After all the tiny flowers that make up the dandelion’s composite flower are mature, the dandelion flower closes for the last time. It stays closed until the seeds have ripened. The flower will open with ripened seeds arranged in a round puffball on the top of a tall hollow stem.
- Dandelions can be used to make a coffee-like drink, cooked as greens, eaten in salads, and made into a wine.
- A Dutch legend says that if you eat dandelion salad on Mondays or Thursdays you will always be healthy.
- Another legend states that if you can blow off all the seeds of the puffball in one breath, then your wish will come true.
- Dandelions are abundant because they use several different methods to survive:
The deep root is resistant to burrowing animals and fire.
Leaves are bitter during summer so they are not grazed.

Seeds are easily spread by the wind.

If the root is cut into pieces, each piece of root grows a new plant.

Activities/observations

- Have the students draw a dandelion and identify and label the flower, stem, leaves, root, etc.
- Look carefully at the seeds on the puffball. Have the students sketch a seed and write down ideas why it might be advantageous for the seed to have the characteristics they identify. (They should see tiny barbs on the seed. These barbs point backward and help the seeds burrow into the ground.)
- Have students observe dandelions in shady versus sunny areas of your school grounds.



Dandelion “puff ball”



Earthworm

Have students write down similarities and differences between plants in the two areas.

- Observe and record opening and closing times of dandelion flowers. Compare flowers on sunny versus cloudy days.

Earthworm

Earthworms have segmented, cylindrical-shaped bodies. Small bristles called setae project from each segment. Earthworms are generally uniform in color, ranging from pink to brown. Their size can range from 1/25 inch to several feet long (for some tropical species).

Fun facts

- Some earthworm species are known as night-crawlers because they come to the surface of the soil at night to feed.
- Earthworms are important to soil ecology. They are essential in the process of loosening and aerating soil, making it more fertile for plant life.
- Earthworms eat dead plant material in the soil. They also must eat through the soil to make their tunnels. Earthworm feces are called casts and they add nitrogen to the soil.
- Earthworms have no eyes or ears, but depend on their sense of touch.
- Earthworms crawl by lengthening the front part of their bodies and pulling up the hind parts.
- Earthworms breathe oxygen through their skins.
- When it rains, the air spaces between the soil particles fill with water, and the worm must come to the surface of the soil or it will drown.
- During extremely hot days earthworms may need to penetrate deeper into the soil in order to avoid dehydration.
- The clitellum, a smooth, swollen band around the body located several segments behind the head, is specialized for reproduction and produces a cocoon for the worm's eggs.

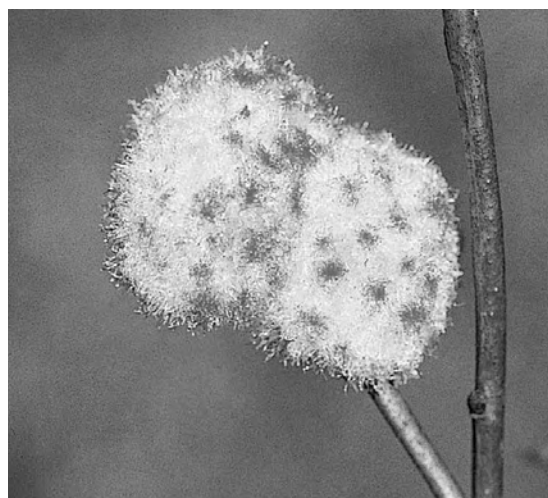
- Earthworms have both male and female reproductive organs; however, they must still mate in order to lay eggs. An earthworm needs to receive sperm from another earthworm to fertilize its eggs. When an earthworm mates, the clitellum secretes a mucous ring that slides past the reproductive organs, picks up the sperm and eggs, and then slides off the body as a cocoon.

Activities/observations

- Earthworms can be dug up from a garden, field, or compost pile. Have the students write down the location and characteristics of the earthworm's habitat. (Is it moist, is it above or below ground, is it in a dark or well-lighted area?).
- Students should be extremely gentle with the worms. If needed, bring a wet paper towel to keep the worm moist.
- Have students observe the earthworm's structure and behavior. Help students notice the earthworm's internal organs, which can be seen through its underside. Have students write down their observations. You may want students to work in groups and to draw a poster of an earthworm with its various parts labeled.
- Don't forget to return the earthworm back to its original habitat.



Goldenrod ball gall, formed by the goldenrod gall fly



Wool sower gall on white oak, formed by cynipid wasps

Galls

Galls are abnormal growths of plant tissue caused by insects and other organisms. They vary in size, shape, color, and texture.

Fun facts

- Plants produce galls in response to physical irritation caused by or chemical secretions released by insects and other organisms.
- Over 1,500 insect species in North America cause galls by laying their eggs in plant tissue.
- The growth of a gall may be the result of the massive swelling or rapid division of individual plant cells.

- The gall provides a protective covering to the larva inside as it pupates and feeds upon the host plant.
- Galls are characteristic of the insect or other species that produces them.
- After a gall is vacated by its maker, it can be used as shelter for other insects.
- Galls are believed to be similar to tumorous growths and are being studied in cancer research.
- Invisible ink, black hair dye, and an astringent were once made using powdered oak galls. A powdered oak gall mixed with honey was once believed to be a cure for baldness.

Activities/observations

- Look for swellings, growths, or discoloration on the leaves, twigs, trunks, etc. of trees and other plants. Galls are commonly found on oak trees, goldenrods, blackberries, roses, and willows.
- Take students out to count galls in the area. Notice the different plants on which you find galls. Also notice the different shapes of galls.
- To see the larva inside, cut the gall open with a knife. Be careful not to cut yourself. Have your students sketch the unopened gall and write down its characteristics. After the gall is open, have them sketch what they found inside. You may see a larva inside the gall; however, tiny holes in the gall may be a sign that the larva has left.
- Have your students compare the different types of galls they find, the plants on which they were found, and the larvae that were found inside. If the galls are similar, do the larvae look similar? If the galls are different, are the larvae inside different? Does the presence of holes in the gall mean there is no larva inside? Have your students write up their results.

Mud Daubers

Mud daubers are long, slender (25–30 mm) wasps with narrow, thread-like waists. Many mud dauber species are found in the United States.

Fun facts

- The mud dauber is named for the nest the female wasp makes from mud. Females gather mud, roll it into a ball, and shape it into nest chambers.
- Different mud dauber species build different types of nests:

The organ-pipe mud dauber is a large, black species. Its nests are shaped like cylindrical tubes that resemble pipe-organ pipes.

A black and yellow species builds cylindrical cells that are plastered with mud. About two to five inches across, the nest resembles a mud clod thrown onto the side of a building.

A common metallic blue species does not build its own nest, but uses the abandoned nests of the two mud dauber species mentioned above.

- After constructing the nest, the female mud dauber provisions each cell with several spiders, paralyzing them with venom from her stinger. A single egg is then deposited on the prey within each cell and the cell is sealed with mud.

- The larva hatches in a few days and feeds on the spiders left in the cell. The larva then pupates in a brown pupal case (resembling an elongate brown jellybean). At the end of the following spring, the wasp emerges as a new adult and starts the process of mating and building nests.
- Unlike social wasps, solitary wasps, such as the mud dauber, are not prone to stinging humans.

Activities/observations

- Look for mud daubers and their nests near doorways or other overhanging structures, as well as on roofs and walls of your school buildings.



Spider prey removed from one organ pipe mud dauber tube



Organ pipe mud dauber nest showing emergence holes of adult wasps

Spiders and spider webs

Spiders have eight legs and six or eight simple eyes. They have two body regions: a cephalothorax (combined head and thorax) and an abdomen.

Spider webs are thin, lightweight silk threads (about 0.01mm in diameter).

Fun facts

- Spiders are members of the phylum Arthropoda and the class Arachnida.
- Spiders have four to eight silk glands; each gland produces a different type of silk.
- All spiders do not spin webs, but they all make silk. Silk is used in capturing prey,

preparing egg cases, and moving about. As it moves, a spider lays a dragline of silk that acts as a safety line. Hatchling spiders can also disperse by “ballooning” on wind-caught strands of silk.

- Spiders feed on insects and other small prey. Using hollow fangs located near their mouth, spiders inject digestive enzymes into their prey. These enzymes liquefy the prey’s insides.
- Not all spiders spin webs to catch prey. Some, like wolf spiders, run after or ambush their prey.
- Spider silk is stronger than steel and more flexible than nylon.

- The tips of spider legs are oily, allowing the spider to walk on its web without getting stuck.

Web makers

sheetweb weavers (filmy dome spiders, bowl and doily spiders)
orb-web weavers (spiny-abdomen spiders and garden spiders)
funnel-web weavers (grass spiders)

Non-web makers

jumping spiders
wolf spiders
crab spiders



Orb weaver web



Some spiders, such as this large wolf spider, do not build webs to capture prey.



Web of bowl and doily spider

Activities/observations

- Look for webs along railings, overhangs, in building corners, and between closely spaced vegetation, etc.
- Show your students how to make a web more visible by misting it lightly with water.
- Divide your students into teams and give them each a spray bottle and spider field guide. Assign each team a specific area to look for webs. Have each team draw the webs they find and identify and draw the spider. Also have the students observe the characteristics of the web and guess what type of prey the web is designed to capture.
- Simple math lessons can be done by estimating the number of total webs in an area based on samples, graphing the number of webs, etc.

Note: Instruct students to observe spiders, not to handle them.



Honeybee approaching flower of white clover

White Clover

A low-growing perennial plant with three round leaflets to one stem. The flowers are small, white, and shaped like pom-poms.

Fun facts

- Clover was once used as a food. Today it is widely used by farmers as “green manure.” Farmers plant clover in their fields to improve the soil.
- Clover, like other members of the legume family, has a symbiotic relationship with certain soil bacteria that transforms atmospheric nitrogen (unavailable to plants) into a form of nitrogen that plants can absorb.

- Drinking clover tea was said to improve the texture of fingernails and to thin and purify the blood.
- Clover blossoms were used to make wine, to flavor cheese and tobacco, to keep moths away from furs in storage, and to make cough medicine.
- The clover flower is actually made up of many small flowers. In white clover these small flowers mature over several days.
- As the tiny flowers mature and are pollinated, they turn brown and bend toward the earth for easy seed dispersal. White flowers have not yet been pollinated.

Activities/observations

- White clover is abundant in lawns and open areas. Find a patch of clover and have students use hand lenses to examine the characteristics of the flower. Sketch the clover and label its parts.
- Observe which insects collect nectar from the flower. Weevils may also be observed near the clover (they feed on the leaves and flowers of the clover).
- Have students work in groups to determine which flowers on the flower head are about to bloom, have bloomed, or are in bloom.

References and Resources

Local agencies can help you with your school grounds projects. Contact your cooperative extension agency, soil and water conservation service, botanical garden, garden supply center, and park and nature center. Peterson, Golden, and Audubon publishing houses offer a range of useful field guides.

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www.naturalsciences.org

Project FeederWatch:
www.birds.cornell.edu/PFW

Appendix A

Nature Neighborhood project suggestions from schools across North Carolina.

Alphabet Garden

Plant a selection of native plants whose names run through all the letters of the alphabet.

Hint: Try yellowroot (Xanthorhiza) and atamasco lilies (Zephyranthes) for the tough letters.

Animal Inn

Leave a dead tree standing (in a safe area) to provide food and shelter for a variety of species from lizards to bluebirds.

Bluebird Trail

Place bluebird boxes in suitable habitat, spaced at least 200 feet apart. Monitor boxes for nesting success.

Bog/Carnivorous Plant Garden

Create an in-ground bog with a preformed plastic pool or by lining a hole in the ground with plastic. Provide small drainage holes before adding rich organic soil mix combined with sand and peat. Plant with carnivorous plants and other wetland species.

Dirt Dauber Mud Factory

Create mud puddles as habitat for temporary pool organisms and as a mud source for mud dauber wasps and other mud nest builders.

Entrance Arbor

Install a wooden arch at the entrance to a habitat feature such as a meadow, trail, or cluster of learning stations in a courtyard. An entrance arbor creates a sense that you are entering a special place. It also provides a place for planting native vines such as coral honeysuckle.

Living Fence

Plant native vines such as coral honeysuckle and wild grape and allow them to grow up over campus fencing to provide wildlife with food and cover.

Migration Maps

Paint large maps of a state, North America, or the western hemisphere to help students understand our connections to other parts of the world through the migration of birds, butterflies, and other wildlife. Use blacktop or building walls as your canvas.

Mountains-to-Sea Native Plant Garden

Plant wildflowers native to different regions of your state, region, or your county. For added interest, plant a garden in the shape of your state.

Natural Edge Habitat

Allow selected areas to return to a more natural state by decreasing the frequency of mowing—perhaps on a cycle of every one to two years. Signage helps identify these less-manicured landscapes as school ground wildlife habitat and not just “waste” areas.

Nature Trails/Learning Stations

Create a meandering mulched pathway or a marked trail to connect learning centers on your grounds. Create a walking path through an existing natural area.

Nesting/Roosting Boxes

Make boxes with specific sizes, designs, and entrance hole dimensions for various species of birds (e.g., owls, woodpeckers, bluebirds), mammals (e.g., flying squirrels, bats), and even insects (e.g., blue orchard bees).

Outdoor Seating/Amphitheater

Provide a comfortable work environment for students and teachers. Ideal sites are situated away from high use areas and are in shade during the hottest parts of the day.

Plant/Animal Walkway

Press leaves or other plant materials (e.g., ferns, pine cones) into wet concrete as it is being poured anywhere on campus. Incorporate simulated animal tracks into the walkway.

Rock and Brush Piles

Create rock and brush piles along edges of school grounds and/or at wildlife feeding stations to provide important cover for birds and other wildlife. Use signage to help people appreciate these critical habitat features.

Rotten Log Habitat

Create habitat for insects, salamanders, and other wildlife by incorporating decaying logs or stumps in your landscape. This type of habitat is specially valuable near miniponds that attract breeding amphibians.

Schoolyard Composting

Create your own topsoil and study decomposition by composting food scraps (mostly fruits and vegetables) and yard waste (leaves, grass clippings) in an outdoor holding bin. Turn periodically.

Seed Box

Create a wildflower seed bed by building a frame with 2" x 12" lumber and adding rich topsoil and a layer of fine mulch. A wire mesh top will help prevent digging and grazing by animals. Sow wildflower seeds as they become available and then transplant to your gardens as needed.

Soil Profile Box

Dig into a sloped area on your school grounds to reveal a vertical soil profile. Install a clear plastic panel to allow for viewing the soil profile and underground organisms. Cover the panel with a wooden door to keep it dark for soil organisms.

Stepping Stones

Have students create their own garden stepping stones using fast-drying bag concrete mixes poured into simple molds (e.g., pizza boxes, pie tins). Add hand prints, leaf impressions, animal tracks, or other artistic designs.

Sun Shelter

Create a shady spot for outdoor study on open school grounds by building a roofed structure or an arbor. Vines can be planted to climb over an arbor to provide additional shade and attract wildlife such as hummingbirds.

Sundial/Outdoor Compass

Use simple sundials to teach about changes over time and the seasons. Paint a compass on any asphalt or concrete surface or create one using rocks or other natural objects. Compasses provide excellent links to studies of migratory animals, geography, and a variety of other disciplines.

Tracking Box

Build a sand-filled, baited area to study animal tracks.

Tree Library

Plant a variety of native trees in an open area on your school grounds, paying close attention to proper spacing and any height limitations. Overhead power lines may dictate small trees such as dogwoods or redbuds. Have students create a "library" of teaching information that can be kept in the media center or laminated and placed in a notebook secured near the plantings.

Vermicomposting

Create an inexpensive classroom composting system by feeding food scraps to worms housed in plastic bins. The worms will process the food waste into castings rich in nutrients, which can enrich your gardens.

Weather Station

Use a variety of weather monitoring equipment (homemade or purchased). Expensive equipment is best kept in a lockable structure.

Wildflower Meadow

Plant a mixture of native wildflowers and grasses. Meadows tend to be larger than typical garden spaces and require site preparation, seeding, and require periodic maintenance (mowing or burning).

Appendix B

Suet log feeder

Both suet and peanut butter mixtures are high energy food sources for a variety of birds including woodpeckers, chickadees, titmice, and nuthatches. These foods are particularly attractive in cold weather when insects are not readily available. Raw suet can be bought at the grocery store; the more convenient suet cakes are available from many sources. Hang suet in mesh bags or wire cages designed to hold the cakes. Peanut butter is an inexpensive, readily available, and highly desirable food source for many birds. Buy the cheapest peanut butter you can find (crunchy style is a good bet). Use it straight out of the jar or mix it with cornmeal. Although some people caution against feeding peanut butter to birds, there is no evidence that it causes choking or digestive problems. Years of observation at feeders suggest that birds are very attracted to peanut butter and suffer no ill consequences. Offer peanut butter only in cold weather, to prevent it from becoming runny and rancid.

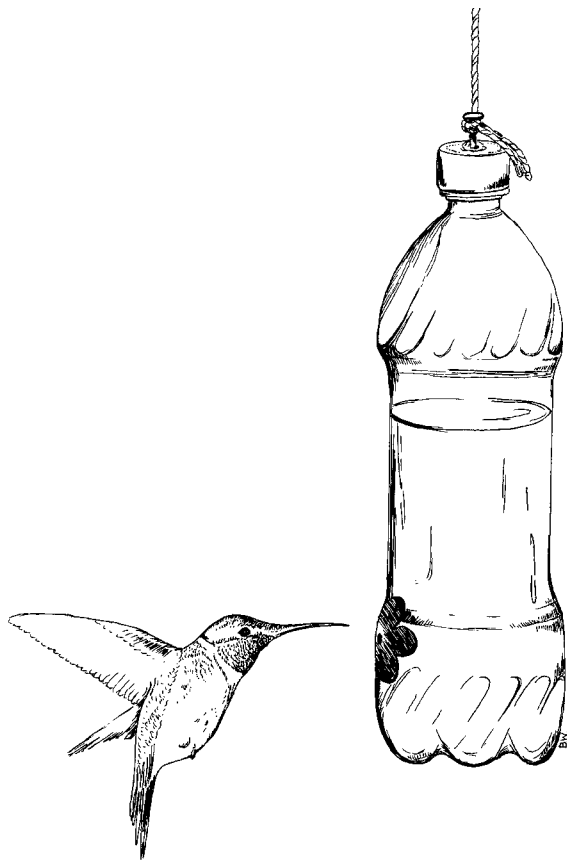


Materials

- one small diameter (two to three inches) hardwood log 12 to 18 inches in length
- drill with 1-inch drill bit
- pliers
- eye screw and S-hook
- two feet of thin wire or fishing line
- optional—sheet of hardware cloth (1/2 inch mesh size) big enough to make a wire cage around the log as a squirrel barrier

Instructions

1. Use the one-inch drill bit to drill several shallow holes (one inch deep) at various places around the log. Allow enough room above and below each hole for a small bird to cling to the log. Four to five holes should be enough.
2. Attach the eye screw to the top of the log and insert S-hook. You may want to squeeze the end of the S-hook going through the eye screw so that it does not fall off.
3. Fill the holes in the suet log with peanut butter or suet.
4. Use the wire or fishing line to hang the feeder by the S-hook at a height convenient for refilling.
5. If squirrels eat too much of your peanut butter, try making a cage for the log by bending hardware cloth into a cylinder that covers the length of the log. Fasten the cylinder together with small pieces of wire or twist ties. Leave the bottom open and bend the top edge of the cylinder inward so it rests on the log when hanging in the feeder position. To refill the peanut butter, simply slide the cylinder over the top of the log. While this doesn't prevent squirrels from feeding at the peanut butter, it limits their access.



Hummingbird feeder

Of more than 330 species of hummingbirds, only one breeds in North Carolina—the ruby throated hummingbird. Each spring, this tiny bird migrates north from Mexico and Central America and nests in the eastern United States and Canada. Males (with the ruby-red throat patch) arrive in North Carolina as early as April. Females (with a white throat) typically arrive about three weeks after males. After mating, the female builds a small lichen-covered nest held together by spider webs and lined with plant down. Nestlings are ready to fly and feed themselves three weeks after hatching. Hummingbird feeders are especially busy places in July, after the young birds have fledged. By late September, most hummingbirds have left for their southern wintering grounds.

In addition to planting nectar plants (e.g., cardinal flower, bee balm, coral honeysuckle, and wild columbine), you can easily attract hummingbirds by placing feeders around your property. It is a good idea to put out several feeders and replenish the sugar water solution every few days (especially in hot weather). Feeders come in a variety of designs. A simple one can be made out of a recycled plastic drink bottle.

Materials

- hammer
- 1 16 oz. plastic drink bottle with plastic cap
- 1 small nail (with large head)
- 2 pieces of red plastic tape OR red contact paper OR red permanent marker
- 2 feet of string or fishing line
- hot glue gun or waterproof glue

Instructions

1. Using the nail, make a very small hole (approximately 1/8 inch in diameter) 1/2 inch from the bottom of the bottle. This will be easier if the bottle cap is on.
2. Hammer the nail into the lid. Leave most of the nail sticking out the top of the lid.
3. Seal around the nail (where it goes through the cap) with a drop of glue.
4. Tie the string to the nail.
5. Using the red tape or permanent marker, make “flower petals” around the hole in the bottle.
6. After the glue is dry, test the bottle by filling it with water. It must be airtight or the liquid will drain through the hole in the bottle. Add more glue around the nail if water continues to drip from the hole during the test. Fill the bottle with hummingbird food. Be certain to clean out the feeder and replace the food at least once a week or whenever the liquid looks cloudy.

Recipe for hummingbird food

Mix 1 part sugar to 4 parts boiling water. Allow to cool before filling the feeder. Red food coloring in the solution is not necessary.

Emergence Cage

Bring science to life in your classroom with this easy-to make emergence cage.

Many butterflies and moths overwinter as pupae (chrysalises and cocoons). Watching an adult butterfly or moth emerge from its pupa is an excellent way to learn more about insect life cycles. Pupae that are kept inside a classroom have a tendency to dry out, so hang this cage in a protected area where pupae can receive the benefits of cool temperatures and high humidity. Outdoor garages, carports or porches, and the underside of the eaves of buildings are ideal locations.

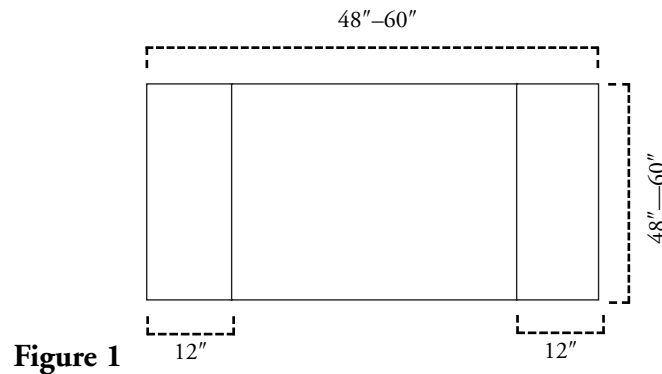
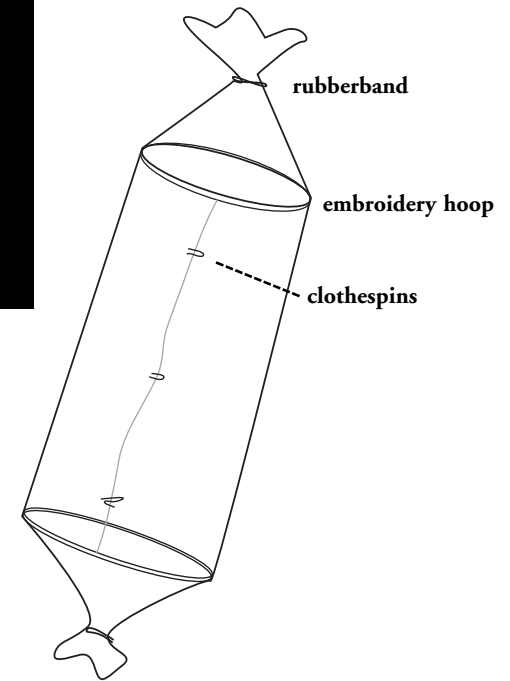


Figure 1



Figure 2



Completed Cage

Materials

- 50-60 inches fine mesh fabric, 48-62 inches wide
- 1 yard of string
- 2 rubber bands
- 2 embroidery hoops (12-inch diameter)
- 1 permanent marker
- ruler
- newspaper or other material to cover work area
- 4-6 clothespins or binder clips

Instructions

1. Cover work area with newspaper.
2. With the permanent marker, draw a line 12 inches from, and parallel to, the bottom of the fabric (see figure 1). Repeat at other end.
3. Gather the material in one hand about two inches from the top edge. Wrap the last six inches of the material around the gathers (see figure 2). Secure the material with a rubber band about two inches from the top.
4. Take the inside ring of one hoop and place it inside the material so that the gathered end is in the center of the ring and the rest of the material is draped over the ring. The material will overlap. Place the outer ring over the outside of the material and join the rings. Tighten slightly.
5. Gently (it will rip if you pull too hard!) pull the material so that the line you drew is between the rings. When all is lined up, tighten the outer ring.
6. Move the rubber band down the material so that the material is taut inside the ring.
7. Repeat steps 3-6 at the other end. Make sure that the material overlaps in the same direction at both ends. The overlap will be your door.
8. Tie the string to the rubber band at one end. Use clothespins or small clamps to keep the door closed.

Caterpillar Cage

Rearing caterpillars is an excellent way to learn more about the life cycles of butterflies and moths. This cage will protect your caterpillars from predation and keep them from escaping. It can be used in the classroom or on the school grounds, and can double as an emergence cage. Place large branches of the caterpillars' host plant in a container of water inside the cage and observe the larvae as they grow. When the caterpillars form chrysalises or cocoons, place the cage in an outdoor setting. Press the cage legs firmly into the ground, and leave pupae in the cage. Depending on the species and the time of the year, the adult may emerge in a few weeks or it may overwinter and emerge the following year.

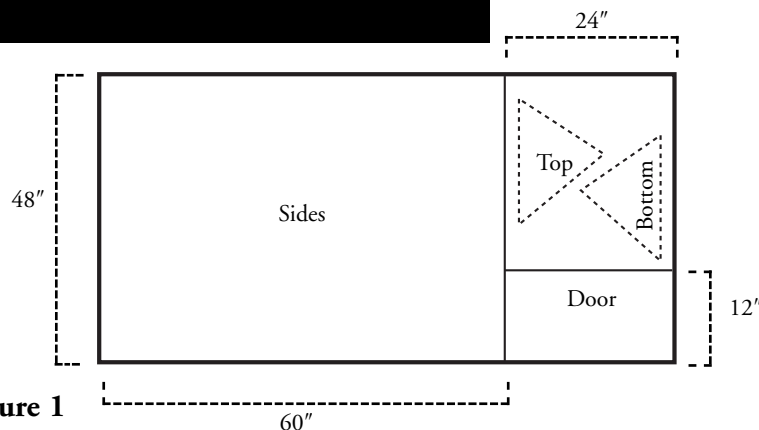


Figure 1

Completed
Cage

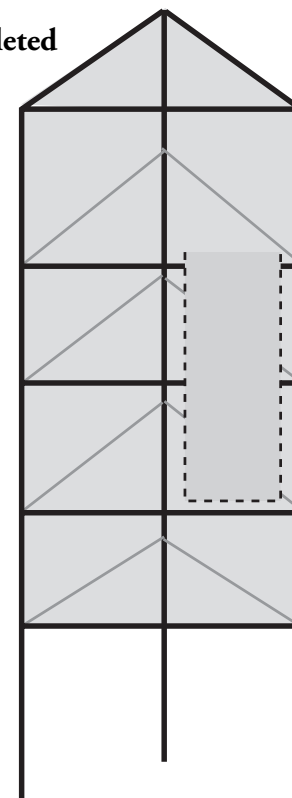


Figure 2

Materials

- Folding tomato cage (available at garden centers and discount stores)
- 84 inches of 48-inch-wide fiberglass window screening
- Fine coated wire (such as telephone wire, available from local phone company) OR monofilament line and large sewing needles
- 12 clothespins or clamps (spring type)
- Newspaper
- Scissors
- Pliers (with wire cutters)

Instructions

1. Unfold tomato cage in upright position (extended wire legs on bottom) and fasten sides together with attached hooks. Crimp hooks closed with pliers.
2. Wrap screen around cage. The unwrapped fabric should not be overly tight. Allow for a two-inch overlap and cut. Trim top and bottom with a two-inch overhang.
3. Line up the screen with one of the vertical wires of the cage. Using coated wire (or monofilament line and needle), "sew" the screening to the vertical wires of the cage. Do not sew around the top and bottom edges yet.
4. Cut a 24-inch x 48-inch piece of screening to make the top, bottom, and door for your cage (see figure 1). Cut two triangular pieces of window screening to fit the top and bottom of the cage. Allow for a two-inch overhang on all sides. Cut a door 24 inches x 12 inches.
5. Using the coated wire (or monofilament line and needle), "sew" the top and bottom to the frame. NOTE: The six extended legs will need to be pushed through the bottom of the screen.
6. Cut a flap in the screening as shown in Figure 2. When cutting the flap, cut about one inch inside the frame wires. The loose end of the flap should be at the bottom.
7. Take the door piece and clip it securely over the flap along the wire frame with clothespins. Remove clothespins for easy access.
8. Place newspaper in the bottom of cage for quick cleaning.
9. Push leg extensions into the ground until the bottom of the cage rests flat. If used indoors the legs should be bent outward until flat.



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