

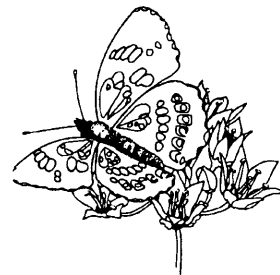
TM

CREATING A SCHOOL HABITAT

**A Planning Guide
For Habitat Enhancement on
School Grounds in Texas**



APPENDICES For Central Texas Edwards Plateau, Blackland Prairies, Cross Timbers and Prairies, and Post Oak Savannah Ecological Regions



Written by:

**Diana M. Foss, Urban Program, Texas Parks and Wildlife
Ronald K. Jones, U. S. Fish and Wildlife Service**

Illustrations on pages A-14, A-16, A-20, and A-21 by:

Michele G. Foss

This project was made possible through funding from:

**Texas Parks and Wildlife, Urban Program
U. S. Fish and Wildlife Service, Ecological Services**

TABLE OF CONTENTS:

- | | |
|--|--|
| A. Resource Professionals | N. Vertical Layering in a Habitat |
| B. Teacher Training Resources | O. Stages of Plant Succession |
| C. Resources for Materials | P. Constructing Raised Beds |
| D. Reference Books | Q. Nest Box Specifications |
| E. Ecological Regions and Map | R. Bat House Plan |
| F. Seasonal Food Chart | S. Small Nest Box Plan |
| G. Common Wildlife Foods Chart | T. Large Nest Box Plan |
| H. Key to Soil Texture Chart | U. Sample Bench Design |
| I. Project Priorities Worksheet | V. Sample Study Platform/ Deck Design |
| J. Cost Estimate Worksheet | W. Plant Tables |
| K. Tips on Planting Trees and Shrubs | |
| L. Butterfly & Hummingbird Garden | |
| M. Establishing a Prairie / Wildflower Area | |

ALL RIGHTS RESERVED. This School Habitat publication may not be reproduced or transmitted in any form without the permission of the authors. Appendix pages may be reproduced as needed.

Additional copies of this manual may be obtained from the offices listed in the manual. Training workshops are offered periodically through the year in association with this manual.



Appendix A: Resource Professionals

The following lists in the Appendices are partial lists.
Write in additional sources as you discover them.

Texas Parks and Wildlife Dept.
Urban Wildlife Program
4200 Smith School Road, Austin, 78744
kelly.bender@tpwd.state.tx.us (512) 389-4974

U.S. Fish and Wildlife Services
Austin Ecological Services Field Office
10711 Burnet Rd., Suite 200
Austin, TX 78758
Telephone: (512) 490-0057
Fax: (512) 490-0974
Email: r2fwe_tx@fws.gov

National Wildlife Federation
<http://www.nwf.org/nwf/natlwild/index.html>
example of a Seattle schoolyard habitat:
<http://www.nwf.org/nwf/education/seattle/shexample.html>
Regional office – Gulf States Natural Resource Center:
4505 Spicewood Springs, Suite 300
Austin, TX 78759 (512) 346-3934,
Fax: (512) 346-3709

Native Plant Society of Texas Statewide Office
Bank One Building, 1111 N. IH 35, Suite 212
Round Rock, TX 78664
http://lonestar.texas.net/~jleblanc/npsot_austin.html
Austin chapter: Ginger Hudson-Maffei
(512) 836-4751, gingerhm@herbalgram.org

Ladybird Johnson Wildflower Research Cntr.
4801 LaCrosse Ave., Austin, 78739-1702
(512) 292-4100, <http://www.wildflower.org/>

Texas Natural Resource Conservation Comm.
P.O. Box 13087, Austin, TX 78711-3087,
(512) 239-5440, Fax: (512) 239-1123
Austin regional office:
1921 Cedar Bend Dr., Suite 150
Austin, TX 78758-5336
(512) 239-1000

Texas Agricultural Extension Service
Room 112, Jack K. Williams Administration Building,
College Station, Texas 77843-7101
Voice: (409) 845-7800 Fax: (409) 845-9542
E-Mail: agextension@tamu.edu

Travis County: 1600-B Smith Rd., Austin 78721,
(512) 473-9600 FAX: (512) 473-9611
Bastrop County: Box 650, Bastrop, TX 78602,
Voice: (512) 303-0187 Fax: (512) 321-8811

Hays County: 1253 Civic Center Loop, San Marcus, TX
78666, Voice: (512) 393-2120 Fax: (512) 393-2136

Williamson County: 1900 Georgetown Innerloop, Suite A,
Georgetown, TX 78626, Voice: (512) 930-4400
Fax: (512) 930-4407

Blanco County: Box 189, Johnson City, TX 78636,
(830) 868-7167 FAX: (830) 868-2348

Burnet County: 133 East Jackson, Courthouse
Annex Burnet, TX 78611, Voice: (512) 756-5420

Texas Forest Service
P.O. Box 15083, Austin, TX 78761-5083
Physical address:
1101 Camino La Costa Rd., RM 215
Austin, TX 78752, (512) 451-2178
Fax (512) 451-6946, tfsaus@swbell.net

Appendix B: Teacher Training Resources

Project WILD and Aquatic WILD, Texas Parks and Wildlife
Department. 4200 Smith School Road, Austin, 78744.
(800) 792-1112
<http://www.tpwd.state.tx.us>

Master Composting Program,
Texas Natural Resource Conservation Commission.
(512) 239-1000

Adopt-a-Wetland Program, Texas A&M University, Corpus
Christi Campus. 6300 Ocean Drive, NRC 3208, Corpus
Christi, TX, 78412, (512) 980-3221

School Habitat Design & Installation Workshop, Texas
Parks and Wildlife Dept. (512) 389-4974 or
U.S. Fish and Wildlife Service (512) 490-0057

Texas Master Naturalist Program,
Capital Area Chapter, Texas Parks and Wildlife.
(512) 389-4974
Statewide program, Texas A&M University.
Department of Wildlife & Fisheries Sciences,
113 Nagle Hall, College Station, TX 77843-2258,
(409) 845-7103

Master Gardener Program,
Texas Agricultural Extension Service,
(Travis County) 1600-B Smith Rd., Austin 78721,
(512) 473-9600

Appendix C: Resources for Materials/ Supplies

This is only a partial list of plant vendors. Other nurseries may carry native species seasonally. Write in additional sources as you discover them.

AAA

5910 HWY 290 W
AUSTIN TX 78749
(512) 892-3636
Retail, trees, shrubs, wildflowers

BREED & CO

718 W 29TH ST
AUSTIN TX 78705
(512) 474-7058
Retail, trees, shrubs, grasses, wildflowers, cacti, succulents

CALLAHAN'S GENERAL STORE

501 BASTROP HIGHWAY
AUSTIN TX 78741
Retail, wholesale, grasses, wildflowers

GARDENS

1818 W 35TH ST
AUSTIN TX 78703
(512) 451-5490
Retail, wholesale, shrubs, grasses, wildflowers, cacti, succulents

GARDEN-VILLE

8648 OLD BEE CAVES ROAD
AUSTIN, TEXAS
(512) 288-6113
Retail, trees, shrubs, wildflowers

HILL COUNTRY LANDSCAPE & GARDEN CENTER

P O BOX 210297
13561 POND SPRINGS ROAD
AUSTIN TX 78729
(512) 258-1049
Retail, trees, shrubs, wildflowers, grasses, cacti, succulents

J'DON SEEDS INTERNATIONAL

P O BOX 10998-533
AUSTIN TX 78766
(800) 848-1641
Retail, wildflowers

JENCO WHOLESALE NURSERIES INC

P O BOX 200755
4601 SWITCH WILLOW ROAD
AUSTIN TX 78720-0755
(512) 346-0562
Wholesale, trees, shrubs, grasses & wildflowers

NATIVE TEXAS NURSERY

1004 MOPAC CIRCLE SUITE 101
AUSTIN TX 78746
(office address only)
(512) 328-2004 FAX 328-6930
Wholesale, Trees, shrubs & wildflowers

PARK PLACE GARDENS

2710 HANCOCK DR
AUSTIN TX 78731
(512) 458-5909
Retail, trees, shrubs & wildflowers

POTS & PLANTS

5902 BEE CAVES RD
AUSTIN TX 78746
(512) 327-4564
Retail, trees, shrubs & wildflowers

POWERS WHOLESALE NURSERY

7310 SHERWOOD ROAD
AUSTIN TX 78745
(512) 444-5511 FAX (512) 444-1844
Wholesale, trees, shrubs, grasses & wildflowers

RED BARN GARDEN CENTERS

13907 HIGHWAY 183 NORTH
AUSTIN TX 78717
(512) 335-0122
Retail, wildflowers, grasses, trees & shrubs

TEXZEN GARDENS

4806 BURNET RD
AUSTIN TX 78756
(512) 454-6471
Retail, shrubs, perennials, wildflower seed, antique roses, organic materials & beneficial insects

WILDSEED FARMS

1101 CAMPO ROSA RD., P.O. BOX 308,
EAGLE LAKE, TX 77434, (800) 848-0078
Mail order, wildflower seeds

LANDSCAPE MARKET PLACE

1031 AUSTIN HWY
SAN ANTONIO TX 78209
(210) 822-1335
Retail, trees, shrubs & wildflowers

NATIVE AMERICAN SEED

127 N. 16th ST., JUNCTION, TX 76849,
(800)-728-4043, seedsource@aol.com
Mail order, wildflowers, native grasses

Appendix D: Reference Books

Also refer to books listed inside the Reference Boxes located at the end of various chapters.

STUDENT REFERENCES

FIELD GUIDES:

Peterson First Field Guides to:

- Butterflies and Moths
- Caterpillars
- And others....

Texas Monthly Field Guide Series -

- Butterflies of Texas by Raymond Neck
- Reptiles and Amphibians of Texas by Garrett and Barker
- Snakes of Texas by Alan Tennant

National Geographic Field Guide to Birds of North America

Mammals of Texas by W. B. Davis and D. J. Schmidly, University of Texas Press

Wildflowers of Texas by Geyata Ajilvsgi, Shearer Publishing

A Guide to Freshwater Ecology by Christine Kolbe and Mark Luedke, Texas Natural Resource Conservation Commission, P. O. Box 13087, Austin, TX 78711-2087

Forest Trees of Texas, How to Know Them, Bulletin 20, Texas Forest Service

Poisonous Snakes of Texas by Andrew Price, Texas Parks & Wildlife Press

OTHER BOOKS:

Birding for the Amateur Naturalist by Laura O'Biso Socha, Acorn Naturalists, (800) 422-8886.

Growing Wild, Inviting Wildlife Into Your Yard, (good for young children) by Constance Perenyi, Beyond Words Publishing, 13950 NW Pumpkin Ridge Road, Hillsboro, OR, 97123.

Habitats, Making Homes for Animals and Plants, by Pamela Hickman, Acorn Naturalists, (800) 422-8886.

TEACHER REFERENCES

Texas Wildscapes Information Packet by Texas Parks and Wildlife Department, Nongame and Urban Program, 4200 Smith School Road, Austin, TX 78744, (800) 792-1112

Native Texas Plants, Landscaping Region by Region by Sally Wasowski, Gulf Publishing Company

How to Grow Native Plants of Texas and the Southwest by Jill Nokes, Gulf Publishing Company

Creative Propagation, A Grower's Guide by Peter Thompson, Timber Press, Portland, Oregon,

Wildflowers of Houston by John and Gloria Tveten, Rice University Press

A Garden Book for Houston and the Texas Gulf Coast by The River Oaks Garden Club, Gulf Publishing Company

Schoolyard Sanctuaries, Houston Arboretum and Nature Center, (713) 681-8433.

Worms Eat My Garbage, by Mary Appelhof, Flower Press, Kalamazoo, Michigan.

Teaching Kids About Birds (and other booklets), Bird Watcher's Digest, Pardson Corporation, 1-800-879-2473.

Green Teacher magazine, \$27. per year, P. O. Box 1432, Lewiston, NY 14092.

Education Goes Outdoors, Addison-Wesley Publishing Co., Acorn Naturalists, (800) 422-8886.

Educator's Activity Book About Bats, Bat Conservation International, (800) 538-BATS.

Beyond the Classroom, Exploration of Schoolground & Backyard, Acorn Naturalists, (800) 422-8886.

Bottle Biology, Kendall/Hunt Publishing Co., 4050 Westmark Dr., Dubuque, IA 52002. Also available from Acorn Naturalists, (800) 422-8886.

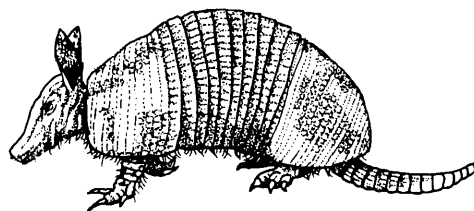
Texas Prairies - Relationships, for Grades 4-7, The Botanical Research Institute of Texas, 509 Pecan St., Ft. Worth, TX 76102-4060, (817) 332-4441.

Additional Resources:

Appendix E: Ecological Regions

by Noreen Damude, Texas Parks and Wildlife

Texas can be divided into 10 ecological regions according to the soil types, rainfall amounts, and vegetation. The Central Texas region surrounds the junction of 4 different ecological areas: the Edwards Plateau, Cross-Timbers and Prairies, Blackland Prairies, and Post Oak Savannah.



EDWARDS PLATEAU

The Edwards Plateau is a rugged area dominated by ashe juniper, various oaks, and honey mesquite. It encompasses 24 million acres in the central-west section of Texas and is built on a foundation of honeycomb limestone and the Edwards Aquifer. Caliche slopes, limestone escarpments, and thin clay soils are riddled with fossil remains of microscopic marine life, bearing testimony to the massive sea that once covered most of the state.

Topography is generally rough with elevations ranging from about 1000 to over 3000 feet, and annual rainfall varies from 15 inches in the west to more than 33 inches in the east. Droughts can be prolonged and frequent.

It is a region of great floral diversity, with 100 of the 400 Texas endemic plants occurring only here, including Texas snowbells, bracted twist-flower, Texabama croton, Texas wildrice, and rock quillwort. Tucked away in protected valleys you might find Texas madrone, Texas smoke tree, witch hazel, and big-tooth maple – trees normally found far from Texas. Perhaps nowhere else are the spring wildflowers so spectacular as in this region, with tapestries of bluebonnets, Indian paintbrush, gaillardia, and golden-wave.

Common vertebrate inhabitants of the Texas Hill Country include the white-tailed deer, armadillo, black-tailed jackrabbit, opossum, and Texas earless lizard. The purity and constant temperature of the waters provide ideal habitat for specialized spring dwellers including the Clear Creek gambusia, San Marcos gambusia, fountain darter, and San Marcos salamander. The unique Guadalupe bass and the Cagle's map turtle make their homes within the

clear waters of the larger rivers. Thousands of caves harbor cave shrimp and blind salamanders, which live only within the confines of these underground systems. The Edwards Plateau also provides a meeting ground for birds typical of both eastern and western regions. The green kingfisher, cave swallow, black-capped vireo, and golden-cheeked warbler nest more commonly here than in any other region in the state.

CROSS-TIMBERS AND PRAIRIES

The Cross Timbers and Prairies region covers about 17 million acres of alternating bands of wooded habitat crossing throughout a mostly prairie region – thus the term “Cross-Timbers.” Elevations range from about 600 to almost 1,700 feet while rainfall varies from about 25 inches in the west to 35 inches in the east. Grassland species of the region include little bluestem, Indiangrass, and big bluestem. Trees include Texas mulberry, American elm, and Osage orange (horse apple). Rusty blackhaw viburnum, American beautyberry, Arkansas yucca, and smooth sumac dominate the understory. In the western Cross-Timbers, live oak becomes more important, replacing the post oaks as you proceed westward. The decrease in moisture in the West discourages trees from growing close together except along streams, resulting in more expansive pockets of prairies separating isolated stands of trees. Here flameleaf sumac, redbud, aromatic sumac, Mexican plum, and eastern red cedar are more prevalent.

BLACKLAND PRAIRIES

The fertile, dark clay soil gives the Blackland Prairies their name. Characterized by gently rolling to nearly level topography, the land is carved by rapid surface drainage. Pecan, cedar elm, various

oaks, soapberry, honey locust, hackberry, and Osage orange (horse apple) dot the landscape. A true tallgrass prairie, the dominant grass is little bluestem. Other important grasses include big bluestem, Indiangrass, eastern gammagrass, switchgrass, and sideoats grama. While elevations from 300 to more than 800 feet match those of the Post Oak Savannah, the annual rainfall varies from 30 to 40 inches west to east. Described as “black velvet” when freshly plowed and moistened from a good rain, true blackland soils are deep, dark, calcareous deposits renowned for their high productivity. Scientists believe the richness of the prairie soils is derived from the abundant invertebrate fauna and fungal flora found in the soils themselves. Like many of the prairie communities comprising the Great Plains of North America, the Blackland Prairies are today almost entirely brought under the plow, with only 5,000 acres of the original 12 million remaining. For this reason, many authorities believe that the Blackland Prairies represent one of the rarest landscapes in Texas.

POST OAK SAVANNAH

The Post Oak Savannah emerges almost imperceptibly from the pine woods of East Texas. It is marked by subtle changes in soils and vegetation and occupies about 8.5 million acres of land. The topography is gently rolling to hilly with elevations ranging from 300-800 feet, rainfall averaging 35 inches to the west to 45 inches in the east. Soils of this region are interesting and complex – generally acidic, sands and sandy loams occur on the uplands, clay to clay loams occur on the bottomlands, and a dense clay pan underlies all soil types. Clay pan soils are nearly impervious to water and underlie the surface layers of soil at depths of only a few feet. As a consequence, the moisture available for plant growth is limited, making the habitat surprisingly arid at times. One curious exception to the clay pan soils occurs in Bastrop County, home of the renowned Lost Pines. The sandy soil harbors a unique community of loblolly pine, post oak, and blackjack oak and is also home to sphagnum bogs with ferns and carnivorous pitcher plants. The distinctive sandy inclusion of the Lost Pines area harbors one of the last refuges for the endangered Houston toad.

The Post Oak Savannah is punctuated by scattered oaks – mainly post oaks – and blackjack oaks. Black hickory may also be locally abundant. Widespread trees include eastern red cedar, cedar elm, sugarberry, and common persimmon. Other important species of the region are Southern red oak, sassafras, flowering dogwood, yaupon, and winged elm. Historically, wide vistas of tallgrasses – little bluestem, Indiangrass, switchgrass – and a myriad of wildflowers, broken only by the occasional motte of giant oaks, lent a park-like atmosphere to the landscape. Today, the Savannah is used largely for improved pasture, with vast acreage seeded with introduced grasses such as Bahia grass or Bermuda grass.



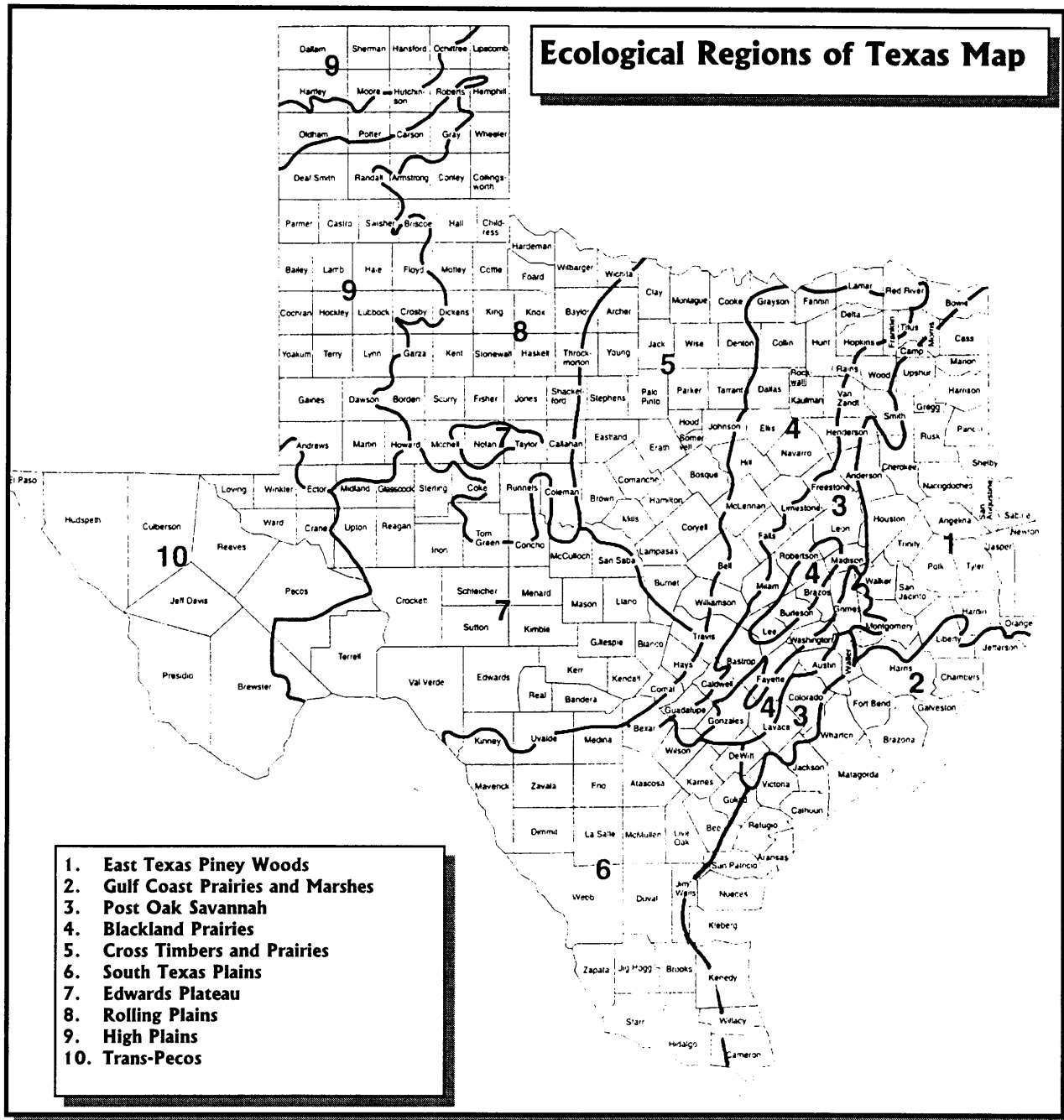


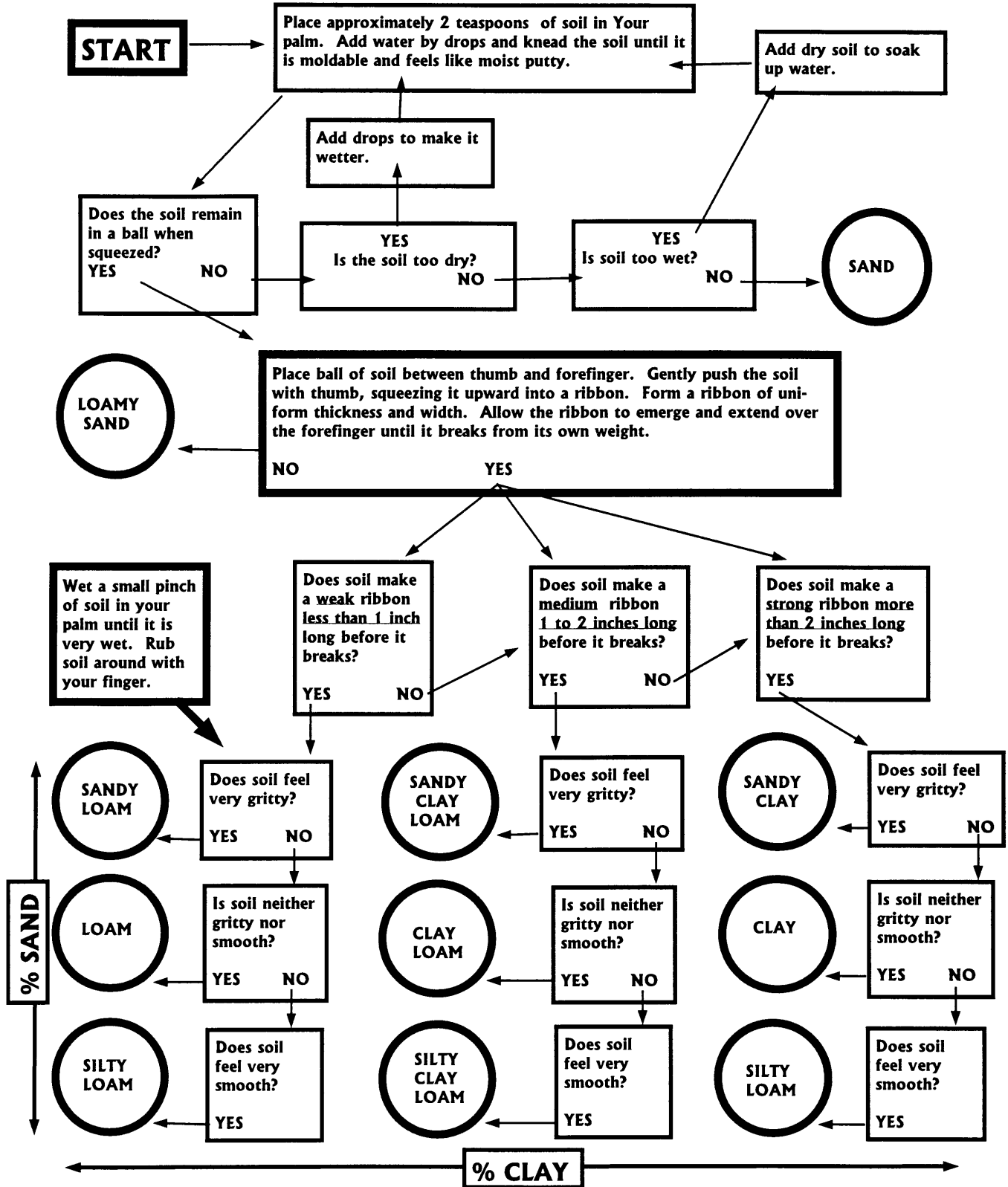
Figure (29). Map of the Ecoregions of Texas. (Source: Map adapted from F. W. Gould, G. O. Hoffman, and C. A. Rechenhth, *Vegetational Areas of Texas*, Texas A&M University leaflet 494.

Appendix G: Common Wildlife Foods

	Frogs	Salamanders	Turtles	River Otter	Bats	Raccoons	Woodpeckers	Snakes	Shrews	Owls	Beaver	Foxes	Hawks	Wood Duck	Bluebirds	Quail	Rabbit	Squirrel	Deer	Turkey	
	X		X			X	X							X	X	X				X	Spiders
						X	X							X				X	X	X	Acorns
						X								X				X		X	Nuts
																		X	X		Mushrooms
						X	X					X		X	X	X		X		X	Seeds
			X			X	X					X		X	X	X	X	X	X	X	Fruit
						X														X	Tubers, Roots
			X			X					X					X	X		X	X	Greens
	X	X	X		X	X	X	X	X	X		X	X	X	X	X				X	Insects
	X	X				X	X							X	X	X				X	Snails
											X						X		X	X	Leaves, Twigs
																			X		Lichens
																			X		Ferns
																	X	X	X		Buds
						X								X		X	X	X	X	X	Grain
											X						X				Bark
			X	X		X	X	X	X				X	X							Fish
	X			X		X		X	X				X	X							Frogs & Salamanders
	X			X				X					X								Snakes
	X		X	X		X							X	X						X	Crayfish
				X		X		X					X								Birds
				X		X		X	X	X		X	X								Small Mammals
			X									X		X							Aquatic Plants
			X								X										Carrion
	X		X			X		X	X			X									Earthworms
		X				X		X													Eggs
			X	X		X								X							Mussels

Appendix H: “Key to Soil Texture by Feel” Chart

Fig. (31). This key was adapted from a flow chart by Steve Thiem, 1979, source unknown.



Appendix I: Cost Estimate Worksheet, Page 1

PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
POND AREA:			
Backhoe rental with operator			
Pond Liner			
PVC Water Pipe to extend Water Line			
PVC Pipe Fittings			
15 gal. plants			
5 gal. plants			
1 gal. plants			
DECK/ STUDY PLATFORM:			
Boards -			
Boards -			
Boards -			
Nails -			
Concrete -			
PATHWAYS:			
Material -			
Edging -			
Lawn Roller Rental?			

Cost Estimate Worksheet, Page 2

PROJECT DESCRIPTION – ITEM	AMOUNT NEEDED	COST PER ITEM	TOTAL COST
WILDFLOWER / PRAIRIE AREA:			
Tiller Rental			
Herbicide			
Wildflower/ Prairie Seed			
OTHER:			
15 gal. plants			
5 gal. plants			
1 gal. plants			
Plants – other			
Mulch			
Tools –			
Wheelbarrow			
6' X 8' Tool Storage Building			
Chain Link Fencing			
Chain Link Double Gate			
Chain Link Single Gate			

Appendix J: Project Priorities Worksheet

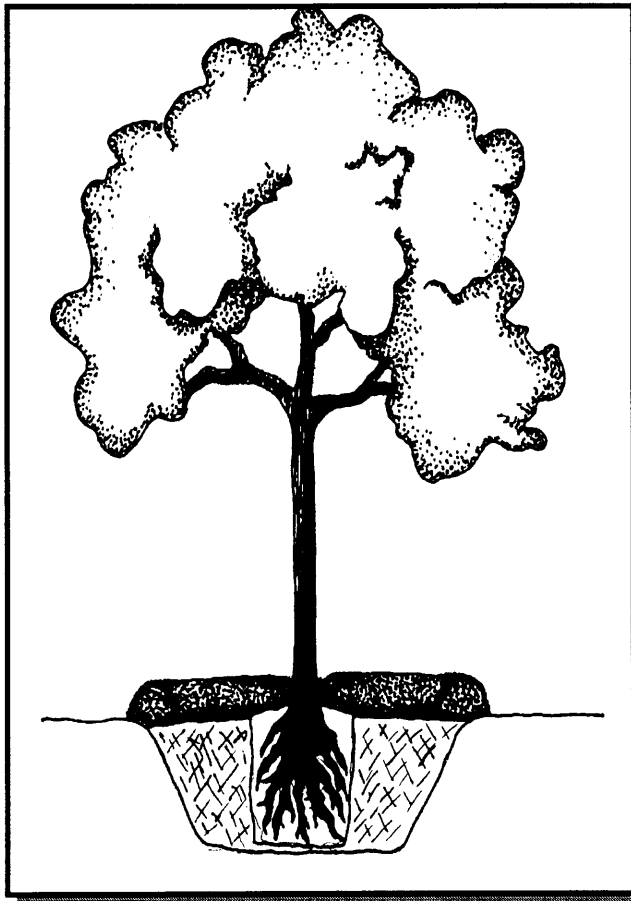
Phase #	Specific Project Name	Description of Task (Everything that must be accomplished to complete that project)	Cost	Start Date	Finish Date	Person To Complete Task

Appendix K: Tips on Planting Trees and Shrubs

from The Houston Area Urban Forestry Council

Trees do wonderful things. They create shade around buildings which decreases summer electric bills. Their cool, green leaves create a peaceful setting, clean and cool the air, buffer wind and noise, protect water quality, prevent soil erosion, screen unsightly areas, and provide food and cover for wildlife. For all the benefits trees provide, it is worth the extra effort to give them a good start.

PROPERLY PLANTED TREE



PLANTING TIME:

Generally, mid-November to late February is the best time to plant trees. Planting in late fall or winter will allow roots to become established before moisture demanding summer sets in. Most shade and ornamental trees sold in the nursery trade are either balled and burlapped or container grown.

6 STEPS TO PLANTING A TREE:

1. PLANTING A CONTAINER GROWN TREE –

Do not remove tree from container until you are ready to place into planting hole. Fine roots dry out rapidly when exposed to air.

2. HOLE SIZE - Loosen the soil in your planting site to a depth of 12 inches using a shovel or tiller. Dig a hole 2 to 3 times wider than the root ball and slightly shallower. The tree should be planted slightly above the original soil level. (This is especially important in heavy clay soils to aid in drainage.) When the hole is ready, gently remove the tree while lightly pressing against the sides of the container. If necessary, cut the container vertically to dislodge the root ball.

3. PLACING THE TREE IN HOLE - Set tree gently into hold, lifting by the root ball. When removing a tree from its container, take care to avoid breaking the root ball. Tree should be centered and level. Hold tree in place while backfilling around the root ball. Tamp soil lightly to eliminate air pockets. Large dirt clods should be broken apart before backfilling.

Figure (32). Properly Planted Tree. Dig the hole at least 2 to 3 times wider than the root ball. Slope sides of the planting hole. Gently place root ball into hole. Backfill with original soil. Build a ring of 3 to 4 inches of mulch around the tree with an indented saucer over root ball. Illustration by Michele G. Foss.

4. MULCHING - Remove any grass or weeds within a 3 foot minimum diameter circle around the tree. Create a slightly indented watering saucer. Cover with 3 – 4 inches of mulch composed of bark, woodchips, compost, or pine needles. Do not use fresh grass clippings. Do not place bark directly against tree bark.

5. WATERING - Adequate water is essential at planting time. Place water hose at base of tree and allow water to slowly trickle until the soil is saturated.

6. CARE OF NEWLY PLANTED TREE - After watering, add mulch to compensate for any settling. If your tree needs additional support, use two or three six-foot stakes pounded into the ground outside the root ball. Attach the tree to the stakes with wide nylon webbing. The tree should have enough freedom to sway in the wind to develop strength. The stakes should be removed after the first growing season.



TREE PLANTING TIPS

- Loosen the soil far beyond the drip line of the tree.
- Brace the tree only if it will not remain upright in a moderate wind.
- Brace with broad, belt-like material that will not injure the bark. Remove after one growing season.
- Cover root ball with mulch, but keep trunk exposed.
- Keep soil moist, but not water-logged.
- Remove dead, diseased and damaged branches.
- If planting a balled and burlapped tree, check with your local resource professionals for advice on proper methods for your area.

MISTAKES TO AVOID

- Do not plant too deep.
- Do not wrap trees.
- Do not amend the soil, unless the soil is very unhealthy.
- Do not brace the tree so tightly that the tree cannot sway.
- Do not leave the bracing material on for more than one growing season.
- Remind students to remove the container before placing the plant in the ground.

Appendix L: Sample Butterfly & Hummingbird Garden

- GARDEN CHECKLIST:**
- For Hummingbirds**
- _____ Open space for flying
 - _____ Tubular, nectar-rich flowers
 - _____ Twig perches nearby
 - _____ Source of small insects, such as gnats
- For Butterflies:**
- _____ Open spaces in full sun for fluttering
 - _____ Away from strong winds or provide windbreak
 - _____ Masses of color (pink, purple, yellow, orange)
 - _____ Fragrant, nectar-rich flowers
 - _____ Larval food plants
 - _____ Puddling area

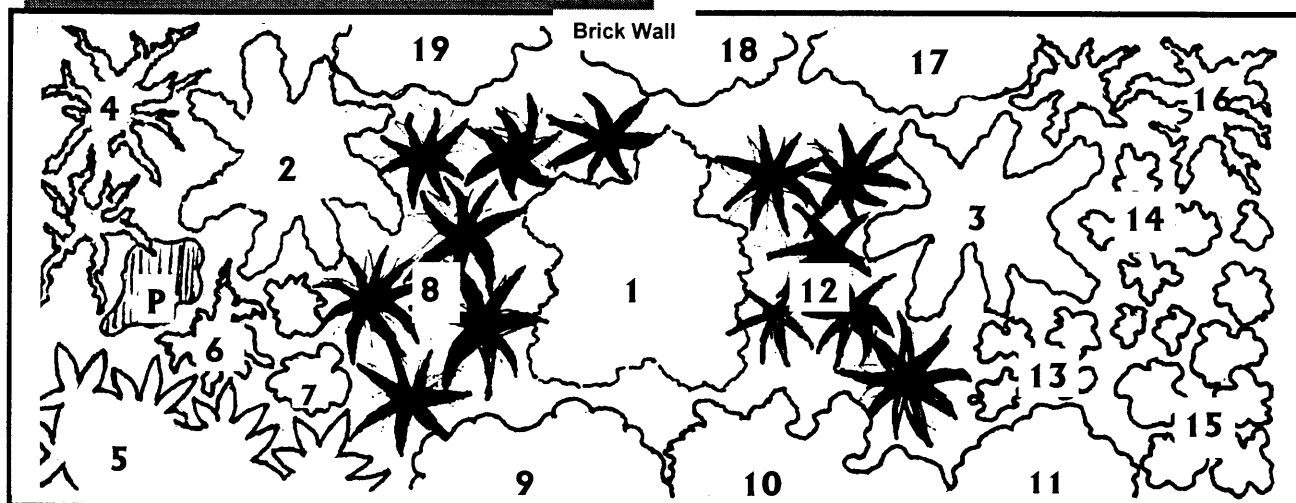


Figure (33). Sample design for a simple 10 foot by 28 foot butterfly and hummingbird garden. The garden is located in full sun against a brick wall. The design includes nectar sources for hummingbirds and butterflies, as well as a few larval host plants for caterpillars. Larger shrubs and vines could be planted nearby. The map scale is 1 inch equals 4 feet. Illustration by Michele G. Foss.

MAP LEGEND:

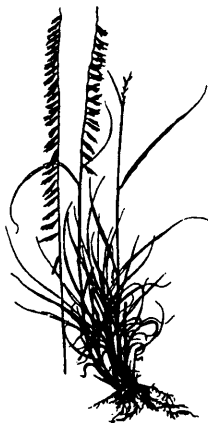
- | | | |
|------------|-------------------------|-----------------------------------|
| 1 | Hummingbird Bush | (<i>Hamelia patens</i>) |
| 2, 3 | Butterfly Bush | (<i>Buddleia sp.</i>) |
| 4 | Mexican Bush Sage | (<i>Salvia leucantha</i>) |
| 5 | Purple Coneflower | (<i>Echinacea purpurea</i>) |
| 6 | Mealy Blue Sage | (<i>Salvia farinacea</i>) |
| 7 | Dill | (<i>Anethum graveolens</i>) |
| 8, 12 | Milkweed | (<i>Asclepias sp.</i>) |
| 9 | Purple Asters + Winecup | |
| 10 | New Gold Lantana | (<i>Lantana sp.</i>) |
| 11 | Prairie Verbena | (<i>Verbena bipinnatifida</i>) |
| 13 | Fennel | (<i>Foeniculum vulgare</i>) |
| 14 | Gulf coast penstemon | (<i>Penstemon tenuis</i>) |
| 15 | Pentas | (<i>Pentas lanceolata</i>) |
| 16 | Scarlet sage | (<i>Salvia coccinea</i>) |
| 17, 18, 19 | Maximilian Sunflower | (<i>Helianthus maximiliani</i>) |
| P | Puddling area | |

REFERENCE MATERIALS

- The Hummingbird Book** by Donald and Lillian Stokes, Little, Brown and Company publishers.
- The Butterfly Book** by Donald and Lillian Stokes, Little, Brown and Company publishers.
- How to Attract Hummingbirds & Butterflies**, Ortho Books, Chevron Chemical Company, Consumer Products Division, Box 5047, San Ramon, CA 94583.
- Butterfly Gardening for the South** by Geyata Ajilvsgi, Taylor Publishing Company.
- Butterflies of Houston & Southeast Texas** by John and Gloria Tveten, University of Texas Press, Austin.

Appendix M: Establishing a Prairie and Wildflower Area

Your school habitat will likely attract more birds and insects than any other wildlife. Both of these wildlife groups can provide many opportunities for observation. Insects not only attract birds to your habitat, but also offer life cycle observations that can be conducted outdoors or moved into the classroom. Herbaceous vegetation in the form of forbs (i.e., wildflowers) and grasses is more likely to attract insect species, including butterflies, than any other type of vegetation.



Schools often want to plant wildflowers for their aesthetics, and it is often seen as an inexpensive and easy project to do with children. Wildflowers alone do not constitute a habitat type. Mixed with native grasses, these areas will resemble the native prairie (see Appendix E) that once covered much of the Houston area. To maximize your ability to attract insects, it is necessary to provide a mix of forbs and grasses that will provide both food and cover for a wide variety of species. This bit of habitat may also provide food and cover for some bird species.

The establishment, maintenance and sustainability of these areas can be one of the most difficult phases of your school habitat projects. The area may also draw the most comments, both positive and negative.



The establishment of a prairie/wildflower area is divided into 3 phases:

1. Site preparation
2. Planting
3. Maintenance

1. SITE PREPARATION

Site preparation may be the most important aspect of this project. The successful establishment of desired species is directly related to how well you remove and control undesirable competitors, many of which are exotic plant species. Complete elimination of this vegetation should be your goal. There are several techniques available to achieve this goal. Choose a technique or combination of techniques suitable for your site and appropriate for your skill level and available resources.

Methods for Removing Vegetation:

Cultivation

This method includes such techniques as plowing, tilling, rototilling, and scarifying. Cultivation serves to kill undesirable plants and their germinating seeds. This process can be effective but labor intensive and requires the use of machinery. Repetition will probably be required to kill plants that germinate from dormant seeds brought to the surface. Many perennial weeds may not be destroyed by this process, and may, in fact, be spread and increased. This is not an appropriate technique for erosion prone sites. Repeated cultivation may be detrimental to the soil structure.

Herbicide Treatment

If this method is chosen, use a low toxicity, non-persistent herbicide, such as Round-up or Kleenup and follow the manufacturer's instructions carefully. Apply the chemical to green, actively growing vegetation. Wait two weeks and apply again, if necessary.

If your site contains a lot of rank or previous year's growth, it will probably be necessary to mow and rake up the cuttings. After cleaning up, allow the regrowth to reach 6-8 inches tall before applying the herbicide. Tilling done later during seed bed

preparation may bring dormant seed to the surface, resulting in the need for an additional treatment with herbicide or additional tilling for control. This treatment is an effective technique for weed removal and works well on erosion prone sites. Remember that school districts may restrict the use of herbicides or require the spraying be conducted by a licensed applicator.

Solarization Method

Solarization is the process of trapping heat generated by sunlight to kill plants and sterilize the soil. This method involves wetting the soil surface and covering it with clear or black plastic sheeting. Some studies indicate that clear plastic is more effective than the black. The material will have to be anchored down to keep it in place. In our climate, ultraviolet light tends to break the plastic down within one season. To be totally effective, the plastic should remain in place for an entire year to allow for the control of both cool and warm season plant species. While this is a safe process, it can be expensive and impractical for a large area. Some of the tougher plant species may still persist after this treatment.

Your site may require a combination of these methods to achieve the best results. You will find that your efforts will be rewarded by higher survival of your desired species.

Seedbed Preparation

For the most part, seedbed preparation should only consist of lightly tilling or discing of the soil. The goal is to prepare the soil to enable good seed contact with the soil. Tilling or discing should be restricted to the top one or two inches of the soil. By tilling deeper, you encourage undesirable dormant seeds to germinate.

2. PLANTING

The planting process provides another good opportunity to involve students. Students can do everything from selecting the proper plant species for your site to doing the actual installation.

Plant Selection

Select species native to this area. Choose species that match your site conditions. Remember that most of the plants in a prairie

wildflower area prefer full sunlight. Select a mixture with approximately 60% grass species and 40% forbs. You may find that emphasizing perennial species will result in a more successful project. Prepared seed mixes available on the market tend to have a high percentage of annual species. Purchase seeds from a reputable source. [Avoid purchasing seed mixes or “seed mats” that don’t list the flower species on their packaging. These mixes are usually designed for cooler climates and cannot handle our summer heat.] If you collect seeds from the wild, make sure you obtain the permission of the landowner. Never collect more than 50% of the seed available in that wild spot. By leaving half the available seed, this will leave seeds to germinate in the wild next year. Rescuing plants from an area that will be developed, with the landowner’s permission, would be the exception to the collection rule.

Seeding Rates

The seeding rate is the amount of seed applied to a given area, usually shown as lbs./acre or ozs./ 1000 sq. ft.. Seeding rate is based on the PLS (pure live seed) content of your mixture. Seed purchased from a reputable dealer will have the PLS content indicated on the packaging, as well as the recommended seeding rate. You will not know the PLS content for seeds you hand collect from the wild and planting rates may be difficult to calculate. For calculating seeding rates for collected seed, use the rates recommended by seed dealers and then err to the excessive.

Planting Technique

Many of the seeds you will be working with are very small. Several thousand seeds per one ounce is not uncommon. To evenly distribute such tiny seed on your site, it is necessary to dilute them by mixing them with a suitable material, such as dampened sand or sawdust. Use a volume of sand or sawdust equal to or greater than the volume of your seeds.

The more you dilute your seed mixture, the more students you can involve in the planting activity. Divide the mixture in half. Distribute one half of the mixture between the students and have them broadcast it gradually while walking across the site. Distribute the second half of the seed and broadcast it while walking perpendicular to your first path. This process will allow for a more even distribution

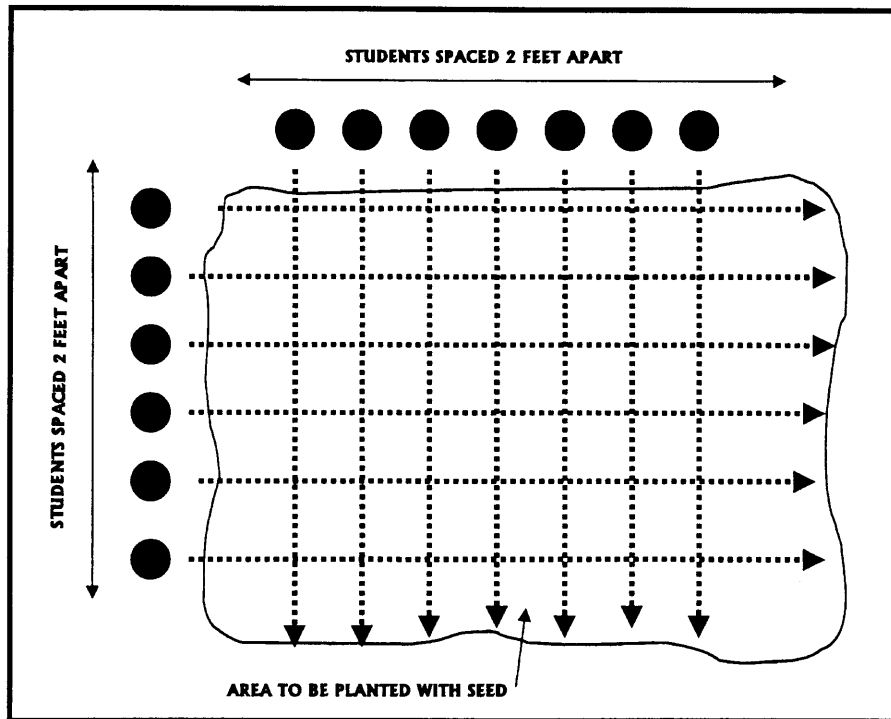


Figure (34). Student Seed Planting Activity. Students line up on two sides of the site to be planted with seed. Students on one side walk in straight lines from their side to the opposite side, gently releasing seed all along their path. Then students from the other side walk in lines perpendicular to the original students' paths. This process results in a fairly even distribution of the seeds.

of the seed mixture. Lightly rake the soil surface. Have the students walk back and forth across the site or rent a lawn roller to gently push the seed mixture into the soil surface. Good soil contact is important for germination success. **Burying the seed is not your goal.** Many of these seeds require light to germinate. Watering after planting may not be necessary and may actually favor the germination of weed seeds. Late summer through fall is the best time to plant warm season grasses and spring or summer blooming wildflowers. Late winter into early spring is the best time to plant fall-blooming wildflowers.

Establishing your habitat with containerized plants rather than from seed will give you quicker results. However, you may find the cost prohibitive and that not as many species are available in containers. An alternative would be to have students raise the plants from seed and transplant them to the habitat. You may choose to use this alternative method for those plant species that are difficult to germinate in the field and then have your students intersperse the seedlings with those that were seeded directly into the ground.

3. Maintenance

Most seeds will germinate the first year. If optimum conditions do not exist the first year, some seeds may lie dormant and then germinate the second year. Many of the grasses concentrate on establishing root systems the first year and as a result, do not produce much top growth. The second year these grasses will produce more top growth and may bloom.

This several year process aids in prairie management. Many unwanted weeds are annuals that will grow taller than your desired prairie species. Therefore, to maintain the prairie, you can cut down the taller annual weeds without damaging your new grass or wildflower seedlings. The goal is to cut the undesirable annuals before they produce and distribute their seed. During the second or third years, you may want to reseed any bare spots or add transplants to increase your plant diversity.

Controlling Invasive Species

You will probably discover that spot applications of herbicide and hand weeding are necessary. If used, a herbicide should be applied to a specific problem plant only, called spot treatment, rather than sprayed widely over the area. Be persistent in controlling invaders, such as bermuda grass and johnson grass. If these tough, invasive grasses persist while your project becomes established, it will be extremely difficult to control them. After these invaders wind their way among your desired plants, spot treatment with herbicide can be almost impossible. Without control, they will eventually outcompete the natives and become the dominate plants in your site.

Prairies benefit from occasionally being burned. In most cases, this is not practical on a school site. An annual mowing in late winter will be your best substitute. However, do not mow your entire site at one time. Instead, mow in small sections at a time, or in a mosaic of strips with unmowed sections in between. As the prairie wildflower area matures, it will provide wintering areas for various insects. Leaving some of it untouched each year assures that some winter cover remains available for wildlife.

ROOT SYSTEMS IN A PRAIRIE

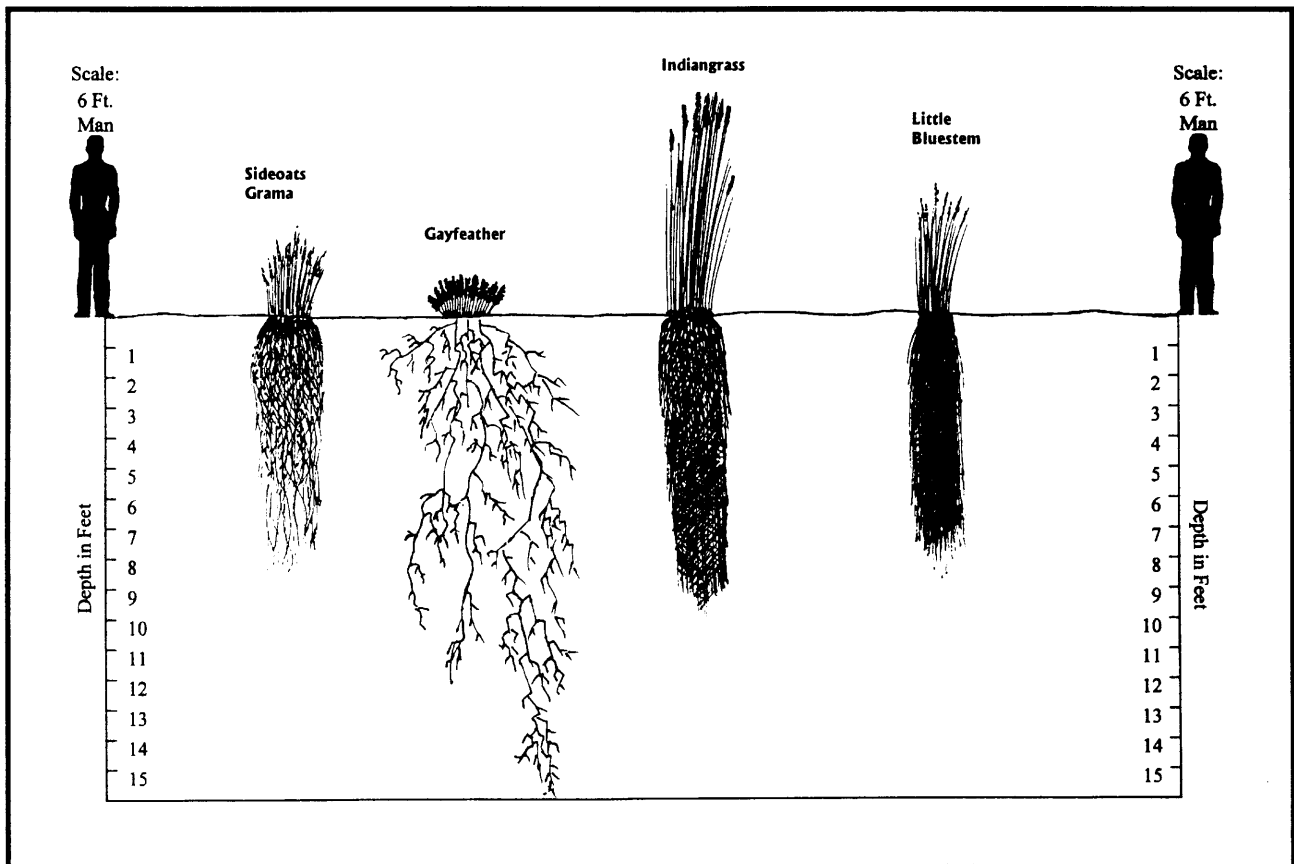
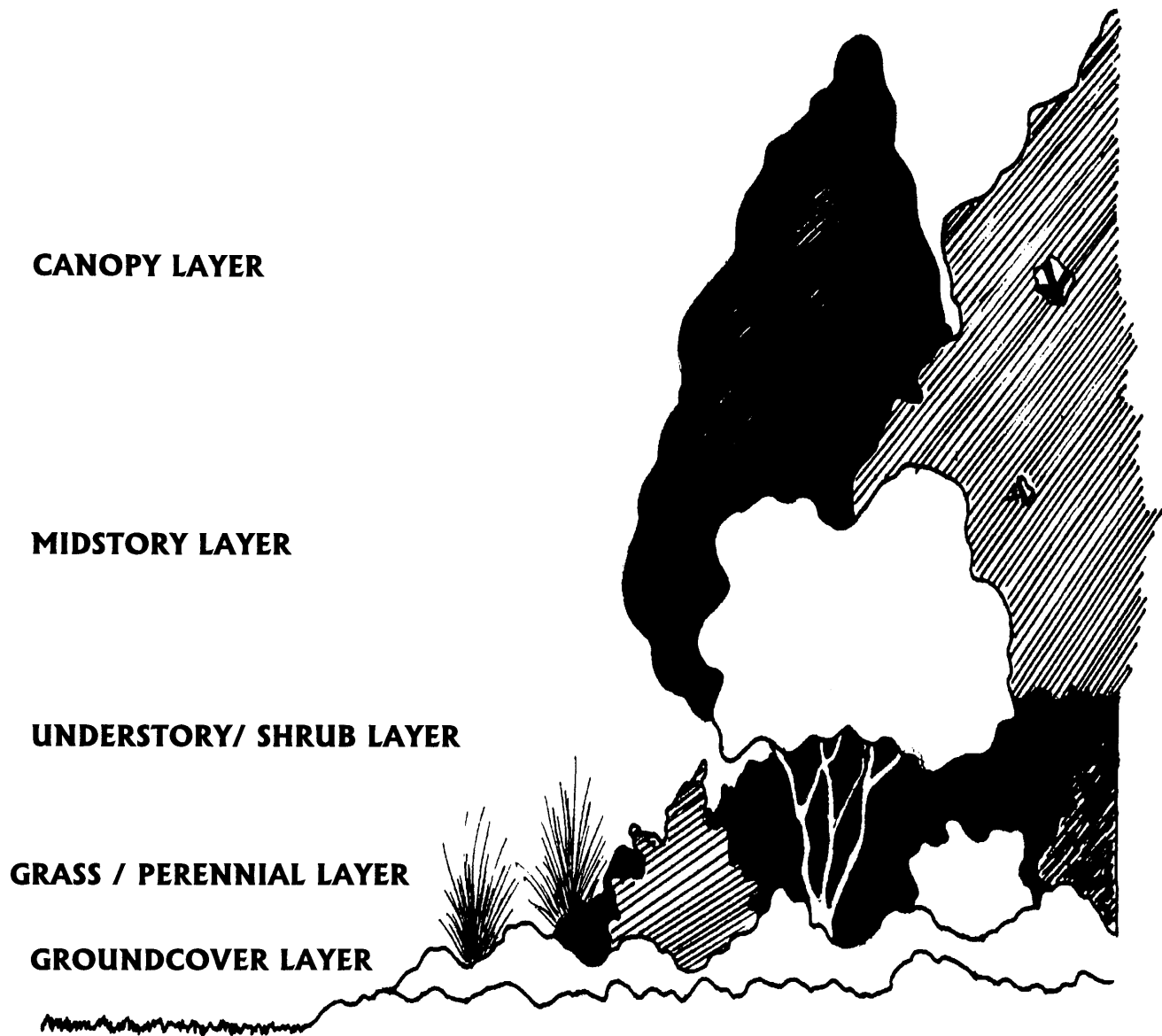


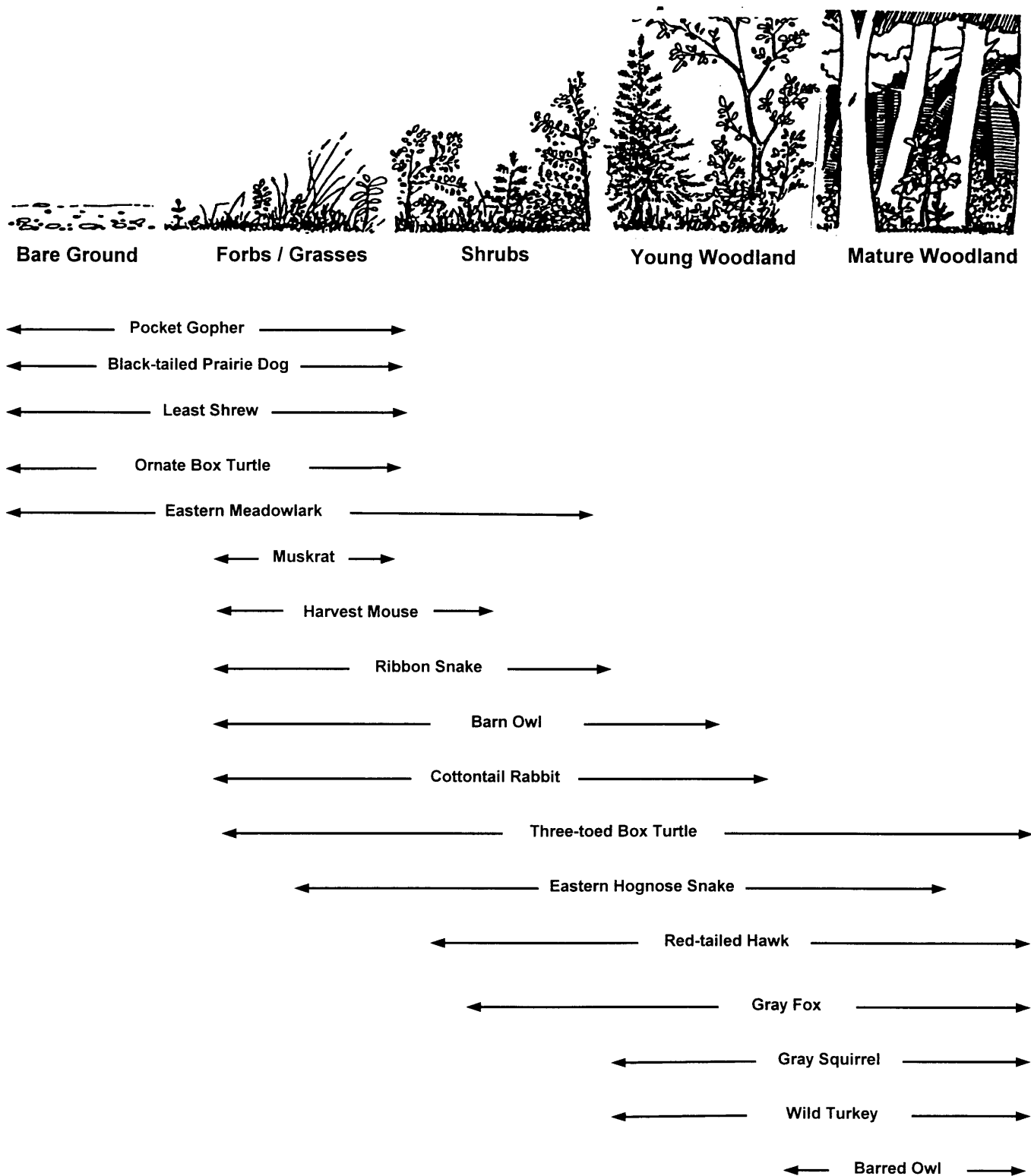
Figure (35). Prairie Root Systems. Extensive root systems are essential for vigorous growth, even during unfavorable weather conditions. The roots hold the plant in place and absorb soil water and nutrients. Perennial plant roots function as surplus food storage centers. Most of the plant root material is concentrated within the top 12 inches of soil; however, as illustrated, many desirable species have deep, vigorous feeding root systems. Illustration by Michele G. Foss.

Appendix N: Vertical Layering in a Habitat



Layers in a habitat. Try to reproduce the many vegetation diversity and layers in a natural habitat in your school habitat. The majority of wildlife species utilize the lower two thirds of a habitat. Illustration by Michele G. Foss.

Appendix O: Stages of Plant Succession and Associated Wildlife Species



Stages of Plant Succession and Associated Wildlife Species. Modified from Homes for Wildlife, published by the New Hampshire Fish and Game Department.

Appendix P: Constructing Raised Beds

If you are constructing raised beds for planting annuals or perennials, delineation and preparation of your beds should be done prior to planting.

1. Kill or remove the grass from the bed area. There are several methods you may choose.

- One method involves using herbicides, such as Roundup, to kill the grass. Remember that most general herbicides kill all plant material they touch, so spray on windless days.
- Another method, called smothering, involves placing black plastic, 3 to 7 layers of newspaper, or cardboard over the grass to deprive it of light. A variation is to place plastic down with a layer of mulch on top. The cover must remain in place for approximately 3 months. When ready to plant, you may remove the cover completely, or simply cut holes through the plastic to plant. The dead grass layer may be left in place to decompose, thus forming a weed barrier and providing nutrients for the soil.
- Another alternative is to dig out the grass layer by hand. Simply tilling the grass, especially Bermuda grass, into the ground without killing it first is a mistake. The grass usually re-seeds or re-sprouts and grows up through your newly planted bed, requiring you to dig it out by hand.

2. Estimate the amount of soil, mulch, sand, or compost you need. To do this, determine the number of square feet of garden bed you need to fill. Then decide how deep (in inches) you want your soil. Remember that fluffy soil will eventually settle, so plan to add a little extra. Use the Soil Estimation Formula (Figure) to determine the number of cubic yards of soil you need. (Example: Your planting area measures 10 feet long by 12 feet wide. You want the soil in a raised bed 4 inches deep. Multiply 10 feet by 12 feet by 4 inches. Divide by 324. You will need to order 1.5 cubic yards of soil for your area.)

3. Add any soil amendments at this time to correct deficiencies in the soil. (See Soil Health) Till or mix the soil by shovel. Water the soil and allow the area to settle for a week.

4. Use garden hose, rope, string, stakes, lines of flour, or spray paint to temporarily delineate bed edges. Add edging, if desired.

SOIL ESTIMATION FORMULA

$$\text{Volume of Soil (cubic yards)} = \frac{\text{Length of Area (feet)} \times \text{Width of Area (feet)} \times \text{Depth of Area (inches)}}{324}$$

Figure (36). This formula determines the amount of soil, compost, or mulch, in cubic yards, that you will need to order. Pay close attention to the units of measurement when using the formula. Do NOT convert so that all the units are the same.

SOIL HEALTH

Good soil health insures plant health. Soil should be loose, fluffy, and fairly well-drained. If your soil resembles hard packed cement, then you need to add some ingredients to amend the soil, such as compost, mulch, leaves, or sand. By mixing in the appropriate ingredients, you return needed nutrients to the soil and improve its ability to drain water.

- **Simply add small amounts of compost and dead leaves to the soil and till them in. Over a long period, these additions will gradually improve the soil.**
- **For a quicker solution, order a larger amount of compost or topsoil and add this regularly to your topsoil.**

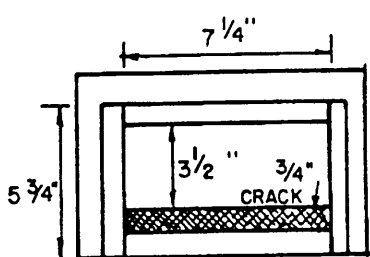
Appendix Q: Nest Box Specifications

BIRD SPECIES	FLOOR SIZE (Inches)	DEPTH OF CAVITY (Inches)	ENTRANCE HEIGHT ABOVE FLOOR (Inches)	DIAMETER OF ENTRANCE (Inches)	HEIGHT ABOVE GROUND (Feet)
Eastern Bluebird	5 x 5	8	6	1 1/2	5
Chickadee	4 x 4	8 – 10	6 – 8	1 1/8	4 – 15
Carolina Wren	4 x 4	6 – 8	1 – 6	1 1/2	6 – 10
House Wren	4 x 4	8 – 10	1 – 6	1 1/4	6 – 10
Tufted Titmouse	4 x 4	8 – 10	6 – 8	1 1/4	6 – 15
Red-headed Woodpecker	6 x 6	12	10	2	10 – 20
Northern Flicker	7 x 7	16 – 18	14 – 16	2 1/2	6 – 20
Barn Owl	10 x 18	15 – 18	4	6	12 – 18
Screech Owl	8 x 8	12 – 15	9 – 12	3	10 – 30
Wood Duck	10 x 18	10 – 24	12 – 16	4	10 – 20

Appendix R: Bat House Plan (Small)

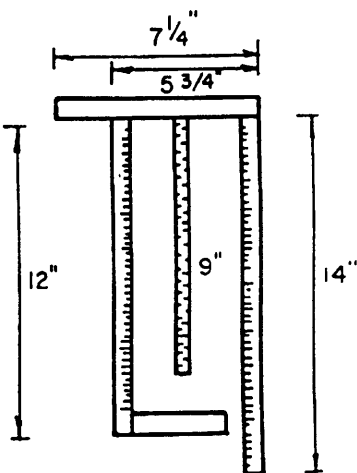


BOTTOM VIEW

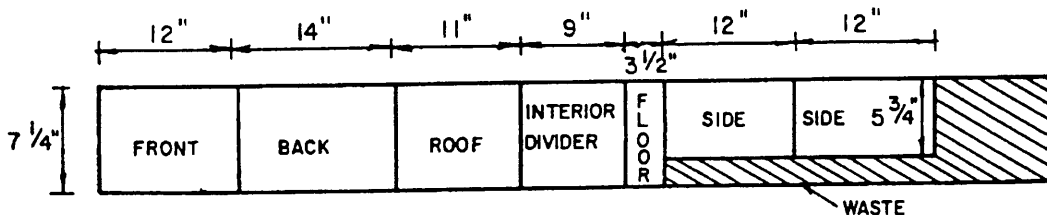
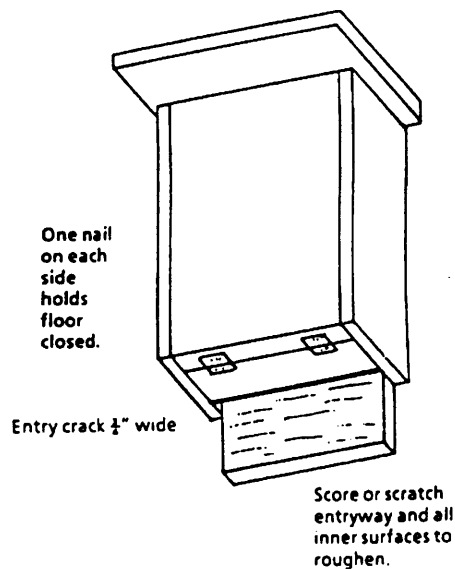


Cover top and 2" down sides with tarpaper.

SIDE VIEW (cut away)



FRONT VIEW (as mounted on bldg.)

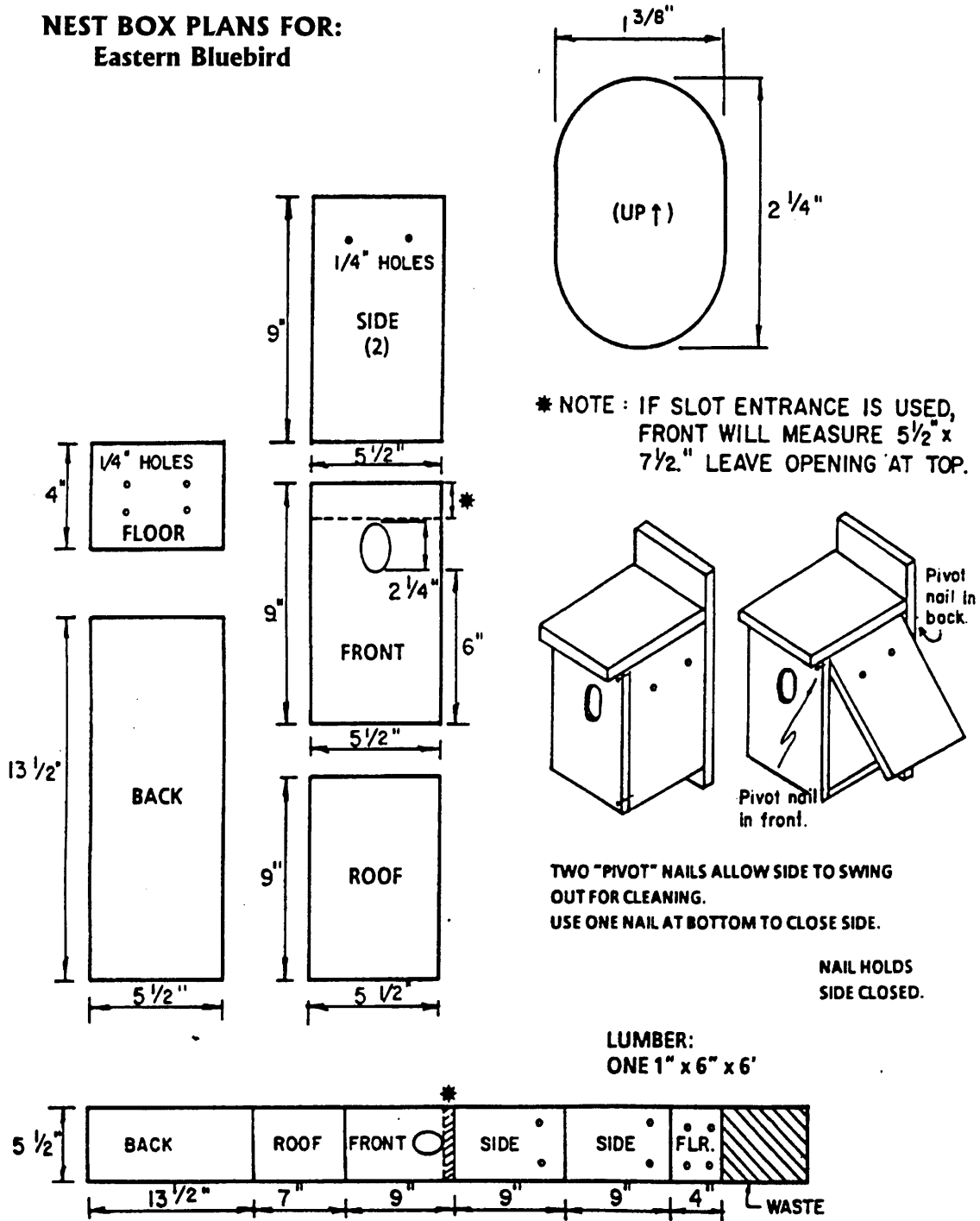


LUMBER: 1 inch X 8 inch X 8 feet

Plans for a small bat house. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

Appendix S: Small Nest Box Plan

NEST BOX PLANS FOR: Eastern Bluebird



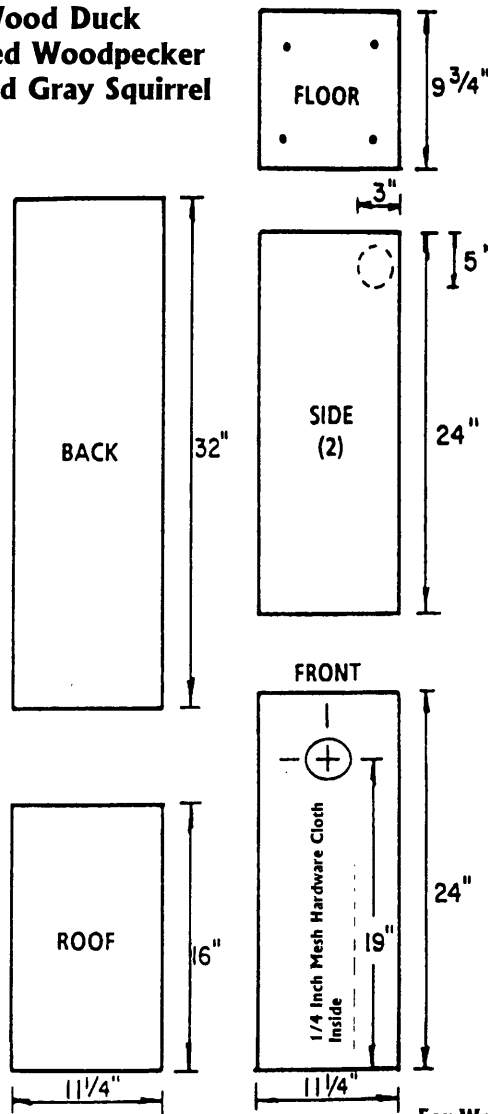
Plans for bluebird nest box. Reprinted from Woodworking for Wildlife, Minnesota Department of Natural Resources.

Appendix T: Large Nest Box Plan

NEST BOX PLANS FOR:

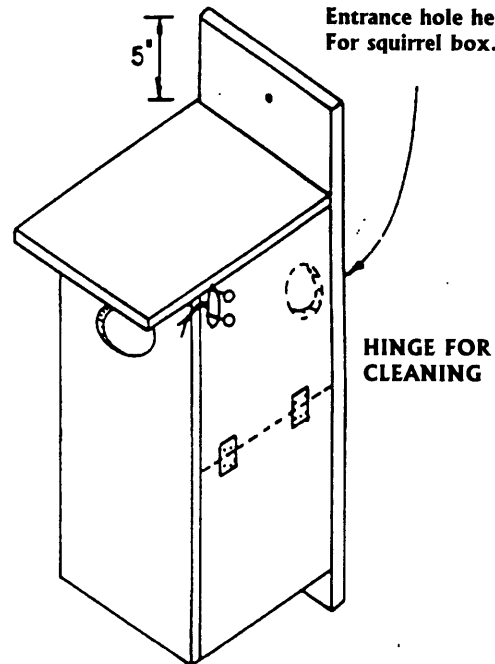
Wood Duck
Pileated Woodpecker
Fox and Gray Squirrel

Wood Duck 3" high & 4" wide oval
Fox and Gray Squirrel 3" diameter round
Pileated Woodpecker 4" diameter round



Optional Site for Squirrel box entrance

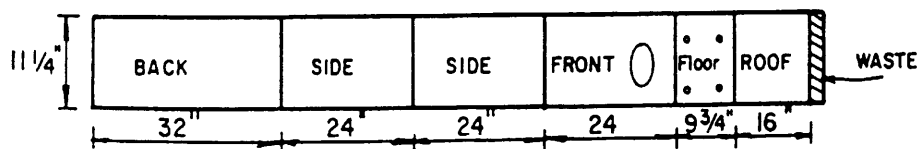
OPTIONAL: Locate 3" diameter Entrance hole here For squirrel box.



Lumber
One 1 inch X 12 inch X 12 foot

For Wood Duck House:
Place 3 to 4 inches of
Wood chips in bottom of
box.

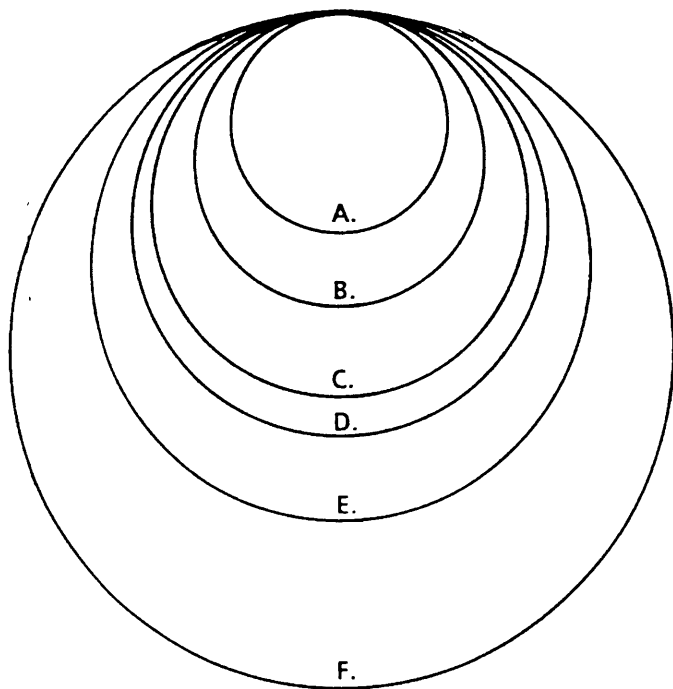
For Pileated Woodpecker
House: Fill box to top with
sawdust.



Note: Pileated Woodpecker box should be constructed from One 2 inch X 12 inch X 12 foot cedar. Floor must be 8 1/4 inches Long instead of 9 3/4 inches.

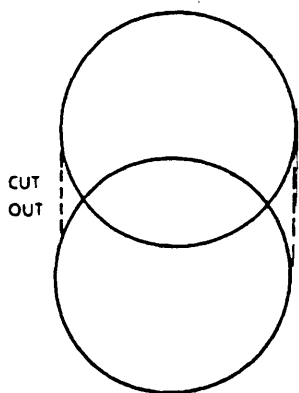
Nest Box Entrance Hole Sizes

ENTRANCE HOLE SIZES FOR SONG-
BIRD, WOODPECKER, AND SQUIRREL
NEST BOXES

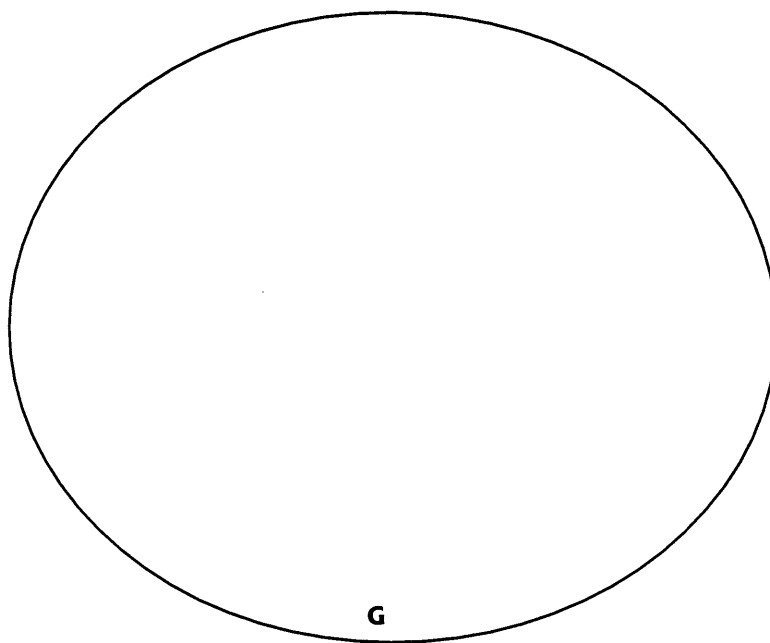


TRACE ONTO WOOD WITH
CARBON PAPER.

- A. House Wren, Chickadee, Titmouse, Prothonotary Warbler
- B. Great Crested Flycatcher
- C. Purple Martin
- D. Common Flicker
- E. Squirrel, Screech Owl, Kestrel
- F. Pileated Woodpecker
- G. Wood Duck



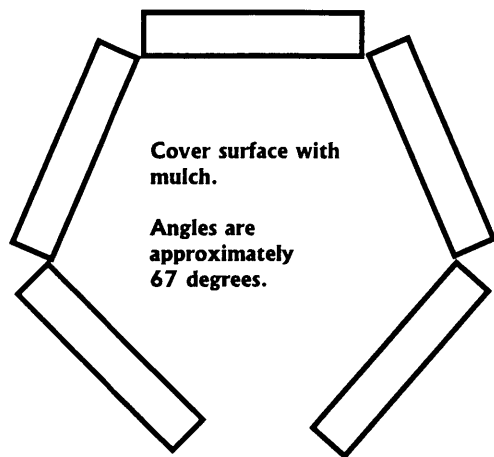
EASTERN BLUEBIRD &
TREE SWALLOW
(DRILL 2 HOLES 1 3/8"
DIAMETER. CENTERED 7/8"
APART.)



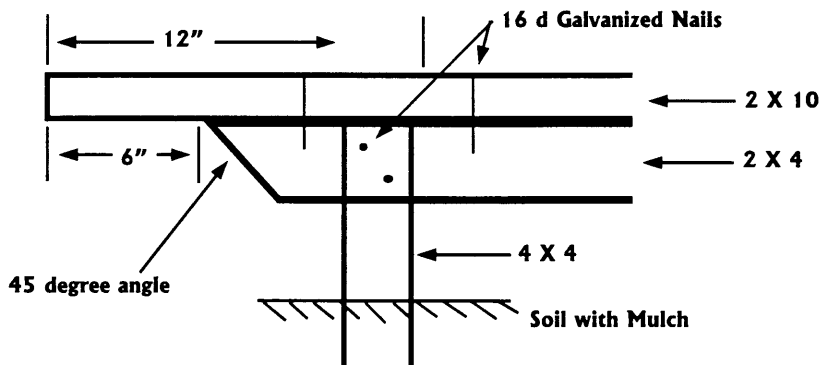
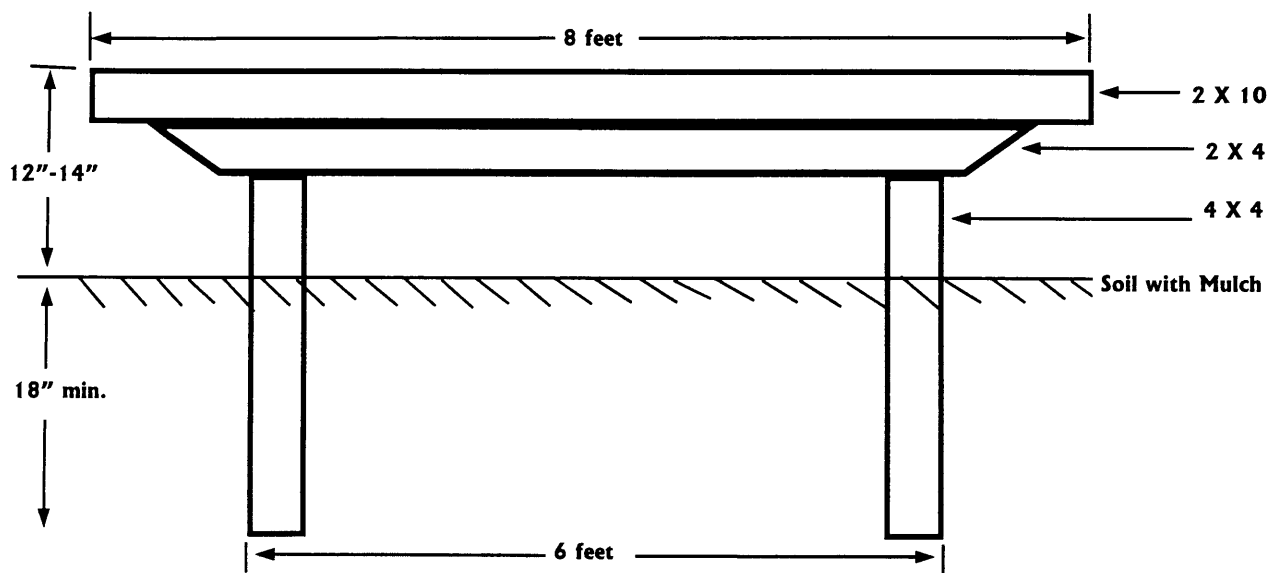
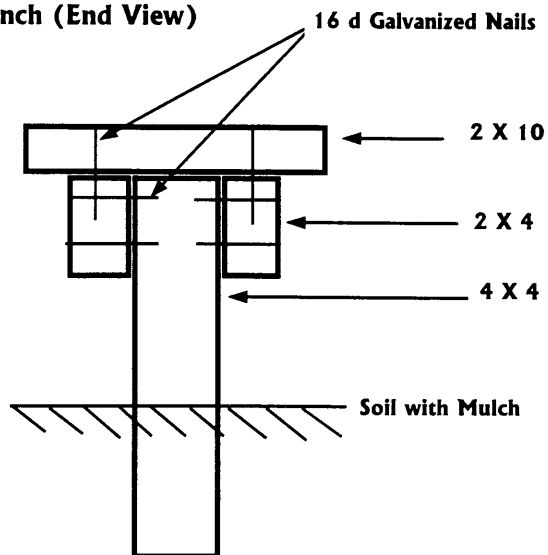
Each species prefers a specific hole size in their in their nest box. Use the illustration above to trace the correct hole shape and size onto the wood.

Appendix U: Sample Bench Design

Bench Configuration



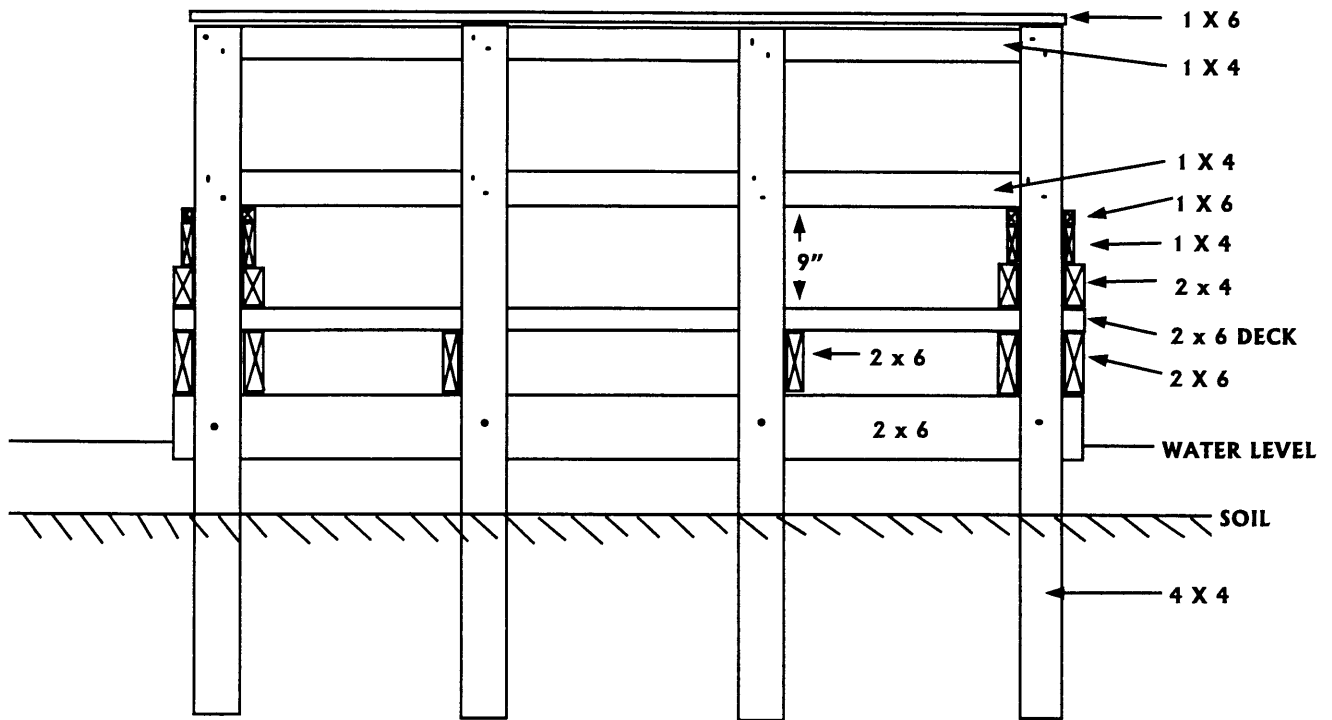
Bench (End View)



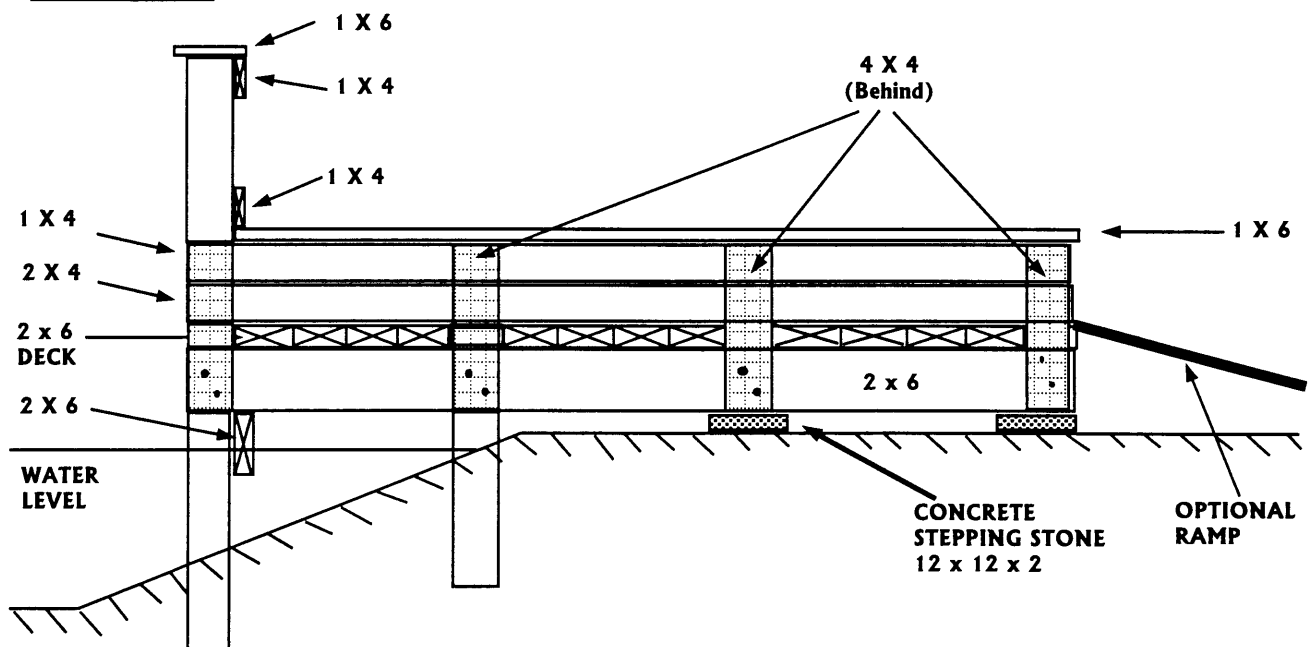
Typical outdoor bench design. Note that all lumber is pressure treated yellow pine. Nails are 16 penny galvanized screw or ring shank. Landscape timbers may be substituted for the 4 X 4 material. Nails are spaced 12 inches apart off center. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix V: Sample Study Platform/Deck Design

FRONT POND VIEW



SIDE VIEW



Concept design for Study Platform to provide student access to water features. Style and dimensions of the platform may vary with need, construction techniques, site modifications, etc. Note that all wood is pressure treated. All fasteners are galvanized. Design by Ronald K. Jones, U. S. Fish and Wildlife Service.

Appendix W: Plant Tables

