

H.O.P.E. Guidebook for Goochland-Powhatan Master Gardener Volunteers



From the Garden

Helping Our Planet Endure

Our mission is to **identify**, **practice**, and **promote** gardening principles that have a positive impact on the environment.



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Table of Contents

- Foreword..... 1
- Call to Action 1
- Build and Maintain a Healthy Soil..... 2
- Minimize the Use of Pesticides 5
- Reduce Lawn Areas 7
- Incorporate Native Plants and Replace Invasive Non-natives 9
- Provide a Healthy Habitat for Wildlife 12
- Conserve Water 14
- Mitigate Storm Water Runoff 16
- Adopt Gardening Practices that Contribute to Clean Air..... 17

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The purpose of this document is to suggest specific practices that our Master Gardener volunteers can adopt to help protect our natural resources and the ecosystems that depend on them. Using this document as a guidebook, our volunteers are developing informational materials, displays, talks, etc. to inform gardeners in our communities about practices they can adopt to help our planet endure.

Foreword

Our planet is in an environmental crisis. Many of our traditional agricultural and horticultural practices contribute to the production of three damaging greenhouse gases: carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). As these greenhouse gases enshroud the earth, they trap the sun's heat, leading to global warming and climate change. Climate change affects temperatures, precipitation patterns and water availability, and causes ever more extreme weather events.

We see the effects in our own gardens and landscapes. Drought, excessive rain, and dramatic temperature swings mean that flowers bloom earlier, plants we once relied on are struggling, and others we thought too tender may thrive. It's more than an inconvenience. Pollinators can't find the right flowers at the right time, migrating birds look for seeds and berries in vain when and where they once were plentiful, and caterpillars can't find the leaves they depend on for food. As a result, populations of countless invertebrates, vertebrates, and plants are diminishing or even disappearing completely.

These organisms form the intricate web that sustains our planet's very life. Together, they keep soils healthy, pollinate our plants, and balance complex natural ecosystems. Like these organisms, we gardeners rely on precious natural resources like water and clean air to keep our gardens (and ourselves) healthy and productive. Using these resources wisely ensures they will be available for generations to come.

Goochland-Powhatan Master Gardener Volunteers Call to Action

As members of a vibrant research-based organization, Extension Master Gardener volunteers can learn, adopt, and teach gardening practices to help protect natural resources and stem the loss of these invertebrates, vertebrates, and plants -- one garden at a time. Practices that we can adopt and promote to other gardeners will "help our planet endure." Some are "no-brainers" and some will take a bit of adjustment in our thinking. Starting in 2022, the Goochland-Powhatan Master Gardener Volunteers will adopt an environmental initiative promoting practices that will help:

- keep our **land** healthy and support the life that depends upon it
- keep our **waters** clean and plentiful
- minimize gardening activities that contribute to **air** pollution.

The remainder of this document outlines the practices we will promote in the following areas:

- Building and maintaining a healthy soil.
- Minimizing the use of pesticides.
- Reducing lawn areas.
- Incorporating native plants into our landscapes and eliminating invasive plants.
- Providing healthy wildlife habitats.
- Conserving water.
- Managing stormwater runoff.
- Adopting gardening practices that contribute to clean air.

For each area, actions to achieve that goal are included as well as research-based reasons why that practice is important.

Build and Maintain a Healthy Soil

The Soil Food Web

A healthy soil is a productive, non-polluting soil that:

- takes less time to maintain
- is less costly to keep productive
- is better able to withstand the impacts of climate change.

Before addressing specific practices for a healthy soil, it's important to understand what is happening on/in the soil. "**Soil food web**" is a term coined by Dr. Elaine Ingham, a leader in soil biology, to refer to the relationships among the wide range of organisms living all or part of their time in the soil. This complex ecosystem provides a healthy environment for plant growth by:

- providing plants with nutrients
- helping soil particles bind together which in turn improves soil aeration, water holding capacity, and drainage
- preying on crop pests.

Growth and reproduction are the primary activities of all organisms. As soil organisms work to survive, they depend on interactions with each other to stay alive. **Understanding how these interactions work, can help gardeners make better decisions about how to effectively manage their soils.** Here's an overview of how this complex ecosystem works:

- Plants (and some algae and bacteria) convert carbon dioxide from the air into carbohydrates via photosynthesis.
- The carbohydrates are broken down by soil organisms for energy, releasing carbon dioxide.
- Residues from these organism (dead cells, excrement, secondary metabolites, plant litter, etc.) add organic matter to the soil.
- Soil organisms break down the organic matter to create new compounds that are sources of energy and nutrients for them and other soil organisms.
- The decomposition process continues until the nutrients are used up and what remains is a relatively inert material called humus that helps aggregate soil particles which in turn improves soil aeration, water holding capacity, and drainage.
- Some soil organisms convert nitrogen from the atmosphere into forms that plants can use; others transform nitrogen from soil organic matter into forms that plants can use.
- Some soil fungi form mycorrhizal associations with plant roots which deliver nutrients and water to the plants as needed.
- Soil organisms provide food for higher level soil-dwelling organisms (e.g., worms) and above-ground organisms like insects and birds.

The gardener's goal is to keep this complex web humming along with few disruptions. Achieving this will result in a soil that is healthy and productive.

Six practices that gardeners can adopt to build and maintain a healthy soil, whether it is in a vegetable garden, flower beds, lawns, or other landscape areas, are listed in the following table.

Practices that Build and Maintain a Healthy Soil

Practice	Actions to achieve this	Why adopt this practice?
<p>Disturb the soil as little as possible</p>	<p>Use no-till or low till methods.</p> <p>Till only if soil is very compacted or devoid of organic matter – and till only once.</p> <p>Use a smothering method to create a new planting area:</p> <ul style="list-style-type: none"> - Mow down vegetation - Cover with cardboard or a thick layer of newspaper - Top with 6” of organic matter - Let it sit for a season 	<ul style="list-style-type: none"> • Avoids disrupting the community of soil organisms which decompose organic matter, cycle nutrients, and enhance soil structure. • Avoids introducing excess oxygen into the soil which speeds up decomposition of organic matter by soil microorganisms leading to nutrient depletion and the release of excess carbon dioxide, a greenhouse gas. • An untilled soil is a carbon sink capturing carbon in a stable form that remains in the soil for years until needed. • Avoids destroying the material in the soil that helps soil particles bind together to improve aeration, water-holding capacity, and drainage. • Avoids creation of “hardpan” below the reach of the tiller tines which is difficult for plant roots to penetrate. • Avoids bringing up weed seeds.
<p>Keep the soil covered with some type of organic material</p>	<p>Leave grass clippings on the lawn.</p> <p>Leave chopped up leaves, plant prunings, weeding residues, etc. on the soil surface.</p> <p>Cover the soil with organic materials such as aged wood chips, pine needles, weed free straw, etc.</p> <p>Consider cover crops and perennial ground covers.</p>	<ul style="list-style-type: none"> • Conserves soil moisture which encourages a healthy, active community of underground organisms that keep plants thriving. • Provides organic material for the soil organisms which in turn create nutrients for the plants growing on the soil. • Keeps the soil surface from crusting over which enhances water penetration and minimizes runoff. • Minimizes the destructive impact of raindrops on the soil’s structure. • Reduces soil temperature which can impact soil organism activity. • Suppresses weed growth.
<p>Avoid soil compaction</p>	<p>Use pathways to avoid constant foot traffic on plant root zones.</p> <p>Avoid working the soil when it is wet.</p> <p>Minimize constant use of heavy equipment on the soil.</p>	<ul style="list-style-type: none"> • A compacted soil contains less oxygen which soil organisms need to thrive. • A compacted soil is less permeable to water and more prone to runoff. • The structure of soil particles that bind together to improve aeration, water holding capacity, and drainage are damaged. • The roots of most plant have a difficult time penetrating compacted soil.

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Practice	Actions to achieve this	Why adopt this practice?
Maintain a healthy soil pH	<p>Do routine soil testing.</p> <p>Add amendments that affect soil pH only as recommended by a soil test.</p>	<ul style="list-style-type: none"> • Soil pH impacts nutrient availability. • Soil pH impacts the number and activity of soil organisms.
Use organic amendments	<p>Avoid synthetic fertilizers.</p> <p>Use a soil test to determine what amendments are needed and how much to add.</p> <p>Build a compost pile to capture plant nutrients.</p> <p>Use organic amendments that are not contaminated with persistent synthetic pesticides, e.g., aminocyclopyrachlor contaminated manure and mulches.</p>	<ul style="list-style-type: none"> • Synthetic fertilizers render soil organisms that feed the plants obsolete; organisms either die off or move elsewhere. • Loss of soil organisms results in the need to add even more costly synthetic fertilizers to keep plants growing. • Under conditions of excess N-containing fertilizer or wet soils, nitrogen compounds can be converted into nitrous oxide a powerful greenhouse gas with 300 times the climate warming potential of carbon dioxide. • Production of synthetic fertilizers is very energy intensive.
Embrace the soil you have, not some ideal soil	<p>Know what kind of soil you have.</p> <p>Learn how to manage that soil type.</p> <p>Grow plants that thrive in your soil type.</p>	<ul style="list-style-type: none"> • Less work. • Less costly – fewer amendments are needed; fewer plants fail to thrive. • Lower water needs.

Key References

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<https://joegardener.com/podcast/understanding-the-soil-food-web/>

Lowenfels, Jeff. *Teaming with Microbes: The Organic Gardeners Guide to the Soil Food Web*. Portland, OR: Timber Press, 2010.

Miessler, Diane. *Grow Your Soil: Harness the Power of the Soil Food Web to Create Your Best Garden Ever*. North Adams, MA: Storey Publishing, 2020.

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Minimize the Use of Pesticides

According to the U.S. Environmental Protection Agency (EPA), a pesticide is any substance or mixture of substances that is/are:

- intended for preventing, destroying, repelling, or mitigating any pest
- intended for use as a plant regulator, defoliant, or desiccant

The pests may be insects, plants, plant pathogens, animals, etc.

Pesticides can have the following detrimental impacts on non-target organisms:

- Hazardous to human health⁽¹⁾, particularly that of farmers and farmworkers
- Threaten pet health
- Kill pollinators
- Destroy beneficial soil organisms
- Cause losses to adjacent crops, fisheries, and birds
- Contaminate food
- Pollute water supplies and contaminate groundwater through leaching and rainwater runoff

(1) After countless studies, pesticides have been linked to cancer, Alzheimer's Disease, ADHD, and even birth defects. *See sources* Pesticides also have the potential to harm the nervous system, the reproductive system, and the endocrine system. Nature, 2011

Five gardening practices that gardeners can adopt to minimize the need for pesticides are listed below.

Practice	Actions to achieve this	Why adopt this practice?
Embrace polyculture (companion planting)	Intersperse a variety of plant types throughout your gardens. Pair plants that seem to be more productive growing together. Plant sacrificial plants to tap insect pests. Avoid large monocultures, like lawns.	<ul style="list-style-type: none"> • Makes it difficult for plant-specific pests to propagate and spread throughout your landscape. • Some plants have complementary characteristics, such as their nutrient requirements, growth habits, or pest-repelling abilities. • Certain plants act as insect repellents or deter hungry critters. • Some plants attract beneficial insects. • Pathogens or insect pests can spread like wildfire through a monoculture.
Plant heirlooms localized to your region	Purchase plants/seeds from local growers of heirloom plants. Research the origins of the plants/seeds before purchasing.	<ul style="list-style-type: none"> • Plants adapted to your area are better able to withstand the disease and pests found in your area. • Heirlooms promote plant diversity.

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Practice	Actions to achieve this	Why adopt this practice?
Remove and dispose of any struggling, infested, or undesirable plants	Burn or bag the struggling plants. Do not add them to the compost pile. Do not leave them in the garden area. Cut down undesirable weeds before they go to seed.	<ul style="list-style-type: none"> • Helps keep disease pathogens from spreading in your landscape. • Helps keep undesirable insects from propagating and spreading. • Helps keep weeds from going to seed and propagating.
Use natural barriers	Keep beds well mulched and top dressed with compost or mulch. Leave chopped up leaves, plant prunings, weeding residues, etc. on the soil surface. (Aka "green mulch")	<ul style="list-style-type: none"> • Feeds soil organisms and ensures healthy plant development. • Conserves soil moisture. • Controls weeds.
Adopt the Integrated Pest Management (IPM) approach to managing pests	Correctly identify the pest. Determine if there are preventative or non-chemical methods to reduce the problem such as: Prevention Cultural controls Physical or mechanical controls Biological controls Use pesticides as a last resort.	<ul style="list-style-type: none"> • IPM combines several methods to prevent and manage pest problems minimizing harm to humans, animals, and the environment.

Sources

- "Cancer Trends Progress Report-2009-2010 Update" *National Cancer Institute* April 15, 2010.
- "Chromated Copper Arsenate (CCA)" *United States Environmental Protection Agency* November 2008.
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- "Pesticide Atrazine Can Turn Male Frogs into Females" *Science Daily* March 1, 2010.
- "Pesticides Exposure During Pregnancy" *American Pregnancy Association* March 2007.
- "Pesticide issues in the works: pesticide volatilization" *United States Environmental Protection Agency* December 2009.
- "Pesticides May Raise Alzheimer's Risk" *WebMD*.
- "Study: A link between pesticides and ADHD" *Time Magazine* May 17, 2010.
- "The Dangers of Pesticides" *Global Healing Center*.
- "The Insect Repellent DEET" *United States Environmental Protection Agency* March 27, 2007.
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- University of California Agriculture and Natural Resources. "Applying IPM to Your Home Landscape." Accessed December 11, 2021. <http://ipm.ucanr.edu/GENERAL/whatisipmurban.html>
- United States Environmental Protection Agency. "What is a Pesticide?" Accessed December 13, 2021. <https://www.epa.gov/minimum-risk-pesticides/what-pesticide>

Reduce Lawn Areas

Beautiful carpets of green lawn became popular in the 1950s with the advent of readily available power tools, better turf grass varieties, and the development of pesticides and fertilizers to keep lawns green. Many homeowners aspire to having a large, well-maintained lawn.

That aspiration, however, has several negative ecological and environmental impacts:

- Power lawn tools account for 5 percent of the total US air pollution.
- Lawn care chemicals expose humans, pets, and wildlife to health risks.
- Vast amounts of water are needed to keep lawns lush (7.9 billion gallons/day in the US - most of which is potable).
- Turf grasses, most of non-North American origin, provide little support for native biodiversity.

Five practices that gardeners can adopt to free themselves from the tyranny and expense of lawn care are listed below.

Practice	Actions to achieve this	Why adopt this practice?
Install lawn areas only for structural and functional purposes	Use lawn areas for pathways in garden beds. Use lawns for play areas. Use lawns to define outdoor rooms.	<ul style="list-style-type: none"> • Reduces the areas that need maintenance with fossil fuel guzzling power tools. • Opens up areas that can be planted with native plants that support a more biodiverse environment. • Reduces watering needs.
Replace remaining lawn areas with lower maintenance plants	Consider ground covers. Use a variety of low maintenance shrubs, trees, and perennials, that provide year-round interest. Select native varieties.	<ul style="list-style-type: none"> • Takes less time to maintain. • Encourages biodiversity and healthier soils. • Reduces monocultures which are more susceptible to devastating spreads of diseases and insect infestations. • Reduces the need for pesticides.
Avoid cultural situations that can lead to diseases	Do not mow wet lawn areas. Aim for 3" grass height. Mow off only 1/3 of the grass blades. Use sharp mower blades.	<ul style="list-style-type: none"> • Avoids exposing cut grass blades to wet situations in which diseases spread more readily. • Avoids stressing the grass which can make it more susceptible to diseases. • Keeps grass roots shaded, reducing weed growth and watering needs. • Reduces the need for pesticides.

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Practice	Actions to achieve this	Why adopt this practice?
<p>Carefully manage the turf grass that you do have</p>	<p>Plant a grass variety that is suitable for your climate, light, and soil type.</p> <p>Adopt IPM practices for pest control.</p> <p>Practice responsible chemical applications. Follow soil test guidelines and package instructions.</p> <p>Water wisely only as needed and at the appropriate time of day.</p>	<ul style="list-style-type: none"> • Reduces the need for pesticides. • IPM practices minimize harm to humans, animals, and the environment. • Reduces runoff pollution. • Uses water more effectively. • Not as costly.
<p>Recycle fall leaves onto your lawn</p>	<p>Chop up leaves and leave them on the lawn surface.</p>	<ul style="list-style-type: none"> • Incorporates nutrients from the leaves into the soil. • Less work. • Provides protection for wildlife.

Key References

Pineo, Rebecca and Susan Barton. *Turfgrass Madness: Reasons to Reduce Your Lawn in Your Landscape*. PDF file. March 10, 2010.
https://canr.udel.edu/wp-content/uploads/sites/16/2018/03/12024155/Turf_Grass_Madness.pdf
 University of Maryland Extension. "Lawn Alternatives, Ways to Reduce Your Lawn." November 3, 2021.
<https://extension.umd.edu/resource/lawn-alternatives>

Incorporate Native Plants and Replace Invasive Non-natives

Native plants are those that occur in the region in which they evolved and have adapted to the local climate and soil conditions. Native insects and wildlife have evolved along with the plants and many can only feed on the plants with which they co-evolved. Unwise development has led to large expanses of lawn and exotic (non-native) plants replacing native plant communities. This loss directly impacts insects and wildlife.

Invasive plants are species intentionally or accidentally introduced by human activity into a region in which they did not evolve and cause harm to natural resources, economic activity, or humans.

Four practices that gardeners can adopt to mitigate the loss of food sources and habitats for our native insects and wildlife are listed below.

Practice	Actions to achieve this	Why adopt this practice?
<p>Know the plants that are native in your area</p>	<p>Learn about the Virginia native plants specific to our region. (See Note 1 for web site with this information.)</p> <p>Select plants that thrive in your specific environmental conditions.</p> <p>Learn about native alternatives to non-natives. (See Note 2 for web site with this information.)</p>	<ul style="list-style-type: none"> • All plants are native somewhere, so learn the ones that evolved in your area. • Like any other plant, natives evolved in certain soil, light, and water conditions and thrive best in those conditions.
<p>Target 70-80% of your landscape biomass as local native plants</p>	<p>Incorporate natives into existing planting beds.</p> <p>Replace areas of your lawn with beds of native flowers, shrubs, and trees.</p> <p>Naturalize large areas like meadows or woods with native plants.</p> <p>Use native plants in specialized gardens such as rain gardens or butterfly gardens.</p>	<ul style="list-style-type: none"> • Provides nutrition and habitats for pollinators, other insects, birds, and wildlife <ul style="list-style-type: none"> - Insects rely on native plants for nutrition and habitat - 89% of songbirds feed their young on insects - Birds rely on native plants for nutrition and habitat. - The highest fat content and energy densities are found in fruits and native shrubs. • Conserves water – natives are often deep-rooted requiring less water to thrive. • Saves money on fertilizers and pesticides. • Reduces mowing costs. • Reduces air pollution by minimizing need for lawn equipment that runs on fossil fuels and emits the greenhouse gas carbon dioxide (CO₂).

Notes:

1. Plant Virginia Natives. "Native Plants for Virginia's Capitol Region." December 2021. <https://www.plantvirginianatives.org/plant-rva-natives>
2. US Forest Service. "Kick the Invasive Exotic Gardening Habit with Great Native Plant Alternatives!" December 2021. https://www.fs.fed.us/wildflowers/Native_Plant_Materials/Native_Gardening/alternatives.shtml

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Practice	Actions to achieve this	Why adopt this practice?
<p align="center">Replace non-native invasive plants</p>	<p>Learn about plants that are non-native invasives. (See note 3 for web site with this information.)</p> <p>Identify invasive species in your landscape and decide on a plan for removal/control. (See note 4 for web site to help with this.)</p> <p>Learn about plants that are alternatives to non-native invasives and plant them in your landscape. (See note 5 for web site with this information.)</p> <p>Avoid situations, such as soil disturbances that favor infestation by invasive plants.</p>	<ul style="list-style-type: none"> • Invasive plants pose a threat to Virginia’s forests, marshes, wetlands, and waterways in many ways including: <ul style="list-style-type: none"> - Altering natural processes, such as water flow or soil chemistry. - Invading undisturbed natural areas. - Impacting rare or vulnerable native species. • Invasive plants also: <ul style="list-style-type: none"> - Are found widely distributed and generally abundant where present. - Disperse readily to new places. - Require significant resources to manage and control. <p><i>On the other hand...</i></p> <ul style="list-style-type: none"> • Native plants are less likely to become invasive.
<p align="center">Shop native</p>	<p>Shop nursery’s offering local native plants and encourage others to do likewise.</p> <p>Encourage local nurseries to stock more local natives.</p>	<ul style="list-style-type: none"> • Supporting nurseries that go native will encourage other nurseries to follow. • Gardeners are more likely to pick up native plants if they are available in their favorite nurseries.

Notes:

3. VA Department of Conservation and Recreation. “Virginia Invasive Species Plant List.” December 2021
<https://www.dcr.virginia.gov/natural-heritage/document/nh-invasive-plant-list-2014.pdf>
Digital Atlas of the Virginia Flora. December 2021 <http://vaplantatlas.org/index.php?do=browse:county> (Browse plants in your county)
4. VA Department of Forestry. “Non-Native Invasive Plant Species Control Treatments – Timing Methods and Herbicide Rates.” December 2021.
https://dof.virginia.gov/wp-content/uploads/FT0031-Nonnative-Invasive-Plant-Species-Control-Treatments_pub.pdf?x15979
5. US Forest Service. “Kick the Invasive Exotic Gardening Habit with Great Native Plant Alternatives!” December 2021.
https://www.fs.fed.us/wildflowers/Native_Plant_Materials/Native_Gardening/alternatives.shtml

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- Kaufman, Syl Ramsey and Wallace Kaufman. *Invasive Plants: Guide to Identification and the Impacts and Control of Common North American Species*. Mechanicsburg, PA Stackpole Books, 2013.
- Miller, James. *Nonnative Invasive Plants of the Southern Forests: A Field Guide for Identification and Control*. US Department of Agriculture, 2007.
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- US Department of Agriculture. *A Management Guide for Invasive Plants in Southern Forests*. US Department of Agriculture, 2015.
- Virginia Department of Forestry. *Common Native Shrubs and Woody Vines of Virginia* (Identification Guide). Charlottesville, VA: Virginia Department of Forestry, 2016.
- Virginia Department of Forestry. *Common Native Trees of Virginia* (Identification Guide). Charlottesville, VA: Virginia Department of Forestry, 2016.

Agencies that provide a wealth of information

- Lady Bird Johnson Wildflower Center - <https://www.wildflower.org/plants/>
- Digital Atlas of the Virginia Flora - <http://www.vaplantatlas.org>
- Virginia Native Plant Society - <https://vnps.org>
- Virginia Department of Conservation and Recreation (DCR) - <https://www.dcr.virginia.gov/natural-heritage/nativeplants>

Provide a Healthy Habitat for Wildlife

Habitat loss is the primary threat to the survival of wildlife in the United States. It is the leading cause of biodiversity loss. Biodiversity loss disrupts the functioning of ecosystems, making them more vulnerable to disruptions and less able support human needs.

Major causes of habitat loss are:

- Agriculture (conversion of habitat areas to fields for crops)
- Land conversion for development
- Water development (dams and waterway diversions)
- Pollution (freshwater wildlife are most impacted by runoff pollution)
- Climate change (examples include wildlife that need the cool temperatures of high elevations may soon run out of habitat; coastal wildlife may find their habitat underwater as sea levels rise.)

Ecosystems dramatically altered by human activities may no longer be able to provide the food, water, cover, and places to raise young that wildlife need to survive. The wildlife in our landscape impacted by habitat loss includes insects, amphibians, birds, and small mammals.

Four practices that gardeners can adopt to help combat wildlife habitat loss are listed below.

Practice	Actions to achieve this	Why adopt this practice?
Let some areas of your property go wild for the winter	Resist fall mowing of the less manicured areas of your property	<ul style="list-style-type: none"> • Provides seed-heads for native birds. • Provides wildlife shelter from predators, weather, etc.
Retain natural covers	<p>Let a thin layer of disease-free leaves stay on your lawn and garden beds.</p> <p>Decrease fall garden bed cleanup.</p> <p>Create a brush pile.</p> <p>Maintain snags and den trees.</p> <p>Clear brush and fallen trees in wooded areas ONLY when needed to maintain the health of the woods or for safety reasons.</p> <p>Cut timber only when necessary.</p> <p>Minimize replacement of natural areas with lawns.</p>	<ul style="list-style-type: none"> • Many species of wildlife use existing habitats for nesting, feeding, resting, escaping, or cover. • Leaves provide a habitat for salamanders, snails, worms, and toads. • Leaving dry stalks and seed-heads intact and upright in gardens provide a safe spot for insects to lay eggs and a place for birds to hide from predators. • Brush piles provide shelter from weather and predators. • Snags and den trees provide cavities for nesting and resting, places to raise young, perches for hunting and displaying, and an abundant supply of food for insect eaters. (A den tree is a living tree that has enough decay that a cavity (hole) has developed in the tree.)

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Practice	Actions to achieve this	Why adopt this practice?
<p>Provide supplemental food and water sources</p>	<p>Plant native plant species that wildlife and insects depend on.</p> <p>Supplement natural food sources with the appropriate food for the targeted species (feeders).</p> <p>Add birdbaths, ponds, and dripping water features to your landscape.</p>	<ul style="list-style-type: none"> • Native plants provide nectar, seeds, nuts, fruits, berries, foliage, pollen, and insects for a wide variety of wildlife. • Most living things need water for survival; some also need it for bathing or breeding.
<p>Make forest edge improvements</p>	<p>Provide a gradual transition from the shorter vegetation in the adjacent habitat to the tallest trees in the forest.</p> <p>Provide a variety of vegetation types and heights.</p>	<ul style="list-style-type: none"> • Many species of wildlife use edge habitat for nesting, feeding, resting, escaping, or cover.

Key References

Pierce, Robert A., II, Charles Nilon, Nadia Navarrete-Tindall, Sarah Denkler, and Eric Fishel. "Improving Habitats for Wildlife in Your Backyard and Neighborhood."

Accessed December 2021. <https://extension.missouri.edu/publications/g9500>

Kirk, Molly, "Do Less and Restore the Wild in Your Own Backyard This Fall!" Accessed December 2021. <https://dwr.virginia.gov/blog/do-less-restore-the-wild-backyard/>

National Wildlife Federation. "Habitat Loss." Accessed December 2021. <https://www.nwf.org/Educational-Resources/Wildlife-Guide/Threats-to-Wildlife/Habitat-Loss>

Conserve Water

According to the EPA Water Sense® partnership program, “nationwide, landscape irrigation is estimated to account for nearly one-third of all residential water use, totaling nearly 9 billion gallons per day. And, some experts estimate that as much as 50 percent of water used for irrigation is wasted due to evaporation, wind, or runoff caused by inefficient irrigation methods and systems.”

Freshwater supplies from natural sources are becoming more and more stressed as rainfall patterns change. Three practices gardeners can adopt to help conserve this precious resource are listed below.

Practice	Actions to achieve this	Why adopt this practice?
Collect wasted indoor water and rainwater	<p>Collect cold shower water while it is heating up.</p> <p>Collect rainwater in cisterns or rain barrels.</p>	<ul style="list-style-type: none"> • Depending on your set-up, many gallons of perfectly usable potable water go down the drain before the shower water heats up. • Rainwater is “free” for the collecting. Using rainwater for watering, not only saves water, but also reduces your water costs. • Collecting rainwater can reduce runoff and the associated pollution issues.
<p>Embrace xeriscape planting practices</p> <p><i>(Xeriscape = practice of designing landscapes to reduce or eliminate the need for irrigation.)</i></p>	<p>Group plants with similar water needs.</p> <p>Place plants in areas of the landscape that already meet their cultural needs.</p> <p>Select native plants.</p> <p>Mulch around plants.</p>	<ul style="list-style-type: none"> • Water is not wasted on plants that do not need it. • Plants growing in the conditions they prefer need less water to keep them thriving. • Native plants are often deep rooted needing less water to survive droughts. • Mulch prevents water loss by evaporation and keeps down weeds which steal water away from the desirable plants.
Water wisely	<p>Water deeply and infrequently.</p> <p>Water only when needed.</p> <p>Avoid watering during the day.</p> <p>Avoid oscillating sprinklers and other devices that throw water high in the air or release a fine mist.</p> <p>Consider drip irrigation or soaker hoses.</p>	<ul style="list-style-type: none"> • Watering deeply and only when needed encourages deep root systems. • Watering during the day and using devices that throw water high into the air leads to water loss due to evaporation. • Drip irrigation and soaker hoses put water close to at the root zone and prevents loss due to evaporation.

In addition to water conserving gardening practices, here are some practical tips for conserving water in your household:

- Replace leaking gaskets around your house.
- Use low-flow showerheads and take shorter showers.
- Run clothes washer only when you have a full load or adjust the water level to the load size.
- Insulate hot water pipes to minimize run times to get hot water.
- Install instant water heaters to reduce the time it takes to get hot water.
- Avoid continuously running the water when washing dishes, cleaning produce, or brushing your teeth.
- Keep a container of cool water in the fridge to avoid running tap water to cool it off for drinking.
- Cover your pool when not in use to prevent water loss by evaporation.

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Mitigate Storm Water Runoff

The Chesapeake Bay program defines stormwater runoff as “precipitation in an urban or suburban area that does not evaporate or soak into the ground but instead runs across the land and into the nearest waterway.” They identify a number of environmental problems caused by stormwater runoff:

- Stream bank erosion damages aquatic life habitats.
- Washing excess nutrients from fertilizers, pet waste, and other sources into rivers and streams can fuel the growth of algae blooms. These in turn, create low-oxygen dead zones that suffocate marine life.
- Washing excess sediment into rivers and streams can block sunlight from reaching underwater grasses and suffocate shellfish.
- Washing pesticides, leaking fuel or motor oil, and other chemical contaminants into rivers and streams can harm the health of humans and wildlife.

Three practices that gardeners can adopt to help mitigate stormwater runoff are listed below.

Practice	Actions to achieve this	Why adopt this practice?
Direct runoff to areas that can better absorb it	Practice contour landscaping. Install stormwater swales.	<ul style="list-style-type: none"> • Contour landscaping places beds across the slope of the land which captures and directs rainwater running down the slope and prevents erosion. • A swale is a wide, shallow, vegetated depression that is gently sloped to carry runoff to areas that can better handle the influx of water. Swales slow down water flow and increases infiltration.
Capture rainwater before it becomes runoff	Install rain barrels or cisterns. Create a rain garden or bioretention garden. Use permeable paving materials. Plant a native meadow.	<ul style="list-style-type: none"> • Rain barrels and cisterns collect and store rainwater until can be used for hand watering or drip irrigation. • A rain garden or a larger bioretention garden is a shallow depression with soil and plants that captures runoff and encourages infiltration. • Permeable paving materials allow stormwater to pass through the pavement and infiltrate the soil. • Low maintenance meadows increase water infiltration and filter out pollutants.
Keep runoff from entering streams and ponds	Install vegetative buffers around the perimeters of streams and ponds.	<ul style="list-style-type: none"> • Vegetative plantings slow down water flow and reduce the influx of eroded soil and pollutants.

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Adopt Gardening Practices that Contribute to Clean Air

Gardening is generally thought of as a healthy pastime but many of the activities we do as gardeners contribute to air pollution and the greenhouse gases causing our planet to warm.

Three gardening practices that gardeners can adopt to help keep the air clean and minimize greenhouse gases are listed below.

Practice	Actions to achieve this	Why adopt this practice?
<p>Adopt landscaping practices that reduce your carbon footprint</p> <p><i>(Carbon footprint = total amount of greenhouse gases released by your actions)</i></p>	<p>Minimize the use of lawn equipment powered by fossil fuels.</p> <p>Reduce the size of your lawn.</p> <p>Disturb your soil as little as possible.</p> <p>Replace products containing peat moss with more sustainable coir-based products.</p> <p>Let snags remain in your landscape.</p>	<ul style="list-style-type: none"> • Burning fossil fuels emit carbon dioxide, a greenhouse gas, along with other noxious gases. According to the EPA, gasoline-powered lawn and garden equipment in the United States emits a total of 20.4 million tons of carbon dioxide per year. • Reducing the size of your lawn reduces your use of mowing equipment. • When soil is disturbed, carbon dioxide is released by soil organisms. Worldwide, soil acts as a vast carbon sink storing between 2K and 3K gigatons of carbon dioxide. • Peat bogs store a vast amount of carbon in the form of decomposed plants and animals. When the bogs are mined, the stored carbon is converted to carbon dioxide which is released into the atmosphere. It takes thousands of years for destroyed peat bogs to regenerate. • Snags act as a carbon sink, storing carbon in their buried roots.
<p>Embrace trees</p>	<p>Protect the mature trees in your landscape.</p> <p>Plant trees in your landscape to control temperatures in your living spaces.</p> <p>Encourage your municipality to plant trees along streets and in other public places.</p>	<ul style="list-style-type: none"> • A tree converts carbon dioxide into carbohydrates which it uses for energy and structure building. A tree can absorb up to 50 pounds of carbon dioxide per year. Thus a 40-year-old tree could sequester up to 1 ton of carbon dioxide. • Judicial selection and placement of trees in your landscape can provide shade in summer and let in warming sunlight in the winter reducing heating and cooling needs and the consumption of fossil fuels. • There are 60-200 million spaces along streets where trees could be planted. This translates to the potential to absorb 33 million more tons of carbon dioxide every year.
<p>Reduce your methane footprint</p>	<p>Limit red meat and dairy consumption.</p> <p>Grow and embrace plant-based proteins.</p>	<ul style="list-style-type: none"> • Methane, another greenhouse gas, is produced by livestock. • 14% of all human induced climate emissions are from livestock.

Key Reference

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Who Are the Goochland-Powhatan Master Gardeners?

The Goochland-Powhatan Master Gardeners are volunteer educators in the community who have received specialized training in environmental horticulture through Virginia Cooperative Extension. Most of the volunteers are members of the Goochland-Powhatan Master Gardener Association (GPMGA) which coordinates volunteer activities, provides monthly educational meetings, and encourages camaraderie among members. Their mission is to bring people together to discover and share knowledge about gardening in Central Virginia.

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